Health effects of heatwaves
Short and long term predictions

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för
avläggande av filosofie/medicine doktorsexamen framläggs till offentligt
förvar i Triple helix, Samverkanshuset,
onsdagen den 24:e maj, kl. 09:00.
Avhandlingen kommer att förvaras på engelska.

Fakultetsopponent: Professor, Scott Sheridan
Kent State University, Kent, USA.
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Background: Climate change is defined by the Intergovernmental Panel on Climate Change as changes in the state of the climate associated with changes in the mean and/or the variability of its properties. Climate change will affect temperatures both as an increase in mean temperature as well as changes in the frequency of temperature extremes. Health effects associated with extreme heat, both mortality and morbidity, have been observed all over the globe. Groups that are often found to be more vulnerable are the elderly and people diagnosed with certain diseases and/or on taking some specific types of medication. The health effects from climate change in the future depend on a number of underlying sociodemographic and other factors. It is difficult to predict how the underlying societal factors that are likely to alter the health effects from high temperatures will change. The aim of this thesis is to investigate the influence of the underlying assumptions and factors that are key components when predicting and projecting heat-related illness, both in the short and long term. This work aims to identify and to some extent quantify different sources of uncertainty that will have effects on the outcome of health impact assessments.

Methods: We wanted to evaluate if different statistical models would alter the ability to identify days with elevated heat-related risk. We used observations of temperatures and daily mortality for Greater Stockholm to model different exposure-response relationships (Paper I). Along the observed data, we collected temperature forecasts for the Stockholm area. We defined what constitutes a risk day and compared the model’s ability to identify these days using both observed and forecasted temperatures to evaluate the predictive performance of models based on the different statistical approaches. To estimate how climate change will alter the heat-related health impacts we used climate change projections from a range of climate change scenarios to be able to get stable estimates as well as a measure of the uncertainty in the climate projections (Paper II-III). We estimated the change in respiratory hospital admissions (Paper II) and the future need for adaptation to keep heat-related mortality at current levels (Paper III) in Europe. We also estimated the change in heat-related mortality due to changes in climate, demographics and health status of the population in Stockholm (Paper IV).

Results: The models using a highly complex exposure-response relationship showed lower predictive performance, especially when looking at a longer time-scale. The more complex models did also estimate a lower mortality increase compared to the less complex ones. There was however high agreement of which days to be considered risk days. The estimated increase in heat-related illness from the three health impact assessment studies showed impacts on a similar order of magnitude when looking at changes in climate only. Respiratory hospital admissions were estimated to more than double in Europe and heat-related mortality in Stockholm was estimated to increase to around 257% of current levels. Therefore, adaptation needs to lower the vulnerability to heat by around 50% in the European countries. In study III and IV we take changes in demographics into account and find that the future health burden from heat will increase due to the growing elderly population.

Conclusion: To be able to make predictions of future health burdens from heat, both in the long and short term, we need to consider the properties of the epidemiological models and how the choice of model might limit its use within a health impact assessment. Climate change seems to be the main driver of the future health burden from extreme temperatures, but our results suggest that changing demographics will add to the burden considerably unless relevant adaptation measures are implemented. Adding this on top of the challenges posed by climate change, we find that need for adaptation will increase substantially in the future.

Keywords
Heatwave, health impact assessment, early warning system, mortality, morbidity, climate change

Language  ISBN  ISSN  Number of pages
English  978-91-7601-689-3  0346-6612  35 + 4 papers