Establishment of a surveillance system for heat-related mortality in Hesse (HEAT II)

Prof. Dr. Henny Annette Grewe, Prof. Dr. Beate Blättner, Dr. Helmut Uphoff, Hendrik Siebert

As a consequence of the excess number of deaths especially seen in the elderly population associated with the heat wave in 2003 many European countries established heat-health watch-warning systems some of which run surveillance systems to assess the health burdens related to heat stress. In Germany, there is no such surveillance system in operation to date. The goal of the project called "Etablierung eines Surveillance-Systems für hitzebedingte Mortalität in Hessen" (HEAT II) is to establish a surveillance system to collect and analyse information on heat related mortality based on both empirical evidence and the experiences other countries have made with their specific approaches. This report presents the methods and results of HEAT II.

A systematic literature search was conducted to identify the main characteristics of existing surveillance systems and to summarize requirements to successfully operate such systems. The systems found were heterogeneous in terms of methods and organizational structures. From a synopsis of the relevant literature three core requirements could be derived: first, mortality and temperature data must be readily available; secondly, the data must be transmitted in a well organized manner embedded in a standardized transmission structure and thirdly, the systems algorithm must be tailored to the given climatic and demographic context of the country. Crucial for calculating the number of excess deaths is to mathematically compare the number of expected with the number of observed deaths on a given day. The well recognized EURO-MOMO project started operating in 2009 as an initiative of several European countries and since then has collected and analysed mortality data from those countries to provide a methodologically sound overview of excess mortality associated with communicable diseases (e.g. influenza) and environmental exposures (e.g. heat waves) at the European level.

In the next step, mortality and temperature data from Hesse were used to analyse associations. Based on time series data from the years 2000 to 2012 a typical wave-like mortality distribution could be shown with high rates of mortality during meteorological winter, decreasing and increasing rates during spring and autumn respectively and relatively low rates in summer. This pattern was observed especially in the elderly population but could barely be reproduced in the young and very young (< 15 years of age). Overall, the years 2003, 2006, 2010 and 2012 appear to show substantial peaks in the mortality distribution. The results support the assumption of a non-linear relationship between the number of deaths and ambient temperature.

In a first attempt, a five-year reference period was used to estimate the expected number of deaths. The sum of the expected number of deaths on a given day and twice the value of its standard deviation was used as a formal excess criterion. As assumed, mortality crises like that of summer 2003 will artificially increase the number of expected deaths and thus will lead to an underestimation of the number of excess deaths. To eliminate this potential source of bias a mathematically simple but methodologically acceptable approach was developed adjusting for the effect of such mortality crises in former years.

To make sure the algorithm will detect only excess deaths that are closely attributed to the exposition to hot ambient temperatures, a temperature threshold (23 °C) was added to the afore-mentioned excess criterion. Excess deaths will only be counted as such if the temperature on a given day exceeds

this threshold. Based on this approach, 268 excess deaths in total were observed in Hesse during the eight years from 2005 to 2012, distributed over 21 excess days. In addition, based on test reference years the state of Hesse was split into two distinct regions (region NORD and region SÜD) which represent approximately 40 percent of the population in Hesse. There were 44 cases of excess deaths detected on 21 excess days (region NORD) and 67 excess deaths during 15 excess days (region SÜD) respectively.

HEAT II has developed the foundations for a surveillance system to observe heat related mortality which is pragmatic and simple and which will ensure high practicability for the institution in charge of operating and maintaining the system. Furthermore, the methods used in HEAT II can relatively easy be understood by lay public so that the results produced are assumed to achieve high acceptance. The surveillance of heat related mortality therefore will serve as a further step in progressing towards developing the existing heat-health warning system in Hesse into a comprehensive heat-health-action-plan. The surveillance system itself will continually need to be evaluated and to be adapted according to demographic trends and climate change.