

Introduction

Regulations have resulted in drastic reductions in tailpipe emissions, but noise and non-tailpipe emissions such as brake wear, tire wear, and associated resuspended road dust continue to increase. The health effects of these non-tailpipe exposures have been little studied.

Project Summary

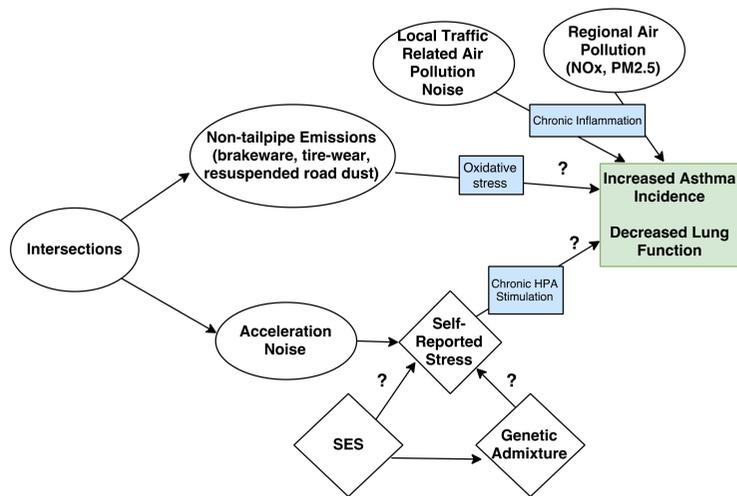


Figure 1. Flow diagram of the study objectives

Study Aims

To examine the multipollutant traffic mixture and determine its complex role as a determinant of children's respiratory health (Figure 1). We focus on the following exposures estimated at the residences and schools of Children's Health Study subjects:

- 1. Non-tailpipe emissions:** Spatially model PM metal concentrations, specifically examining intersections and freeway ramps.
- 2. Tailpipe emissions:** Use existing exposure estimates of near roadway pollutants such as NOx.
- 3. Noise:** Model traffic-related noise, supplemented with measurements at intersections and on/off ramps.
- 4. Modifying factors:** Neighborhood greenspace, subject SES, stress, and genetic admixture.

Particulate Matter Air Pollution: The Intra-Community Variability (ICV) Study

In the eight Southern California communities, monitoring of quasi-ultrafine (<0.2 μm), fine and coarse (2.5 to 10 μm) PM was conducted using modified Harvard Cascade Impactors at homes and schools of participating children in month-long integrated samples in the cool (Oct-Mar) and warm (Apr-Sep) seasons. Chemical speciation was conducted on each size fraction, providing a unique spatially rich dataset (Figure 2). For more detail see Fruin et al. [1]

Noise

The most recent version of the U.S. Federal Highway Administration (FHWA) Traffic Noise Model (TNM) version 2.5 uses roads, traffic volume, posted road speeds, pavement type, and vehicle type (cars, heavy trucks, light trucks, buses and motorcycles) to estimate traffic noise in decibels (Figure 3). We will supplement the modeled data with measurements at different road types and intersections in the 8 ICV communities using two 2238 Mediator™, Class 1 Integrating Sound Level noise meters manufactured by Brüel & Kjær.



Figure 3. Noise estimates over the Southern California region, derived from a scaled version of the Federal Highway Administration (FHWA) Traffic Noise Model

The Southern California Children's Health Study

The CHS is one of the longest and most detailed studies of the effect of air pollution on children's health. Cohorts began enrolling in the early 1990s and were followed through 2018. For this research we used the most recent cohort (Cohort E), which began enrolling children from kindergarten and first grade classes in 2002-2003.

Epidemiological Assessment

In a cross-sectional analysis of CHS subjects, we found a strengthened association between near-roadway tailpipe emissions and reduced lung function when we adjusted for noise (Figure 6). For more details see Franklin & Fruin [2].

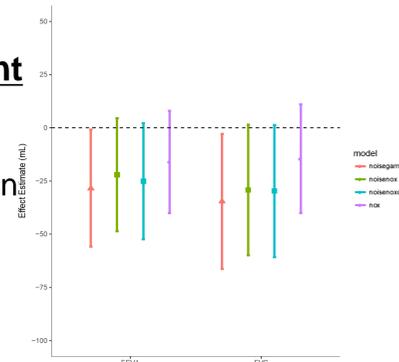


Figure 6. Effect Estimates

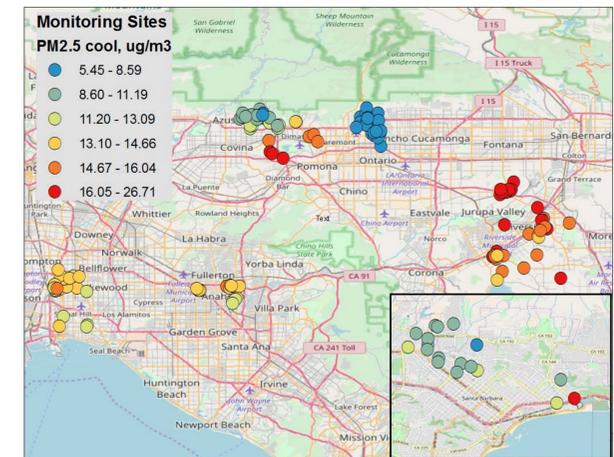


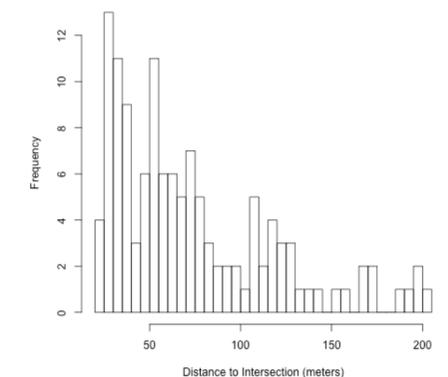
Figure 2. Map of study region: the ICV locations in 8 Southern CA communities

Intersections

Using OpenStreetMap Overpass API, we queried the 8 Southern California Communities for intersections of different types (traffic lights, stop signs), on ramps, off ramps, and bus stops. For example, in Anaheim we found that many of the ICV monitoring sites were close to residential freeway ramps (Figure 4 left), and under 50 m from intersections (Figure 4 right).



Figure 4. Anaheim: Identified intersections and on/off ramps near ICV monitors (left); histogram of distances between ICV monitors and intersections (right)



Spatial Assessment

Preliminary assessment of the spatial variability in the ICV PM concentrations showed small scale spatial gradients (< 600 m) in metals such as copper in the fine fraction, indicating higher brake wear emissions near roadways (Figure 5).

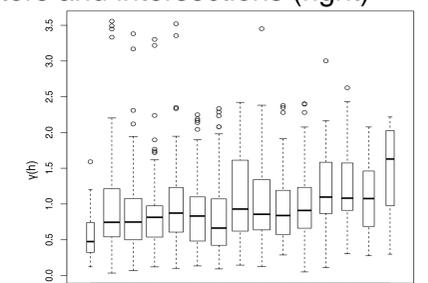


Figure 5. Semivariogram Cu