California Building Resilience Against Climate Effects (CalBRACE) Project

Short Title: Fine Particulate Air Pollution
Full Title: Annual Mean Ambient Concentration of Fine Particulate Matter ($PM_{2.5}$)

CalBRACE Domain: Environmental Exposures

Healthy Community Framework: Quality and sustainability of environment

What is our aspirational goal: Minimize toxics, greenhouse gas emissions, and waste

Why is this important to health?

Clean air is a fundamental building block of human health. Air pollution from fixed and mobile sources (e.g., factories and cars, respectively) is a complex mixture of gases, fumes, and particles released into the atmosphere from the combustion of fossil fuels and evaporation of solvents. Particulate matter (PM) is one of two indicators of air pollution, ozone being the other, that is linked to short- and long-term adverse health effects. Specifically, particulate matter ($PM_{2.5}$) is an extremely small pollutant whose exposure is linked to adverse health outcomes. $PM_{2.5}$ is capable of reaching deep into the lungs and causing a host of diseases, including lung cancer, heart disease, respiratory disease, and acute respiratory infections.[1] The health impacts of air pollution are likely to be exacerbated by climate change, because degradation of air quality will compound the health hazards posed by warmer temperature.[2] In a warmer climate, populations will be exposed to higher levels of air pollutants and the enhanced pollutant emission and production rates.[2] In addition, more frequent and intense wildfires will expose people to smoke that contains PM and numerous chemicals. In California, given the $PM_{2.5}$ levels between 2004 and 2006, the Air Resources Board estimates that over nine-thousand deaths could be prevented each year if California met its current statewide $PM_{2.5}$ standard of 12 $\mu g/m^3$.[3] The elderly, pregnant women, children, people with chronic underlying diseases (e.g., diabetes, cardiovascular diseases, obesity, respiratory diseases), agricultural and outdoor workers, urban residents, and communities with low socioeconomic status are more prone to the impacts of worsened air quality due to climate change.[1] With projected increasing temperatures, demand for electric power generation will increase and may contribute further to poor air quality.

Summary of Evidence for Climate and Health

Based on numerous community-based epidemiologic studies, both short-term and long-term exposures to $PM_{2.5}$ increase the risk of cardiovascular disease and mortality.[3] $PM_{2.5}$ is linked to adverse respiratory outcomes such as chronic obstructive lung disease, hospital and emergency department admissions for asthma, increased respiratory symptoms, altered pulmonary function, and pulmonary inflammation among asthmatic children.[1, 3] While not definitive, evidence is accumulating for $PM_{2.5}$ effects on low birth weight and infant mortality, especially due to respiratory causes during the post-neonatal period.[1]

Key References:

1. Particulate Matter Integrated Science Assessment Project Team. Integrated Science Assessment for Particulate Matter. Research Triangle Park, NC: U.S. Environmental Protection Agency; 2009.

2. Sujaritpong S, Dear K, Cope M, et al. Quantifying the health impacts of air pollution under a changing climate – a review of approaches and methodology. *International Journal of Biometeorology.* 2013; 58: 149-160.
3. Tran HT, Alvarado A, Garcia C, et al. Methodology for Estimating Premature Deaths Associated with Long-term Exposures to Fine Airborne Particulate Matter in California. Sacramento, CA: California Air Resources Board; 2009.

What is the indicator?

Detailed Definition

- Indicator = Annual mean concentration of $PM_{2.5}$ (average of quarterly means, $\mu g/m^3$), over three years (2009-2011 and 2012 to 2014)
- Stratification: 8 race/ethnicity strata (African American, American Indian/Native Alaskan, Asian, Latino, Multiple, Native Hawaiian and Other Pacific Islander, White, Total).
- Interpretation: Healthier communities will have lower $PM_{2.5}$ levels

Data Description and Methodology

For 2012-2014:

- Air Monitoring Network, California Air Resources Board (CARB); CalEnviroscreen 3.0
  - Years available: 3-year average of 2012-2014
  - Geographies available: census tracts, county (derived), region (derived), state (derived)
- American Community Survey (ACS)
  - Years available: 2011-2015
  - Geographies available: census tract, county, region (derived), state

For 2009-2011:

- Air Monitoring Network, California Air Resources Board (CARB)
  - Years available: 3-year average of 2009-2011
  - Geographies available: census tracts, place (derived), county subdivision (derived), county (derived), region (derived), state (derived)
- Population of 2010 U.S. census blocks, U.S. Census Bureau Redistricting File for California
  - Years available: 2010
  - Geographies available: census block

California Air Resources Board (CARB), local air pollution control districts, tribes and federal land managers maintain a wide network of air monitoring stations in California. These stations record a variety of different measurements including concentrations of the six criteria air pollutants and meteorological data. The density of the stations is such that specific cities or localized areas around monitors may have high resolution. However, not all cities have stations. The site information gathered from each air monitoring station audited by CARB includes maps, locations coordinates, photos, pollutant concentrations, and surveys. See the CalEnviroscreen website for more information on methods.

For 2009-2011, population weighted $PM_{2.5}$ concentration averages by race/ethnicity were calculated for census tracts, cities/towns, counties, regions, and the state, from census tract air quality estimates merged with census block population data. For 2012-2014, population

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