Extreme ambient temperatures and emergency room visits: a time series study in Toronto, Canada

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State of knowledge

- Climate change and extreme ambient temperatures
- Extreme heat and mortality/morbidity
  - Basu, 2009, *Environ Health*; Ye et al. 2012, *Environ Health Perspect*; Turner et al., 2012, *Epidemiology*
- How can epidemiology best inform policy?
  - Understand etiology
  - Guide interventions targeted to vulnerable groups

Objective

Evaluate the association between extreme ambient temperatures and emergency room visits for cardiorespiratory diseases among vulnerable groups in Toronto, Canada

Methods

- Time series study
- Toronto, April 1st 2002 to March 31st 2010
- Daily numbers of emergency room (ER) visits (NACRS)
  - Cardiovascular diseases, ICD-10 codes: I00-I99
  - Respiratory diseases, ICD-10 codes: J00-J99
- Meteorological data (Environment Canada)
  - Daily mean temperature and relative humidity

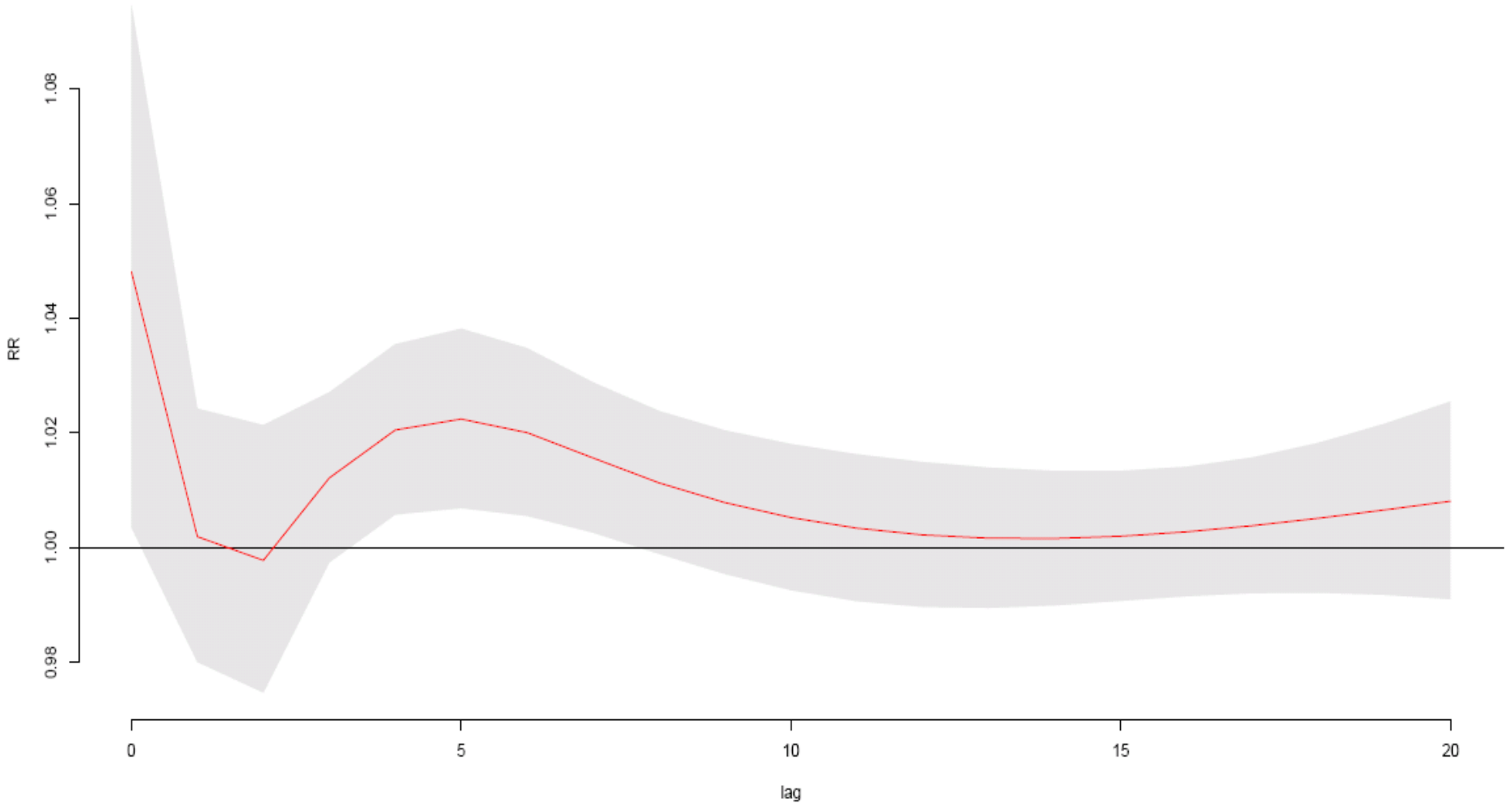
Methods

- Poisson regression with a distributed lag non-linear model (DLNM)
- Exposure of interest: Mean daily temperature
- Outcome: Daily counts of ER visits
- Confounders
  - Seasonal effects and long-term trends, day-of-the-week and air pollutants

Results

Variables	Number of days of measurements	Mean	Standard deviation	Minimum	Percentiles			Maximum
					25th	50th	75th	
Mean Temperature (° C)	2922	8.7	10.7	-20.3	0.3	9.0	18.2	31.5
Mean relative Humidity (%)	2922	69.3	14.4	-25.3	61.9	70.5	78.3	98.8
$PM_{2.5}$ (Ug/m^3)	2922	8.4	6.85	0	3.8	6.3	10.5	49.2
NO_2 (Ug/m^3)	2922	20.5	7.7	5.0	15.0	19.4	24.8	62.6
O_3 (ppb)	2920	22.1	12.3	2.2	14.6	21.0	28.0	248.0
CO (Ug/m^3)	2915	0.4	0.2	0	0.2	0.3	0.5	1.8
SO_2 (Ug/m^3)	2922	2.2	2.1	0	1.0	1.5	3.0	17.3
Cardiovascular admissions	2922	100.2	20.9	49.0	84.0	101.0	116.0	161.0
Respiratory admissions	2922	192.6	62.8	93.0	156.0	182.0	213.0	801.0

Relative risks (RRs) of daily emergency room visits for respiratory diseases at hot temperatures along lag days in Toronto, Canada



Relative risks (RRs) of daily emergency room visits for cardiovascular and respiratory diseases at hot temperatures over cumulative lag days stratified by age groups in Toronto, Canada

Emergency room visits	Lagged effect (days)	0 - 14		15 - 39		40 - 59		≥ 60	
		RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Respiratory diseases	Lag 0 - 1	**1.31**	**1.04 – 1.48**	1.04	0.98 – 1.11	1.03	0.96 – 1.11	**1.07**	**1.01 – 1.13**
	Lag 0 – 13	0.99	0.93 – 1.06	1.07	0.90 – 1.28	0.98	0.80 – 1.20	1.15	0.98 – 1.34
Cardiovascular diseases	Lag 0 - 1	N.E	-	0.99	0.94 – 1.03	0.97	0.90 – 1.04	**1.16**	**1.04 – 1.30**
	Lag 0 – 13	N.E	-	0.99	0.87 – 1.11	0.97	0.79 – 1.20	1.23	0.91 – 1.66

Relative risks (RRs) of daily emergency room visits for cardiovascular and respiratory diseases at hot temperatures cumulated over a lag period of 0 to 1 day and stratified by pre-existing medical conditions in Toronto, Canada

Pre-existing medical condition	Cardiovascular disease emergency room visits		Respiratory disease emergency room visits	
	RR	95% CI	RR	95% CI
Diabetes	**1.13**	**1.01 – 1.26**	1.04	0.89 – 1.22
Respiratory diseases	0.92	0.68 – 1.23	**1.22**	**1.01 – 1.46**
Respiratory infections	0.56	0.17 – 1.88	0.95	0.82 – 1.11
Hypertension	1.05	0.88 – 1.25	1.12	0.82 – 1.53
Atherosclerosis	0.49	0.11 – 2.07	N.E.	-
Cancer	0.89	0.60 – 1.32	**1.25**	**1.04 – 1.50**
Kidney diseases	1.14	0.82 – 1.58	1.15	0.77 – 1.71
Pneumonia	0.91	0.62 – 1.33	1.09	0.90 – 1.32
Cardiac diseases	0.98	0.86 – 1.12	1.10	0.91 – 1.33

Relative risks (RRs) of daily emergency room visits for cardiovascular and respiratory diseases at hot temperatures cumulated over a lag period of 0 to 13 days and stratified by pre-existing medical conditions in Toronto, Canada

Pre-existing medical condition	Cardiovascular disease emergency room visits		Respiratory disease emergency room visits	
	RR	95% CI	RR	95% CI
Diabetes	1.08	0.74 – 1.64	0.85	0.47 – 1.52
Respiratory diseases	1.09	0.38 – 3.10	1.42	0.83 – 2.42
Respiratory infections	N.E.	-	0.95	0.64 – 1.43
Hypertension	1.26	0.75 – 2.11	1.03	0.32 – 3.33
Atherosclerosis	N.E.	-	N.E.	-
Cancer	1.44	0.46 – 4.54	1.00	0.35 – 2.89
Kidney diseases	0.85	0.32 – 2.25	0.66	0.15 – 2.94
Pneumonia	1.82	0.63 – 5.32	1.00	0.49 – 2.07
Cardiac diseases	0.92	0.63 – 1.33	0.92	0.47 – 1.80

Discussion

- Higher temperatures were associated with increased risks for children and older adults
- Higher temperatures were associated with increased risks for persons with pre-existing medical conditions (respiratory diseases, diabetes and cancer)

Discussion

- Limitations
  - Non-differential misclassification errors will likely underestimate the effects
  - Lack of individual data
  - Single city
- Strenths
  - Size of population & statistical model

Conclusion

- Further work needed at the individual level
- The findings should strengthen the need for public health decision makers to consider the impacts of extreme heat in specific vulnerable groups

Ongoing work

- Variation and acclimatisation in the effects of ambient temperature on mortality across the globe
- Attributable mortality related to hot temperature in a multi-country approach
- Variation in air conditioning use on heat related mortality in Canada and the U.S.
- Evaluate the impacts of heat wave during pregnancy on adverse birth outcomes

Thank you for your attention

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