Project ENRRICH

A Public Health Assessment of Residential Proximity to a Goods Movement Railyard

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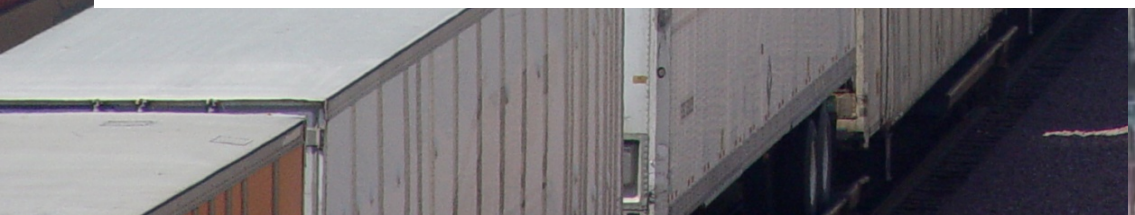
GOODS MOVEMENT

- Crucial component of modern society
- Generally seen as positive as it is an indicator of a flourishing trade
- However society has paid little attention to potential community impacts



Proximity to the Goods Movement Network

- **HEALTH DISPARITIES: THE BIG QUESTIONS**
  - **Are the Californians who live near ports, rail yards, and along high traffic corridors subsidizing the goods movement sector with their health?**
  - **Are low-income, minority communities disproportionately impacted?**

California Air Resources Board. Decemeber 2005. Emission reduction strategies. In: Draft Emission Reduction Plan for Ports and International Goods Movement. Sacramento, CA:California Air Resources Board, III-1–III-60. http://www.arb.ca.gov/planning/gmerp/dec1plan/chapter3.pdf [accessed 17 April 2013].

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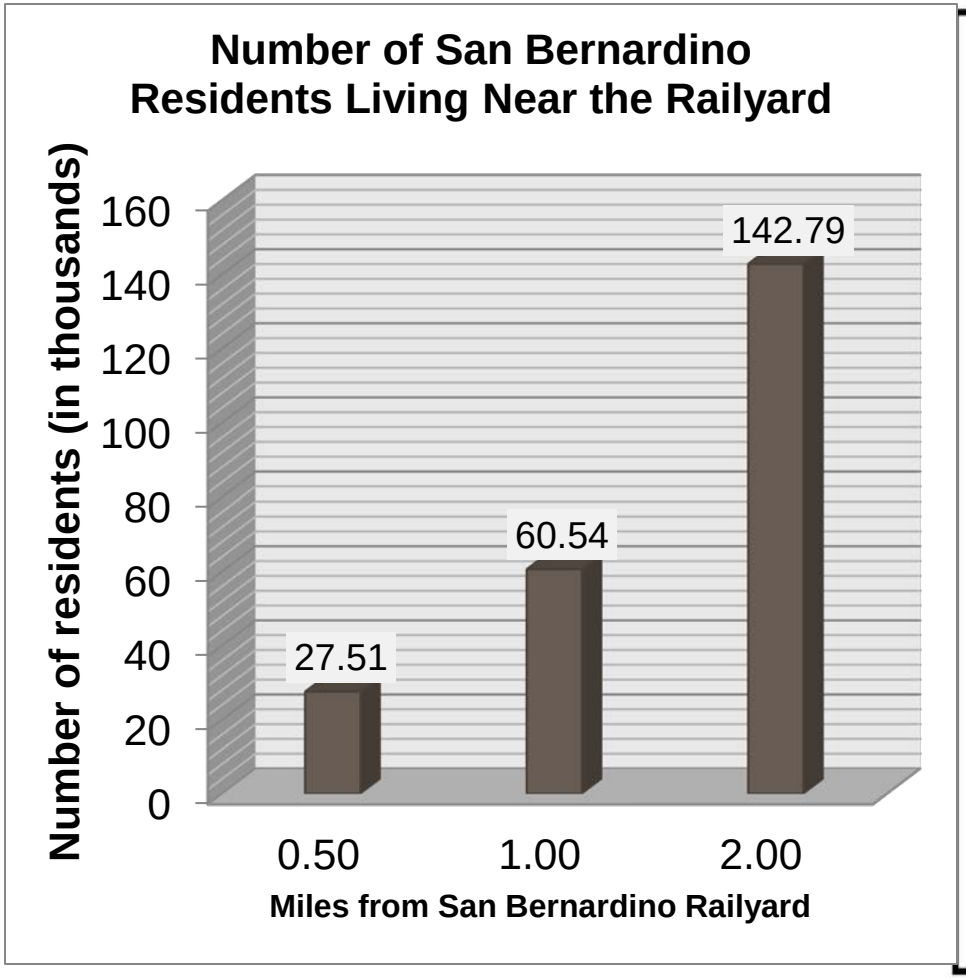
The San Bernardino Railyard



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Project ENRRICH: A Public Health Assessment of Residential Proximity to a Goods Movement Railyard

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ORIGINAL PAPER

Respiratory Health Risks for Children Living Near a Major Railyard

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Abstract Inland southern California is a region of public health concern, especially for children, given the area's perennially poor air quality and increasing sources of local pollution. One elementary school specifically is located only a few hundred yards from the San Bernardino Railyard, one of the busiest goods movement facilities in California, potentially increasing respiratory problems. Through ENRRICH (Environmental Railyard Research Impacting Community Health) Project, we assessed association of proximity to a major freight railyard on adverse respiratory health in schoolchildren. Respiratory screening was provided for children at two elementary schools: one have values suggesting inflammation ($FE_{NO} > 20$ ppb) (PR = 1.44, 95 % CI 1.02–2.02) and present with a trend for increased adverse respiratory symptoms. Children attending school near the railyard were significantly more likely to display respiratory health challenges. Ideally these low-income, low resource communities should be supported to implement sustainable intervention strategies to promote an environment where children can live healthier and thrive.

Keywords Air pollution · Children · Respiratory · Railyard · Health professionals

Study area, illustrating the location of the San Bernardino Railyard (SBR), and the two participating elementary schools in relation to the transportation infrastructure (railroads and roadways). The inset map displays the full geographic extent of the impact zones in relation to the study area (rectangle).

Design

- Parental consent and questionnaire
- School-based respiratory health screenings over the last two weeks of February, 2012 with students from grades K-5.
- Protocol approved by the Loma Linda University Institutional Review Board (IRB), Human Research Participant Protection (HRPP) Program.

Air Pollution Exposures

- GIS-derived traffic exposure variables
  - Proximity to traffic (≤ 100 m, 100-200 m, > 200-300 m, and > 300 m)
  - Density of the transportation infrastructure (mi/mi^2)—total road length within a 300-m radius of each subject's residence
  - Traffic density—VMT per square mile within a 300-m radius of each subject's residence.
- Diesel PM exposure (kg/day)—local sources
  - Stationary, mobile
  - 2 km x 2 km MATES-III emissions inventory (SCAQMD)

Potential Confounders

- Individual-level confounders via questionnaire
  - Residential locations
  - Sex, age, race/ethnicity, furry pets, time spent outdoors, ETS, type of heating system, length of time at current address, BMI, symptoms, health history, access to medical care
- Neighborhood characteristics
  - 2010 Census BG variables (36)
    - Ethnic and race composition, income/poverty levels, population density, housing indicators

Statistical Analysis

- The association of school location with the respiratory health outcomes measures was studied using log-binomial and logistic regression models
  - Prevalence Ratios and Odds Ratios
  - FE_{NO} values: elevated inflammation ($\geq$20 ppb) *vs*. normal.
  - PEF values: decreased lung function (< 80% of predicted value) *vs*. normal.
  - Covariates were not retained if they confounded the exposure-outcome relationship (i.e., a change of 10% in the estimate of the modeled outcome variable).
- Base model: school variable, age, gender, race/ethnicity, ETS, time spent outdoors, BG median household income, proximity to nearest major road, and total diesel pollution from local sources.

RESULTS

Basic characteristics and exposures of participating children

Characteristic	All subjects (n = 877)	By School of Enrollment	
		Exposure School (n = 435)	Comparison School (n = 442)
Age, yr, mean ± SD	7.96 ± 1.8	7.97 ± 1.8	7.95 ± 1.8
Race/Ethnicity, n (%)			
Non-Hispanic White	42 (4.8)	19 (4.4)	23 (5.2)
Hispanic	732 (83.4)	356 (81.8)	376 (85.1)
African American	48 (5.5)	32 (7.4)	16 (3.6)
Other	55 (6.3)	28 (6.4)	27 (6.1)
Gender, male, n (%)	414 (47.2)	201 (46.2)	213 (48.2)
Grade, n (%)			
Kindergarten	128 (14.6)	74 (17.0)	54 (12.2)
1st	145 (16.5)	57 (13.1)	88 (19.9)
2nd	161 (18.4)	77 (17.7)	84 (19.0)
3rd	139 (15.9)	71 (16.3)	68 (15.4)
4th	156 (17.8)	81 (18.6)	75 (17.0)
5th	148 (16.9)	75 (17.2)	73 (16.5)
BMI, n (%)			
Underweight (<18.5 kg/m2)	39 (4.5)	28 (6.4)	11 (2.5)
Normal (18.5 - 24.9 kg/m2)	481 (54.8)	233 (53.6)	248 (56.1)
Overweight (25.0 - 29.9 kg/m2)	144 (16.4)	71 (16.3)	73 (16.5)
Obese (>30 kg/m2)	213 (24.3)	103 (23.7)	110 (24.9)

Peak Expiratory Flow

- Significant effects seen for airway obstruction measured by PEF among children attending school near the railyard
  - PR = **1.59**, 95% CI:1.19-2.12.
- Among children who had lived at least 6 months at their current address
  - PR = **1.41** 95% CI: 1.03-1.92

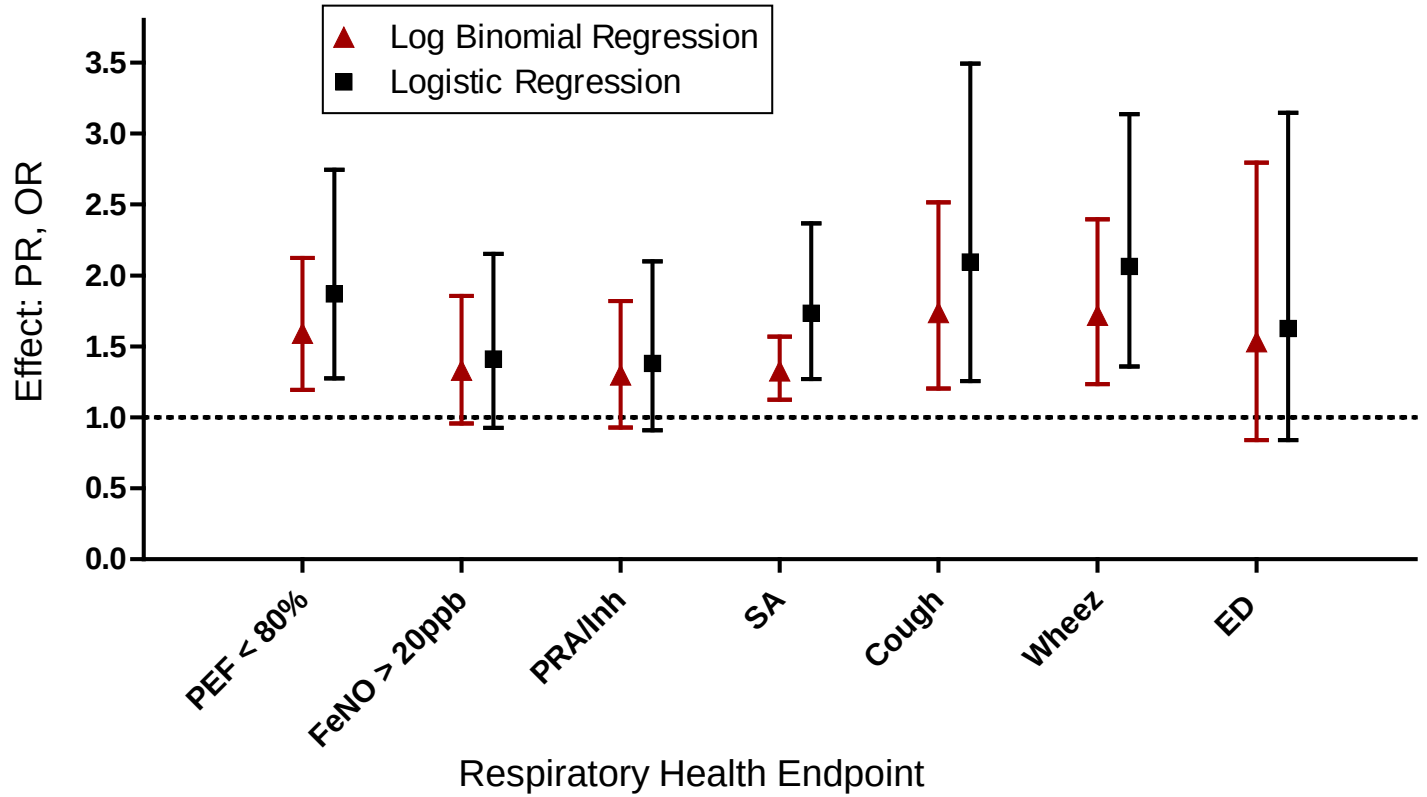
Airway Inflammation

- Children at the ES exhibited higher airway inflammation measured by FE_{NO}
  - PR = 1.33, 95% CI:0.96-1.86
- Among children who had lived at least 6 months at their current address findings were stronger
  - PR=**1.44**, 95%CI: 1.02-2.02.

Respiratory Outcomes/Symptoms

- Parent-reported asthma/inhaler use
  - PR = 1.30, 95% CI:0.93-1.82
- Parent-reported asthma/PEF<80%/FeNO>20ppb
  - PR = **1.33**, 95% CI:1.12-1.57
- Cough
  - PR = **1.74**, 95% CI:1.20-2.51
- Wheezing
  - PR = **1.72**, 95% CI:1.23-2.39
- Parent-reported ED visit within last year
  - PR = 1.53, 95% CI:0.84-2.79

LB and LR Modeling Results (Prevalence Ratios and Odds Ratios, 95% Confidence Intervals) of Children at the Exposure Elementary School Experiencing Adverse Respiratory Health Outcomes in Contrast With the Comparison Elementary School



Model = *school, age, gender, race, ETS, time spent outdoors, median household income, proximity to nearest major road, total diesel* $PM_{2.5}$

DISCUSSION

- Through screening we identified a non-trivial number of children exhibiting reduced lung volume and increased airway inflammation, potentially indicative of undiagnosed respiratory problems
- Self report measures confirmed these results– all were in the direction of increased risk

- The pattern of adverse effects suggests that proximity to the rail yard might enhance the respiratory risk for children attending school nearby.
- In addition to symptoms data, together, both biological respiratory tests provide insight into the health of children at the participating elementary schools and are useful in identifying potential airway problems that are not burdened by self-report.

Limitations

- Cause-effect relationship cannot be established (cross-sectional design)
- In the children sample school location, rather than actual personal exposure measurements, was used as a surrogate of exposure
- Difficult to isolate the exposures to on-site emissions given the presence of other off-site sources of pollution in the community aside from the railyard

CONCLUSION

- Our study represents one of the first direct investigations on the concerns about diesel exhaust's impact on children residing near a goods movement intermodal railyard.
- The ENRRICH study has identified a significant association with increasing proximity to a major goods movement rail yard and adverse respiratory health outcomes among children, even in an area already plagued with poor background air quality.

Implications

- Expansion of the goods movement sector
  - Many low-income families across the United States also live near different segments of the goods movement network
- Location of schools and residential developments in close proximity to major freeways and goods movement facilities should be carefully evaluated

Implications

- EJ--Disproportionate exposures
  - The majority of children attending the schools in our study are from low income, minority households as are their families, who live residences close to the school– they too are generally low income, minority residents
    - Chronic psychosocial stress may enhance susceptibility to environmental hazards

Shankardass, K., R. McConnell, et al. (2009). "Parental stress increases the effect of traffic-related air pollution on childhood asthma incidence." *Proc Natl Acad Sci U S A* 106(30): 12406-12411.

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