STATENS SERUM INSTITUT

Denmark: Information on recent and ongoing work in the area of climate change impacts on human health

1. Institution(s) and collaborating partners

The Department of Infectious Disease Epidemiology, Department of Microbiology & Infection Control at Statens Serum Institut (the National Danish Institute for Infectious Diseases) in collaboration with:

- Norwegian Institute of Public Health
- National Institute for Health and Welfare Finland
- Public Health Agency of Sweden
- DHI Danmark; Danish Hydrological Institute
- Norwegian Meteorological Institute
- European Centre for Disease Control and Prevention (ECDC), Sweden
- University of Bath
- Public Health England
- University of East Anglia
- University of Thessaly

2. Country of focus

Denmark is the southernmost and smallest of the Scandinavian countries in North Europe, covering an area of approximately 43.000 square kilometres with a population of 5.7 million. The country consists of a main peninsula and an archipelago of around 440 islands. The Danish climate is temperate, and the country is characterised by flat arable land, sandy coasts and low elevation. Winters are mild (average temperatures of 1.5°C) and summers are cool (17°C). On average, Denmark has 180 days with precipitation per year, receiving an average of 765mm annually. Autumn is the wettest season and spring the driest.

As for all other countries in Europe, the projected climate changes are likely to impact the Danish climate. During the past century, average temperatures in Denmark have increased slightly more than expected (1.5°C) when compared to IPCC model estimates, and it is predicted that the end of this century will see temperature increases of 1.2°C- 4.0°C, depending on the IPCC scenario used (1). Since the mid-20th century, the average annual precipitation in Denmark has increased by 100 mm (1), and the

time period between extreme precipitation events (i.e. more than 100 mm in a few hours) is now significantly shorter compared to 100 years ago. Overall, the average amount of precipitation is expected to increase with a particular increase in the frequency of extreme precipitation events (1).

3. Relevant impacts of climate change on human health

- Changes in transmission of food-and waterborne diseases
- Changes in transmission of vector-borne diseases (introduction of new vectors and relevant diseases)
- Changes in prevalence of allergic symptoms
- Changes in direct disease or injury risk associated with extreme heat and/or flooding

4. Description of activities

Numerous reviews have been published in the Danish press and scientific journals speculating on the possible consequences of climate changes for human health in Denmark (2- 6). Further, several adaptation reports have been commissioned by the Government, the Ministry of Health, the Environmental Protection Agency and the Danish Meteorological Institute in order to accumulate expert knowledge and recommendations for current and future adaptation strategies (7-9).

With respect to direct effects of temperature on human health in Denmark, an 8°C increase average temperature over 5 days in 2002-2006 resulted in a 7% increase in respiratory emergency hospital admissions but an 8% reduction in cardiovascular admissions during the summer period in the capital of Copenhagen (10).

Infectious diseases are of notable interest in relation to climate changes in Denmark. During the past decade, several episodes of extreme precipitation (local flooding) have been followed by an increase in sporadic cases of bacterial infections such as leptospirosis (11,12) as well as large outbreaks of gastrointestinal illness (13, 14,15). In addition, several studies have been undertaken, focusing primarily on the effects of weather extremes on water-borne gastrointestinal diseases.

A collaborative effort between the Scandinavian countries (Denmark, Finland, Norway and Sweden) established that outbreaks of waterborne diseases occur regularly in all countries but most commonly during the summer months (16). By linking these outbreaks to days with heavy precipitation (i.e. above average daily rainfall) during the

foregoing weeks, it was shown that heavy precipitation for two or more days was significantly associated with the occurrence of a disease outbreak (OR = 3.06) (17). Presently, this collaboration is ongoing in the KLIMAFORSK project which, among others, aims to investigate links between the incidence of *Campylobacter* and precipitation, particularly heavy precipitation events, at high resolution in the four Scandinavian countries. The output from this project is expected to form a baseline for further research into the connection between gastrointestinal illness and extreme weather in Scandinavia and across Europe.

In August 2010, a heavy flood affected the Greater Copenhagen Area, in the day preceeding a large triathlete event, involving a 3.8 km swimming distance in the sea next to a large urban area. An established model of bacterial concentrations was used to examine the pollution in the swimming area, showing that the swimming competition coincided with the peak of post-flooding bacterial contamination (18). Swimming in, and concurrent accidental ingestion of, this water was significantly associated with subsequent gastrointestinal illness. This study highlights a significant risk of disease in people ingesting small amounts of flood water following extreme rainfall.

5. Planned future steps

Population health in Denmark is vulnerable to climate changes. Studies and surveillance suggest that there may be a particularly sensitive link between certain infectious diseases and heavy precipitation (flooding) events which are predicted to become more frequent during the coming years. Denmark has a unique system for registration of all confirmed cases of a range of notifiable infectious diseases, allowing very high resolution mapping of disease cases. In combination with high resolution climate data, our infectious disease databases can be used to examine disease-climate links in closer detail, ultimately paving the way for development of early warning systems at local level (19). In this respect, vector-borne diseases is also a particular area of interest as they are not common in Denmark (tick-borne infections being the only vector-borne diseases present here). Indeed as is a concern for the rest of Europe, the risk of establishment of new vectors – and diseases - in Denmark is a topic which need to be assessed in much more detail in order to make plans for future surveillance and adaptation strategies (20).

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