Temperature Variation and Domestic Violence

September 2025

Martin Habets

European University Institute

Domestic Violence as a Global Crisis

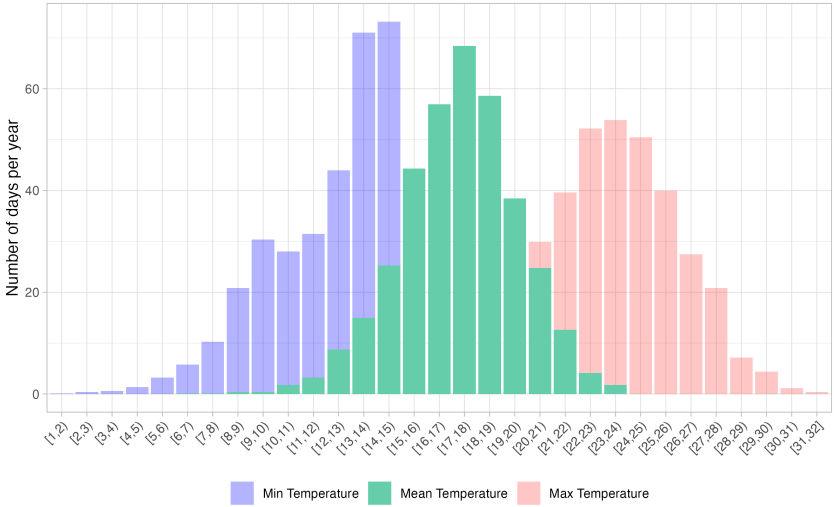
- 1 in 3 women worldwide have been subjected to physical and/or sexual violence
  $\approx$ 736 million women
- DV is broader than gender-based violence
  - Affects women, men, children, and the elderly
  - Ecompasses physical, sexual, psychological, and economic abuse
- Profound consequences across the life cycle
  - Identifying drivers is crucial
- Higher temperatures linked to aggression and conflict
  - Bring this link to DV specifically

My paper:

How do temperature variations affect domestic violence in Mexico City?

- I document a positive association between temperature and DV
  - On average, 1°C increase in daily temperature → a 2.8% increase in reported DV [95% CI: 2.1% – 3.5%]
- Aligns with crime literature, but ...
  - Most existing studies focus on extreme weather events
  - Temperature matters for DV, even in a moderate climate

Mexico City: Mild Temperatures Year Round



- Temperature = tmean = average of 24 hourly readings

Small Scale Heterogeneity within Mexico City

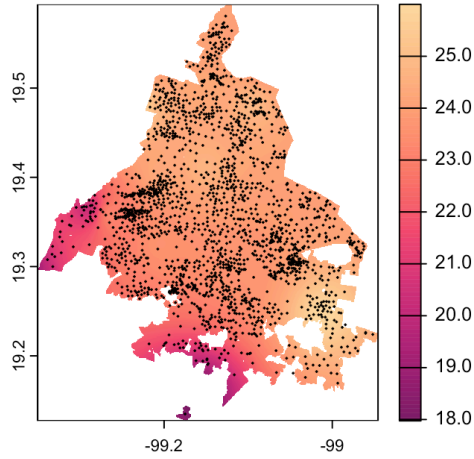
- Same climate exposure across the city, but very different responses
  - Effects much larger in poorer neighborhoods
  - Strongest where housing quality is lower
- Interpretation:
  - Not only about climate, but ability to cope
  - Climate stress compounds existing inequalities in the city
- Heterogeneity is "man-made"
  - Implies a role for targeted prevention and adaptation measures

Conceptual Framework

- How might temperature affect domestic violence?
  - **Physiological channel:** heat increases irritability, stress, and aggression
  - **Time use channel:** temperature changes daily routines, increases interactions at home
- Channels are *complementary* and not mutually exclusive
- We will return to these mechanisms throughout the presentation
- + Important to consider the role of reporting:
  - Temperature may also affect the likelihood of incidents being reported

Weather Data from Ground-Based Stations

- Hourly weather data from 30 monitoring stations
  - Temperature, humidity and windspeed
  - + PM2.5 for pollution
- Daily precipitation from 95 weather stations
  - Total daily precipitation (mm)
- Construct neighborhood-level measures (≈2400 neighborhoods)
  - Inverse-distance weighting between each station and each neighborhood centroid

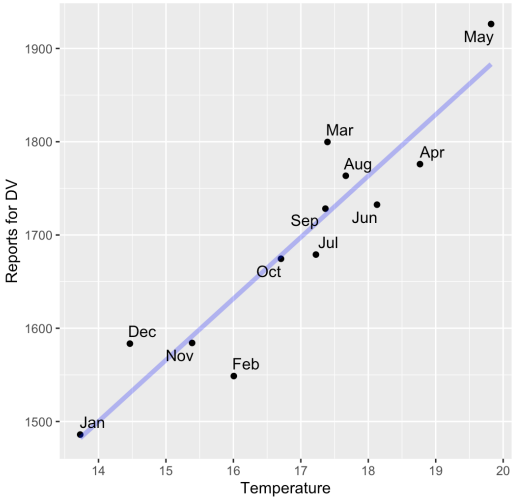


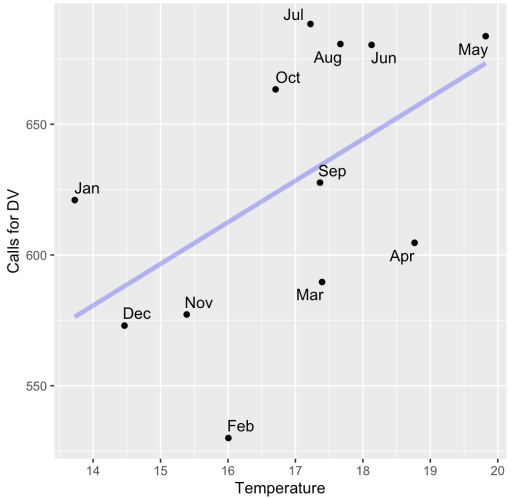
Domestic Violence Data

- Two complementary sources of data:
  - Incident-level crime reports from Mexico City Attorney General's Office ($\approx$ 74 per day)
  - Calls to a dedicated helpline ($\approx$ 19 per day)
- Information recorded:
  - Time and date of occurrence, geo-coded to neighborhood
  - Coverage: 2016 – pandemic onset
- Daily count for each of $\approx$ 2400 neighborhoods ($\approx$ 95% zeroes)

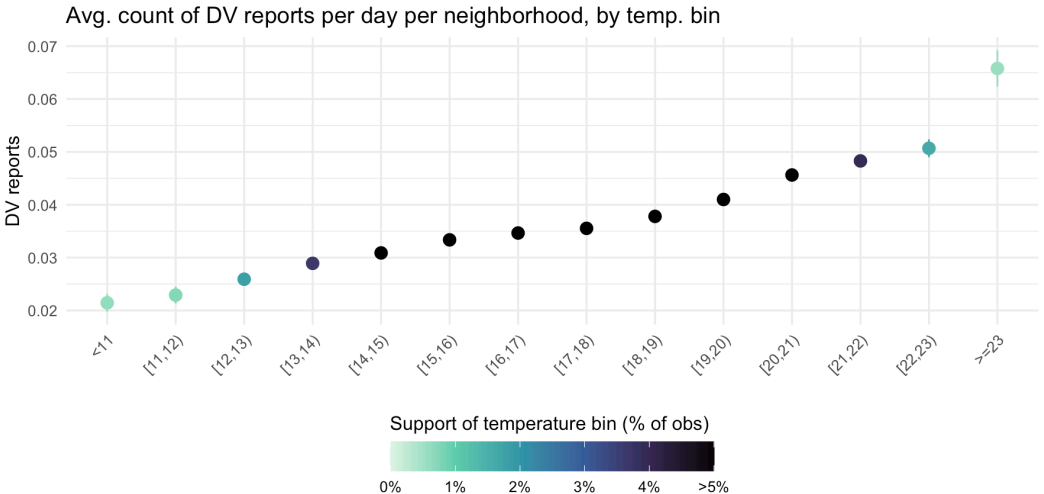
Raw Data: Monthly Averages

Monthly averages for DV cases and temperature





Raw Data: Daily DV by Temperature Bin



Baseline Specification: Poisson Count Model

$$C_{i,d} = \exp\left(\mu_i + \lambda_d + \theta \cdot Temp_{i,d} + \gamma \cdot W_{i,d} + \varepsilon_{i,d}\right) \tag{1}$$

- $C_{i,d}$ daily DV counts in neighborhood i on day d
- Estimation: Poisson QML (robust to overdispersion)
- $Temp_{i,d}$ 24-hour mean temperature
- $W_{i,d}$ weather controls
  - Precipitation, humidity, windspeed (quintile indicators)
- Fixed effects:
  - μ_i neighborhood FE
  - λ_d year-by-month, day-of-week, day-of-year FE

Flexible Specification: Temperature Bins

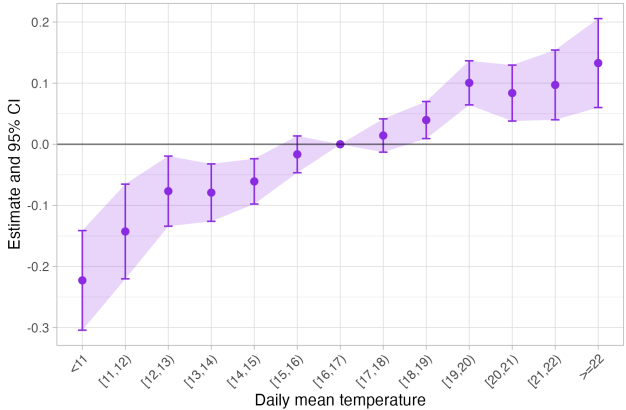
$$C_{i,d} = \exp\left(\mu_i + \lambda_d + \sum_b \theta^b \cdot Temp^b_{i,d} + \gamma \cdot W_{i,d} + \varepsilon_{i,d}\right) \tag{2}$$

- $Temp^b_{i,d}$: binary indicators for 1°C bins (collapsed at extremes)
- Parameters of interest: θ^b = effect relative to reference bin
- Reference bin: 16–17°C (typical conditions in Mexico City)
- Captures potential thresholds effects and nonlinear responses

Identification Strategy

- Identification from within-neighborhood variation over time
- Conditioning on:
  - Rich set of temporal FE
  - Weather controls (precipitation, humidity, windspeed)
- Assumption: after conditioning, temperature is as good as random
- Standard errors clustered at neighborhood level

Semi-Parametric Evidence: Temperature–DV Relationship



- Semi-parametric bin estimator (1°C bins)
- Relationship is almost linear across the full support

Main Specification Results

	Reports for DV		
	(i)	(ii)	(iii)
Panel A:			
24-hour Mean Temperature	0.0274***		
	(0.0034)		
Observations	3,624,826		
Panel B:			
Maximum temperature	0.0197***		0.0159***
	(0.0026)		(0.0030)
Minimum temperature		0.0178***	0.0097***
		(0.0029)	(0.0034)
Observations	3,624,826	3,624,826	3,624,826
Panel C:			
Daytime temperature	0.0246***		0.0220***
	(0.0030)		(0.0041)
Nighttime temperature		0.0188***	0.0039
		(0.0031)	(0.0042)
Observations	3,624,815	3,624,809	3,624,797

- **Panel A: 24-hour mean temperature**
  - 1°C increase → 2.8% increase in DV reports
  - Estimate aligns with semi-parametric results
- **Panel B: Max vs. Min temperature**
  - Both significant, but weaker than 24-hour mean
  - Literature often uses T_{max}, but may understate sustained exposure
- **Panel C: Daytime vs. Nighttime**
  - Daytime effect stronger; Nighttime smaller
  - Suggests exposure during daytime social/household interactions drives DV

Dynamic Adjustments and Cumulative Effects

- Concern: is the effect of temperature purely contemporaneous?
  - **Harvesting**: incidents today displace those that would occur tomorrow
  - **Persistence**: spill over into subsequent days
- Approach: distributed lag models

Distributed Lag Results

	Reports			
	(i)	(ii)	(iii)	(iv)
Temperature	0.0274***	0.0234***	0.0236***	0.0237***
	(0.0034)	(0.0046)	(0.0047)	(0.0047)
l(tmean,1)		0.0051	0.0073	0.0078
		(0.0041)	(0.0056)	(0.0056)
l(tmean,2)			-0.0060	-0.0063
			(0.0056)	(0.0057)
l(tmean,3)			0.0059	0.0058
			(0.0041)	(0.0055)
l(tmean,4)				0.0026
				(0.0056)
l(tmean,5)				-0.0041
				(0.0056)
l(tmean,6)				-0.0006
				(0.0054)
l(tmean,7)				0.0019
				(0.0040)
Cumulative effect	0.0274	0.0285	0.0309	0.0308
Observations	3,624,826	3,622,403	3,617,557	3,607,865

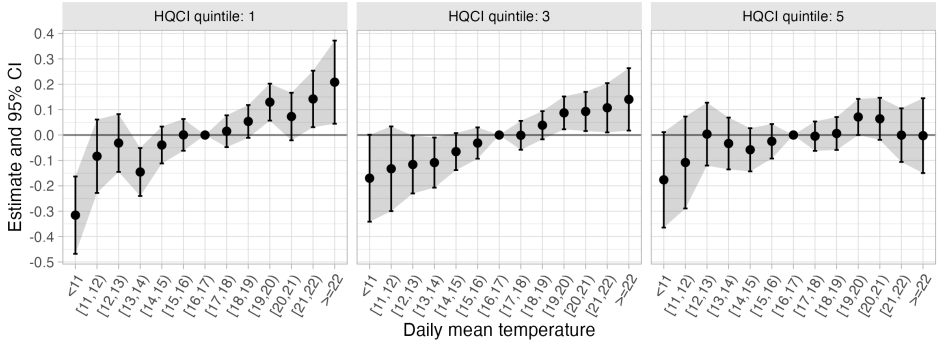
- Contemporaneous effect stable and highly significant
- Lagged coefficients: small, unstable, not significant
- Cumulative effects $\approx$ contemporaneous effect
  - No evidence of displacement (harvesting)
  - No evidence of persistence beyond same day
- DV incidents induced by temperature are **additional**, not shifted in time

Heterogeneity by Neighborhood Income

	Reports for DV
Temp × Quintile 1 (poorest)	0.0342***
	(0.0048)
Temp × Quintile 2	0.0297***
	(0.0044)
Temp × Quintile 3	0.0254***
	(0.0045)
Temp × Quintile 4	0.0239***
	(0.0046)
Temp × Quintile 5 (richest)	0.0216***
	(0.0048)
Observations	3,578,253

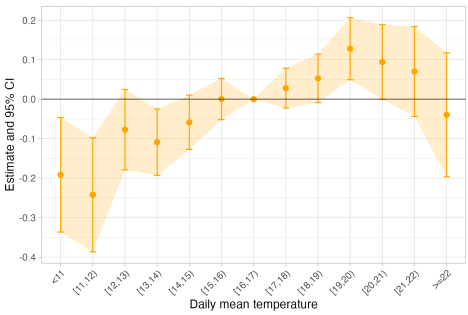
- Clear income gradient:
  - Poorest quintile: 3.5% increase
  - Richest quintile: 2.2% increase
- Rising temperatures disproportionately affect poorer neighborhoods

Heterogeneity by Housing Quality and Crowding (HQCI)



- Living conditions, beyond income alone
- Gradient persists; better construction and lower crowding buffer exposure
- Capacity to adapt

Alternative Outcome: Helpline Calls



- Semi-parametric slope nearly linear, mirrors reports
- Concordance across data sources
  - Linear estimate: 0.029
  - Statistically indistinguishable from reports (0.027)
- Shows temperature matters even at early stages of conflict escalation

Reporting-Delay Diagnostics

- Concern: could the temperature effect reflect **reporting behavior**, not true incidence?
- Survey evidence:
  - Only $\sim$13% of women experiencing partner violence file a report
  - Reporting barriers (fear, stigma, costs) dominate — unlikely weather-driven
- Direct data on unreported DV don't exist $\rightarrow$ test timing of reporting as a proxy
  - No effect of temperature on probability of same-day reporting
  - Slightly shorter reporting delays
- $\Rightarrow$ Negligible reporting bias — results reflect genuine increases in DV

Results Cross-crime benchmark

Could Pollution Confound the Results?

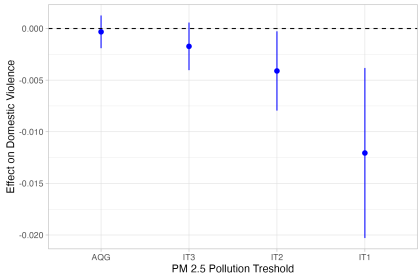
- Mexico City faces chronic air-quality challenges
- Why worry about pollution?
  - Correlated with temperature $\rightarrow$ looks like omitted variable
  - But also partly caused by temperature $\rightarrow$ bad control if included directly
- Still, pollution could independently affect stress, behavior, or mobility
- Approach: augment baseline regressions with measures of pollution exposure

Measuring Pollution Exposure

- Daily $PM_{2.5}$ coded as **hours above WHO thresholds**: Table
  - At least one hour above AQG (most stringent) on ∼80% of days
  - At least one hour above IT1 (least stringent) on ∼2.5% of days
- Captures intensity and persistence, not just daily average
- Allows test of whether extreme pollution systematically alters DV incidence

Pollution and Domestic Violence

- **Low/Moderate exceedances (AQG, IT3):** estimates small, insignificant
- **Extreme exceedances (IT2, IT1):** negative estimates
  - ∼1.2% fewer DV reports per hour above IT1



- Crucially, temperature-DV relationship unaffected when pollution included

What Mechanisms Survive These Tests?

- Reporting or measurement artifacts are unlikely to be the main drivers
- My results narrow the mechanisms:
  - **Timing and shape:** contemporaneous, linear, no thresholds
    $\Rightarrow$ rules out *purely* physiological channel
  - **Heterogeneity:** stronger in poorer neighborhoods
    $\Rightarrow$ consistent with greater exposure *and/or* vulnerability
- Short-run behavioral mechanism that combines mild physiological stress with temperature-driven changes in social interactions and time-use

Conclusion

- **Main effect:** 1°C ↑ ⇒ ∼2.8% more DV reports
  - Immediate, nearly linear, short-lived
- **Robustness:** across temperature measures, data sources, and specifications
- **Continuous risk factor:** not just extreme events
- **Inequalities:** effects strongest in vulnerable neighborhoods
  - Climatic stressors compound existing disparities
- **Policy priority:** targeted prevention and adaptation

Appendix

On Other Types of Crime

	Domestic violence (i)	Homicide (ii)	Theft (iii)	Fraud (iv)
tmean	0.0274***	0.0268**	0.0023	0.0052
	(0.0034)	(0.0111)	(0.0015)	(0.0046)
Observations	3,624,826	2,843,215	3,636,874	3,454,739
Dependent variable mean	0.023	0.002	0.119	0.015
Prec, hum, wsp quintiles	✓	✓	✓	✓
ageb FEs	✓	✓	✓	✓
year-month FEs	✓	✓	✓	✓
day_of_week FEs	✓	✓	✓	✓
day_of_year FEs	✓	✓	✓	✓

Back

Reporting-Delay Diagnostics

	Same day report	Positive delay	
	(i)	(ii)	(iii)
	Logit	Neg. Bin.	Neg. Bin.
Temp (incident day)	0.0035	-0.0124**	-0.0109*
	(0.0083)	(0.0061)	(0.0062)
Temp (reporting day)			-0.0117**
			(0.0046)
Observations	72,378	47,764	47,764

- **Same-day reporting:** no effect of temperature
- **Positive delays:** small, negative coefficients
  - $\approx$ 1.1–1.2% shorter delays per °C
  - Effect appears on both incident-day and reporting-day temperature
- **Takeaway:**
  - Small reductions in delay do not bias main results

Back

Air pollution defined as number of hours above WHO's thresholds

	Target PM 2.5	Hour-Neighborhood	Days-Neighborhood
Air Quality Guideline (AQG)	25 $\mu g/m^3$	35.8 %	80.2 %
Interim Target 3 (IT3)	37.5 $\mu g/m^3$	11.5 %	47.8 %
Interim Target 2 (IT2)	50 $\mu g/m^3$	3.3 %	17.8 %
Interim Target 1 (IT1)	75 $\mu g/m^3$	0.5 %	2.6 %

Back