Historical & Projected Effects of Cold Temperatures on All-Cause Mortality in Connecticut

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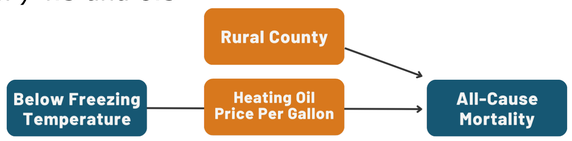
Background

- Most weather-related deaths in CT related to cold (63%)
- Majority households rely on oil (43%) and fossil fuel heating sources (78%)
- Heating oil prices may impact ability to adapt to cold weather
- **Effects of climate change on cold-related deaths vary by geographical region**
- **Understanding regional risk important for adaptation efforts**

Aims

1. Evaluate effects of cold temperature on daily mortality in CT over ten-year observation period (2006–2015)
2. Project future mortality due to cold temperatures in CT using projected daily temperatures for 2041–2050 under Representative Concentration Pathways (RCP) 4.5 and 8.5



Methods

1 Generalized additive distributed lag models to evaluate association between cold and mortality

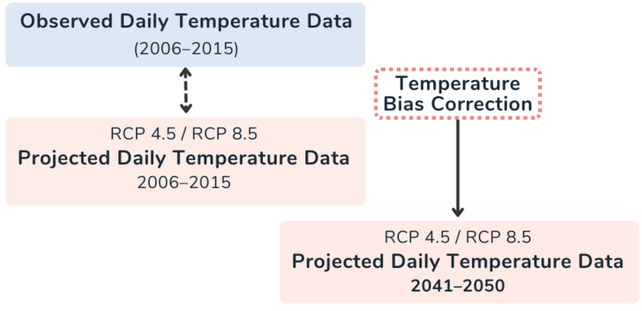
$$\log(\text{all-cause mortality}) = \beta_0 + \beta_1 \underset{(dichotomous)}{\text{Below freezing days}} + \beta_2 \underset{(dichotomous)}{\text{Rural}} + \beta_3 \underset{(dichotomous)}{\text{Quartile of heating oil price}} + \beta_4 \text{Below freezing days * Quartile of heating oil price} + \text{Smoothing spline}$$

Models Stratified for Heating Oil Price Quartiles

	Heating Oil Price Quartile	Heating Oil Price Per Gallon (ppg)
Model 1	1	≤ $1.74 ppg
Model 2	2	> $1.74 and ≤ $2.10 ppg
Model 3	3	> $2.10 and ≤ $2.92 ppg
Model 4	4	> $2.92 and ≤ $3.99 ppg

Measure	Data Source
Daily mortality	Connecticut Vital Statistics
Daily temperature	PRISM Spatial Climate Datasets
Rurality	Census Bureau
Heating oil average weekly price per gallon	United States Energy Information Administration
Projected temperature data	Community Climate System Model (CCSM) 4 and Multivariate Adaptive Constructed Analogs (MACA)

2 Estimated projected mortality attributable to cold under RCP scenarios



Results

- Below freezing temperatures associated with 12–13% increased risk mortality in all models
- **Historical heating oil prices had little effect** on the relationship between cold temperatures and mortality

Relative Risk of Cold-Related Mortality

Model	Relative Risk
Model 1 First quartile heating oil price	RR = **1.13** 95% CI [1.11, 1.15]
Model 2 Second quartile heating oil price	RR = **1.12** 95% CI [1.09, 1.15]
Model 3 Third quartile heating oil price	RR = **1.12** 95% CI [1.10, 1.14]
Model 4 Fourth quartile heating oil price	RR = **1.13** 95% CI [1.11, 1.16]

Projected Cold-Attributed Mortality (CAM) and Excess Mortality Under RCP 4.5 (2041–2050)

Projection (2041–2050)	Observed CAM (2006–2015)	CAM Uncorrected	Excess CAM Uncorrected	CAM with Temperature Bias Correction	Excess CAM with Temperature Bias Correction
Model 1	5928	5092	−836	5238	**−690**
Model 2	5535	5754	−781	4891	**−644**
Model 3	5495	4720	−775	4856	**−639**
Model 4	5932	5095	−837	5242	**−690**

Under RCP 4.5, **warmer temperatures lead to net reduction** in **cold-related mortality**

What is RCP 4.5? Possible scenario of how world's climate may change in the future

- Assumes action will be taken to mitigate climate change
- Global temperatures still rise, but not as much

Key Points

- **Cold temperatures positively associated with mortality in Connecticut**
- Projections estimate **reduction in cold-related deaths in Connecticut** under RCP 4.5

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