Assessment of Premature Heat-Related Mortality in Cyprus

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Outline

- Background and context
- Goal of this study
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Background and context

Change in daytime maximum temperature in summer months (JJA) from baseline period to mid-century (left panel) and end-century (right panel) periods for the East Mediterranean and Middle East (EMME) region.
Background and context

Schematic showing the effect on extreme temperatures when the mean temperature increases, for a normal temperature distribution.
Background and context

Probability distribution of daytime maximum temperatures in the summer months (JJA) in Nicosia
Background and context

The frequency and intensity of heat waves is projected to increase due to climate change:

Changing number of heat wave days per year: observations (red) and model calculations (black)

Heat wave definition used here:

six or more consecutive days with maximum temperatures exceeding the local 90th percentile of the reference period 1961-1990
Background and context

Hot effects are an increasing public health threat, especially in the light of climate change.

Example: European heat wave of 2003
- Temperature anomalies up to 10°C
- 70 thousand fatalities

Main causes of death during a prolonged period of extreme temperatures are of respiratory and/or cardiovascular origin and the most vulnerable people to heat-related mortality are the elderly and people with pre-existing diseases.

Source: NASA
Due to climate change, EMME region is projected to experience a rapid rise of extremely high summer temperatures.

However, little research on the heat-mortality relationship has been done so far in this region.
Goal of this study

Assessment of the impacts of climate change on heat-related cardiovascular mortality risk in Cyprus

The temperature-response relationship is not universal. Differences in sensitivity, coping capacity and adaptation measures of different populations as well as climatic differences across the globe, all play a role.

The bigger picture:
In order to assess the heat-related premature mortality for the entire EMME region, the relative risk derived for Cyprus will be used in the health impact function assuming that due to its central position, Cyprus is climatically as well as socio-economically representative for the region.

So how do we estimate the relative risk?
Methodology

The analysis of the relationship between temperature and mortality is carried out using a case-crossover design that captures the non-linear and distributed lag effects of temperature on mortality using a distributed lag non-linear model (DLNM)

- **Case cross-over study design:**
  - Special case of time-series analysis
  - Each case serves as its own control and is used to investigate the transient effects of an intermittent exposure on the onset of acute outcomes
  - Benefits of self-matching:
    - *increased efficiency*
    - *elimination of the bias normally imposed by the selection of the control*

- **DLNM**
  - Nonlinear temperature effect and the lagged effect are both modeled using a natural cubic spline
  - R software package “dlnm” is used
Data

- Climate Data – Cyprus Meteorological Service
  - Period: 01/01/2003 – 31/12/2010
  - 34 weather stations

- Mean, maximum and minimum temperature records are analyzed
- The data is weighed in order to create one representative daily value for the entire area under study
Data

- Daily Mortality Data – Ministry of Health
  - Diseases taken into account – ICD10 (by WHO) classification:
    - Hypertensive diseases (HD) - 1066
    - Ischaemic heart diseases (IHD) – 1067
    - Other heart diseases (OHD) - 1068
    - Cerebrovascular diseases (CD) - 1069
    - Remainder of diseases of circulatory system (RDCS) - 1071
  - Period: 01/01/2004 – 31/12/2011
  - No spatial distribution
Data

Mortality data at first glance

– Total 2004-2010: **13889** *(5.43 deaths per day)*
– Total 2004-2010 mortality per disease:
  • Hypertensive diseases – **1220** *(8.78% of the total)*
  • Ischaemic heart diseases – **4773** *(34.37% of the total)*
  • Other heart diseases – **4595** *(33.08% of the total)*
  • Cerebrovascular diseases – **2893** *(20.83% of the total)*
  • Remainder of diseases of circulatory system - **408** *(2.94% of the total)*
Results

How to read a 3D graph
Results

Temperature and lag effects on combined mortality

- Lags up to 10 days were used.
- The temperature that corresponds to minimum mortality was used as baseline temperature for calculating the relative risks.
- 5 degrees of freedom for temperature and 4 degrees of freedom for lag.
Maximum temperature and lag effects per disease

1. Tmax – IHD
2. Tmax – CD
3. Tmax – OHD
4. Tmax – HD
5. Tmax - RDCS
Mean temperature and lag effects per disease

1. Tmean – IHD
2. Tmean – CD
3. Tmean – OHD
4. Tmean – HD
5. Tmean - RDCS
Minimum temperature and lag effects per disease

1. Tmin – IHD
2. Tmin – CD
3. Tmin – OHD
4. Tmin – HD
5. Tmin - RDCS
Conclusion

- *Ischaemic heart diseases, cerebrovascular diseases and other heart diseases* show a strong increase in relative mortality risk on days with maximum temperatures.
- *Hypertensive diseases and remainder of diseases of circulatory system* show a random behaviour with respect to temperature:
  - Data scarcity?
  - Lack of interrelation with temperature?
- Short time lags (0-2 days) are of the highest importance in the occurrence of heat-related mortality. This is in accordance with previous studies.
- No major differences between the effect of different temperature time-series (Tmax, Tmin, Tmean), however Tmean seems to have slightly higher peaks: highest relative risks are associated with consecutive high day and night-time temperatures.
Thank you for your attention!