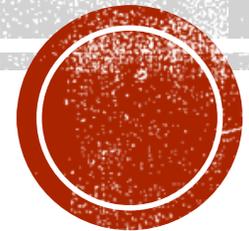


AIR POLLUTION IN EL PASO AND ITS IMPACT ON CHILDREN'S SCHOOL PERFORMANCE



Sara Grineski, Professor of Sociology, University of Utah

Our studies on the topic:

*Clark-Reyna, S, Grineski, SE, Collins, TW. 2016. Ambient concentrations of metabolic disrupting chemicals and children's academic achievement in El Paso, Texas. *International Journal of Environmental Research and Public Health*. 13(9): E874.

*Clark-Reyna, S, Grineski, SE, Collins, TW. 2016. Health status and residential exposure to air toxics: What are the effects on children's academic achievement? *Family & Community Health* 39(3): 160-8.

*Grineski, SE, Clark-Reyna, S, Collins, TW. 2016. School-based exposure to hazardous air pollutants and grade point average: a multi-level study. *Environmental Research*. 147: 164-171.

*Grineski, SE, Collins, TW. 2018. Geographic and social disparities in exposure to air neurotoxicants at U.S. public schools. *Environmental Research*. 161: 580-587

Focus of this presentation

*Clark-Reyna, S., Grineski, SE, Collins, TW. 2016. Residential exposure to air toxics is linked to lower grade point averages among school children in El Paso, Texas, USA. *Population and Environment*. 37(3): 319-340.



School-based exposure to hazardous air pollutants and grade point average: A multi-level study



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ABSTRACT

The problem of environmental health hazards around schools is serious but it has been neglected by researchers and analysts. This is concerning because children are highly susceptible to the effects of chemical hazards. Some ecological studies have demonstrated that higher school-level pollution is associated with lower aggregate school-level standardized test scores likely, related to increased respiratory illnesses and/or impaired cognitive development. However, an important question remains unexamined: How do school-level exposures impact individual children's academic performance? To address this, we obtained socio-demographic and grades data from the parents of 1888 fourth and fifth grade children in the El Paso (Texas, USA) Independent School District in 2012. El Paso is located on the US-side of the Mexican border and has a majority Mexican-origin population. School-based hazardous air pollution (HAP) exposure was calculated using census block-level US Environmental Protection Agency National Air Toxics Assessment risk estimates for respiratory and diesel particulate matter (PM). School-level demographics were obtained from the school district. Multi-level models adjusting for individual-level covariates (e.g., age, sex, race/ethnicity, English proficiency, and economic deprivation) and school-level covariates (e.g., percent of students economically disadvantaged and student-teacher ratio) showed that higher school-level HAPs were associated with lower individual-level grade point averages. An interquartile range increase in school-level HAP exposure was associated with an adjusted 0.11–0.40 point decrease in individual students' grade point averages (GPAs), depending on HAP type and emission source. Respiratory risk from HAPs had a larger effect on GPA than did diesel PM risk. Non-road mobile and total respiratory risk had the largest effects on children's GPA of all HAP variables studied and only mother's level of education had a larger effect than those two variables on children's GPA. The five school-level demographic indicators were only weakly associated with GPA. The study findings indicate the need for regulations on school siting and adjacent land uses to protect children's environmental health.

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1. Introduction

Nearly 600 million children attend primary school worldwide, yet little attention is paid to school-based environmental health hazards confronting them (Legot et al., 2010; Pastor et al., 2002; Sampson, 2012). The problem of environmental hazards in and around schools is serious (Rudnai et al., 2012; Wargo, 2004). For example, in the US, a significant portion of the top 100 polluting facilities for developmental toxics are located in close proximity to multiple schools (Legot et al., 2010). Children are highly susceptible to the effects of chemical hazards because of heavy exposures (i.e., they consume more air and food per unit of body weight than

do adults), biologic sensitivity associated with early growth and development, and their long future lifetimes as early insults can manifest in adult diseases (Perera, 2008). The World Health Organization has published guidelines for integrating environmental considerations into school siting policies (Wargo, 2004), as has the United States Environmental Protection Agency (USEPA) (Environmental Protection Agency, 2014). Because these guidelines are designed to inform voluntary decision-making only, there is no enforcement component. The lack of enforcement is reflected in the fact that only 10 US states actually prohibit school siting near environmental health hazards (Gaffron and Niemeier, 2015).

One documented consequence of school-based exposure to environmental health hazards is a reduction in children's aggregate standardized test scores. Subpar academic performance at a young age can have lifelong impacts on a child's developmental trajectory and life chances, including lower economic and educational attainment in adulthood. Statewide in California (USA),

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PLAN FOR THIS TALK

- Hazards at school
- Pollution and student achievement: what do we know
- Our El Paso studies about the impacts of pollution on student achievement
- Implications
- Next steps



HAZARDS AT SCHOOL

- Nearly 600 million children attend primary school worldwide, yet little attention is paid to school-based environmental health hazards confronting them
- Children are highly susceptible to the effects of chemical hazards because of:
 - Heavy exposures (i.e., they consume more air and food per unit of body weight than do adults)
 - Biologic sensitivity associated with early growth and development
 - Their long future lifetimes as early insults can manifest in adult diseases
- WHO and EPA have published guidelines for siting schools away from hazards.
- The voluntary nature of those guidelines is reflected in the fact that only 10 US states actually prohibit school siting near environmental health hazards.
 - Texas does not.



PRIOR WORK ON POLLUTION AND SCHOOL ACHIEVEMENT

- A series of studies using aggregated data have come out of California and Louisiana. For example:
- In CA, hazardous air pollutant risks were negative and statistically significant predictors of lower standardized test scores, adjusting for school demographics (Pastor et al. 2006)
- In Baton Rouge, LA, researchers found that a school's proximity to industrial facilities was significantly and negatively associated with lower aggregate standardized test scores, controlling for a host of relevant school-level covariates (Legot et al., 2011; Lucier et al., 2011; Scharber et al., 2013).



WHY IS POLLUTION LINKED TO ACADEMIC PERFORMANCE?

- **2 hypothetical (linked) mechanisms**
 - Poorer air quality is linked to increases in respiratory illnesses, which results in school absenteeism, and diminished academic performance
 - Exposure damages the body's natural barriers, permitting airborne pollutants to enter the body. This induces neuroinflammation, which contributes to cell loss within the central nervous system and cognitive deficits.



OUR DATA: EL PASO CHILDREN'S RESPIRATORY HEALTH STUDY (NIH-FUNDED)

- We surveyed the families of all 4th and 5th graders in the EPISD in 2012.
 - The EPISD is the 10th largest district in Texas and the 61st largest district in the US, with more than 64,000 students across 94 campuses.
 - Nearly 40% of EPISD students are enrolled in 58 elementary schools, all of which are represented in this study.
- A total of 6295 surveys were delivered to 4th and 5th grade children's home address and we received a total of 1904 responses from caretakers, which gave us a response rate of 30%.



POLLUTION VARIABLES

- School-level pollution values were created from the USEPA's National Air Toxics Assessment (NATA) census block-level database
 - The NATA includes all hazardous air pollutants (HAPs) regulated by the US Clean Air Act (except criteria pollutants) that are known or suspected to cause cancer or neurological, respiratory and immunological diseases as well as reproductive ailments.
 - We used respiratory risk & diesel PM risk for total, on-road mobile, and non-road mobile sources (6 indicators in total)
- In terms of the levels of air pollution surrounding the schools, some schools face alarmingly high levels of exposure to HAPs known to be associated with respiratory illness.
 - All 58 elementary schools have respiratory risk estimates above 1.0 and 27 schools have diesel PM risk values above 1.0.
 - Above 1 = potential for adverse effects



AN ASIDE:

ENVIRONMENTAL INJUSTICE IN EPISD

- Demonstrating a pattern of environmental injustice, we observed that EPISD elementary school sites with greater exposure to HAP risk were more likely to be poor and minority.
- Schools with respiratory risk values at or above the mean of 2.0 (n=23) have higher percentages of Hispanic students (95% vs. 75%, $p < 0.05$) and students qualifying for free and reduced price meals (88% vs. 65%, $p < 0.05$) than do the schools with respiratory risk values below the mean (n=35).
- The schools with diesel PM values at or above 1.0 (n=27) have greater percentages of Hispanic students (90% vs. 77%, $p < 0.05$) and students qualifying for free and reduced price meals (87% vs. 63%, $p < 0.05$) than do the schools with diesel PM values below 1.0 (n=31).



OUTCOME OF FOCUS

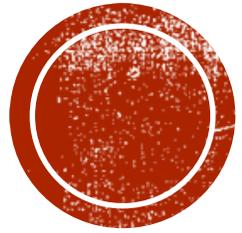
- **Child's GPA**
 - Survey question: “what grades has your child received in the following subject areas: reading, language arts, math, social studies, and science?”
 - Children performed well in school as the mean GPA was 3.3 out of 4.0.
 - This grade distribution mirrors the national grading pattern for elementary schools.
 - According to the US Department of Education (2009), 82% of students received either mostly A's or mostly B's nationwide in 2009 and 78% of children in our sample had GPAs above 3.0.



CONTROL VARIABLES

- **School-level (obtained from EPISD)**
 - Total enrollment
 - % qualifying for free-reduced price meals
 - % of teachers with MA degree (reflects teacher quality)
 - Student teacher ratio (reflects school resources)
 - % of students in special education
- **Child-level (obtained from survey)**
 - Receives free/reduced price meals
 - Mother's educational level
 - Mother was a teenager when child was born
 - Race: Hispanic, Black, or Other
 - Mother's English proficiency
 - Child's age
 - Child's sex





RESEARCH QUESTION

What is the effect of outdoor HAPs surrounding school sites on attending students' GPAs, accounting for individual-level covariates and school-level demographics?

RESULTS

- **An interquartile range increase in school-level respiratory risk from HAP exposure was associated with an adjusted 0.40 point decrease in individual students' grade point averages.**
 - **5 of 6 pollution variables were significantly linked to GPA**
- **At the individual-level, qualifying for free/reduced price meals and being a boy were associated with significantly lower GPAs. Having a mother with higher levels of education and with greater English proficiency were positive and significant influences on GPA.**
- **Total respiratory risk and non-road mobile respiratory risk had the largest effects on children's GPA of all HAP variables studied and only mother's level of education had a larger effect on GPA.**



IMPLICATIONS

- Exposure to HAPs likely compounds the learning challenges faced by the average EPISD student, who comes from a low-income, limited English background and may already be struggling in school.
- He/she may also lack access to regular healthcare. Children in this sample did report greater cost-related barriers to accessing healthcare than did US Hispanic children more generally (Balcazar et al.,2015).
- The confluence of social and environmental risk factors creates a situation of ‘multiple jeopardy’ for many El Paso school children.
- The reduced GPA among children exposed to HAPs at school is a disadvantage that contributes to an uneven playing field, which further decreases these children's life chances, compared to their more advantaged counterparts.



IMPLICATIONS

- These effects are unlikely to be perceived, but may have substantial impacts over the life course.
- There was national coverage of our studies:

SCIENTIFIC AMERICAN. English ▾ Cart 0

SUSTAINABILITY

Dirty Air Correlates with Lower Grades in Texas Schoolchildren

El Paso school kids with higher exposure to air pollution had worse grades

By Brian Bienkowski, Environmental Health News on July 24, 2015 3

Mother Jones

POLITICS ENVIRONMENT FOOD MEDIA CRIME & JUSTICE PHOTO

Kids Who Breathe More Pollution Have Lower Grades

GABRIELLE CANON SEP. 5, 2015 6:00 AM





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6.21.16

TOUR

Tuesday, June 21st @ 3 p.m.

Begin 3 p.m. @ Beall Elementary, 320 S. Piedras
End @ Chamizal National Park (corner of Paisano & S. San Marcial St.)

TOXIC TOUR ENV. EXPERTS:
HECTOR A. OLVERA, Env. Health Fellow,
Harvard University, School of Public Health.
SARA GRINESKI, Research Focus: health
equities & env. hazards along the border:

for more information:
Call Hilda Villegas
@ (915) 642-1946

OTHER FINDINGS FOR EL PASO

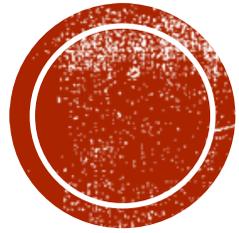
- Higher levels of residential air toxics, especially those from non-road mobile sources, were significantly associated with lower grade point averages (Clark-Reyna, Grineski & Collins, 2016, *Population and Environment*).
 - 85% of the respiratory risk burden in El Paso County came from mobile sources (with 20 % from non-road mobile sources); only 15% came from point and nonpoint sources
 - Important non-road mobile sources in El Paso: airport, railways and military base
- Poorer subjective health status and higher levels of residential air toxins were significantly associated with lower grade point averages. There was an independent effect of air pollution on children's academic achievement that cannot be explained by poor health alone (Clark-Reyna, Grineski & Collins, 2016, *Family and Community Health*).
- Results indicate that concentrations of metabolic disruptors at children's residences are significantly associated with lower grade point averages directly and indirectly through body mass index (Clark-Reyna, Grineski & Collins, 2016, *Journal of Environmental Research and Public Health*).



NEXT STEPS

- Continue to work with individual-level data to...
 - Examine if some social groups of children are more vulnerable to the effects of toxics on academic performance
 - Consider a broader range of outcomes, including socioemotional development, executive functioning, and mental health.
 - Look at longitudinal associations between exposure and outcomes
- Use findings to advocate for national-level school siting policies





THANK-YOU!

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I also recognize my co-authors: Stephanie Clark-Reyna (PhD Student, Northeastern University) and Tim Collins (Professor, University of Utah)