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Household Income and Air Pollution at Public Schools in the United States

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Abstract

Poor air quality at schools may negatively impact students' academic performance.[1 2 3] In this study we look at the relationship between ambient, outdoor air quality and student socioeconomic status at United States public schools. We used free and reduced lunch eligibility, as part of the USDA's National School Lunch Program, as an indicator of household income. We focus on nitrogen dioxide (NO_2), ozone (O_3), and particulate matter smaller than 2.5 microns ($PM_{2.5}$). We used ambient pollutant concentration estimates at census block group resolution (Kim et al.) as the outdoor air pollution concentration at each school.[4] We found a positive correlation between lower socioeconomic status and higher levels of ambient air pollution. We found that on average, NO_2 concentrations are 1.8 - 3.1 ppb higher (22-42%, $p < .001$) for students in the lowest SES quartile than the highest. The concentration of $PM_{2.5}$ is 0.7 - 1.2 $\mu g/m^3$ higher (7-13%, $p < .001$) for students in the lowest SES quartile than the highest. At elementary and high schools, average O_3 concentrations are 0.5 ppb lower (1%, $p < .001$) for students in the lowest SES quartile than the highest. At middle schools there is no significant difference ($p > 0.1$) in O_3 concentration between the lowest and highest SES quartiles. Atkinson Index values are highest for NO_2 (0.15 - 0.17, ε=1). Values for $PM_{2.5}$ are one order of magnitude lower (.04, ε=1) and two orders of magnitude lower for O_3 (.009, ε=1).

Introduction

It is widely accepted that air pollution has a negative impact on health outcomes. The World Health Organization (WHO) estimates that ambient air pollution accounts for 41.2 million deaths a year and that 91% of the world's population lives in areas where air pollution levels exceed safe WHO limits.[5] Air pollution has been linked to increased risk of stroke, ischemic heart

disease, chronic obstructive pulmonary disease, and lung cancer.[6] [7] With respect to negative health outcomes, the pollutants NO_2, $PM_{2.5}$, and O_3 are of particular concern. Negative health effects can occur due to short, acute exposure as well as long term exposure to lower levels of air pollution.[8]

Nitrous oxides, such as NO_2, can impact the respiratory system by causing nose and throat irritation as well as increasing an individual's susceptibility to respiratory infections.[8] Particulate matter (PM) consists of fine particles that are suspended in the air and breathed into the lungs. Sources of PM include factories, power plants, automobiles, construction, and fires. Particulate matter varies in size and is measured in microns. Smaller sizes of PM, such as $PM_{2.5}$, are able to reach the lungs and enter the bloodstream.[8] In a statement on particulate matter and cardiovascular disease, the American Heart Association (AHA) concluded that exposure to $PM_{2.5}$ increases cardiovascular-related disease morbidity and mortality.[9] Additionally, chronic exposure to Ozone (O_3) has been shown to initiate lung inflammation and reduce lung function.[8]

Multiple studies have been conducted examining the relationship between outdoor ambient air pollution and health outcomes. In a study on exposure to PM_{10}, NO_2, and O_3 in Kermanshah, India, Khaniabadi et al.[10] found an increase in risk of cardiovascular disease that resulted in 304 premature deaths between the years 2014 - 2015. In a meta-analysis conducted by Anderson et al.[11], populations with long-term exposure to PM experience a significantly higher cardiovascular mortality rate. Shorter, acute exposures also result in an increase in cardiovascular events during the period of increased exposure.[11] Exposure to $PM_{2.5}$ also has negative effects on asthmatic individuals. In a longitudinal study, Williams et al.[12] found that a weekly increase of

1μ/m[3] increased inhaler use by 0.82%. A meta-analysis by Bell et al.[13] concluded that there is notable evidence of a short-term association between ozone exposure and cardiovascular and respiratory mortality.

Environmental injustice impacts the most vulnerable and susceptible populations, putting them at a higher risk of adverse health effects. Environmental injustice has been a rising concern since the 1960's, when research first started emerging about how environmental disparities disproportionately affect minority groups. Initial studies mainly focused on the location and proximity of minority groups to hazardous waste sites.[14] Air pollution remains a major concern in the United States with urban outdoor air pollution ranked in the top ten causes of death in high-income countries.[15] Multiple studies have been conducted analysing the relationship between air pollution and race in urban areas across the contiguous United States[16]. Brooks et al.[17] found the exposure of air toxics to be higher for nonwhites than whites as well as for people below the poverty line compared to those above it. Similarly, Lopez et al.[18] found exposure to air toxics were higher for non-Hispanic African Americans than non-Hispanic whites in 44 U.S metropolitan areas. In a study conducted in Sacramento, California, Gaffron and Niemeier[19] found exposure to traffic related $PM_{2.5}$ to be higher at schools with higher percentages of non-white students and higher percentages of students eligible for free and reduced lunch. In Salt Lake City, Utah, Mullen et al.[20] found that schools with higher percentages of racial/ethnic minorities were exposed to higher levels of $PM_{2.5}$. The relationship between air pollution and socioeconomic status (SES) has also been studied, with a focus on geographic location (urban vs rural) and exposure to NO_2.[21] Clark et al.[21] found a higher Atkinson index for NO_2 than income across the United States.

Socioeconomic status is of particular interest because populations with lower SES tend to have higher exposures to air pollution and experience more adverse health effects.[22] This may be because they have limited access to resources that would be more accessible for people of higher SES.[22] Air pollution has been linked to shorter life expectancy, increased instances of hospitalization, and asthma[22]. In addition to increased vulnerability among lower SES populations, children are especially susceptible to experiencing adverse health effects due to air pollution.[23] [24] In a longitudinal study, Gauderman et al.[23] found that elementary age children who lived in close proximity to highways had significant deficits in 8 year lung growth. Brauer et al.[24] found a positive correlation between air pollution and asthma, ear/nose/throat infections, and wheezing. Childhood exposure to air pollution has been linked to impaired adult lung function as well as higher instances of respiratory diseases such as asthma.[25] [26] McConnell et al.[26] found that traffic-related exposure to air pollution at schools had an independent effect from traffic-related exposure at home on the development of asthma in elementary age children. The effect of air pollution exposure at school was found to be comparable in magnitude to that of exposure at home, indicating the importance of air quality at schools.[26]

In addition to adverse health effects, air pollution also negatively impacts students' performance at school. Air pollution exposure at schools has been studied internationally, mostly with respect to traffic related air pollutants. A longitudinal study conducted in Spain found that increased levels of traffic related air pollutants such as NO_2 and $PM_{2.5}$ resulted in 10-20% slower cognitive development in elementary school children over a 3.5 year period.[1] In Michigan, a statistically significant decrease in standardized test performance was observed in schools within the top

40% of air pollution exposure.[2] In a study on schools in California, a higher exposure to air pollution was correlated to lower academic performance and higher respiratory risks.[3] A study conducted in Salt Lake County elementary schools found that more disadvantaged schools (as measured by SES and demographics of student population) experienced both higher ambient $PM_{2.5}$ levels and a higher frequency of peak $PM_{2.5}$ exposures.[27] This study also found a positive relationship between the frequency of peak $PM_{2.5}$ exposures and the percentage of students with low proficiency levels in English and Mathematics (determined by standardized test scores) after controlling for school disadvantage.[27] Gaffron and Niemeier[19] found a positive, statistically significant relationship between higher traffic-related $PM_{2.5}$ levels near schools and lower academic performance in Sacramento, California. A study conducted by Grineski et al.[28] in El Paso, Texas found that higher levels of hazardous air pollutants at schools were associated with lower GPAs.

In this study we demonstrate an approach using estimates of ambient air pollution at public schools to determine if there is an environmental injustice occurring.

Methods

We paired rates of free and reduced lunch at public elementary, middle, and high schools in all 50 states with concentration estimates for three air pollutants (NO_2, O_3, and $PM_{2.5}$) to quantify levels of environmental injustice at the national-scale.

We used estimates of NO_2, O_3, and $PM_{2.5}$ concentrations developed by the Center for Air, Climate, and Energy Solutions at the census block group level.[29] These estimates were developed

using a land use regression model. Estimates for $PM_{2.5}$ and NO_2 are annual-averages, while estimates for O_3 are daily maximum 8-hour moving averages for the months of May through September. The model used concentration measurements from U.S. EPA regulatory monitors in conjunction with land use information and satellite measurements of air pollution to estimate pollutant concentrations in locations without available measurements. [29] The pollutants chosen for this study were nitrogen dioxide (NO_2), ozone (O_3), and particulate matter smaller than 2.5 microns ($PM_{2.5}$). We used pollutant concentration data from 2010.

We used cartographic shapefiles from the United States Census Bureau for each state. [30] We collected school information from the National Center for Education Statistics for the 2010-2011 school year to correspond with pollution data that was obtained for that year.[31] This information included the location of the school, grade levels offered, total number of students, and number of students eligible for or receiving Free and Reduced lunch. Because information regarding household family income of students was not readily available, we used eligibility for Free and Reduced Lunch as a substitute for household income. According to the National School Lunch Program, students that qualify for free lunch have family household incomes at or below 130% of the Federal poverty line and students that qualify for reduced lunch have family household incomes within 130%-185% of the Federal poverty line.[32] [33]For a family of four, this corresponded to an annual income below $28,665 to receive free lunch and an annual income between $28,665-$40,793 to receive reduced lunch.[34]

We added school data to the national cartographic shapefile using latitude and longitude. We used Federal Information Processing System (FIPS) codes to combine the pollution data. FIPS

codes are numbers that identify geographic areas in the United states.[35] For this study, we used 11-digit FIPS codes that identified the state, county, tract, and block group. See the appendix for a more detailed description.

We then determined the percentage of students at each school that were eligible for or receiving free and reduced lunch (PFRL). We obtained data for schools ranging from 0% of students eligible for F&RL to over 99% of students eligible for F&RL.

The Atkinson Index is a measure of income inequality. For our purposes, air quality is used instead of income. The Atkinson Index also has a sensitivity parameter ($\boldsymbol{\varepsilon}$) in which higher $\boldsymbol{\varepsilon}$ values increase sensitivity to inequalities at the bottom of the distribution.[36] The Atkinson index was calculated at sensitivity parameters ($\boldsymbol{\varepsilon}$) of 0.5, 1, and 2. These three values of $\boldsymbol{\varepsilon}$ are widely accepted and used in research. The Spearman Correlation Coefficient Rho was also calculated to determine correlation between pollutant concentration and PFRL. We used a Spearman correlation to account for the non-normality in our distribution of values.[37] [38] A Welch's two-sided unpaired T-test was also performed to determine statistical significance of the difference in air pollution concentration between the lowest and highest quartile.

Results and Discussion

Figure 1 shows the concentration of NO_2, $PM_{2.5}$, and O_3 versus PFRL. Lines of best are included to depict observable trends. Figure 1a-1f shows an observed trend between the PFRL and the concentrations of $PM_{2.5}$ and NO_2. Average concentrations of both pollutants increase as the PFRL increases. An increase in PFRL corresponds to a decrease in SES. In figure 1g-1i there does not appear to be any clear trend between socioeconomic status and concentration of O_3.

Table 1 shows the Spearman correlation, ρ, for each pollutant and grade level. Values for the Spearman correlation range between -1 and +1, where a negative value indicates an inverse relationship between two variables (as one variable decreases, the other increases) and a positive value indicates a positive relationship (both variables increase or decrease together).[37] The closer the value is to either -1 or +1, the stronger the correlation. A value of 0 means there is no correlation. For NO_2, we found a Spearman correlation coefficient ranging from .04 to .16 depending on the grade level, indicating a positive correlation between concentration of NO_2 and lower SES. For $PM_{2.5}$, we found a correlation between 0.11 and 0.2, which is slightly higher than that of NO_2. For O_3, we found a slightly negative correlation between -.02 and -.04, meaning that students with higher SES experience higher concentrations of O_3 than their lower SES counterparts.

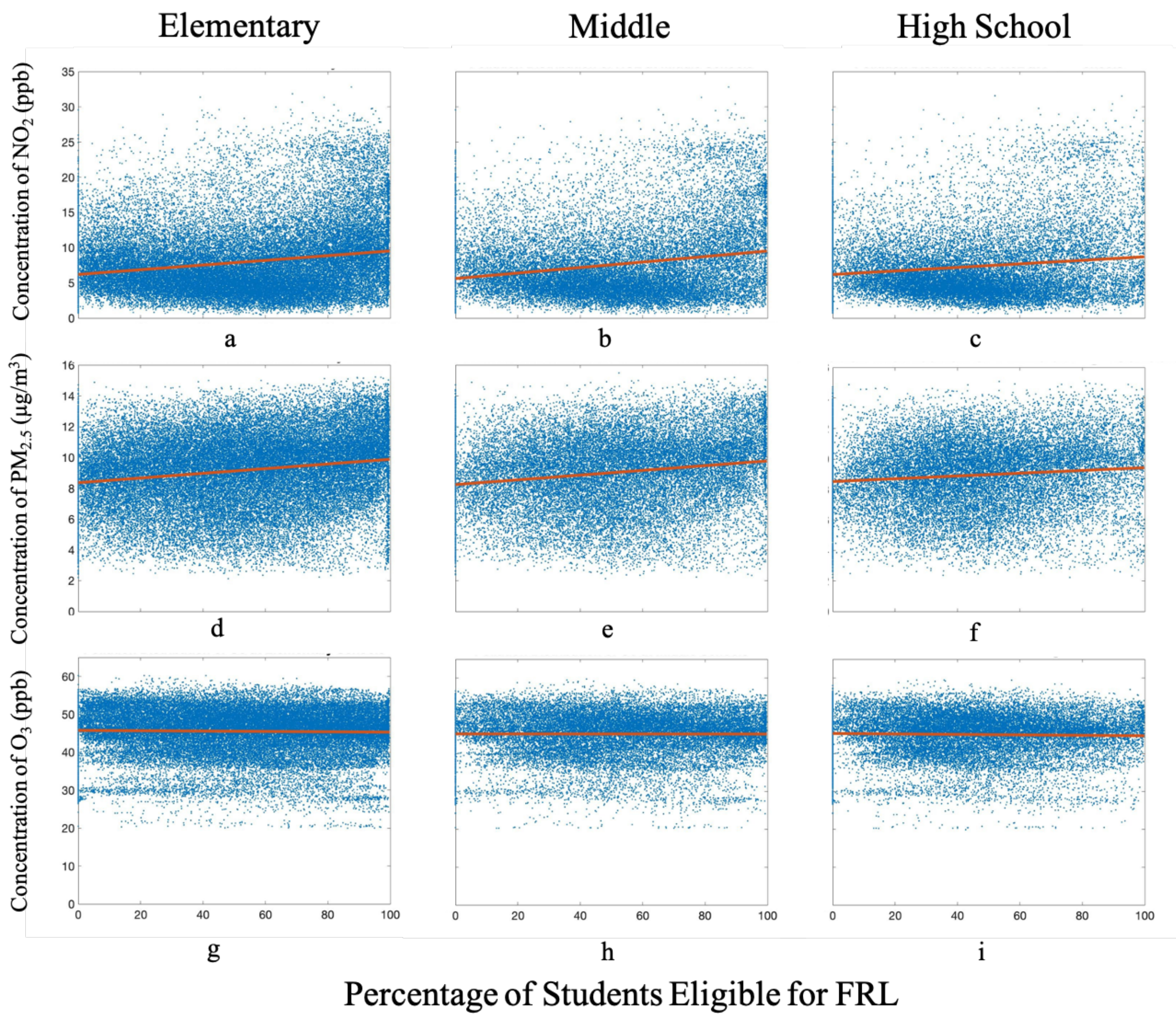

Figure 1: Scatter plots with linear line of best fit depicting the concentration of pollutants at elementary, middle, and high schools in the United States versus the percentage of students eligible for or receiving free and reduced lunch.

Table 1: Spearman correlation values for each grade level and pollutant.

		Spearman Correlation
Pollutant	**Grade**	**ρ**
NO_2 (ppb)	Elementary	0.160
	Middle School	0.150
	High School	0.045
O_3 (ppb)	Elementary	-0.043
	Middle School	-0.017
	High School	-0.043
$PM_{2.5}$ (μg/m^3)	Elementary	0.196
	Middle School	0.188
	High School	0.110

Figure 2 shows box and whisker charts depicting the concentration of NO_2, $PM_{2.5}$, and O_3 versus PFRL. Each box represents a 10% increment in PFRL (the first box depicts pollution concentration at schools with 0-9.99% of the student population eligible for or receiving F&RL). Figure 2a-2f shows average concentrations of NO_2 and $PM_{2.5}$ at schools increase as the percentage of students eligible for F&RL increase. In figure 2g-2i there does not appear to be any clear trend between PFRL and concentration of O_3.

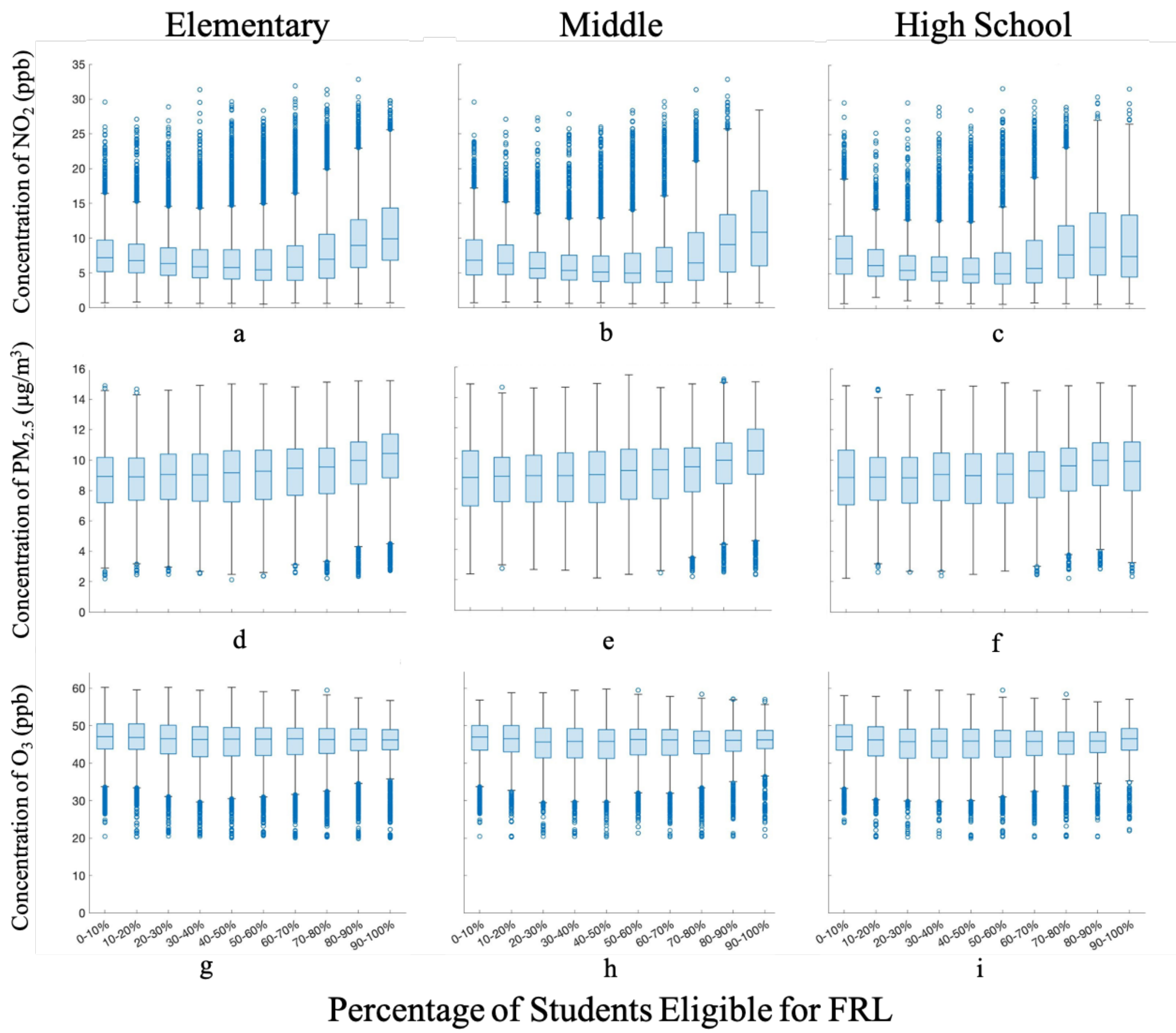

Figure 2: Box and whisker charts depicting the concentration of pollutants at elementary, middle, and high schools in the United States. Each box represents the percentage of students eligible for or receiving free and reduced lunch in increments of 10%.

Figure 3 shows box and whisker plots depicting the concentration of pollutants versus SES quartile. The first quartile consists of the schools with the lowest PFRL and therefore the highest SES, whereas the fourth quartile consists of schools with the highest PFRL and therefore the lowest SES. Figure 3a-3f shows higher concentrations of NO_2 and $PM_{2.5}$ for the quartile with the highest PFRL than the lowest quartile across all grade levels. Figure 3g-3i does not show an

observable trend for O_3. We performed an unpaired, single tailed Welch's T-Test between the concentrations of pollutants observed for the highest and lowest quartiles (the top 25% and bottom 25%) to determine statistical significance. As shown in Table 2, we found that on average, NO_2 concentrations are between 1.8 and 3.1 ppb (22-42%, $p < .001$) higher for students in the lowest SES quartile than the highest. The concentration of $PM_{2.5}$ is between 0.7 and 1.2 ppb (7-13%, $p < .001$) higher for students in the lowest SES quartile than the highest. The average concentration of O_3 at elementary and high schools is 1.1 ppb (1.2%, $p < .001$) lower for students in the lowest SES quartile than the highest. However, there was no statistical difference between the lowest and highest quartile for the average concentration of O_3 at middle schools, with a 0.07 ppb difference (.14%, $p > .1$). Although a statistical significance was observed between the concentration of O_3 for the lowest and highest SES quartiles at elementary and high schools, there was only a 1.2% difference, which indicates that differences in O_3 concentrations are smaller than differences observed for NO_2 and $PM_{2.5}$.

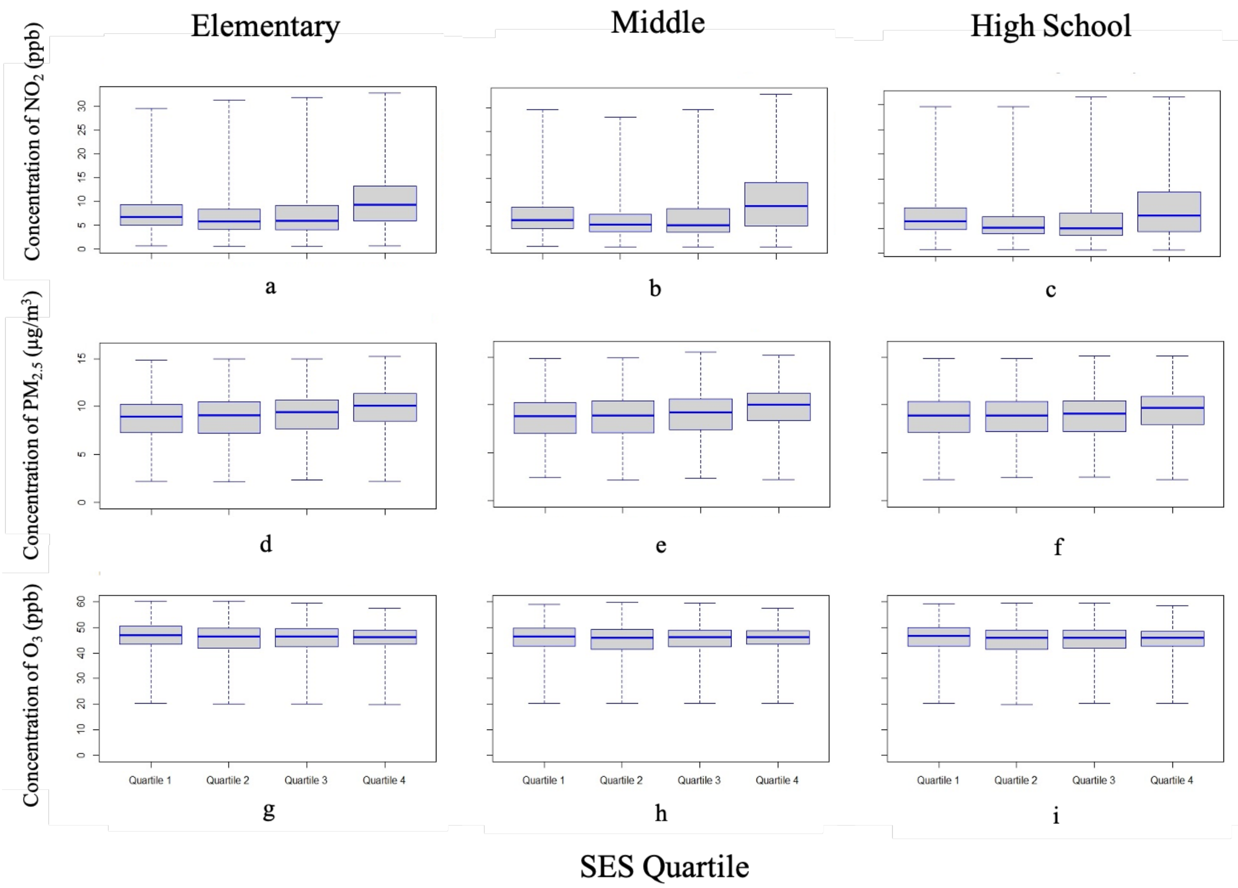

Figure 3: Box and whisker plots depicting concentration of pollutant versus SES quartile for elementary, middle and high schools.

Table 2: Difference in pollutant concentration between lowest and highest SES quartile.

Pollutant	Grade	Lowest SES Quartile	Highest SES Quartile	Difference	Percent Difference	Welch's T-Test p Value
NO_2 (ppb)	Elementary	7.51	10.24	2.73	36.39%	$p < .001$
	Middle School	7.20	10.27	3.07	42.59%	$p < .001$
	High School	7.41	9.23	1.82	24.59%	$p < .001$
O_3 (ppb)	Elementary	45.92	45.41	-0.51	-1.10%	$p < .001$
	Middle School	45.47	45.40	-0.07	-0.14%	$p > .001$
	High School	45.56	45.02	-0.55	-1.20%	$p < .001$
$PM_{2.5}$ ($\mu g/m^3$)	Elementary	8.74	9.89	1.15	13.16%	$p < .001$
	Middle School	8.63	9.78	1.15	13.30%	$p < .001$
	High School	8.74	9.40	0.66	7.54%	$p < .001$

To determine if an environmental injustice is occurring because of the statistically significant differences in air pollution and socioeconomic status at public schools, we used the Atkinson Index of Inequality. Atkinson Index values for each pollutant and grade level with various values of epsilon are shown in the table below. The values observed for NO_2 with an epsilon value of 1 are similar to those found in literature. [21] Inequality levels are highest for NO_2 and smallest for O_3. Although our calculated Atkinson Index inequalities are small, they cannot be easily compared to other inequalities, such as that for income (range of incomes is greater than range of

ambient air pollution). Also, small values of inequality do not mean that students with lower socioeconomic status are not at higher risk for air pollution related health and cognitive development problems.[39]

Table 3: Calculated Atkinson values for **ε** values of 0.5, 1, and 2 for each grade level and pollutant.

		Atkinson Index		
Pollutant	**Grade**	**ε = .5**	**ε = 1**	**ε = 2**
NO_2 (ppb)	Elementary	0.079	0.154	0.291
	Middle School	0.091	0.174	0.318
	High School	0.087	0.165	0.296
O_3 (ppb)	Elementary	0.005	0.010	0.021
	Middle School	0.004	0.009	0.020
	High School	0.005	0.010	0.020
$PM_{2.5}$ (μg/m^3)	Elementary	0.018	0.036	0.080
	Middle School	0.019	0.039	0.086
	High School	0.018	0.037	0.080

Although this paper is novel in that it explores the relationship between air pollution and socioeconomic status at public schools with regard to environmental justice, it does have a few limitations. Because we use Census demographic data at the block group level, we are unable to examine disparities in air quality within block groups. Also, due to limitations on publicly

available data, our study only examines public schools in the United States. We cannot draw any conclusions about private K-12 institutions. In addition, we use Free and Reduced Lunch as a measure of socioeconomic status, which does not account for variations in SES above the requirements to receive F&RL (differences in higher income families) or variations below the requirements. Because we use outdoor ambient air pollution data from CACES, we are unable to account for individual variability in exposure to pollutants (such as proximity to roadways and indoor air quality).

Conclusion

We examined the relationship between air pollution and socioeconomic status at public schools in America to determine environmental justice. We found that there is a positive correlation between higher ambient concentrations of NO_2 and $PM_{2.5}$ and lower socioeconomic status (represented by eligibility for F&RL). There is not a strong correlation between the concentration of O_3 and socioeconomic status. We also found that students at public schools in the highest quartile of percentage of students eligible for F&RL (students with lower SES) experience a significantly higher exposure to NO_2 and $PM_{2.5}$ than their counterparts in the lowest quartile. These differences result in an observable environmental injustice as measured by the Atkinson Index. Future work includes a state-by-state comparison of environmental justice as well as the inclusion of private schools.

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Caressa Wakeman created the basis of the procedure to join files in ArcMap detailed in the Appendix.

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Appendix: *General Procedure for Creating a Concentration Map*

Adding a shapefile of the United States

Procuring the shapefile:

- Download all 50 2010 Census Block Group shapefile from the census website.
- The shapefile can be found here: https://www.census.gov/geographies/mapping-files/time-series/geo/carto-boundary-file.html
- Once on the website, click on "2010 Census" and then select each state under "Download:"
- The folder should begin to download automatically.
- Navigate to the "Downloads" folder on your computer and locate the recently downloaded files
- Right click on the folder and select "Extract All"

Adding the shapefiles to ArcMap:

- Click on the "Catalog" button and then on the "Connect to Folder" button to locate the shapefile
- Click on the shapefile and then proceed to drag and drop it into the workspace or select the "Add data" button and click on the "Connect to folder" button. Connect to the folder where all 50 state shapefiles are located and upload them.
- Repeat this method until the shapefiles for all 50 states are uploaded to ArcMap.

Creating an FID for the shapefile:

- Navigate to the “Layers” section under the “Table of Contents” and right click on the shapefile
- Select “Open Attribute Table” and click on “Table Options” and select “Add Field”
- Under “Name:” type the following, “FIPS,” and under “Type:” select “Double” and click “OK”
- Right click on the newly generated field and select “Field Calculator”
- Click anywhere in the white area under “FIPS =” and double click on “STATE” and then follow it with a plus sign
- Proceed to double click on “COUNTY,” then add a plus sign, then double click on “TRACT” and add a plus sign, then double click on “BLKGRP” and click “OK” (there should be a plus sign between each word)

Procuring Pollution information

- Navigate to https://www.caces.us/data
- Under “Step 1 | Geographic Area” select “State”
- Under “Step 2 | Spatial Resolution of Output” select “Block Group”
- Under “Step 3| Choose Pollutant(s)” select “O3, NO2, and PM2.5”
- Under “Step 4| Choose Date(s)” select “2010”
  - Note: Certain pollutants are not available for all years. Pollution data is available starting for the year 1992 until the year 2015.
- Check the box under “Step 5| Check you are not a robot and submit”
  - You will receive a message saying your download and email is being processed. The data will be sent to you via email in the form of an Excel file.

Creating the Map in ArcGIS/ArcMap with a Shapefile

Adding the pollution data:

- Open ArcMap 10.1 and click “OK” when prompted
- Navigate to the “Add data” button and click on it
- Click on the “Connect to folder” button
- Click on “This PC” and locate your home server
- Enter your server and navigate to the folder you would like to save the map in
- Locate the CACES Pollution data and click “Add”

Displaying the data as points:

- Navigate to the table of contents and right click on the newly added layer (this is the pollution data added above) and select “Display XY data”
- Under “X field” select the longitude
- Under the “Y Field” select the latitude
- Under “Description: “Unknown Coordinate System” will be displayed. Click “Edit …” and Click on “Geographic Coordinate Systems, then “Country Systems”, then “North America”, “USA and territories” then select “NAD 1983”. This will appear as “GCS_North_American_1983”. Click “Ok”

Converting the points to a shapefile:

- Navigate to the table of contents again and right click on the added layer, hover over “Data,” and click on “Export Data”

    - Be sure not to right click on the table but the actual layer itself. This is the item next to the white checkbox.
- Click on the “Browse button”
- Then click on the “Connect to Folder” button and navigate to where you would like the file to be stored
- Under “Save as type” select “Shapefile” and click “Ok”
- It will take a few seconds to process. Once it does a warning box will appear, when it does, click “Yes.” The data will now appear as a new layer.

Adding the School Information to the Map

Procuring school information with Free and Reduced Lunch data:

- Navigate to https://nces.ed.gov/ccd/elsi/tableGenerator.aspx
- Under “Select A Table Row” select “Public School”
- Under “Select Years” select the year “2010-11”
- Under “Select Table Columns” there are six tabs.
- Navigate to the “Information” tab and click on “Basic Information” subtab
- Select the checkbox next to “School Name [Public School],”
- Navigate to the “Contact Information” subtab and select the checkbox next to “Location Address 1 [Public School],” and “Location City [Public School].”
- Navigate to the “Characteristics” tab and click on the “School/District Classification Information” subtab and select the checkbox next to “Latitude” and the checkbox next to “Longitude”

- Navigate to the “Grade Span Information” subtab and select the checkbox next to “Lowest Grade Offered [Public School],” and “Highest Grade Offered [Public School]”, and “Grade 3, 7, or 11 Offered”, depending on the desired grade level
- Navigate to the “Total Enrollment” subtab under the “Enrollments” tab and select the checkbox under “Total Students, All Grades (Excludes AE) [Public School]”. Then navigate to the “Enrollments” tab and select “Enrollment by Grade” then select the checkbox next to “Grade 3, 7, or 11 Students”[Public School]”
- While under the “Enrollments” tab, navigate to “Students in Special Programs” subtab and select the checkbox under “Free and Reduced Lunch Students [Public School]”
- Under the “Select Filters” tab select “All 50 States + DC”
- Navigate to the “Grade 3, 7, or 11 Students [Public School](2010-11) subtab, click on it, and then proceed to click on the filter button. In the box next to the “Greater than or equal to” tab, delete the 0 and put a 1
- Navigate to the “Grade 3, 7, or 11 offered [Public School](2010-11)” tab and select “Filter”. Under “Select your choice to filter Grade 3, 7, or 11 offered [Public School]” select the button next to “1-Yes”.
- Navigate to the “Create Table” button and click on it. Check to see if the format of the data requested is satisfactory
- Proceed to download it and add it to your map

Joining the school data with the shapefile of Connecticut

Uploading the CSV file:

- Upload a csv file of the school file and export it as a shapefile
- Follow the steps above under "Converting the points to a shapefile" with the appropriate file

Joining the school data with the Connecticut shapefile:

- Right click on the shapefile of the schools and hover over the "Joins and Relates" button and click on the "Join…" button
- Under "What do you want to join to this layer?" select "Join data from another layer based on spatial location"
- Under "1. Choose the layer to join to this layer, or load spatial data from disk:" select the shapefile of Connecticut
- Under 2 it should say "You are joining: Polygons to points" and under "Each point will be given all the attributes of the polygon that" "it falls inside" should automatically be selected, if not select it and click on "Browse" button and save the file as a shapefile and click "OK"
- For national shapefile, click on the school shapefile, then click join, then choose the national shapefile data.

Joining the school data with the Pollution data:

- Right click on joined shapefile of the U.S. and the school data
- Click Joins and Relates, then Join
- Select "Join attributes from a table"
- Choose the CSV file of the Pollution data
- Under "Choose the field to base this join on" select FIPS

- Under “Join Options” make sure “Keep all Records” is selected
- Then click “Ok”
- Now when you right click on the shapefile and the high school data and open the attribute table, the pollutants should be there

Exporting data to create graphs:

- Click the help bar, then select “Tools” and search “Table to Excel” select this, then select the joined table to export to an excel file where you can extract the data.