Associations between air pollution and temperature on glycated hemoglobin levels in women of child bearing age

Clinical Climate Change Conference

January 7, 2022

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Introduction

- Particulate matter (PM), temperature and health: widely studied, health effects well-documented, including for cardiovascular morbidity
- Glycated hemoglobin (HbA1c)
  - Longer-term marker of blood glucose
  - More stable than fasting blood glucose, since it does not capture post-prandial fluctuations
- Mechanistic studies have provided plausibility for different biological pathways of fine particulate matter ($PM_{2.5}$) and temperature at different time metrics
  - Short-term (i.e. days to weeks)
  - Intermediate-term (i.e., months)
  - Long-term (i.e., years)
- **Goal: to investigate the association between intermediate- and long-term exposure to $PM_{2.5}$ and temperature and HbA1c**

Methods

▶ Exposure assessment
- PM$_{2.5}$ and average temperature from 1 × 1 km^2 satellite-based models
- Developed by our group specifically over this area
- CV R$_2$: 0.78 (PM$_{2.5}$), 0.78 – 0.95 (temperature)

▶ Outcome assessment: Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS) cohort
- 490 women living across the Mexico City area
- Study period: 2013 to 2019
- Participants' addresses were geocoded then matched with exposure data
- Main outcome: HbA1c, measured during 48-month, 72-month, and 96-month follow up visits
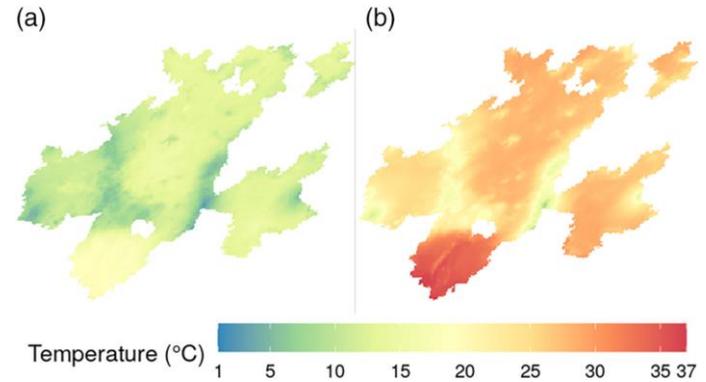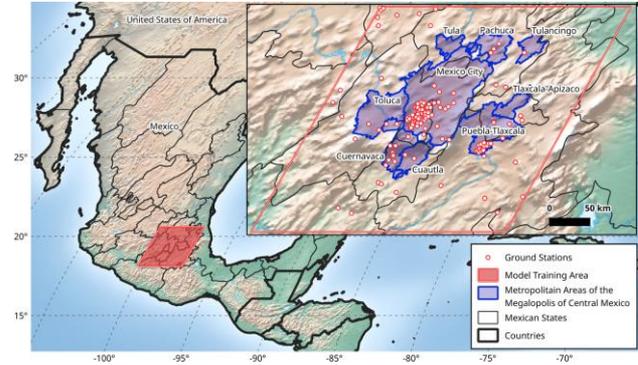
Gutiérrez-Avila et al. (2021)

Methods

▶ Statistical analysis: linear mixed-effects models
  – Random intercept per women
  – Adjusted for: calendar year, season, and individual-level confounders (age, BMI, marital status, smoking status, alcohol consumption, education level)

▶ Main analysis: 3-month, 6-month, and annual associations using all available data

▶ Sensitivity/secondary analyses
  – Excluding diabetes cases
  – Excluding pregnant women (during follow-up)
  – Inverse probability weights

Results

Exposure Type	Analysis Type							
	Main Analysis		No Diabetes Cases		No Pregnant Women		IPW	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
3-Month $PM_{2.5}$	**0.28**	**(0.14, 0.42)**	**0.27**	**(0.14, 0.40)**	**0.27**	**(0.13, 0.42)**	**0.27**	**(0.13, 0.41)**
6-Month $PM_{2.5}$	**0.28**	**(0.04, 0.52)**	**0.35**	**(0.13, 0.57)**	**0.27**	**(0.03, 0.52)**	**0.30**	**(0.06, 0.53)**
Annual $PM_{2.5}$	-0.19	(-0.71, 0.33)	-0.02	(-0.47, 0.44)	-0.20	(-0.72, 0.32)	-0.18	(-0.69, 0.32)
3-Month Avg Temperature	**-0.63**	**(-1.06, -0.21)**	**-0.48**	**(-0.84, -0.11)**	**-0.60**	**(-1.02, -0.17)**	**-0.57**	**(-0.98, -0.15)**
6-Month Avg Temperature	**-0.61**	**(-1.08, -0.13)**	**-0.42**	**(-0.81, -0.02)**	**-0.57**	**(-1.05, -0.09)**	**-0.55**	**(-1.02, -0.09)**
Annual Avg Temperature	-0.14	(-0.90, 0.63)	-0.15	(-0.77, 0.48)	-0.10	(-0.87, 0.67)	-0.06	(-0.82, 0.69)

Conclusions

▶ Intermediate-term exposure to $PM_{2.5}$ and temperature are associated with opposing changes in HbA1c levels

- Positive association between $PM_{2.5}$ and HbA1c
- Negative association between temperature and HbA1c

▶ Observed associations are robust to sensitivity analyses

▶ Limitations:

- Sizable portion of excluded data (23.6%)
- Lack of personal-level exposures
- Lack of additional exposures of interest