Institute of Atmospheric Physics AS CR
National Institute of Public Health

Effects of temperature extremes on cardiovascular mortality and morbidity in the Czech Republic

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Outline

- Introduction – motivation, aims
- Data & methods
- Main results
- Conclusions

Motivation

- hot spells/heat waves (anomalous hot periods):
  - considered to be atmospheric phenomena with the most pronounced effects on human health and mortality (especially in large cities in mid-latitudes)
  - major heat waves associated with enormous heat-related mortality impacts (~50,000 excess deaths – Western Europe 2003, Russia 2010)

- cold spells (anomalous cold periods):
  - mortality and morbidity effects much less understood
  - mortality impacts less direct and more lagged
  - confounding effects of epidemics of ARI/influenza

- effects of both hot and cold spells usually most pronounced on mortality due to cardiovascular diseases (CVD)

- **most of studies** – heat related mortality in big cities
- **lack of comparative studies** of hot and cold spell effects in different populations

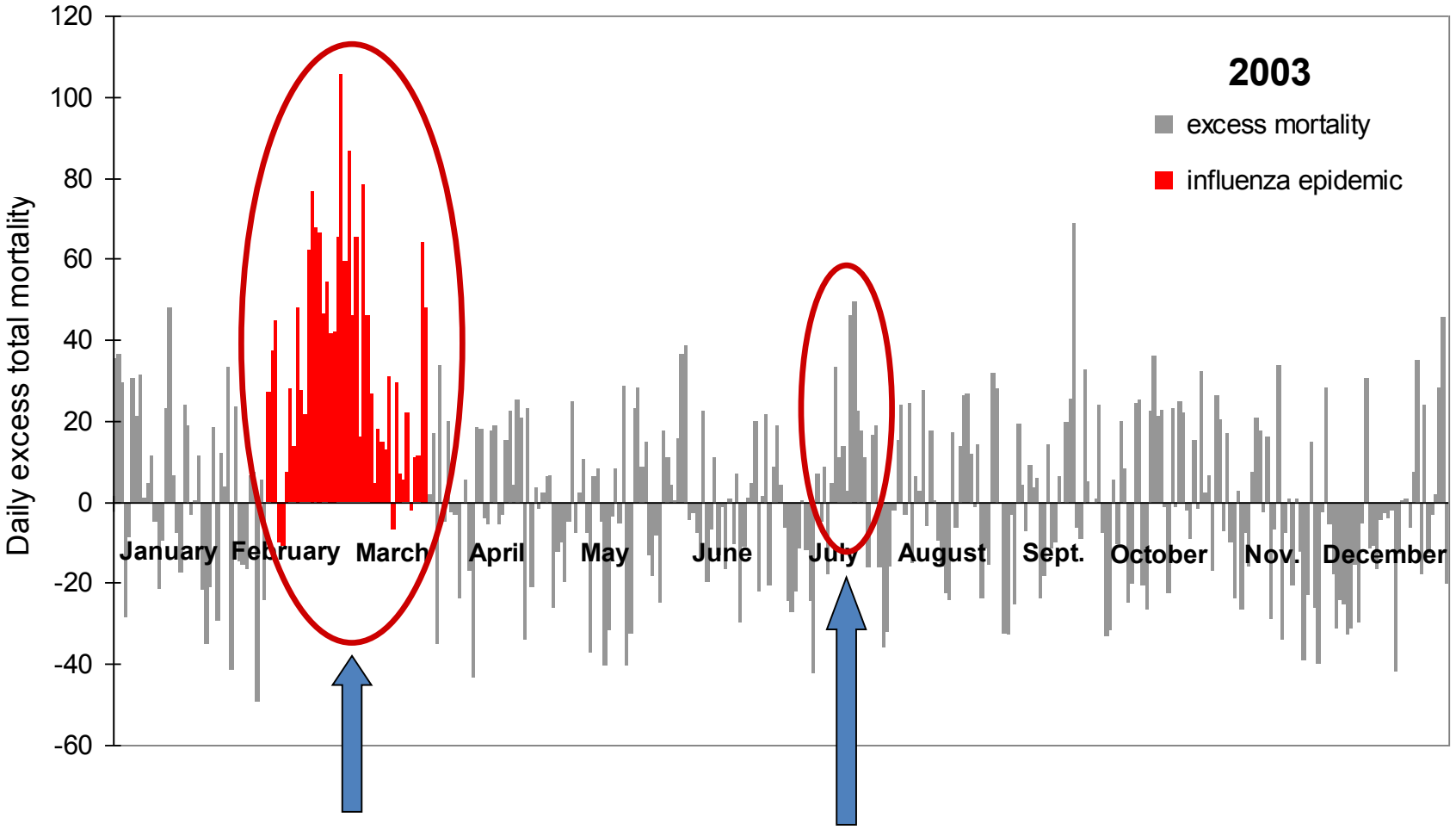
Aims

- to compare the effects of summer hot spells and winter cold spells on CVD mortality and morbidity in the Czech Republic
- to compare the mortality impacts in individual population groups and groups of diagnoses
- to examine differences in these effects between urban and rural populations

Epidemiological data

- nationwide database on daily mortality/morbidity over 1986–2009
- provided by the Institute of Health Information and Statistics and the Czech Statistical Office
- cardiovascular diseases (CVD; ICD–9 codes 390–459, 1986–1993; ICD–10 codes I00–I99, 1994–2009) as primary cause of death/hospital admission
- data standardized to remove the effects of long-term trends and seasonal cycle
- relative deviations of mortality from baseline examined
- epidemics of ARI/influenza identified and corresponding periods removed from the analysis (Kynčl et al. 2005; Kyselý et al. 2009)
- all epidemics occurred in December-March

Influenza epidemics



‘usual’ influenza epidemic

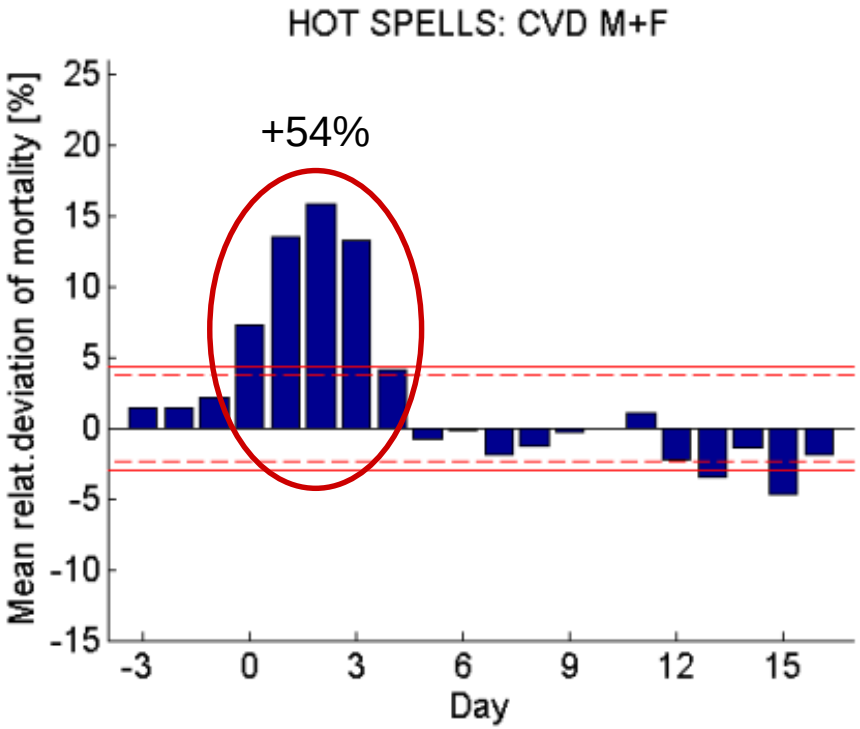
x

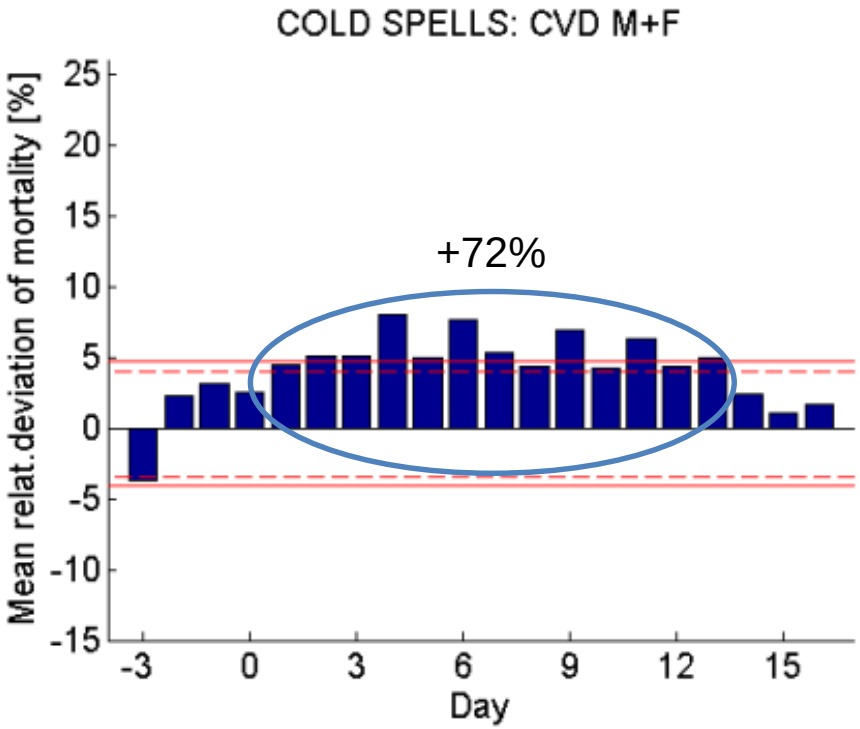
‘extraordinary’ heat wave

Hot and cold spells

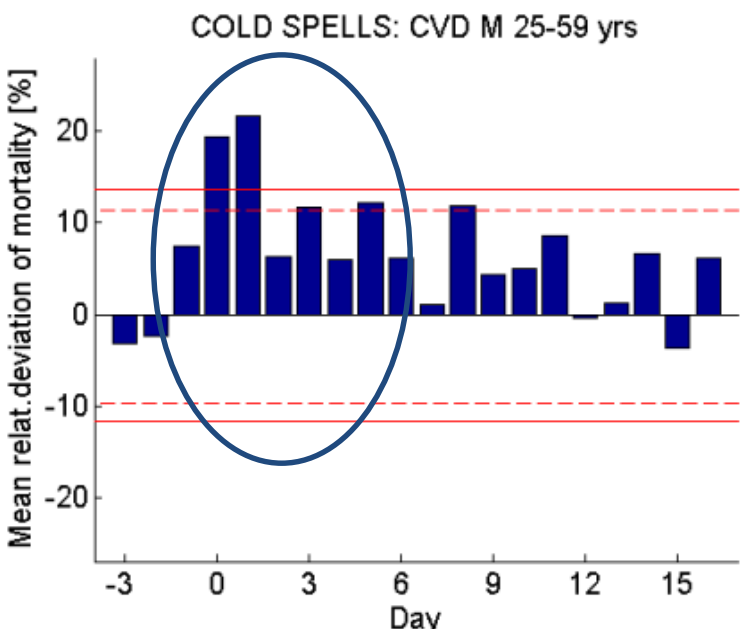
- average daily temperature series (TAVG)
- quantile-based definitions from TAVG distribution
- hot spell: days with TAVG above the 95% quantile in JJA
- cold spell: days with TAVG below the 5% quantile in DJF
- no location-specific threshold
- comparable samples of hot spells / cold spells
- relative deviations of mortality and morbidity averaged over the identified hot/cold spells

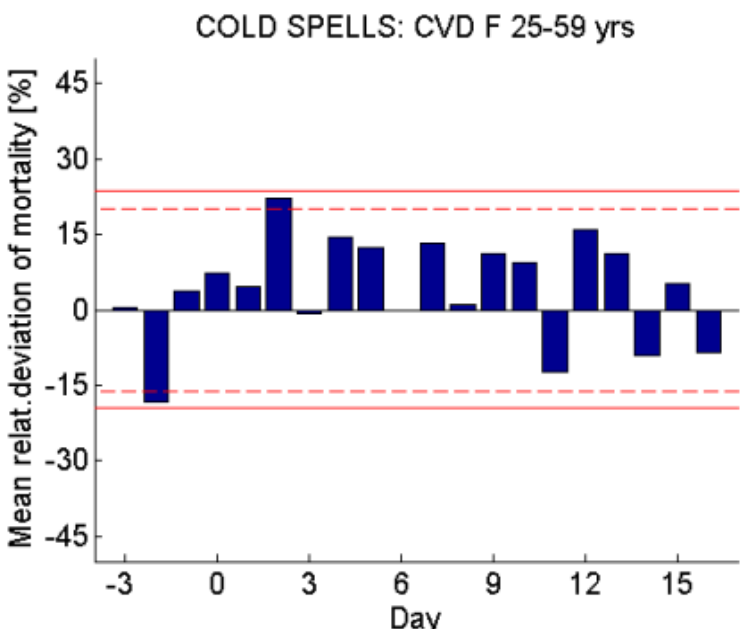
CVD mortality



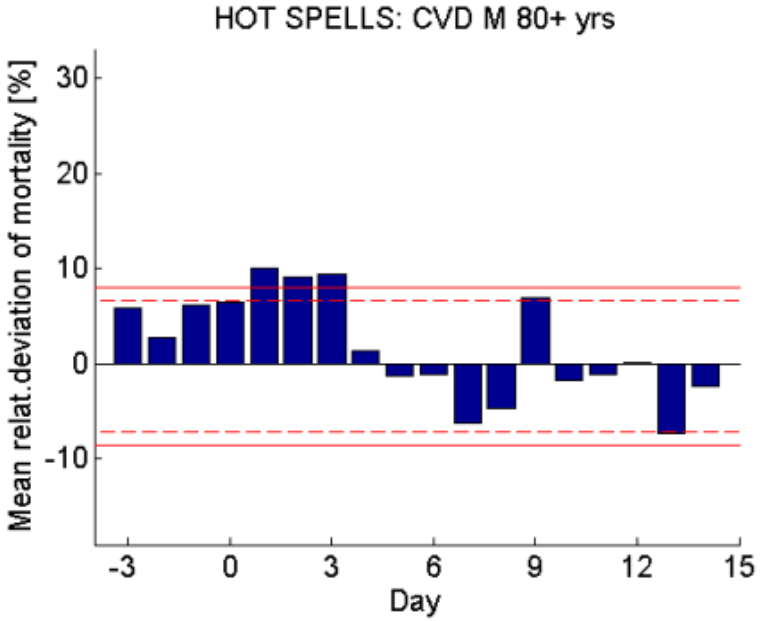


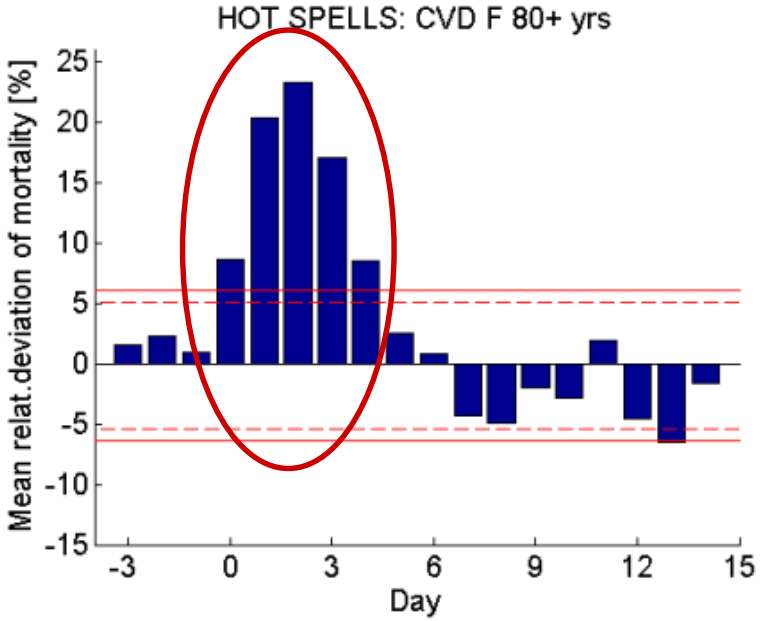
- lines: 95% and 99% CI around zero
- both hot and cold spells linked to significant excess CVD mortality
- mortality displacement = negative anomalies after hot spells
- large difference in the lag
- peak excess mortality much larger for hot spells than cold spells
- BUT the cumulative excess mortality larger for cold than hot spells





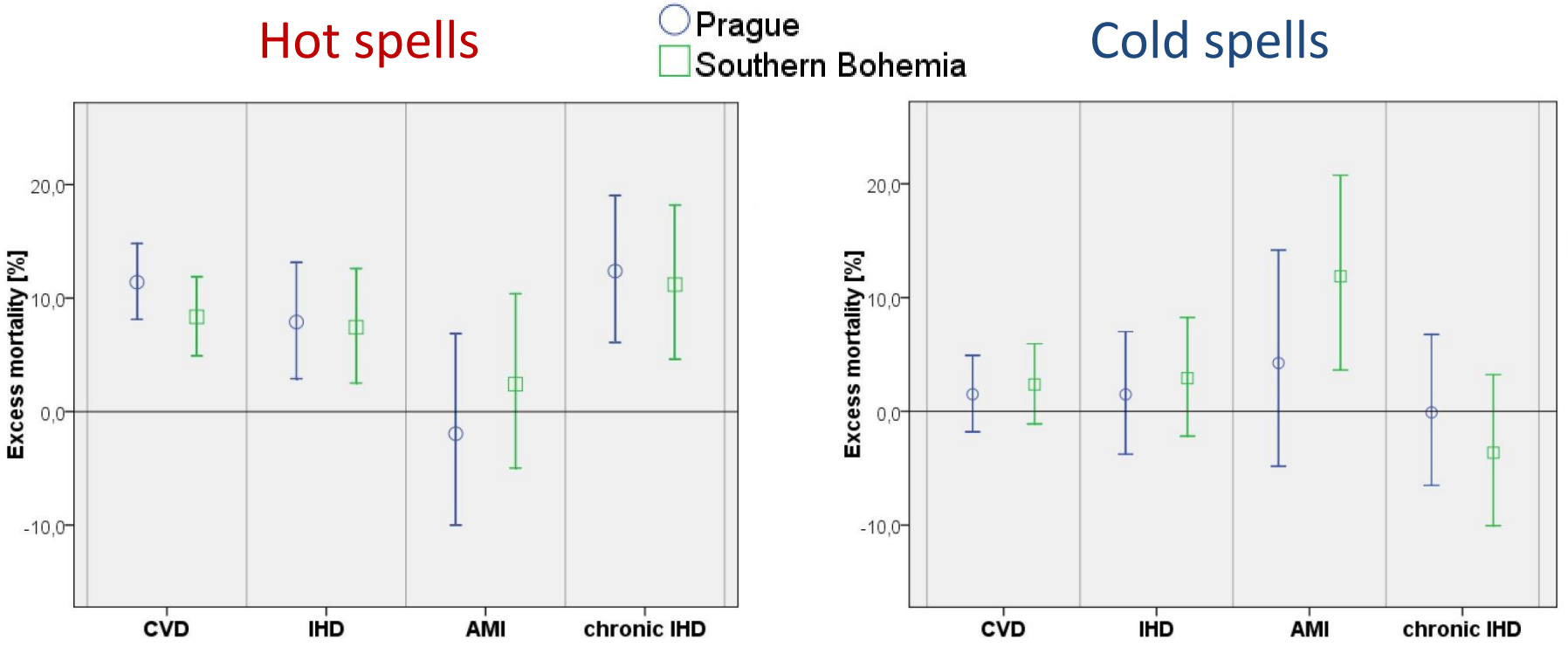
- cold spells in the middle-aged population: esp. M
- hot spells in the elderly: esp. F





Urban *vs.* Rural

Hot spells

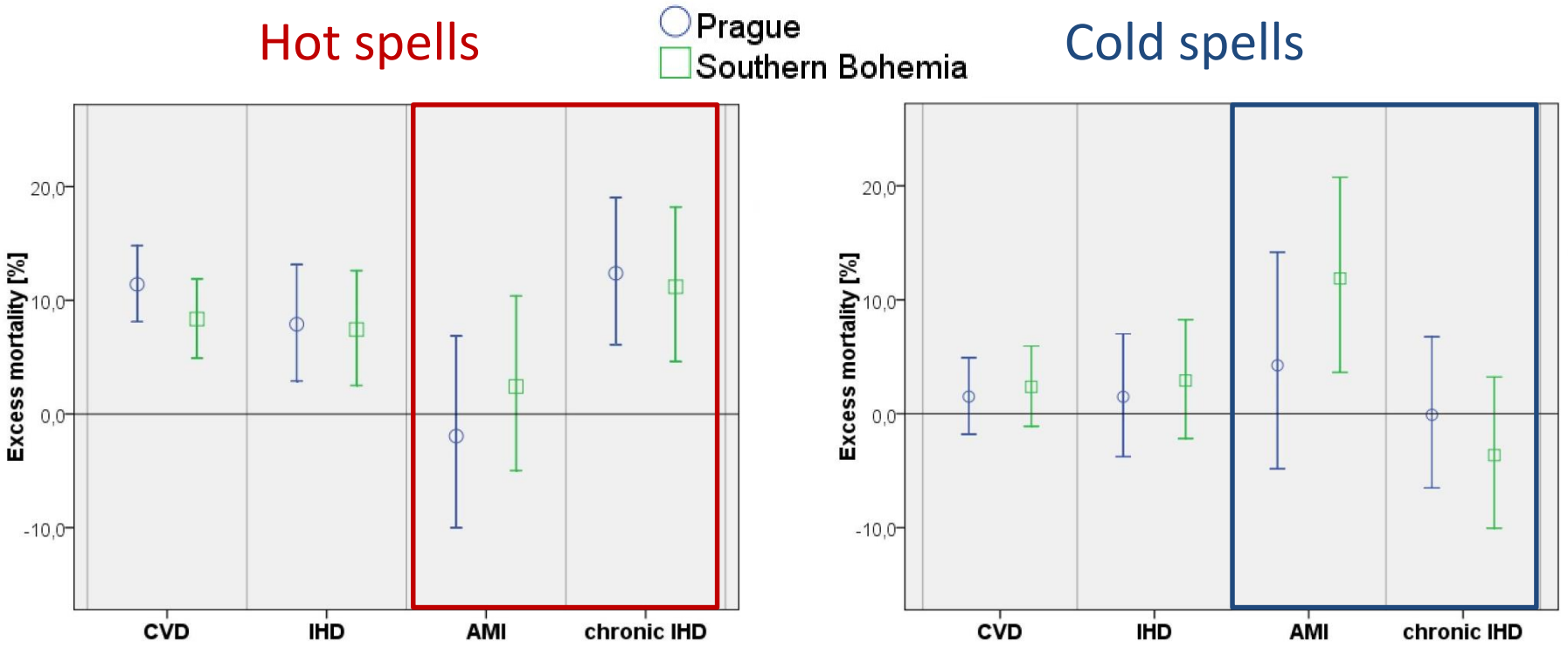


Cold spells

(D_0+D_{+1}), error bars: 95% CI

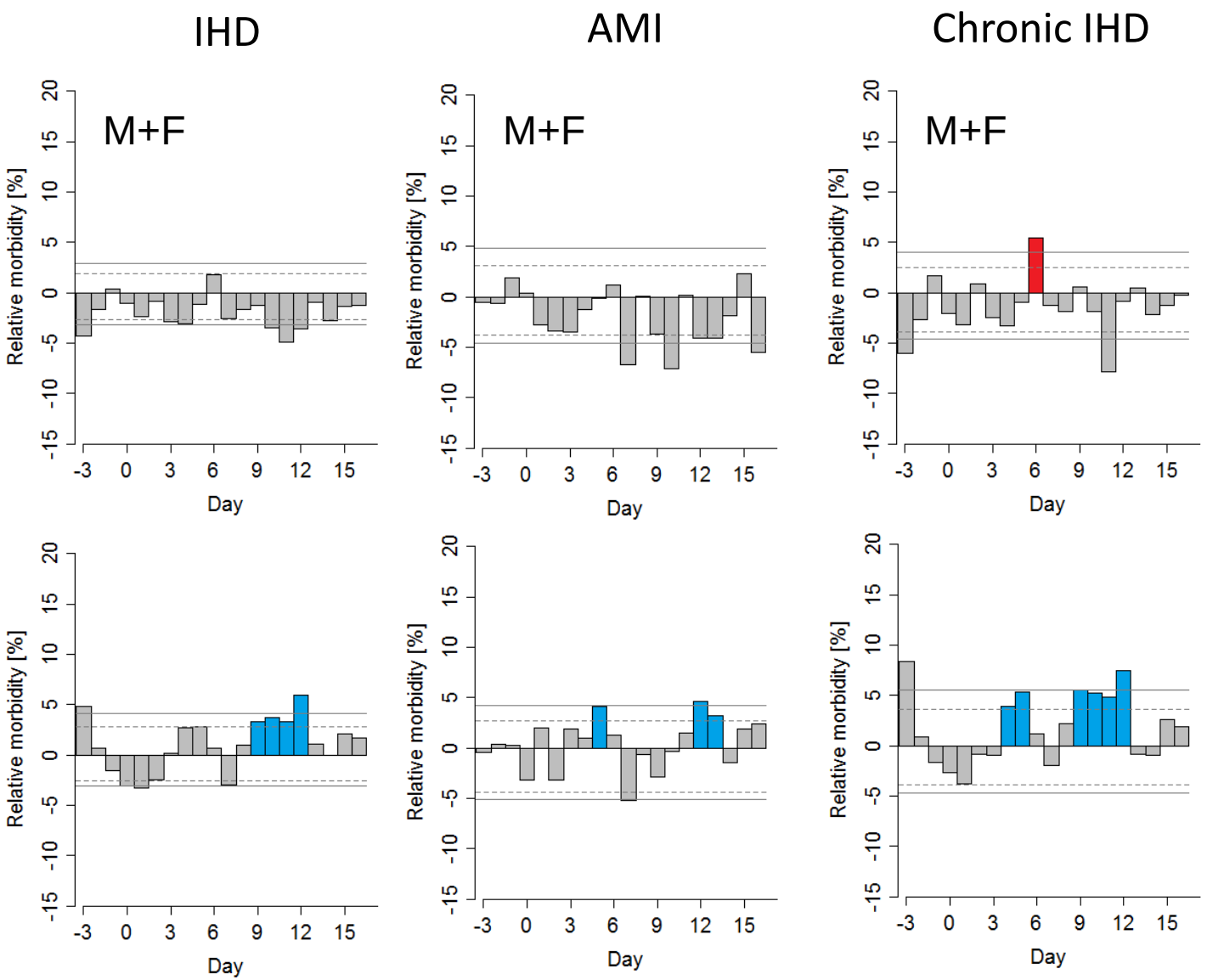
- no clear differences in heat and cold effects
- heat effects on mortality significant also in the rural population

IHD mortality



- IHD = Ischeamic heart disease (I20–I25): >40% of all CVD deaths
- AMI = Acute myocardial infarction (I21–I22)
- chronic IHD = Chronic ischaemic heart disease (I25)
- IHD mortality – similar patterns to CVD mortality
- BUT **contrasting patterns of individual diagnoses**
- **heat stress** increases mortality especially due to **chronic IHD**
- the effects of **cold stress** are most pronounced on **AMI**

HOSPITAL ADMISSIONS – weak effects



Conclusions (1/2)

- Both **high** and **low** temperatures are associated with excess CVD mortality
- cold spells: have at least similar effects as hot spells, in terms of cumulative excess mortality
- hot spells: affect mostly elderly F, similar lags in all population groups
- cold spells: middle-aged M most affected, very different lags for population groups
- => cold-related mortality shows no evidence of mortality displacement
- => related to occupational exposure & health status
- weak effects on morbidity
- however, sudden pressure decreases in winter were associated with significant increases in the number of hospital admissions (Plavcová and Kyselý, 2014)

Conclusions (2/2)

- heat stress increases mortality especially due to chronic CVDs, while the effects of cold stress are most pronounced on acute CVDs
- no significant regional differences in heat and cold effects, BUT heat effects are generally slightly higher in the urban region and cold effects are slightly higher in the rural population
- => influence of other meteorological variable (humidity, solar radiation, wind speed) => esp. wind when cold-related mortality is considered (Urban and Kyselý 2014)
- Follow-up research: regional differences in CVD mortality with respect to environmental and socio-economic differences

Articles

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Thank you for your attention!