JUST HEALTH

Air Quality and Diabetes in California

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BACKGROUND

Sansum Diabetes Research Institute (SDRI) has a 75-year tenure conducting care, education, and research in diabetes. Incited by the disproportionate burden of diabetes on Latino families and recognizing that effective diabetes prevention and treatment rest on understanding the determinants of diabetes as well as accurate risk calculation, SDRI launched Mil Familias in 2018.

California is home to 6 of the 10 most air polluted cities in the U.S.[1]

Diabetes costs California more than $27 billion annually[2]

Diabetes has a higher prevalence among minorities[3]

One specific pollutant, particulate matter ($PM_{2.5}$) has been linked to a range of negative health impacts including diabetes. There has been no study exploring this association in California. **This project aims to fill this crucial gap by assessing relationships between particulate matter 2.5 ($PM_{2.5}$) and diabetes prevalence in California, USA, using a cross sectional and panel data approach.**

RESEARCH QUESTIONS

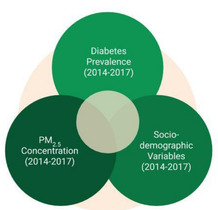
1. **What are the yearly average $PM_{2.5}$ concentrations for each census tract in California?**
2. **What is the relationship between $PM_{2.5}$ concentration and diabetes prevalence in California?**
3. **How do these relationships change if we incorporate threshold values for $PM_{2.5}$ levels or demographic subgroups?**

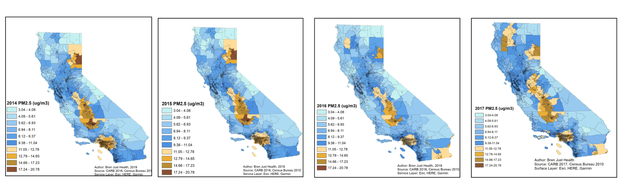
1 DATA

In this project we combine publically available datasets for the years 2014-2017:

1. **$PM_{2.5}$ concentrations from the California Air Resource Board**
2. **Diabetes prevalence from the Centers of Disease Control**
3. **Sociodemographic variables from the Census Bureau's American Community Survey.**

The $PM_{2.5}$ data was recorded as daily or hourly measurements from air quality monitors throughout the state, but for our statistical tests we needed to convert these values to an annual $PM_{2.5}$ value for each census tract. Diabetes prevalence and socioeconomic variables were already provided in this format. We first averaged annual $PM_{2.5}$ concentrations for each monitoring location and interpolated these concentrations across the state. Annual $PM_{2.5}$ levels for each census tract are shown in the maps below. **After wrangling all datasets, we retained observations for 5,084 census tracts across California.**





WHAT IS DIABETES?

TYPE 1	TYPE 2	Diabetes of either type can lead to:
Risk Factors Hereditary	**Risk Factors** Unhealthy lifestyle	• Blindness
Why Body doesn't produce insulin	**Why** Body can't process insulin correctly	• Amputations
Prevention No known prevention	**Prevention** Healthy lifestyle	• Stroke
		• Heart Attacks
		• Deaths

Well-established risk factors contributing to type 2 diabetes include family history, an unhealthy diet, sedentary lifestyle and age.

2 STATISTICAL ANALYSIS

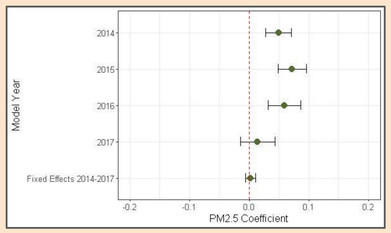
METHODS:
We used two different model types to assess possible relationships between $PM_{2.5}$, diabetes prevalence, and sociodemographic indicators.

Diabetes Prevalence = $PM_{2.5}$ + Education + Poverty + Unemployment + Ethnicity

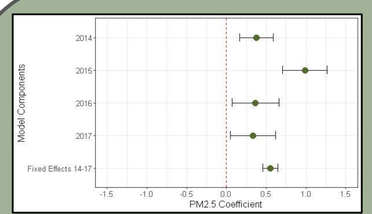
The cross sectional model assesses the relationship between diabetes, $PM_{2.5}$, and sociodemographic variables within each year of study.

Diabetes Prevalence = PM 2.5 + Census Tracts + Year + Socio-demographic

The fixed effects model uses the same variables as the cross sectional model, but also controls for time-invariant factors between census tracts, making it a more rigorous test.



RESULTS:
Among the cross sectional models, we see a **positive and significant association** between diabetes prevalence and $PM_{2.5}$ concentration for the years 2014, 2015, and 2016. In models incorporating the year 2017 there is **no significant association**.



3 THRESHOLDS

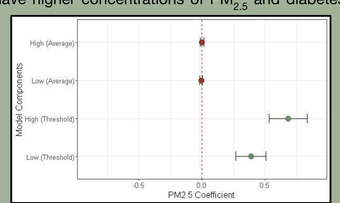
We also used the CARB dataset to calculate the proportion of days a census tract is in non-attainment of the National Ambient Air Quality Standard (NAAQ), which is 12µg/m3. The same two model types as above were ran on this dataset. The coefficient association between $PM_{2.5}$ and diabetes prevalence shows a small but significant positive association between $PM_{2.5}$ and diabetes prevalence in both the cross sectional and fixed effect models.

SUBGROUPS

	2014		2015		2016		2017	
	Low	High	Low	High	Low	High	Low	High
Diabetes	8.63	11.53	8.22	11.19	8.49	11.15	8.4	11.06
$PM_{2.5}$	10.58	11.90	9.59	10.91	9.48	10.63	10.63	11.53
Unemployment	5.96	8.50	5.33	7.62	4.69	6.69	4.13	5.83
Education	8.84	31.71	8.68	31.17	8.57	30.70	8.38	29.88
Poverty	11.47	23.41	11.36	23.20	11.10	22.48	10.74	21.12

We explored interactions between $PM_{2.5}$ and Latino populations to assess if the Latino subpopulation is more or less sensitive to air pollution. Census tracts in California with a high Latino population (>33% Latino of any race) consistently have higher concentrations of $PM_{2.5}$ and diabetes prevalence.

We ran the statistical analysis on both subgroups using $PM_{2.5}$ data calculated as yearly averages and as non-attainment days. We see that there is a larger positive relationship between $PM_{2.5}$ and diabetes prevalence in heavily Latino-populated census tracts compared to areas with small Latino populations only when we calculate $PM_{2.5}$ as non-attainment days.



KEY FINDINGS

1. We find suggestive evidence of a positive association between **average $PM_{2.5}$ concentration** and diabetes prevalence that is sensitive to time and cross-sectional units.
2. We find stronger evidence of an association between **non-attainment days of $PM_{2.5}$** and diabetes prevalence.
3. We see these same trends reflected in Latino subgroups. We see a larger positive association between non-attainment days of $PM_{2.5}$ and diabetes prevalence in high-Latino census tracts compared to low-Latino tracts.

FUTURE RESEARCH

Literature studying the relationships between chronic health conditions and environmental factors is not conclusive on the timeline at which pollution can affect the body

Diabetes prevalence in the United States differs by race and ethnicity. Additional studies could incorporate interactions between pollution and demographics.

ACKNOWLEDGMENTS

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[1]American Lung Association. 2017. State of the Air, Most Polluted Cities.
[2]American Diabetes Association 2018. Facts About Type 2.
[3]Office of Minority Health. 2016. Diabetes and Hispanic Americans.