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LATEST RESEARCH

AIR POLLUTION IMPACTS ON CHILDREN

Laura Van Winkle, PhD
UC Davis

Associate Adjunct Professor
School of Veterinary Medicine
Department of Anatomy, Physiology and Cell Biology

Associate Research Cell Biologist
Center for Health and the Environment,
John Muir Institute of the Environment
Resources

ALA State of the Air Report and National Summaries on Air Pollution

NIEHS/EPA Centers for Children’s Environmental Health-
https://www.niehs.nih.gov/research/supported/centers/prevention/index.cfm

Environmental Health Perspectives “Children’s Health Collection”
http://ehp.niehs.nih.gov/childrens-health/

NEW UC Davis Environmental Health Sciences Center
https://ehscc.ucdavis.edu/

Part of a national program of NIEHS funded EHS CC:
http://www.niehs.nih.gov/research/supported/centers/core/

Review article of So Cal Children’s Health Study:
Chen et al J Thoracic Dis 2015
Children are a uniquely susceptible population for adverse health outcomes from air pollution exposures due to postnatal development of many organs, high potential for outdoor exposures, small body size.
The lung is not fully formed at birth and during the postnatal period many cells are still differentiating while the lung is also growing.

Maturation of conducting airway epithelium occurs in a proximal to distal direction.
Longitudinal Normal Lung-Function Trajectory

Longitudinal Lung-Function Trajectories

Ozone Effects in the Healthy Lung?

**Animal Studies have shown:**

Episodic exposures having larger long term effects on lung remodeling than chronic exposures or single acute exposures. Younger animals are more susceptible. Barr et al TAP 1990. Fanucchi et al AJP: Lung 2006


Early postnatal, adolescent and young adult animals are more susceptible (than adult or aged animals) to ozone induced changes in ventilation and pulmonary injury/inflammation. Snow et al Inhalation Toxicology 2016

Episodic ozone exposure enhances allergic sensitization and addition of an allergen exposure to an ozone exposure results in greater airway remodeling and reactivity. Schelegle et al TAP 2003
Epidemiologic studies have shown decreased lung function and possible increases in asthma incidence:

Chronic exposure to ozone results in decreased lung function in young adults, and an effect on small airways is implicated. Tager et al Epidemiology 2005

This change can take place early in life: Schoolchildren in Mexico City (8yrs) have a deficit in lung function that correlates with ozone exposure (also PM). Rojas-Martinez et al AJRCCM 2007

Children who exercise outdoors in a high ozone environment can have an increased incidence of new diagnoses of asthma. McConnell et al Lancet 2002

Early life ozone exposure was associated with increased asthma without detectable allergic sensitization in a Latino population of asthmatic children aged 8-21. Nishimura et al JACI 2016
Episodic Ozone Exposure Alters both Alveolar Growth and Airway Growth in Animal Models

Ozone and Alveolar Growth

Ozone and Airway Growth

Avdalovic et al. 2012 Anat Rec 295(10):1707-16

Lee et al. 2011 Inhalation Toxicology 23(9):520-31
Ozone effects during lung development?

Ozone exposure during lung development causes airway, immune system and parenchymal remodeling changing lung function in humans and possibly predisposing to asthma ….

BUT the mechanisms involved and the interaction of these effects with other co-pollutants, such as PM and near roadway vehicle exhaust, is a very active area of current research.
Fetal Effects of Air Pollution
Pre-term Birth/Low Birth Weight

A California statewide nested case–control study population from 2001-2008 and exposures to both primary (PM2.5 and ultrafine particles from traffic sources) and secondary (ozone, nitrate, ammonium and SOA) pollutants were associated with an increase in pre-term birth. Near roadway traffic related exposures had the strongest associations. Laurent et al, EHP 2016

The time-stratified case-crossover design in Brisbane Australia found that high levels of hourly ambient air pollution in the preceding 24 or 48 hrs prior to birth (N02, S02, CO in the 95th percentile) increased OR for preterm birth. BUT Ozone and PM were not found to have an effect. Li et al EHP 2015

Decreased air pollution in Beijing China associated with the Olympics resulted in higher birthweights. Rich et al EHP 2015

How?
Air Pollution and Obesity

Epidemiologic Studies
Traffic within 150m of a child’s home had a significant positive association with BMI at age 18. Longitudinal cohort was of children 10-18 years old and was based in Southern CA. Jerrett et al Prev Med 2010

Traffic pollution was positively associated with growth in BMI in S CA children aged 5-11. Jerrett et al Env Health 2014

Mexico City normal weight school children exposed to high levels of PM2.5 and ozone have fasting hyperleptinemia and altered appetite-regulating peptides. These changes could signal the future trajectory of urban children towards the development of insulin resistance, obesity, type II diabetes. Calderón-Garcidueñas et al Env Research 2015.

Animal Models:
Rats with a sedentary lifestyle had an increase in ozone induced eosinophilia (inflammation that has been related to asthma) that was reduced by activity. Gordon et al AJP: Lung 2016
Near Roadway Vehicle Exhaust

Proximity to a major roadway/traffic pollution is associated with
- **Increased asthma** with closer residential distance to a freeway and also exposure to outdoor freeway air pollution Gauderman et al Epidemiology 2005
- **Asthma exacerbations** was associated with air pollution exposure and the association was stronger among individuals who lived with higher levels of traffic related air pollution. Delfino et al Epidemiology 2014
- **Increased exhaled NO** in breath, indicative of distal airway effects and **inflammation** Eckel et al Eur Resp J 2016

Traffic related air pollution exacerbates upper and lower **respiratory infections** (based on ED visits). Darrow et al Am J Epidemiol. 2014

Ongoing studies are investigating the causative agents in near roadway pollution (including PAH components) and the critical windows of exposure that result in susceptibility to lung health effects.
Air Pollution affects more than the respiratory tract- Brain health

PM2.5 from traffic associated with **reduction in cognitive development**. Basagana et al EHP 2016

Exposure to TRAP, NO2, PM2.5 and PM10 during pregnancy and the first year of life was associated with **autism**. Volk et al JAMA Psychiatry 2013. Volk et al EHP 2011

Prenatal air pollution exposure associated with **autism**. 7000 + children of mothers who gave birth in LA. Ozone and PM2.5 associated with 12-15% increased risk and NO2/NO risk was an increase of 3-9% per IQR increase. Becerra et al EHP 2016

Childhood exposure to traffic-related pollution may adversely affect **executive function development**. Harris et al Neurotox and Teratology 2016
Thanks!

Acknowledgements:

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CLEAN AIR FUTURE

HEALTH AND CLIMATE BENEFITS OF ZERO EMISSION VEHICLES
WHAT DOES PASSENGER VEHICLE POLLUTION COST US?

TENS OF BILLIONS IN HEALTH AND CLIMATE IMPACTS

Passenger Vehicle Health and Climate Costs

<table>
<thead>
<tr>
<th>Year</th>
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<tr>
<td>2015</td>
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<td>2030</td>
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<tr>
<td>2050 (ZEV Future)</td>
<td>$12</td>
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Billions
WHAT DO WE CONTRIBUTE?

EVERYDAY COSTS OF COMBUSTION VEHICLES

$18.42 in Health and Climate Harm per 16-Gallon Tank of Gas

- Health $11.87
- Climate $6.55
THE HEALTH BENEFITS OF ZEVS?

MORE ZEVS = GREATER HEALTH AND CLIMATE BENEFITS

Asthma Attacks Due to Vehicle Pollution

- 2015: 109,637
- 2030: 45,426
- 2050 (ZEV Future): 13,267

64,212 Fewer Asthma Attacks Per Year

96,370 Fewer Asthma Attacks Per Year

Premature Deaths Due to Vehicle Pollution

- 2015: 2,580
- 2030: 1,152
- 2050 (ZEV Future): 334

1,429 Fewer Deaths Per Year
THE HEALTH BENEFITS OF ZEVs?

MORE ZEVs = GREATER HEALTH AND CLIMATE BENEFITS
NEXT STEPS

AIR RESOURCES BOARD

• **December 2016** staff report on implementation of vehicle standards
  - Zero Emission Vehicle Standards
  - Greenhouse Gas *“Pavley”* Standards
  - Particle Pollution Standards

• **February 2017** Board Hearing on Mid-Term Review, followed by:
  - Potential for updates to 2025 standards
  - Planning for post-2025 standards
CELEBRATING SENATOR FRAN PAVLEY
A LIFETIME OF CLEAN AIR ACHIEVEMENTS
ANNOUNCEMENTS

PLEASE SHARE YOUR UPCOMING EVENTS AND INFO!