FIPRP | Firearm Injury & Policy Research Program

BOSTON UNIVERSITY

# Daily Ambient Temperature and Firearm Violence


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# Disclosures

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Dr. Wellenius reports receiving consulting income from the Health Effects Institute and Google

# Background

- Firearms are the **leading cause of death** among youth in the United States
  - About **2/3 firearm-related deaths are homicide**
  - Firearm **homicides are 2x more common in urban areas** compared to rural
- Some evidence that **more shootings occur on hotter days**
- Cities often hotter than their surroundings (**Urban Heat Island Effect**)
- **Climate change** expect to both increase average daily temperatures as well as extreme heat events

# Methods

**Research Question: Is there an association between daily temperature and firearm incidents across US cities?**

**Study Design:** Time-series (2015-2020)

**Exposure:** Daily ambient temperature (percentile, population-weighted to city boundaries) [NLDAS]

**Outcome:** Count of firearm incidents [Gun Violence Archive]

**Statistical Analysis:** Two-stage Distributed Lag Non-Linear Model (DLNM)

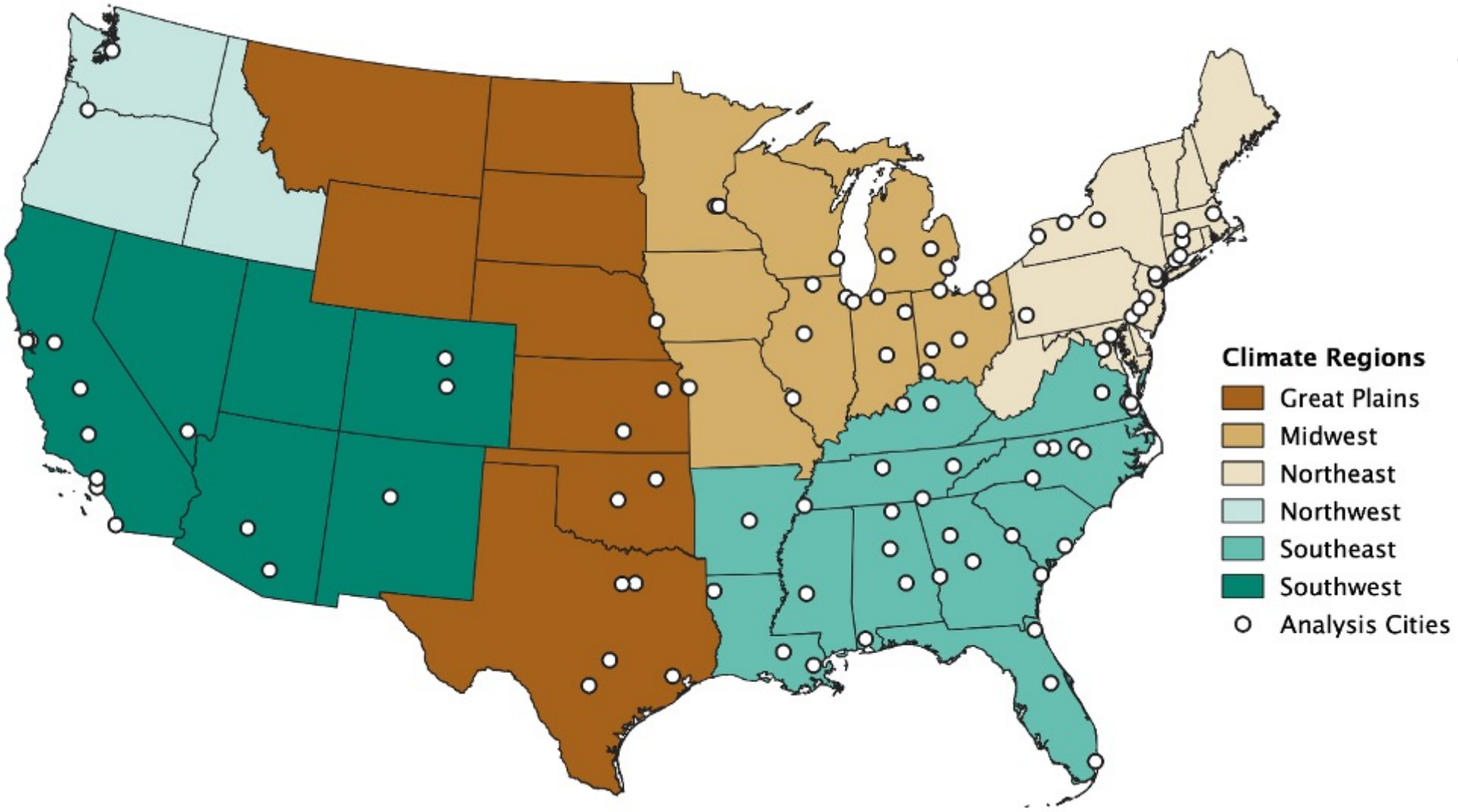
**Model covariates**: Day of week

Seasonality of firearm incidents

**Meta-regression predictors**: Mean temperature

Annual temperature range

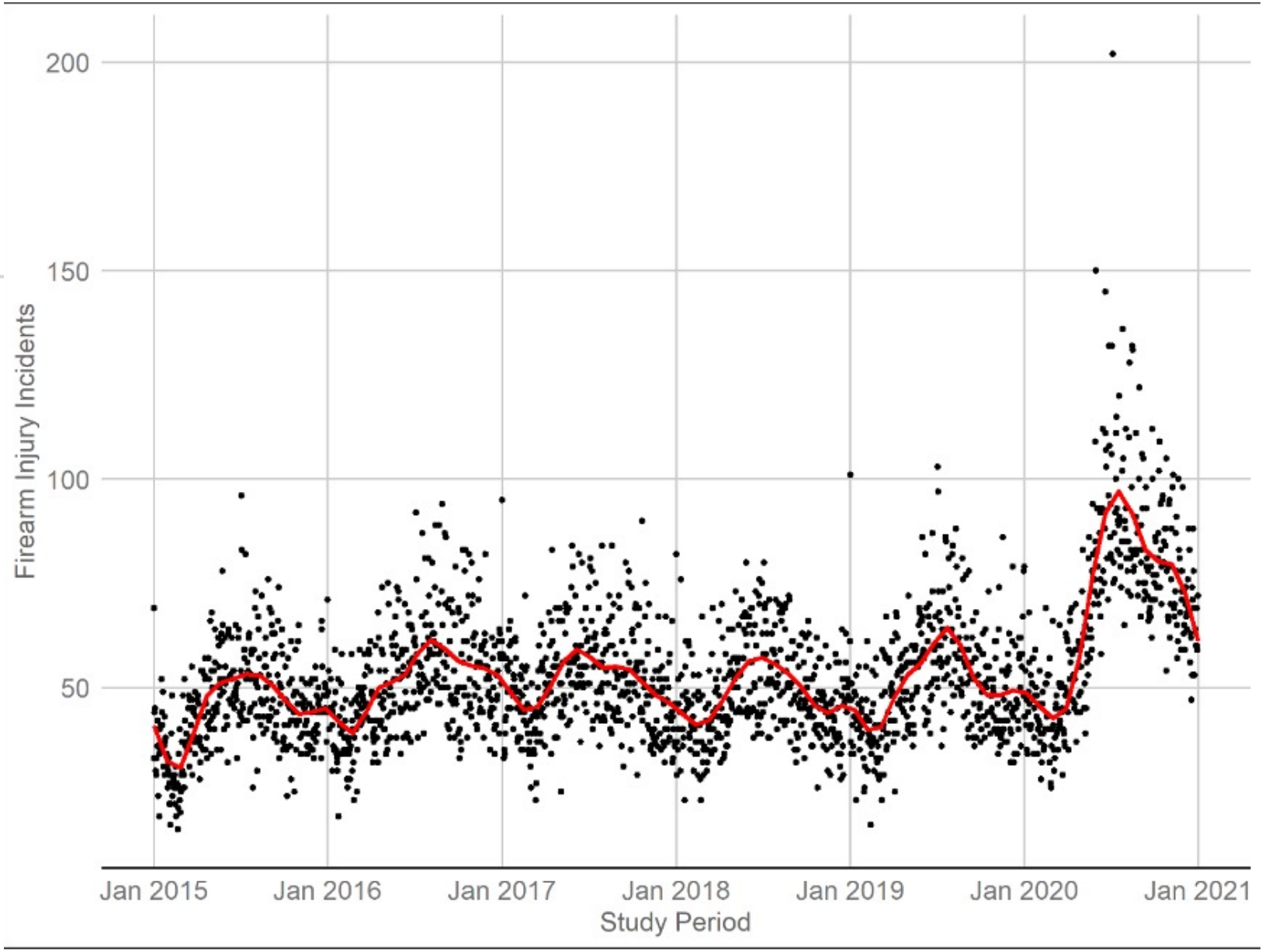
# 100 Cities Included



# Seasonality of Shootings

**More shootings occurred in summer months**

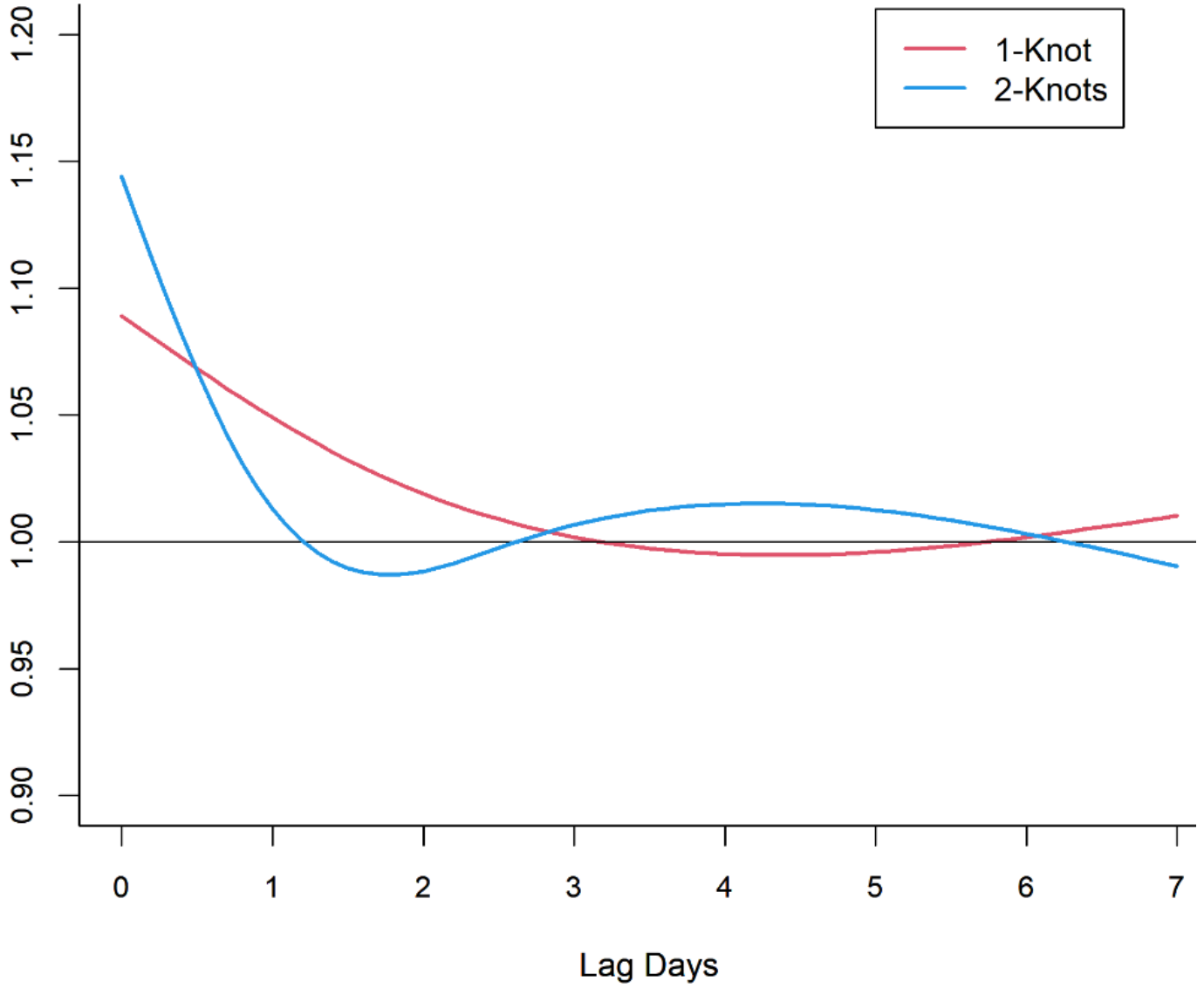
**Adjusting for seasonal patterns** is crucial to understanding the heat and shootings risk



# Lagged Heat and Shootings Risk

Estimated risk across seven lagged days suggests that **risk of shootings is highest on the same day**.

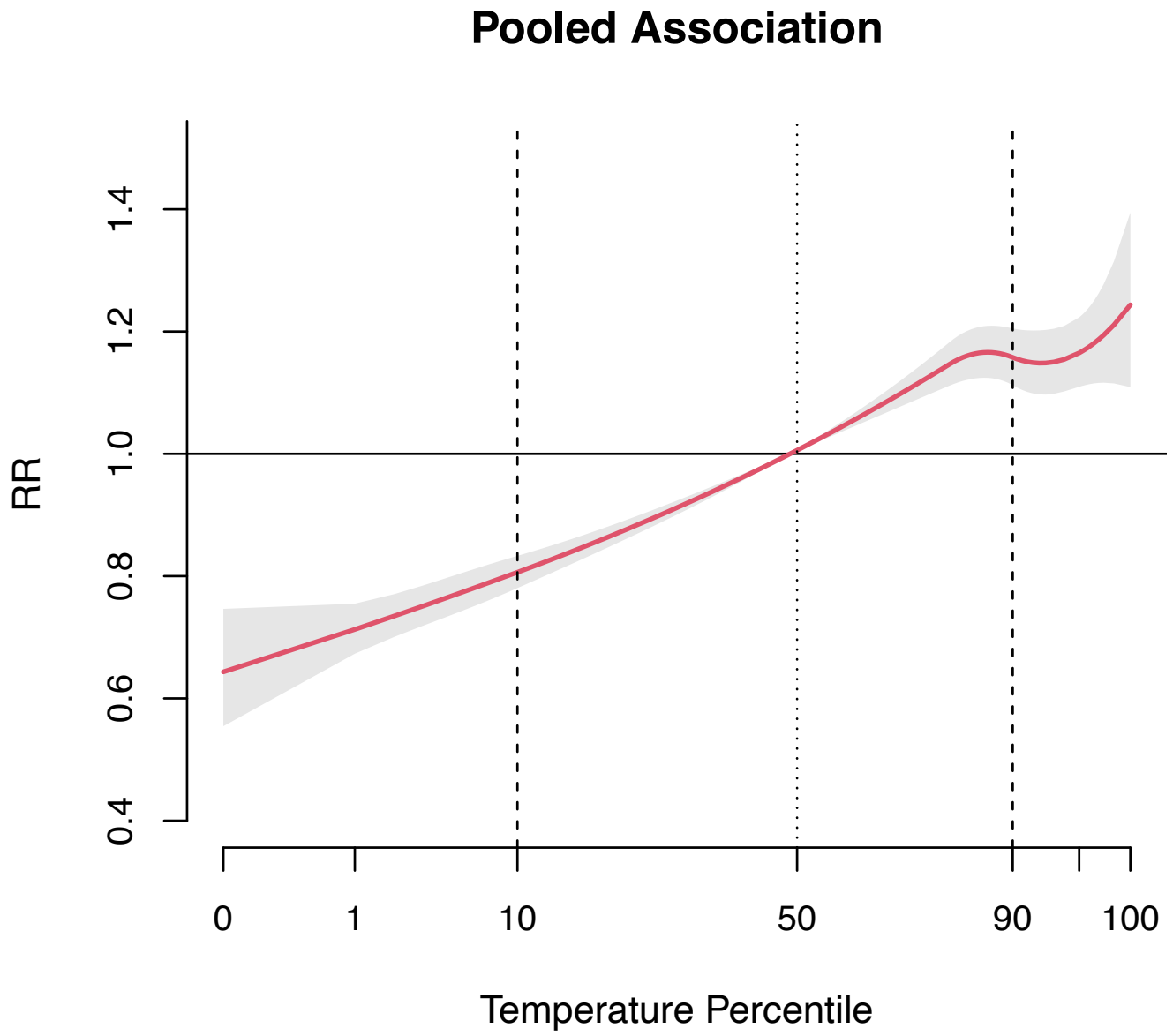
We found little evidence of either continued increase in risk or a harvesting effect in the following several days



# Risk of Shootings Across Temperature Gradient

**Risk of shootings increases monotonically with higher temperatures**.

Peak risk occurs around the 84th temperature percentile – between **84°-90° F** for most cities – with a relative risk of **1.17 (95% CI, 1.12-1.21)** compared to median temperature



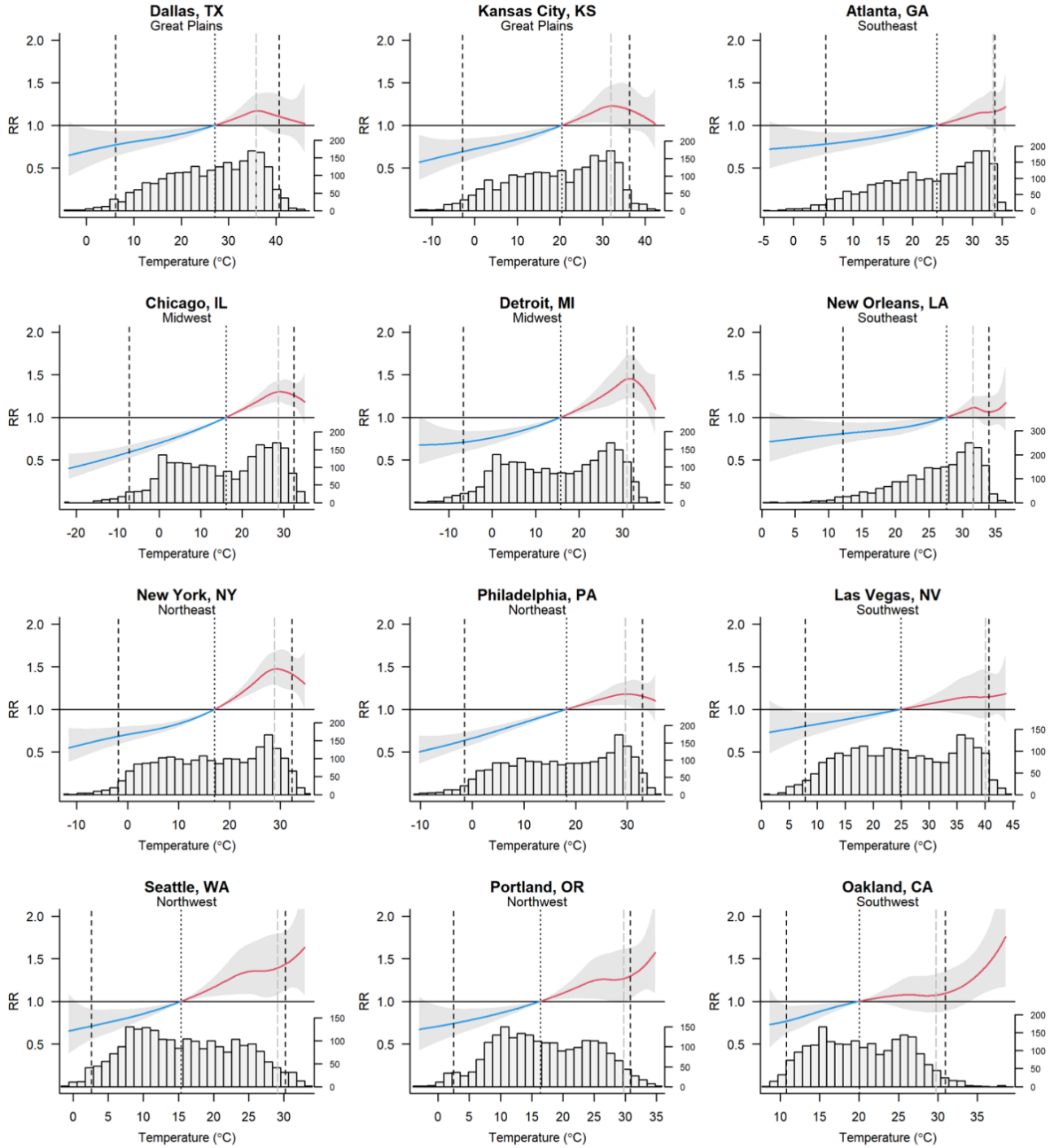
# Overall and Regional Results

| | All Heat | Moderate Heat | Extreme Heat | Count of Shootings | Median Temp C |
|---|---|---|---|---|---|
| Overall Model (n=100) | 6.85 (6.09, 7.46) | 5.00 (4.44, 5.43) | 1.86 (1.58, 2.05) | 116,511 | - |
| Regional Estimates | | | | | |
| Great Plains (n=11) | 4.12 (2.21, 5.70) | 3.37 (2.13, 4.45) | 0.75 (-0.02, 1.32) | 11,175 | 25.3 |
| Midwest (n=21) | 9.51 (8.46, 10.50) | 6.79 (5.95, 7.58) | 2.73 (2.36, 3.02) | 39,714 | 17.2 |
| Northeast (n=18) | 9.54 (6.55, 11.90) | 6.96 (5.01, 8.38) | 2.60 (1.49, 3.40) | 25,970 | 16.9 |
| Northwest* (n=2) | -- | -- | -- | 964 | 15.9 |
| Southeast (n=34) | 2.98 (1.95, 3.70) | 2.38 (1.63, 2.96) | 0.61 (0.17, 0.92) | 29,389 | 25.1 |
| Southwest (n=14) | 0.48 (-1.58, 2.17) | 0.02 (-1.46, 1.17) | 0.46 (-0.36, 1.07) | 9,299 | 22.2 |

* Too few cities to reliably estimate overall climate region estimates

# City-Specific Results from All Climate Regions

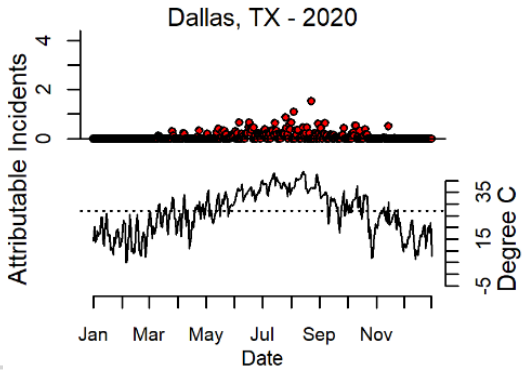
**All city-specific risk curves have an increasing risk of shootings with higher temperatures**, but magnitude and kurtosis differ between cities

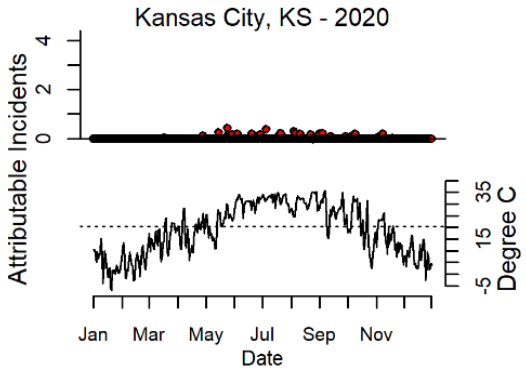


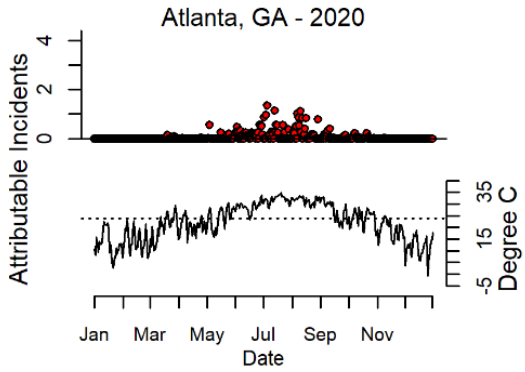
# Attributable Shootings Across Seasons in 2020

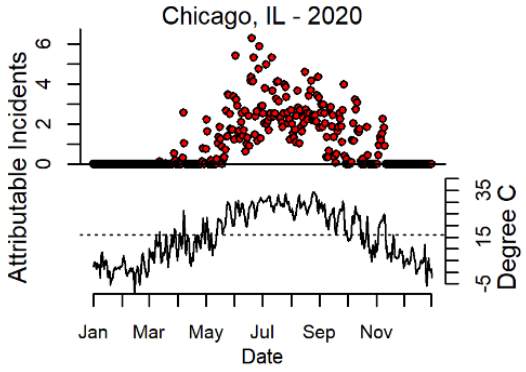
Risk of shootings is higher on days with unseasonably hot temperatures

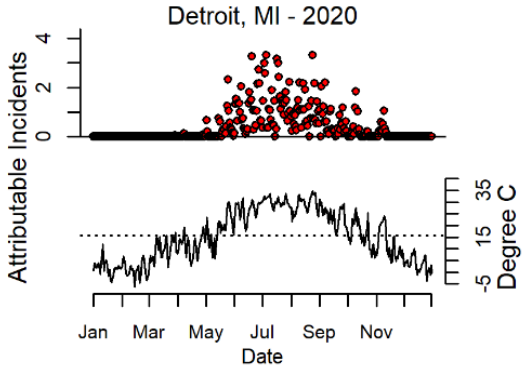
**Risk is not confined to the hottest extreme heat days**

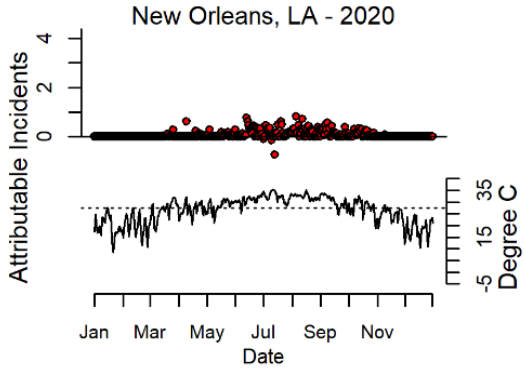


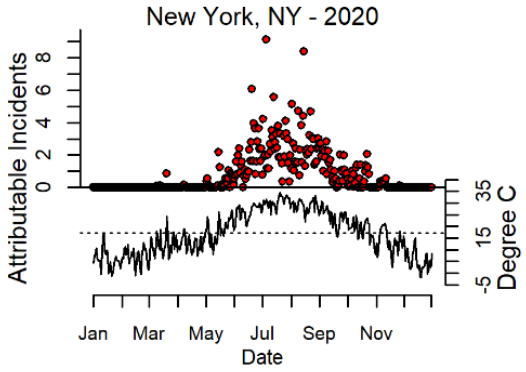



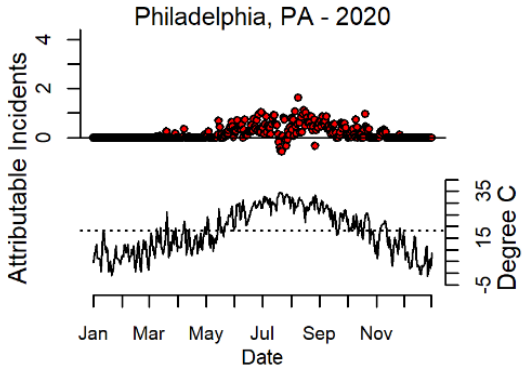



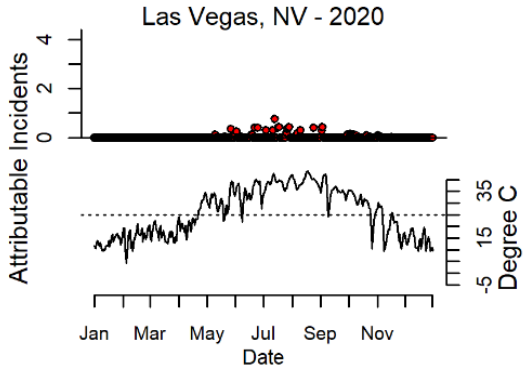



# Takeaways and Next Steps

- Risk of shootings is higher with hotter temperatures
  - While hotter temperatures have higher risk of shootings, risk is not constrained to extreme heat wave days
- We found that 6.85% (95% CI: 6.09%-7.46%) of all shootings during the study period could be attributable to unseasonably warm temperatures

**Next Steps:**

- Are certain neighborhoods more resilient to hot temperatures?
- Can heat adaptation strategies reduce firearm injuries? How?

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# Thank You

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