Air Quality & Health:

A brief overview of pediatric environmental health and how **outdoor** air quality can affect health

Elizabeth Friedman, MD, MPH

Asthma Ready SNAC-S Presentation

May 2025

MAPEHSU
MID-AMERICA PEDIATRIC ENVIRONMENTAL HEALTH SPECIALTY UNIT

BEST CHILDREN'S HOSPITALS U.S.News RANKED IN 10 SPECIALTIES 2020-21

MAGNET RECOGNIZED AMERICAN NURSES CREDENTIALING CENTER

UMKC School of Medicine

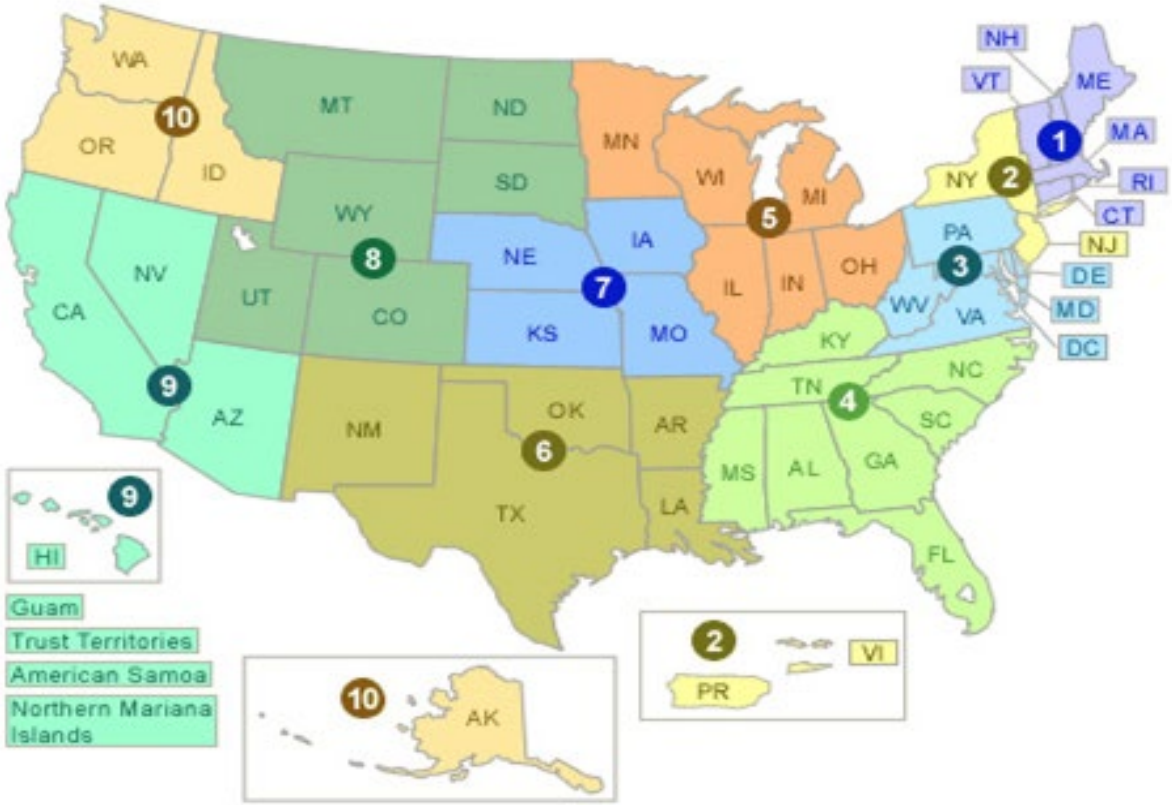
KU SCHOOL OF MEDICINE The University of Kansas

Children's Mercy KANSAS CITY

MAPEHSU

MID-AMERICA PEDIATRIC ENVIRONMENTAL HEALTH SPECIALTY UNIT

- HHS/EPA funded network of interdisciplinary pediatric EH specialists based at academic medical centers
- R7-PEHSU at Children's Mercy Hospital, Kansas City, MO
- Provide free consultation, referral, outreach and education
  - Public Health Departments
  - Clinicians
  - Public health and medical trainees
  - Communities
  - Families



PEHSU: 1-800-421-9916

www.pehsu.net

Children's Mercy KANSAS CITY

Environmental Health at Children's Mercy

Healthy Homes

Lead

Asthma

Complex Medical Cases (developing)

Healthy Schools

Industrial hygiene services for children in schools rather than adults at work (i.e. OEM)

*COVID-19 (see resources section)

Healthy Homes/Schools Training Programs

Services to CHWs, Public health departments, etc.

The Unique Vulnerabilities of Children

- Critical Windows of Vulnerability (esp. fetal development)
- Changing Physical Environments
- Normal Behaviors and Stages of Development

- Physiologic Features in the Context of Environment
  - Absorption
  - Distribution
  - Metabolism
  - Chronicity

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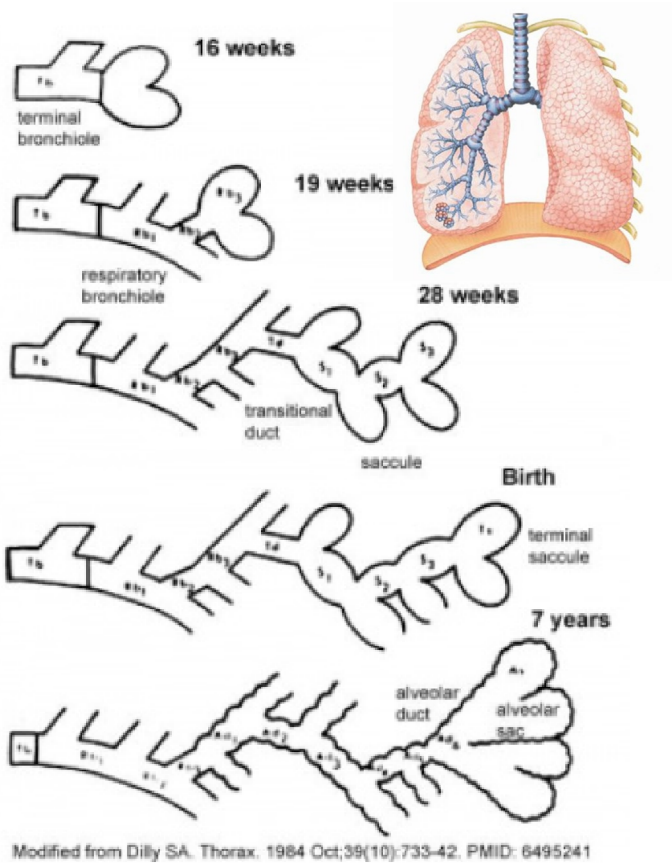
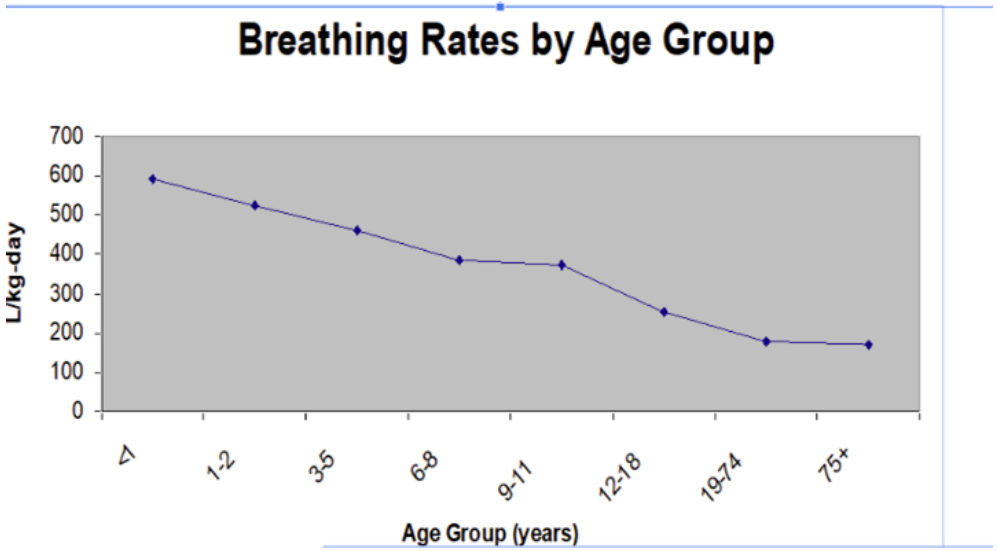
Lung Development & Physiology



Modified from Dilly SA. Thorax. 1984 Oct;39(10):733-42. PMID: 6495241

Increased Exposure from Inhalation



Higher minute ventilation

- Newborn 400 ml/min/kg
- Adult 150 ml/min/kg

Miller M et al., Intl J Tox 2002d
Pediatric Environmental Health Toolkit 2006
Boston & San Francisco Bay Area PSR, UCSF PEHSU

Health Effects of Air Pollution

- Asthma
- Decreased lung function
- Aggravation of respiratory and cardiovascular diseases
- Increased frequency and severity of respiratory symptoms
- Increased susceptibility to respiratory infections
- Effects on the nervous system
- Premature death
- Cancer

REFERENCES
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Bates V, *Environmental Health Perspectives*,1995.
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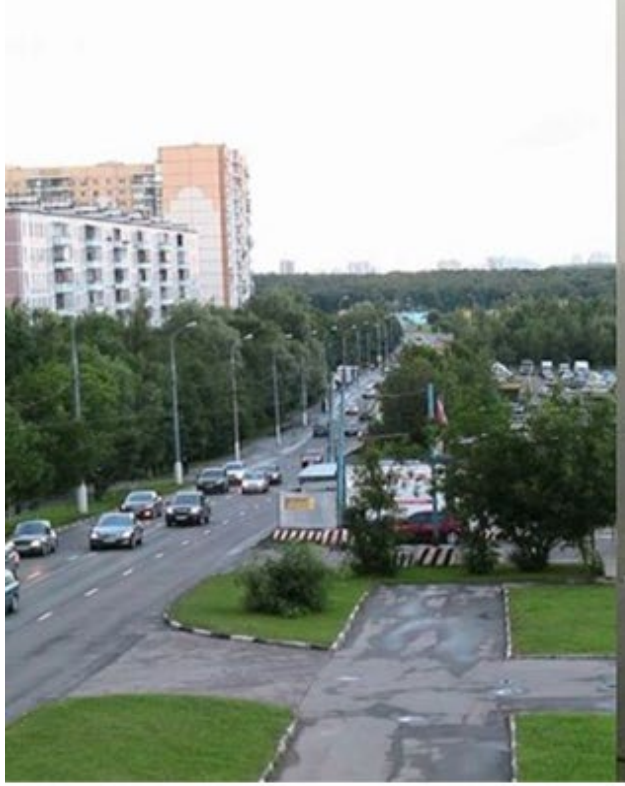
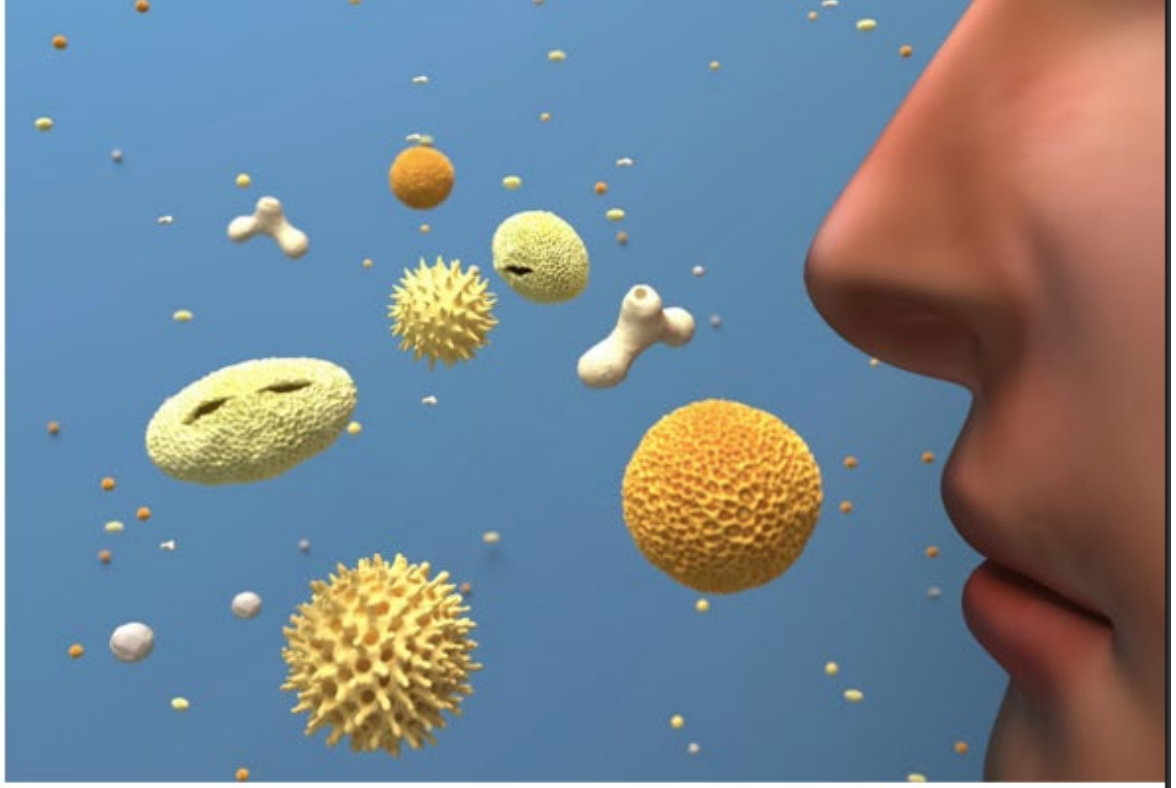
Fraga J et al, *Int J Environ Res Public Health*, 2011.





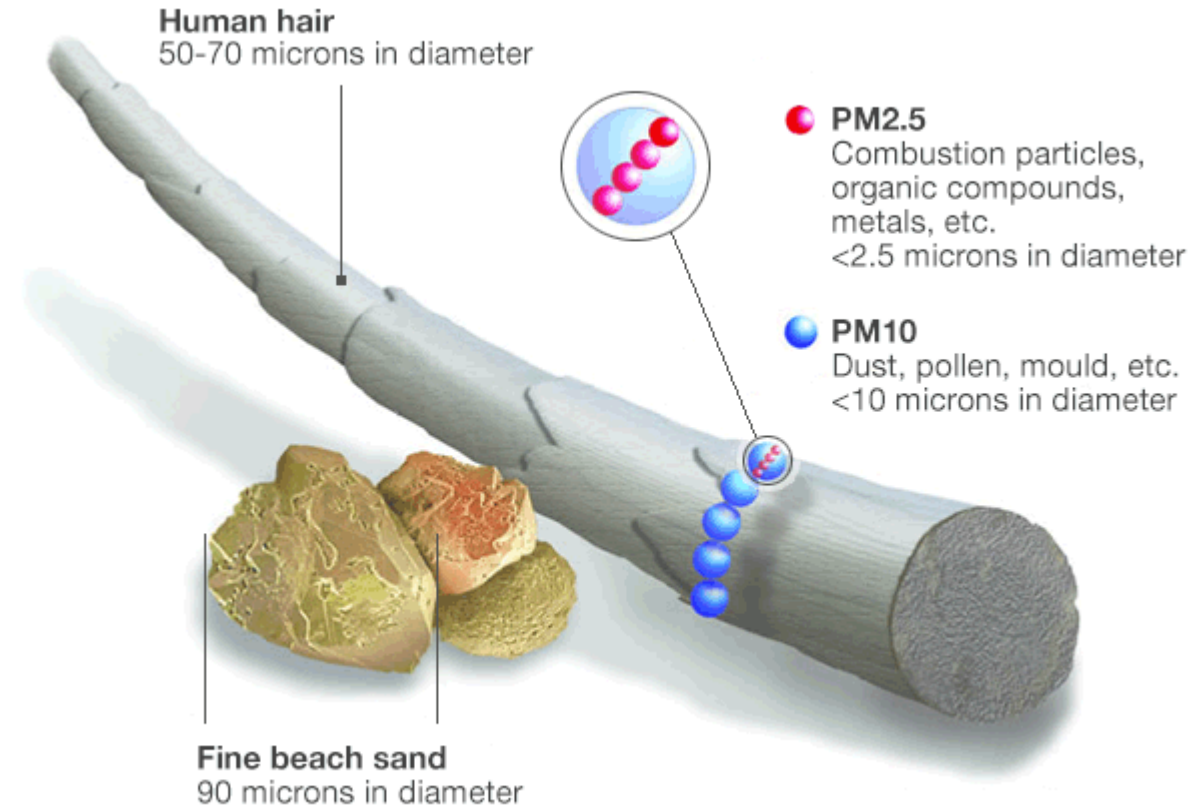
Ozone

VOC chemicals + NOx chemicals + (sunlight +heat) = Ozone gas

Particulate Matter

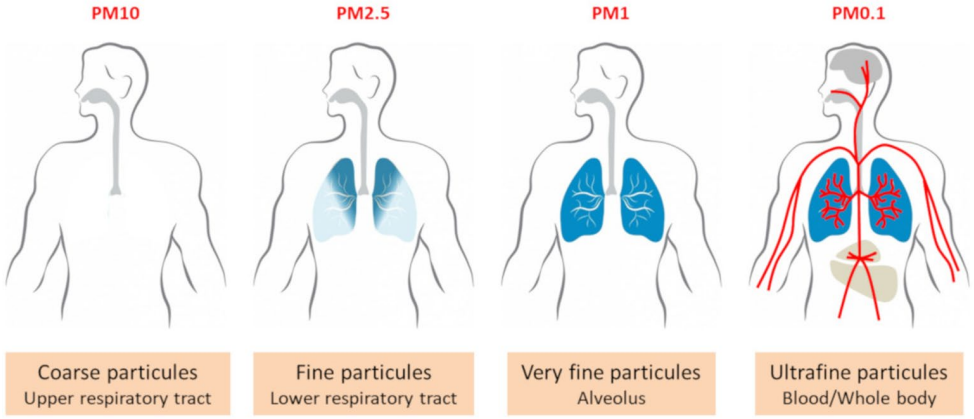
Solid dust particles, solid combustion products or ash, soot, and exhaust.

Particulate Matter



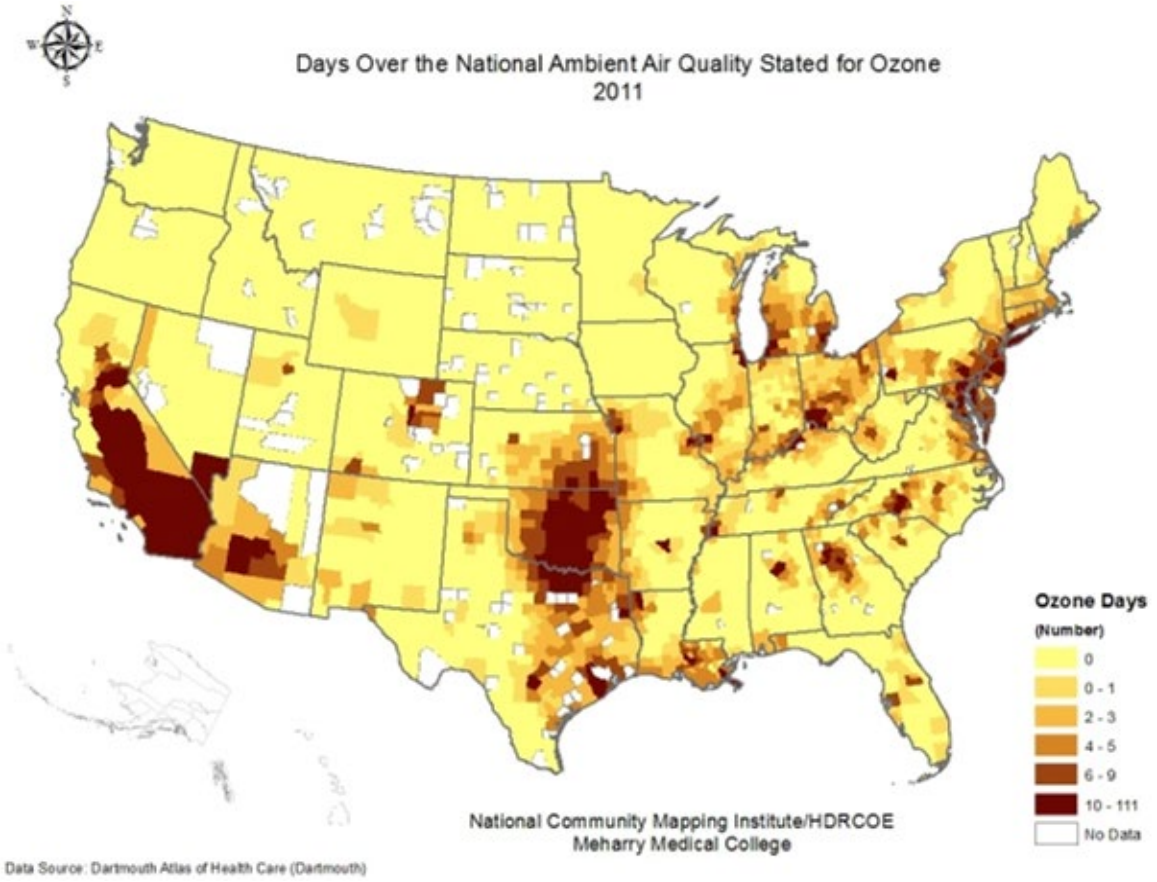
Source: US EPA

Respiratory Exposure to Particulate Matter

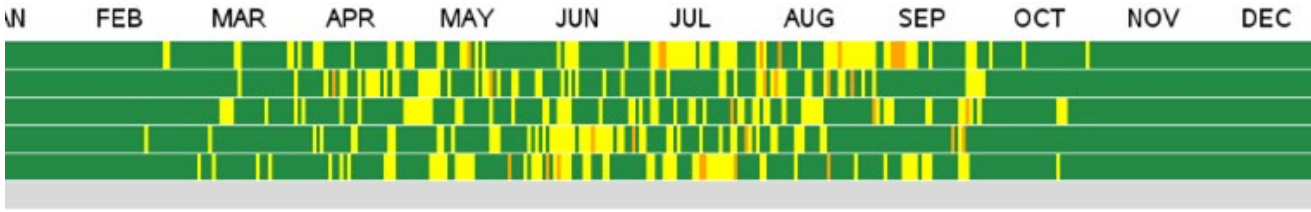


Source: Danel V (2021), Airborne particulate matter and their health effects, Encyclopedia of the Environment, [online ISSN 2555-0950] url : https://www.encyclopedie-environnement.org/en/health/airborne-particulate-health-effects/.. Accessed May, 2021

Days Over Ozone Daily Max



Ozone Daily Value by time of Year in KC MO/KS



AQI Category

- Good (<=0.054 ppm)
- Moderate (0.055-0.070 ppm)
- Unhealthy for Sensitive Groups (0.071-0.085 ppm)
- Unhealthy (0.086-0.105 ppm)
- Very Unhealthy (>=0.106 ppm)

Source: U.S. EPA AirData <https://www.epa.gov/air-data>
Generated: May 28, 2018

Source: https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors

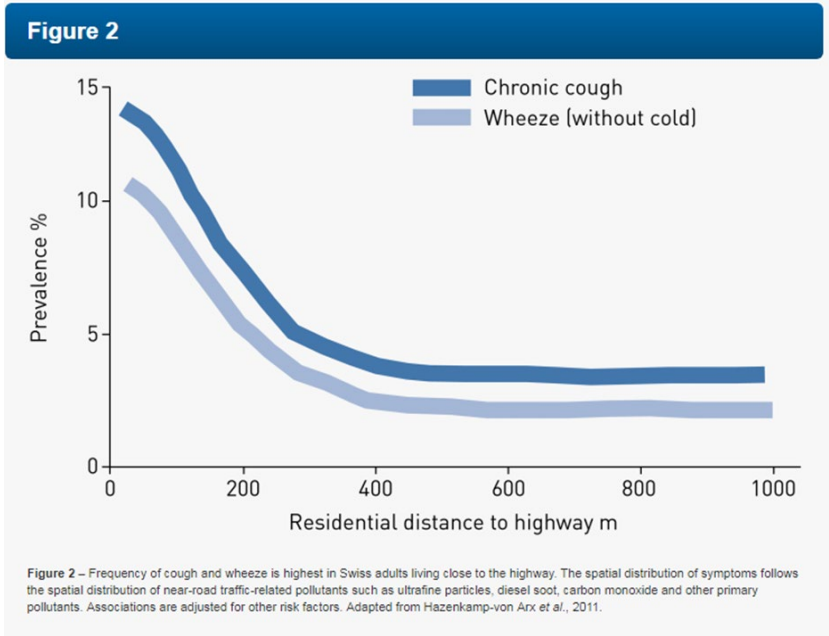
Evidence from the Field

Southern California Children's Health Study

Traffic-related air pollution and childhood asthma

Swiss Study

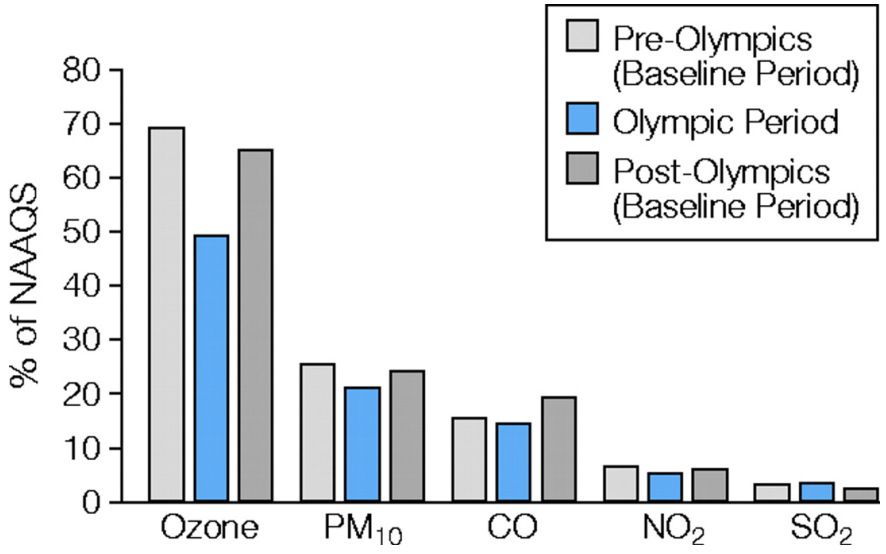
Residential distance to highway



[1]McConnell R, et al. (2006) Traffic, Susceptibility, and Childhood Asthma. *Environ Health Perspect* 114(5)
[2]Jerrett M, et al. (2008) Traffic-Related Air Pollution and Asthma Onset in Children: A Prospective Cohort Study with Individual Exposure Measurement. *Environ Health Perspect* 116(10)
[3]McConnell R, et al. (2010) Childhood Incident Asthma and Traffic-Related Air Pollution at Home and School. *Environ Health Perspect* 118(7)

Evidence from the Field

1996 ATL Olympics



Type of claim	% change in mean # of Asthma claims per day	% change in mean # of Non-Asthma claims per day
Medicaid Hosp and ED Visits	**- 41.6%**	**- 3.1%**
HMO ED, Urgent Visit, Hosp	**- 44.1%**	**+ 1.3%**

Friedman, M. S. et al. JAMA 2001;285:897-905.

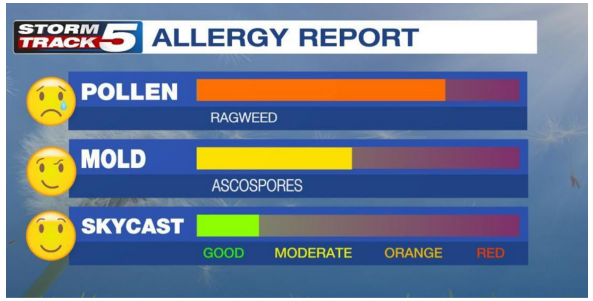
Allergens

Schramm P, Brown, C., Saha, S, Manangan, A, Conlon, K, Bell, J, Gerber, K, Atalla, L, Hess, J. Global Pollen Trends:
Effects of Temperature and Precipitation and Implications for Human Health. National Center for Environmental Health – Division of Environmental Hazards and Health Effects. American Meteorologic Society Conference, Seattle, Washington. 26 January 2017. Electronic reference: https://ams.confex.com/ams/97Annual/webprogram/Paper300718.html. Accessed 4/2021.
Ziska , World Resource Rev, 2000

Over time we are seeing:

Changes in (Temperature + precipitation + CO_2)

- Longer pollen season
- Greater mean daily pollen
- Greater total annual pollen



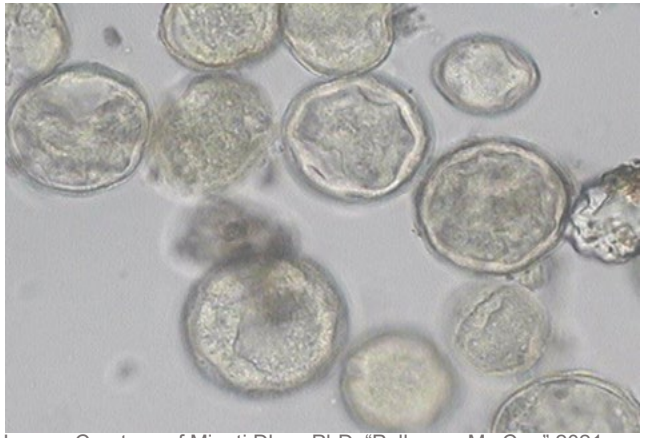


Image: Courtesy of Minati Dhar, PhD, "Pollen on My Car," 2021

Image by Ted Aanensen, Blogfinger photographer; Ttaken from: https://blogfinger.net/2018/05/07/surprise-the-green-stuff-all-over-everything-is-tree-pollen-and-the-counts-are-very-high-2/

Portnoy, J. M., Barnes, C. Clinical relevance of spore and pollen counts. Immunology and allergy clinics of North America 23, 389-410 (2003)
Barne C, Alexis NE, Bernstein JA, et al. Climate change and our environment: the effect on respiratory and allergic disease. J Allergy Clin Immunol Pract. 2013;1(2):137-141. doi:10.1016/j.jaip.2012.07.002
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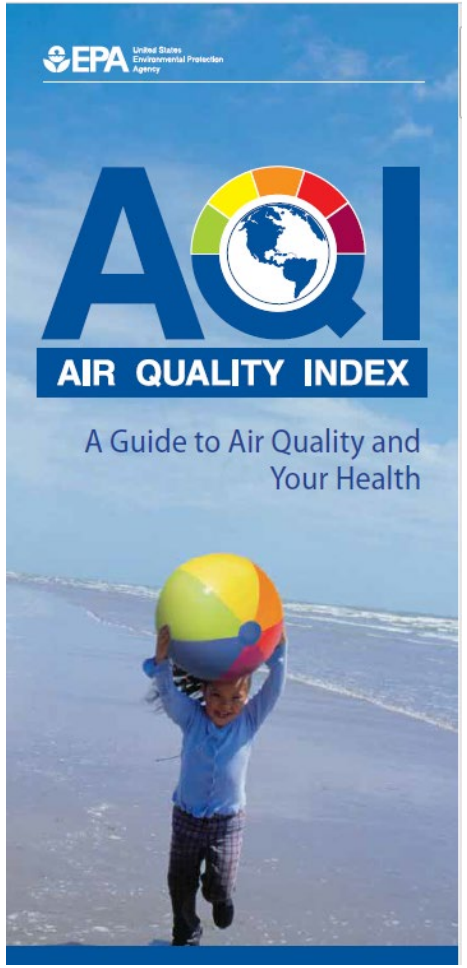
Effects of Temperature and Precipitation and Implications for Human Health. National Center for Environmental Health – Division of Environmental Hazards and Health Effects. American Meteorologic Society Conference, Seattle, Washington. 26 January 2017. Electronic reference: https://ams.confex.com/ams/97Annual/webprogram/Paper300718.html. Accessed 4/2021.
Gong H Jr, Wong R, Sarma RJ, Linn WS, Sullivan ED, Shamoo DA, Anderson KR, Prasad SB. Cardiovascular effects of ozone exposure in human volunteers. Am J Respir Crit Care Med. 1998 Aug;158(2):538-46. doi: 10.1164/ajrccm.158.2.9709034. PMID: 9700133.
Séguin, J., Berry, P., Bouchet, V., Clarke, K. L., Furgal, C., Environmental, I., & Maciver, D. (2008). Human health in a changing climate: a Canadian assessment of vulnerabilities and adaptive capacity. Human health in a changing climate, 1.

Management – Addressing Outdoor Air Pollution

- Treatment
- Prevention (individual)
  - Air Quality Index (AQI) – https://www.airnow.gov/;
    - Purple Air – https://www2.purpleair.com/
  - Pollen Count – https://pollen.aaaai.org/#/ (for KC and STL)
  - Hygiene practices
- Prevention (population) – policy, built environment

EPA's Air Quality Index



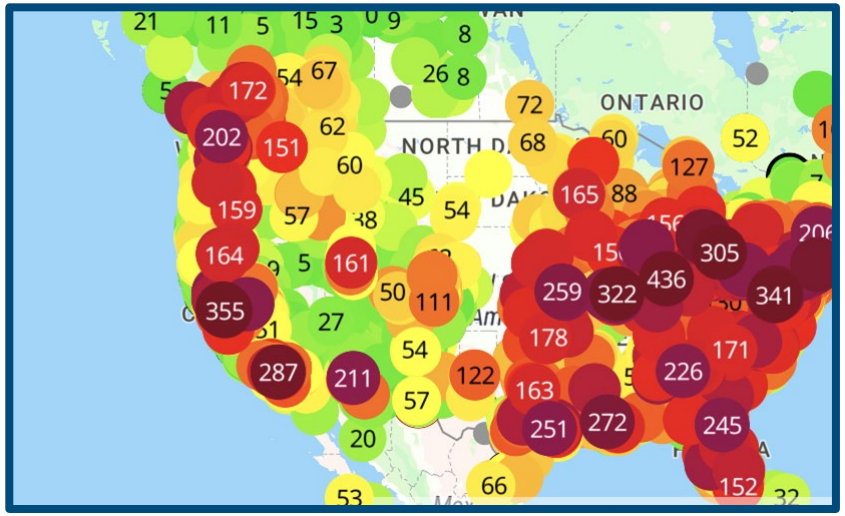
Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*...as symbolized by this color:*
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

4 Major Air Pollutants
- Ground Level Ozone (O3)
- Carbon Monoxide (CO)
- Sulfur Dioxide (SO2)
- Particle Pollution

- Large Cities (>350,000 people) are required to report AQI daily
- AQI >100 , agencies also report who may be sensitive to that pollutant
- If 2+ pollutants have AQI >100, announcement must be made for groups sensitive to both pollutants

Community-level air quality reporting is a powerful *tool*.

Low-Cost Air Sensors Monitoring Air Quality in United States - The Night of July 4, 2021



Source: https://www2.purpleair.com/. Taken July 4, 2021.

Hygiene Practices

- Closed windows on high pollution (PM and ozone) and allergen (pollen and mold) days
- Consider using additional indoor air filters
- Use HEPA filters in household vents
- Timely changing of home air filters (including HVAC system filters)
- Advise kids to stay away from exhaust pipes of idling vehicles
- Remove and wash clothes after being outdoors
- Bathe after being outdoors and before going to bed
- Consider indoor activities, or relocating on higher risk days

Roberts, J, McCurdy L. Environmental Management of Pediatric Asthma Guidelines for Health Care Providers. August 2005. Electronic reference: https://www.niehs.nih.gov/health/materials/environmental_management_of_pediatric_asthma_guidelines_for_health_care_providers_508.pdf. Accessed July 21, 2021

END

- Questions?
- Contact: efriedman@cmh.edu

THANK YOU!

Resources for Healthcare Providers

National PEHSU - links to CDC, FDA, etc. regarding a variety of pediatric environmental health care concerns. Note many regional PEHSUs have their own collection of useful materials.

E-mail: **efriedman@cmh.edu**

Agency for Toxic Substances and Disease Registry - provides technical information to health professionals on the effects of hazardous substances, also provides CME and other educational opportunities.

Children's Health Protection - EPA department – link to health topic indices, based on location (environment), toxic exposures and general health topics

NIEHS Kids Page - Fun stuff for kids.

Environmental Working Group – Consumer product reference

Environmental Health News – Collection of news reports from publications around the world

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