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Temperature-Related Mortality in Finland
- Socio-demographic factors affecting sensitivity to temperature extremes

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Abstract: The relationships between mortality and temperature was studied in 21 hospital districts (HD) in Finland based on daily mortality time series. Regional differences in the relationships are small, and can partly be explained by morbidity indices and population in the hospital districts. Based on long mortality time series, sensitivity of Finnish population to temperature extremes has decreased over the decades – even among the elderly, 75 years or older. Urban heat island (UHI) and distribution of elderly populations may affect temperature-related health risks in Helsinki.

Data

Daily number of deaths
- In hospital districts (HD) and in Helsinki, 1971−2015
- All-cause mortality
- Age groups:
  - All, < 65, 65-74, ≥ 75
  - No gender information

Climate data
- Synoptic data (T, RH, v, G) for calculating PET (Physiologically Equivalent Temperature)
- Gridded temperature data for calculating spatially averaged temperatures for the hospital districts

Methods

Temperature−mortality relationship in HDs
- 2000−2014 (15 years)
- Distributed lag non-linear model (DLNM)
- Without lag and with 25-day lag
- Confounding factors: season, long-term trend, day-of-the-week

- Meta-regression with climatic and sociodemographic covariates: annual mean temperature, temperature ranges, population, share of elderly, THL morbidity index

Changes is mortality related to temperature extremes
- Helsinki−Uusimaa HD
- 1972−2014
- Use of relative mortality i.e. deviation of mortality from expected mortality, that varies seasonally
- Time series of relative mortality are stationary, and thus comparable over the decades regardless of changes in population
- Changes is relative mortality between two 21-year sub-periods were assessed in percentile categories of the thermal indicies

- Station-wise PET in Helsinki−Vantaa
- Spatially averaged daily Tmean in Helsinki−Uusimaa HD

Results

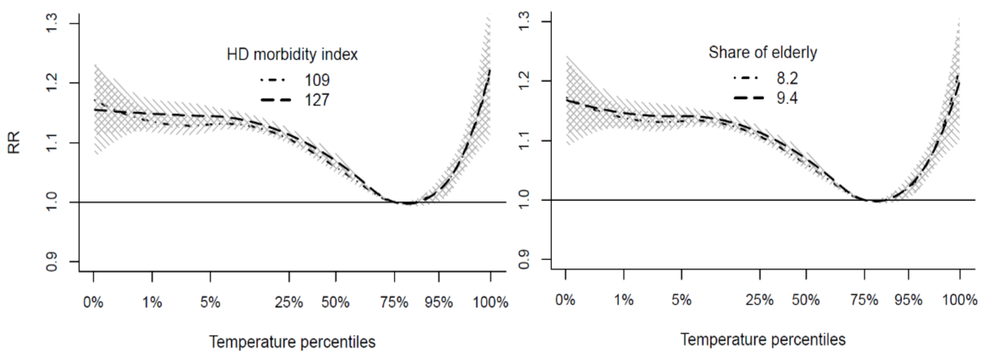

Figure 1. Morbidity index and population of the HD affect slightly to the shape of the temperature-mortality relationship in the HD. Meta-regression with 25th and 75th percentile values of the covariate (morbidity index, share of elderly).

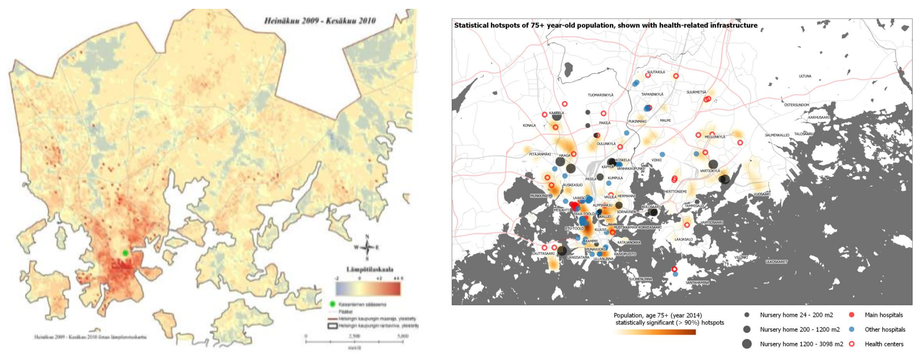

Figure 2. Annual temperature deviation within Helsinki compared to temperature in Helsinki-Kaisaniemi weather station. UHI appears to be strong in areas with high number of elderly.

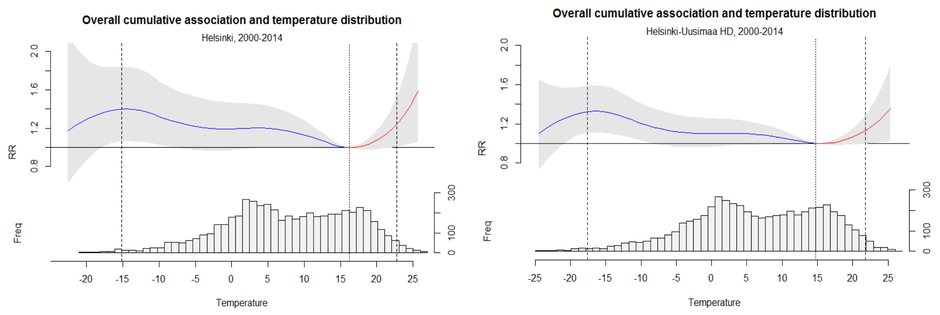

Figure 3. Temperature-mortality relationships in city of Helsinki (left) and in wider area in Helsinki-Uusimaa HD (right).

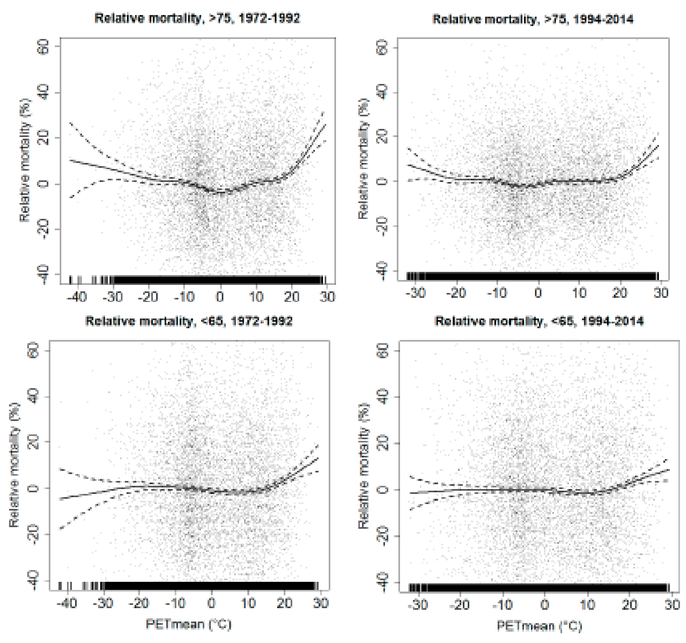

Figure 4. Relative mortality as a function of PET daily mean values in two age groups and sub-periods. 75 years and older (upper row) and younger than 65 years (lower row), sub-periods 1972-1992 (left) and 1994-2014 (right).

Regional differences
- In simple DLNM without lag, temperature-mortality modelling produces U-shaped relationships even in less-populated hospital districts. The differences in the relationships between hospital districts are small, but meta-regression suggests that morbidity indices and HD population might explain some of the small differences (Fig1 and Fig 5)
- Preliminary modelling of the temperature-mortality relationship in the city of Helsinki shows that the relationship differs from the one in Helsinki-Uusimaa HD (Fig 3). This HD is a wider area including also rural areas around more urbanized metropolitan area.

Changes in temperature−mortality relationship in the period 1972−2014
- The sensitivity of Finnish population to temperature extremes has decreased over the decades in all aged groups in upper percentiles of thermal distribution (Fig 4).

- Relative mortality at 99th percentile of PET
- All ages
  - 1972-1992: 18 %
  - 1994-2014: 9 %
- 75 years or older
  - 1972-1992: 21 %
  - 1994-2014: 11 %

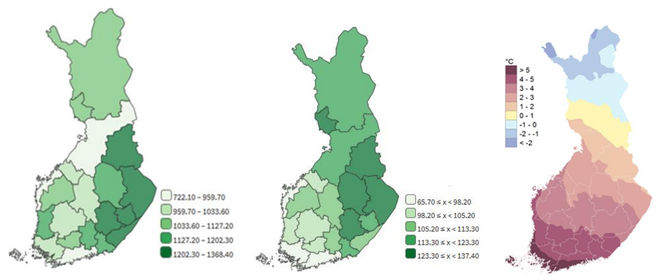

Figure 5. Mortality (1/100,000; left) and THL morbidity index (middle) in hospital districts (HD) in 2014 and annual mean temperature in Finland 1981−2010 (right). (THL, Sotkanet; Pirinen et al., 2012).

More:

Ruuhela R, Jylhä K, Lanki T, Tiittanen P, Matzarakis A, 2017. Biometeorological Assessment of Mortality Related to Extreme Temperatures in Helsinki Region, Finland, 1972–2014. Int. J. Environ. Res. Public Health 14(8), 944. doi:10.3390/ijerph14080944.

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