

CHILDREN'S EXPOSURE TO TRAFFIC POLLUTION IN TEXAS SCHOOL DISTRICTS: ANALYZING SOCIAL DISPARITIES AND ADOPTION OF MITIGATION STRATEGIES

Jayajit Chakraborty

University of Texas at El Paso

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16. Abstract: This project examined social disparities in exposure of public schools and school districts to vehicular pollution (Phase 1) and adoption of mitigation strategies for reducing school exposure to vehicular pollution (Phase 2), in Texas. Phase 1 study results indicated that Texas school districts exposed to greater traffic proximity and vehicular pollution contain significantly greater proportions of racial/ethnic minority, foreign-born, disabled, and socioeconomically vulnerable children. Students attending schools with the highest exposure to both air pollution and road noise were also significantly more likely to be Black, Hispanic, and socioeconomically deprived. These findings emphasize the need to reduce traffic-related air and noise pollution at school locations, especially in schools and districts with higher proportions of socially disadvantaged students. Phase 2 focused on an online structured survey administered to school district superintendents in Texas. Results indicated that almost 90% of superintendents did not consider traffic-related air pollution to be a problem, and a large majority were not concerned with traffic-related pollution causing health problems for students. The knowledge gained from this statewide survey on the most widely adopted practices for air pollution reduction and implementation barriers can inform policy interventions to reduce school children's exposure to vehicular pollution within and beyond Texas..			
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Executive Summary

Problem Statement

This project sought to address two important gaps or limitations associated with previous work:

1. Research on assessing racial/ethnic and socioeconomic disparities in exposure to traffic-related pollution for school-age children is underdeveloped and few state-scale studies have been conducted. Prior studies at the national scale and in specific U.S. urban areas analyzing associations between environmental pollution exposure and school level socio-demographics have found schools serving non-White and low-income students to be exposed to higher levels of pollution than those serving White and high-income students. These findings suggested a disturbing pattern that warrant additional investigation focusing on traffic-related pollution sources using a wider range of pollution exposure indicators and socio-demographic variables for children, compared to those used in previous studies.
2. Several approaches have been used by school districts and communities across the United States for reducing school children's exposure to traffic-related pollution. A report published by the U.S. Environmental Protection Agency on *Best Practices for Reducing Near-Road Pollution Exposure at Schools* (2015) recommended strategies such as anti-idling and idle reduction policies, bus fleet upgrades, promotion of active transportation (e.g., walking or bicycling), site location guidelines for new schools, and use of roadside or vegetation barriers. No systematic research, however, has been conducted to evaluate the actual implementation of these best practices and strategies for mitigating vehicular air pollution exposure at schools. Additionally, no previous study has examined how school districts in Texas are attempting to reduce the effects of traffic-related air pollution on children's health.

Project Objectives

This project addressed the aforementioned gaps by focusing on Texas, an appropriate state for studying social disparities in children's exposure to vehicular pollution. Texas is ranked second in terms of total number of children (population < 18 years) and first in the number of children below poverty level out of all U.S. states. Media reports also indicate that numerous schools and school districts in Texas are exposed to very high levels of traffic-related air and noise pollution.

In the first phase of this project (Phase 1), a detailed geospatial database was built to analyze spatial and statistical associations between multiple indicators of transportation-related pollution (e.g., traffic proximity/volume, exposure to air pollutants, and roadway transportation noise) and socio-demographic characteristics of school children (based on both residential and school enrollment data) in Texas. Two case studies were then conducted to determine whether: (1) socially disadvantaged children are disproportionately located in school districts burdened by higher vehicular pollution exposure; and (2) public schools disproportionately exposed to higher levels of traffic-related air and noise pollution are characterized by significantly greater percentages of racial/ethnic minority and socioeconomically deprived students. Statistical analyses were based mainly on multivariable generalized estimating equations that account for spatial clustering of school districts.

In the second phase of the project (Phase 2), an online structured survey of public school district superintendents in Texas was conducted to examine and understand their level of concern for traffic-related air pollution, practices or policies currently being adopted for traffic pollution mitigation in schools, and the barriers or challenges they face for reducing vehicular pollution in their school district.

Finally, an important educational goal of this project was to recruit, support, and train students from historically underrepresented groups as graduate research assistants and provide them with various professional development opportunities.

Key Findings

Phase 1: Results from the first study, conducted at the school district level (1,020 districts), revealed significantly greater traffic proximity/volume and air pollution exposure in Texas school districts where higher percentages of children (population < 18 years) reside, after controlling for clustering, population density, and several contextual factors. Districts exposed to higher levels of traffic proximity/volume and traffic-related air pollution exposure also contain significantly greater proportions of racial/ethnic minority, foreign-born, disabled, and socioeconomically vulnerable children. Results from the second study, conducted at the school level (8,428 public schools), indicated that children attending schools with the highest exposure to both traffic-related air pollution and road noise were significantly more likely to be Black, Hispanic, and socioeconomically deprived. Multivariable statistical models that control for spatial clustering and other relevant factors revealed that schools with greater traffic-related air pollution exposure were significantly more likely to serve racial/ethnic minority and younger (< 12 years) students, while schools with greater road noise exposure were significantly more likely to serve socioeconomically deprived and older students. These findings underscore the urgent need to reduce traffic-related pollution at school locations, especially in Texas school districts and schools attended by higher proportions of socially disadvantaged children that are often additionally burdened with financial and other challenges.

Phase 2: The statewide structured survey of public school district superintendents in Texas (n = 64) indicated that almost 90 percent of superintendents did not consider traffic-related air pollution to be a problem in their school district, and a large majority were also not concerned with traffic-related air pollution causing health problems for students. The most widely adopted practices and policies included the use of mechanical ventilation such as heating, ventilation, and air conditioning systems and anti-idling policies for buses. More than 20 percent of superintendents indicated that the fiscal budget of the school district limited the ways the district could mitigate traffic-related air pollution. School districts with lower levels of concern for traffic-related air pollution were more likely to adopt anti-idling policies for buses, as well as upgrade and retrofit buses in their district. These districts with lower levels of concern were also characterized by relatively smaller numbers of students, teachers, and student-teacher ratios, as well as lower fiscal budgets and expenditures. The knowledge gained from this statewide survey can be expected to inform policy changes and interventions to reduce children's exposure to vehicular pollution in school districts within and beyond Texas.

Project Impacts

Project results contributed new empirical knowledge and increased understanding of racial/ethnic and socioeconomic disparities in traffic pollution exposure for school children in Texas—an understudied topic that has significant implications for equitable transportation policy, children's health, and social justice. Project findings can be used to inform policy interventions and transportation infrastructure changes for mitigating the adverse and disproportionate impacts of vehicular pollution in Texas, especially in schools and school districts where greater vehicular pollution exposure coincides with significantly higher proportions of racial/ethnic minority and socioeconomically disadvantaged children. The statewide survey of Texas school district superintendents provided important information on the application of mitigation strategies and best practices adopted by public school districts to reduce vehicular air pollution, as well as barriers that limit the successful adoption of best practices. Finally, this project provided hands-on training and professional development opportunities for three graduate students from historically underrepresented groups who worked as project research assistants. One of these students authored an outstanding master's thesis that focused on the structured survey of Texas school districts, and another student coauthored a peer-reviewed journal article in collaboration with the principal investigator.

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Phase 1

Children's Exposure to Vehicular Pollution: Environmental Injustice in Texas, USA

Distributive environmental justice research on children's exposure to vehicular pollution is underdeveloped and few empirical studies have been conducted in the United States. This study seeks to address this gap by examining if socially disadvantaged children are disproportionately located in public school districts burdened by higher vehicular pollution in Texas—the second largest U.S. state based on population size. Vehicular pollution exposure is measured using two variables: (1) an index developed by the U.S. Environmental Protection Agency that combines traffic proximity and volume; and (2) outdoor concentrations of nitrogen dioxide (NO₂), a widely used proxy for vehicular air pollution. These variables are linked to school district level data on socio-demographic characteristics of children obtained from the latest American Community Survey. Statistical analysis is based on multivariable generalized estimating equations that account for spatial clustering of school districts. Results reveal significantly greater traffic proximity and NO₂ exposure in Texas school districts with higher percentages of children, after controlling for clustering, population density, and other socio-demographic factors. Districts exposed to higher levels of traffic proximity and NO₂ exposure also contain significantly greater proportions of racial/ethnic minority, foreign-born, disabled, and socioeconomically vulnerable children. These findings highlight the urgent need to develop mitigation strategies for reducing vehicular pollution exposure, especially in districts with higher proportions of socially disadvantaged students that could be additionally burdened with limited resources. School districts represent a policy relevant analytic unit since school district boards can act as advocates for the environmental health of children and implement mitigation strategies for reducing pollution exposure.

More details on background, research questions, data, methodology, results, conclusions, and recommendations associated with this study are available here:

Chakraborty J, 2022. Children's Exposure to Vehicular Pollution: Environmental Injustice in Texas, USA. *Environmental Research*. 204 (A), 112008; <https://doi.org/10.1016/j.envres.2021.112008>.

Social Inequities in Exposure to Traffic-Related Air and Noise Pollution at Public Schools in Texas

Although children are particularly vulnerable to the adverse impacts of vehicular pollution and spend significant portions of their time at school, previous studies have not examined or compared school-level social inequities in exposure to both traffic-related air and noise pollution in the same study area. This study addressed this gap through a case study in Texas—the second-largest U.S. state based on total population and number of children. Vehicular pollution exposure was measured using: (1) outdoor concentrations of nitrogen dioxide (NO₂), a widely used proxy for traffic-related air pollution; and (2) road noise estimates from the U.S. Department of Transportation’s National Transportation Noise Mapping Tool. These variables were linked to data on locations and sociodemographic characteristics of children enrolled in Texas public schools. The study found children attending schools with the highest exposure to both NO₂ and road noise (top 25 percent) were significantly more likely to be Black, Hispanic, and eligible for free/reduced lunches (socioeconomically deprived). Results from multivariable generalized estimating equations that control for spatial clustering and other relevant factors revealed that schools with greater NO₂ exposure were significantly more likely to serve racial/ethnic minority and younger students, while schools with greater exposure to road noise were significantly more likely to serve socioeconomically deprived and older students. These findings underscore the urgent need to reduce both air pollution and noise exposure at school locations, especially in schools attended by higher proportions of socially disadvantaged children that are often additionally burdened with other challenges.

More details on background, research questions, data, methodology, results, conclusions, and recommendations associated with this study are available in:

Chakraborty J, and Aun J J, 2023. Social Inequities in Exposure to Traffic-Related Air and Noise Pollution at Public Schools in Texas. *International Journal of Environmental Research and Public Health*, 20(7), 5308; <https://doi.org/10.3390/ijerph20075308>.

Phase 2: Reducing Children’s Exposure to Traffic-Related Pollution: Evaluating Policies and Strategies Used by Texas School Districts

Children are most vulnerable to the effects of traffic-related air pollution because of their developing respiratory systems, amount of time spent outdoors, and faster rates of breathing. As one of the largest states in the United States in terms of both total population and number of children, Texas is a particularly important place for studying policies and strategies used by school districts to reduce children’s exposure to vehicular pollution. No previous study had examined how public school districts in Texas are attempting to mitigate the effects of traffic-related air pollution on children’s health. This study sought to address this knowledge gap by conducting an online structured survey of public school district superintendents in Texas and providing new insights regarding their level of concern for traffic-related air pollution, the practices or policies currently being adopted for traffic pollution mitigation, and the challenges or barriers they face for reducing vehicular pollution in their district. Results indicate that 90 percent of superintendents did not consider traffic-related air pollution to be a problem in their district, and a large majority were also not concerned with traffic-related air pollution causing health problems for students. The most widely adopted practices and policies across Texas school districts included the use of mechanical ventilation such as heating, ventilation, and air conditioning systems and anti-idling policies for buses. More than 20 percent of superintendents indicated that the fiscal budget of the district limited the ways the district could mitigate traffic-related air pollution. School districts with lower levels of concern for traffic-related air pollution were more likely to adopt anti-idling policies for buses, as well as upgrade and retrofit buses in their district. These districts with lower concern were also characterized by relatively smaller numbers of students, teachers, and student-teacher ratios, as well as lower fiscal budgets and expenditures. The knowledge gained from this study can be expected to initiate policy changes to reduce children’s exposure to vehicular pollution in school districts within and beyond Texas.

More details on background, research questions, data, methodology, results, conclusions, and recommendations associated with this study are available in:

Schwanke, L, 2022. Reducing Children’s Exposure to Traffic-Related Pollution: Evaluating Policies and Strategies Used by Texas School Districts. *Open Access Theses & Dissertations*. 3549.
https://scholarworks.utep.edu/open_etd/3549.

Outputs, Outcomes, and Impacts

- Project results contributed new empirical knowledge and increased understanding of racial/ethnic and socioeconomic disparities in traffic-related air and noise pollution exposure for school children in Texas—an understudied topic that has significant implications for equitable transportation policy, children’s environmental health, and social justice.
- Project findings can be used to inform policy interventions and transportation infrastructure changes for mitigating the adverse and disproportionate impacts of vehicular pollution in Texas, especially in public schools and schools districts where elevated vehicular pollution exposure coincides with significantly higher proportions of socially disadvantaged children.
- The statewide survey of Texas school district superintendents provided important information and new insights regarding their level of concern for traffic-related air pollution, practices or policies currently being adopted for traffic pollution mitigation in schools, and the barriers they face for reducing vehicular pollution in their school districts.
- The project provided hands-on training and professional development opportunities for three students from historically underrepresented groups who were employed as project research assistants. One of these students authored a master’s thesis on a project-related topic (Phase 2 study), and another student coauthored a peer-reviewed journal article.

Research Outputs, Outcomes, and Impacts

PUBLICATIONS:

- Chakraborty J, 2022. Children's Exposure to Vehicular Pollution: Environmental Injustice in Texas, USA. *Environmental Research*, 204 (A), 112008; <https://doi.org/10.1016/j.envres.2021.112008>.
- Chakraborty J, and Aun J J, 2023. Social Inequities in Exposure to Traffic-Related Air and Noise Pollution at Public Schools in Texas. *International Journal of Environmental Research and Public Health*, 20(7), 5308; <https://doi.org/10.3390/ijerph20075308>.
- Schwanke, L, 2022. Reducing Children's Exposure to Traffic-Related Pollution: Evaluating Policies and Strategies Used by Texas School Districts. *Open Access Theses & Dissertations*, 3549. https://scholarworks.utep.edu/open_etd/3549.

INVITED PRESENTATIONS:

- Chakraborty, J [presenter & panelist]. Life Near the Highway: Examining Environmental Justice and Equity in Land Use and Transportation Planning. *Webinar on Highway Impacts*. Urban Institute: Metropolitan Housing and Communities Policy Center, Washington DC; November 2022.

Technology Transfer Outputs, Outcomes, and Impacts

- PROJECT WEBPAGE: <https://www.utep.edu/liberalarts/sega/vehicular-pollution-texas-schools.html>
- INTERACTIVE GEOSPATIAL DATA DASHBOARD: Chakraborty J, Schwanke L, and Salas K. 2022. *Characteristics of Children and Vehicular Pollution in Texas School Districts Dashboard*. Available at: <https://tinyurl.com/CCVPTXSD>.

Education and Workforce Development Outputs, Outcomes, and Impacts

STUDENTS WHO WORKED ON THIS PROJECT:

- Laura Schwanke, MA in Sociology, Department of Sociology and Anthropology, University of Texas at El Paso.
- Jacob J. Aun, MA in Sociology, Department of Sociology and Anthropology, University of Texas at El Paso.
- Katalina Salas, PhD in Environmental Science and Engineering, University of Texas at El Paso.

MASTER'S THESIS COMPLETED:

- Schwanke, L, 2022. Reducing Children's Exposure to Traffic-Related Pollution: Evaluating Policies and Strategies Used by Texas School Districts [Graduation date: 05/01/2022] https://scholarworks.utep.edu/open_etd/3549/.