

Endocrine Disruptors, Chronic Disease, and COVID19?

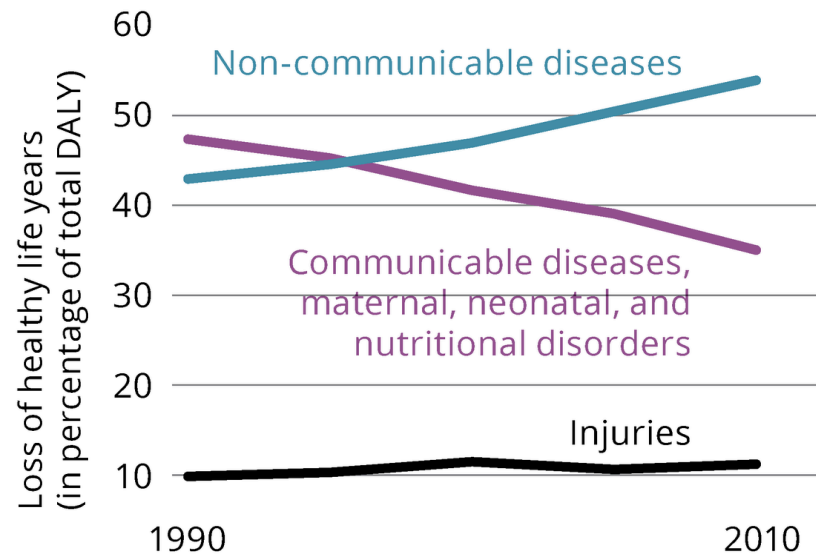
Linda S. Birnbaum, Ph.D., D.A.B.T., A.T.S.
Scientist Emeritus and Former Director
NIEHS and NTP

Collaborative on Health and the Environment
Webinar – June 18, 2020

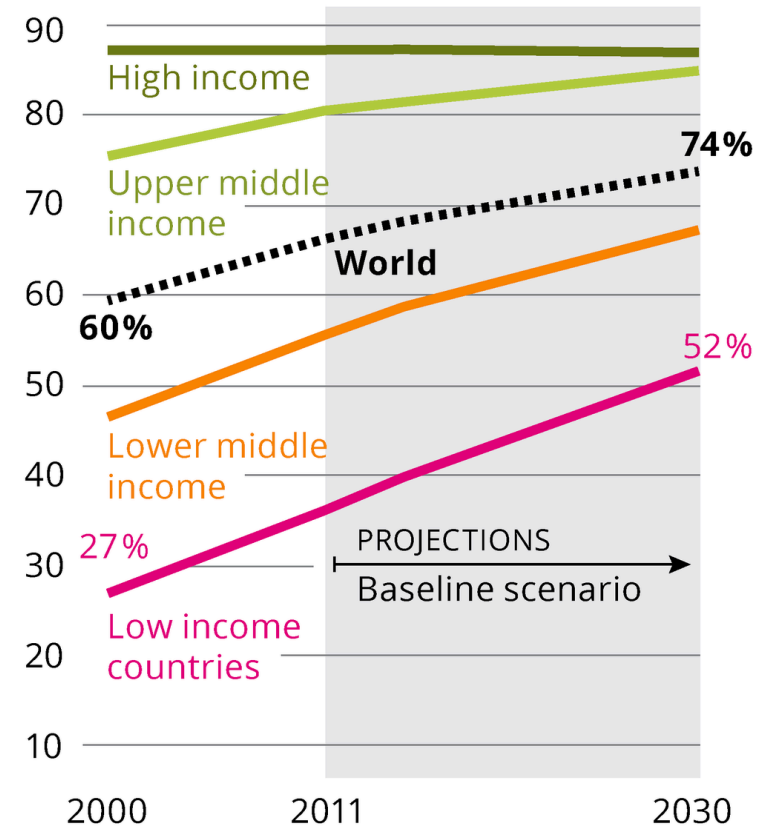
Global Health Trend: Non-Communicable Disease “Epidemic”

Examples:

- Type II Diabetes
- Cardiovascular Disease
- Obesity
- Asthma
- Autism
- Cancer

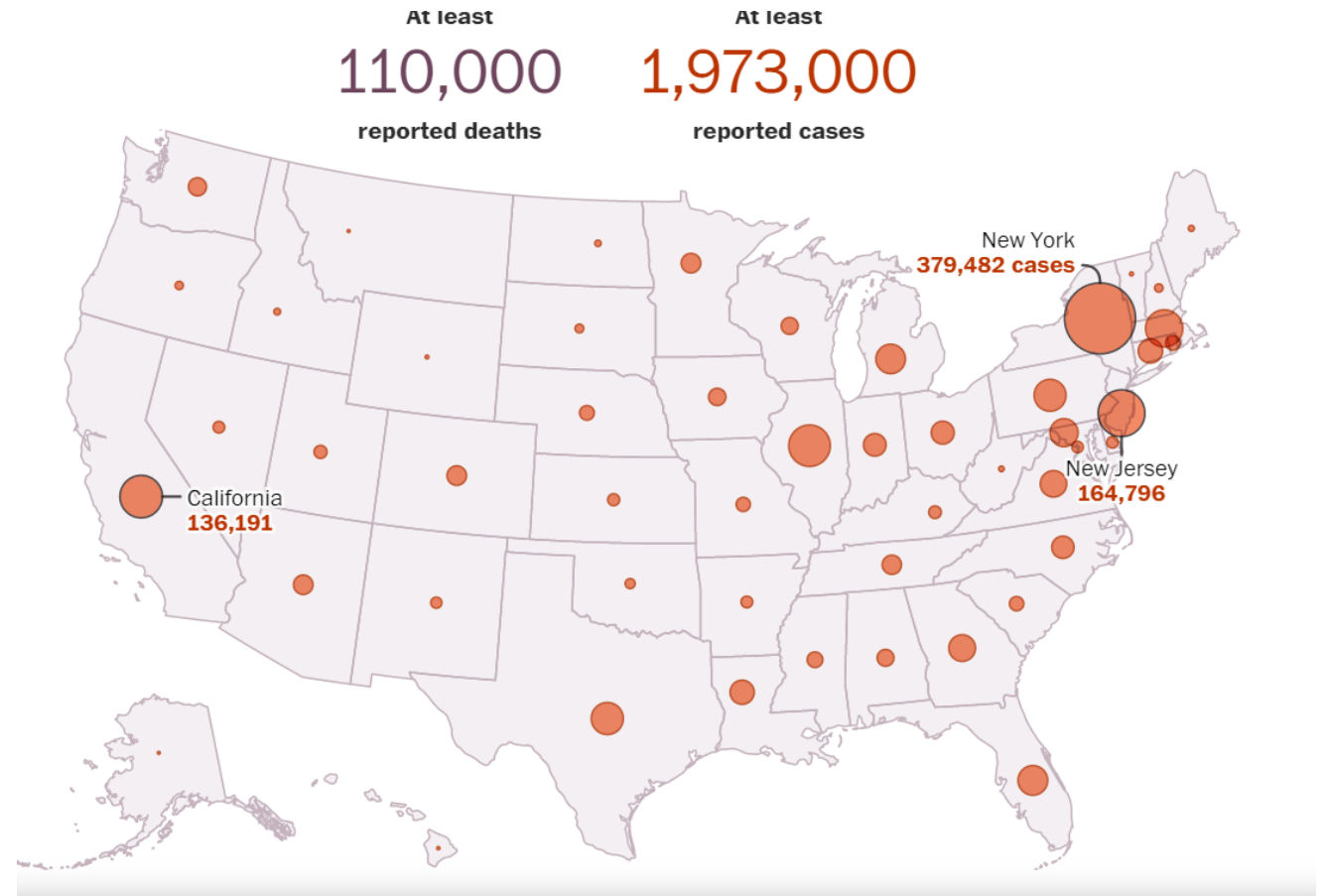


Deaths related to non-communicable diseases (in percentage of total deaths)



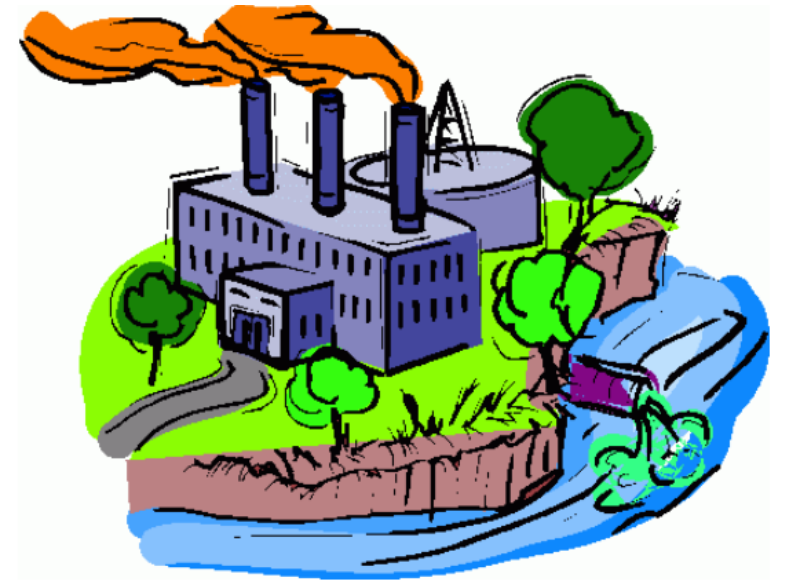
COVID19 Pandemic and Risk Factors

- Age(>65)
- Chronic Lung Conditions
- Heart Disease
- Obesity
- Diabetes
- Immunocompromised



America is an Unhealthy Nation

- >130,000,000 are Obese
- ~34,000,000 have Type 2 Diabetes
- ~23,500,000 have Autoimmune Disorders
- ~25,000,000 have Asthma
- #43/183 countries for Deaths due to Lung Disease
- #2 or #3 for Deaths due to High Blood Pressure and Heart Attacks



Our Environment

ENVIRONMENTAL IMPACTS ON HEALTH

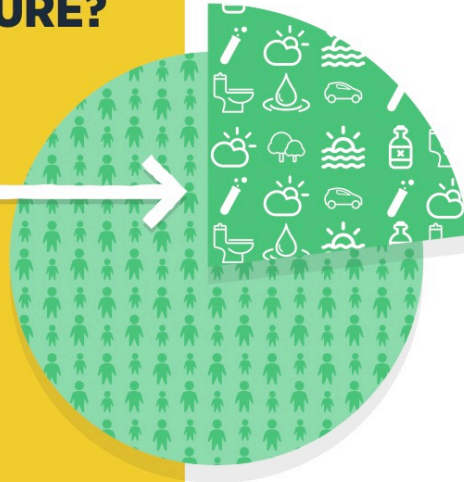
WHAT IS THE BIG PICTURE?

FACT:

23%

of all global deaths are linked to the environment.

That's roughly **12.6 million deaths** a year.



The Endocrine System

- Extremely complex, many controls, interacting parts
- Multiple points of regulation for finely-tuned responses
- Sensitive to perturbations
- Naturally operates at low doses
- Effects can be activational and/or organizational

Involved in multitude of chronic diseases



EDCs are becoming a "global threat" that needs to be addressed

EDC = An exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub) populations.

Exposures to Endocrine Disruptors Are Ubiquitous



Agricultural Chemicals (pesticides/
herbicides/fungicides),
Food Additives, Packaging (plastics)

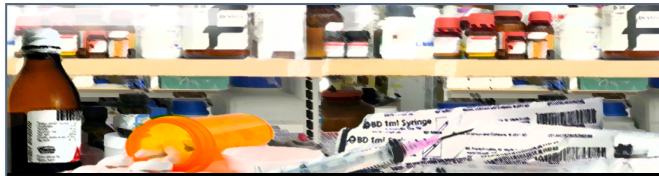


Industrial Chemicals and By-Products
(Air Pollutants, solvents, PCBs)

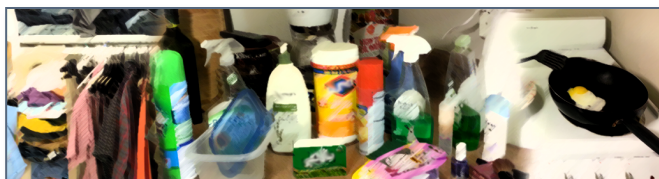


Waste Products
(Dioxin, PAHs)

**Some
bioaccumulate
and/or are persistent**

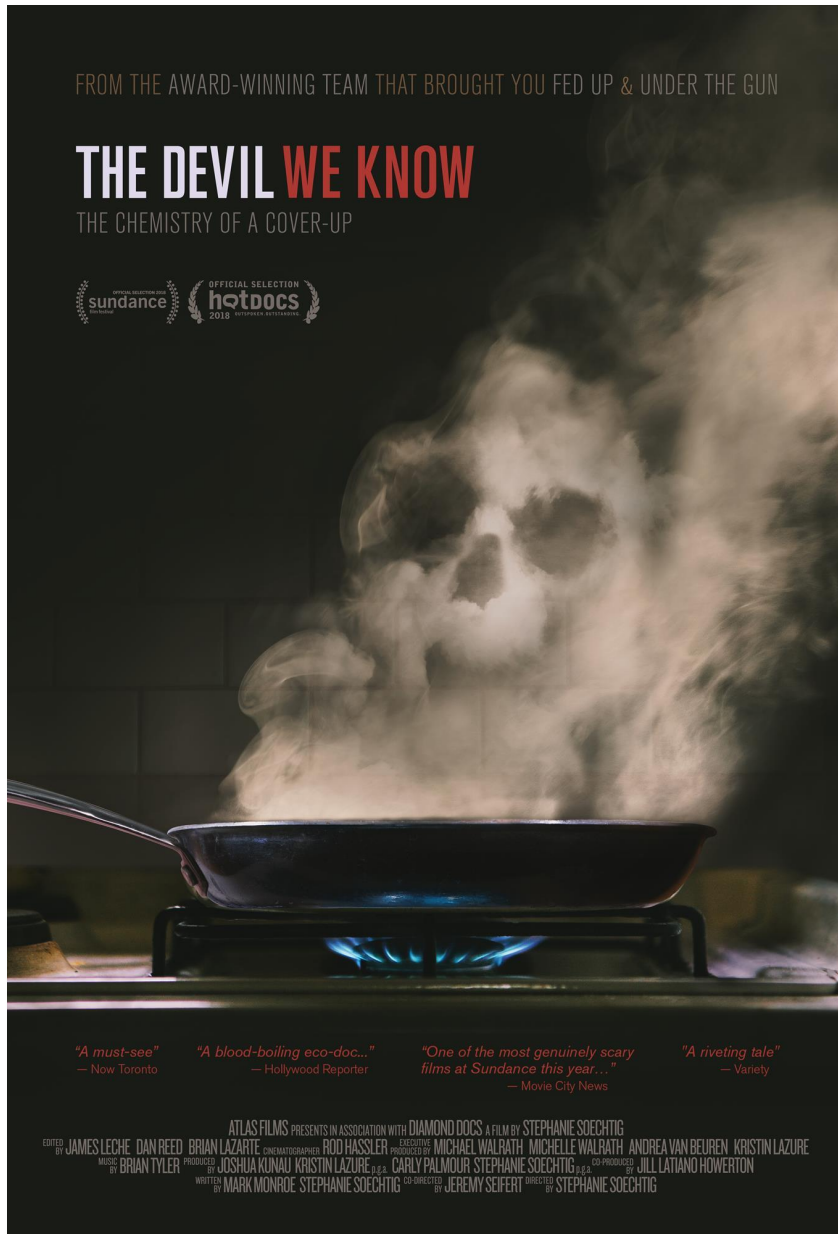


Pharmaceutical Products
Phytochemicals



Personal Care Products, Flame Retardants,
Coatings (BPA, phthalates, parabens,
PFOA/PFOS)

WHY DO WE CARE ABOUT PFAS?



- ***They are everywhere and won't go away.***
PFAs are stable and persistent in the environment, present in water, air and soil, and distributed globally.
- ***They are in our body... even in polar bears!***
PFOS (C8, ~40 ppb), PFOA (C8, ~5 ppb), PFHxS (C6, ~3 ppb) and PFNA (C9, ~ 3 ppb) have been detected in humans, while PFOS, PFOA, PFNA (C9) and PFDA (C10) are found in wildlife.
- ***They hang around.***
Estimated half-life in humans for PFOS is 5.4 yrs. PFOA, 3.8 yrs; PFHxS, 8.7 yrs; and PFBS, 2-3 wks.
- ***They are bad.***
Results from animal studies have indicated adverse health effects, and a plethora of associations have been observed in epidemiology studies.

Immune-Related Health Effects of PFAS Exposure

National Toxicology Program Systematic Review

Animal Studies

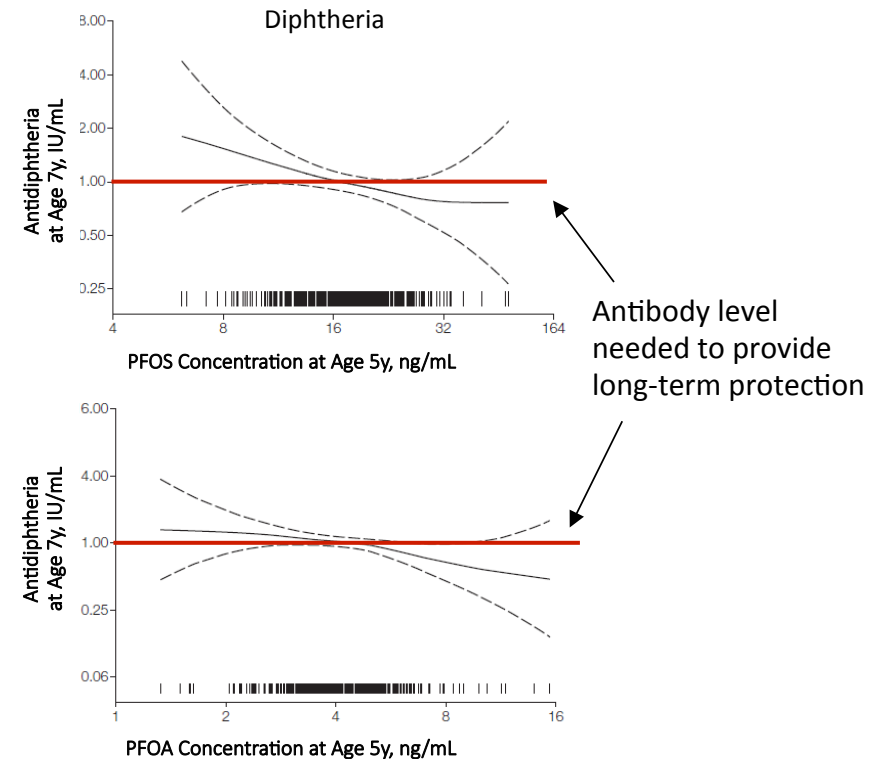
- Experimental studies:
 - **Immunosuppression:** Reduced antibody response, disease resistance, etc.
 - **Hypersensitivity:** Increased airway hypersensitivity
- Wildlife studies

Human studies

- **Immunosuppression:** Reduced antibody response to vaccines
- **Hypersensitivity:** Increased asthma in children
- **Autoimmunity:** Increased incidence of ulcerative colitis

Monograph on Immunotoxicity Associated with Exposure to PFOA and PFOS, National Toxicology Program, 2016

Elevated PFAS exposure associated with reduced diphtheria and tetanus antibody concentrations at ages 5, 7, and 13



Grandjean et al., JAMA, 2012; Grandjean et al., EHP, 2017

Increased lower respiratory infections in children (Impinen et al., Environ Res, 2017)

Why do we care about Phthalates?

- Large group of chemicals used to make plastics soft and flexible
- Present in food packaging, cosmetics, toys
- Diet and Dust are major sources of exposure



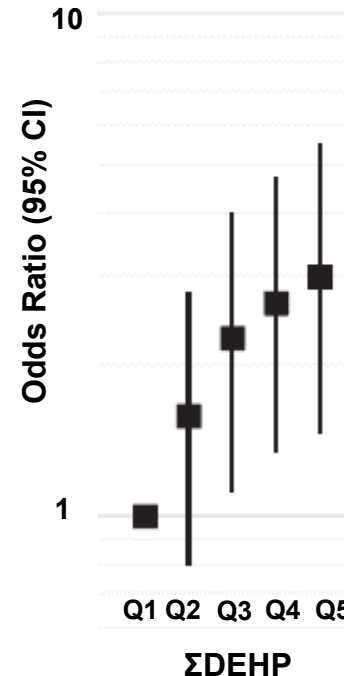
Phthalate Health Effects:

BLOOD LEVELS CORRELATED WITH HUMAN EFFECTS

- Endocrine outcomes
- Reproductive outcomes
- Fetal development
- Obesity
- Neurodevelopment
- Cancer
- Diabetes and insulin resistance
- Immune system and allergic disease
- High blood Pressure
- Insulin resistance, a precursor of diabetes

ADHD increases with prenatal DEHP exposure

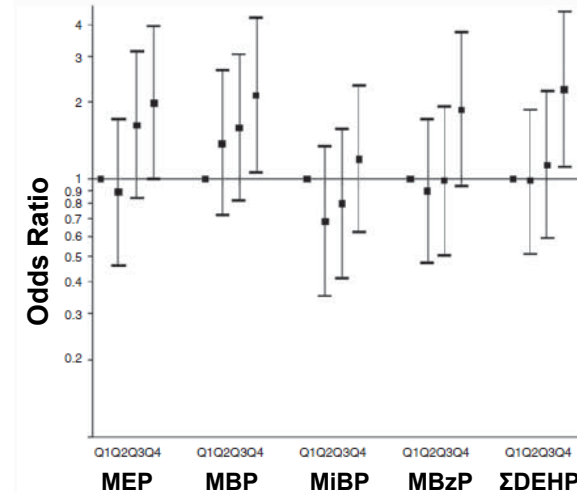
Modified from: Engel et al., EHP, 2018



Benjamin et al., J Haz Materials, 2017;
Trasande & Attina, Hypertension, 2015
Attina & Trasande, J of Clin Endocrinol and Metab, 2015

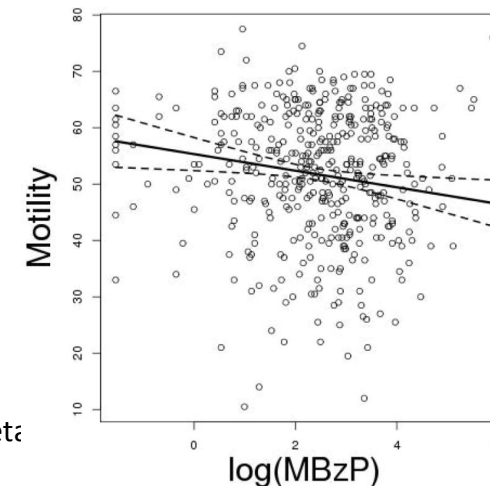
Prenatal exposure to some phthalates linked to increased child BMI

Modified from: Harley et al., *Pediatr Res*, 2017



Monobenzyl phthalate linked to decreased sperm motility

Thurston et al., *Andrology*, 2016



Why do we care about BPA (and alternatives)?

- Endocrine Disruptor
- Obesity
- Diabetes
- Neurological Disorders
- Cancer
- Reproductive Abnormalities
- Heart Disease



OBESITY

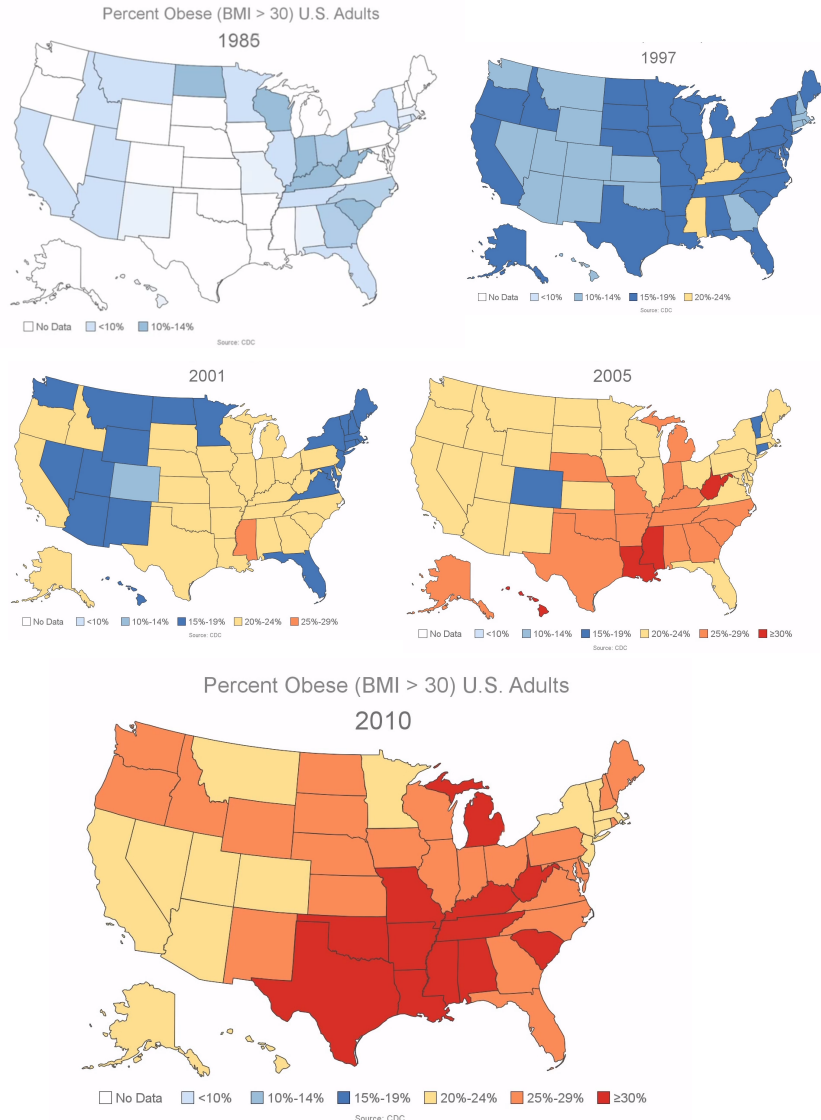
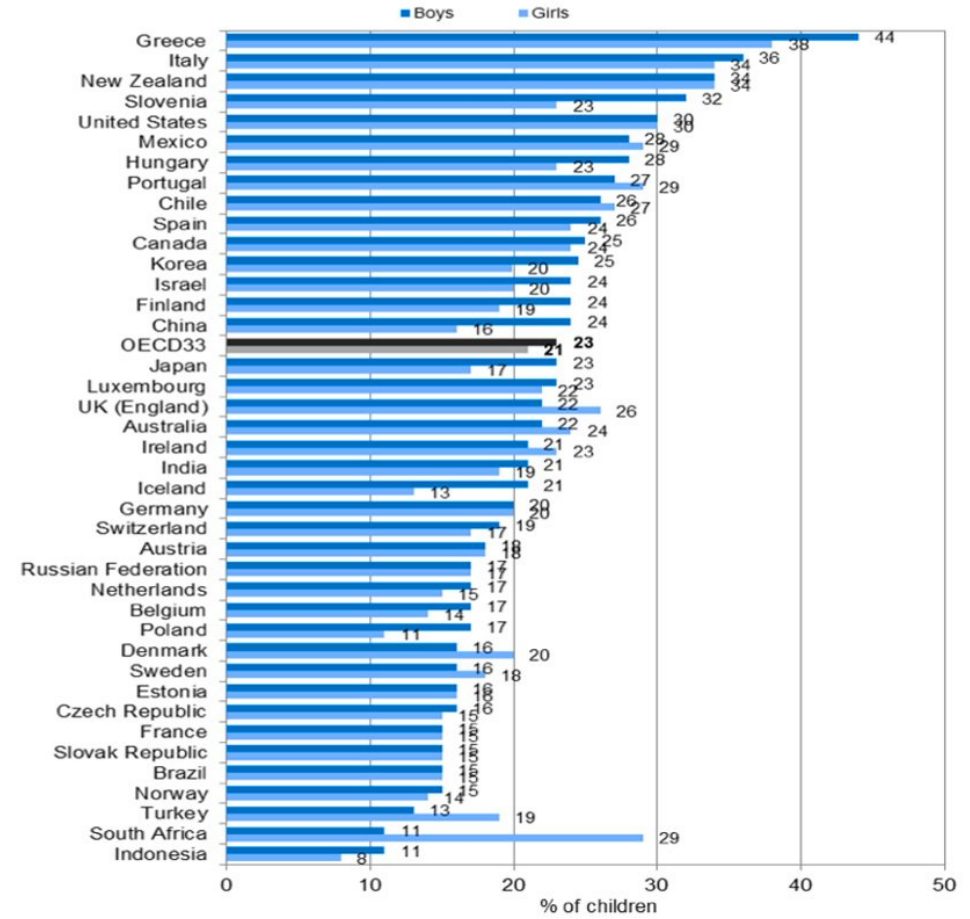
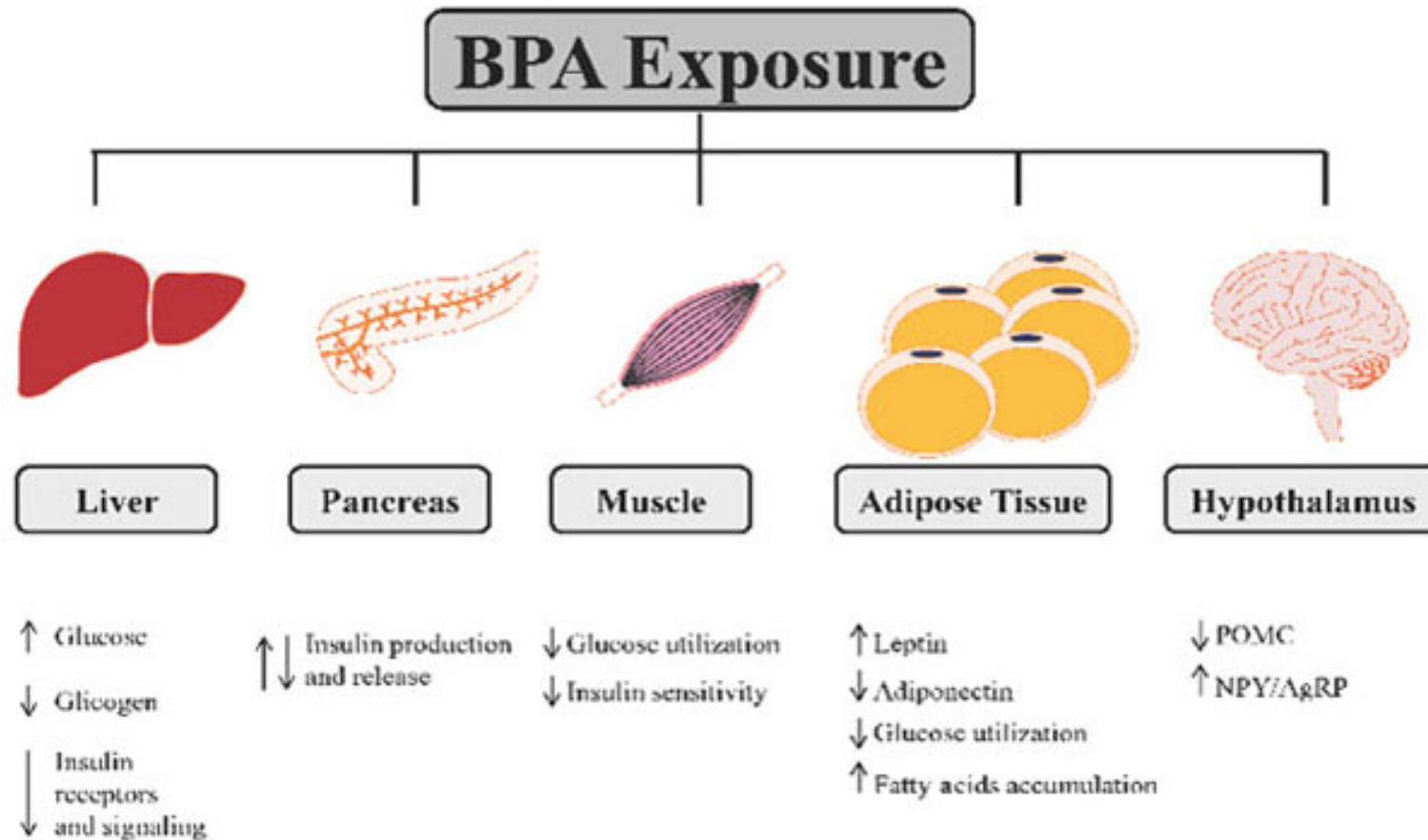


Figure 4. Measured overweight (including obesity) among children aged 5-17, 2010 or nearest year



Source: International Association for the Study of Obesity, 2013; Bös et al. (2004), Universität Karlsruhe and Ministère de l'Éducation nationale et de la Santé for Luxembourg; and KNHANES 2011 for Korea.

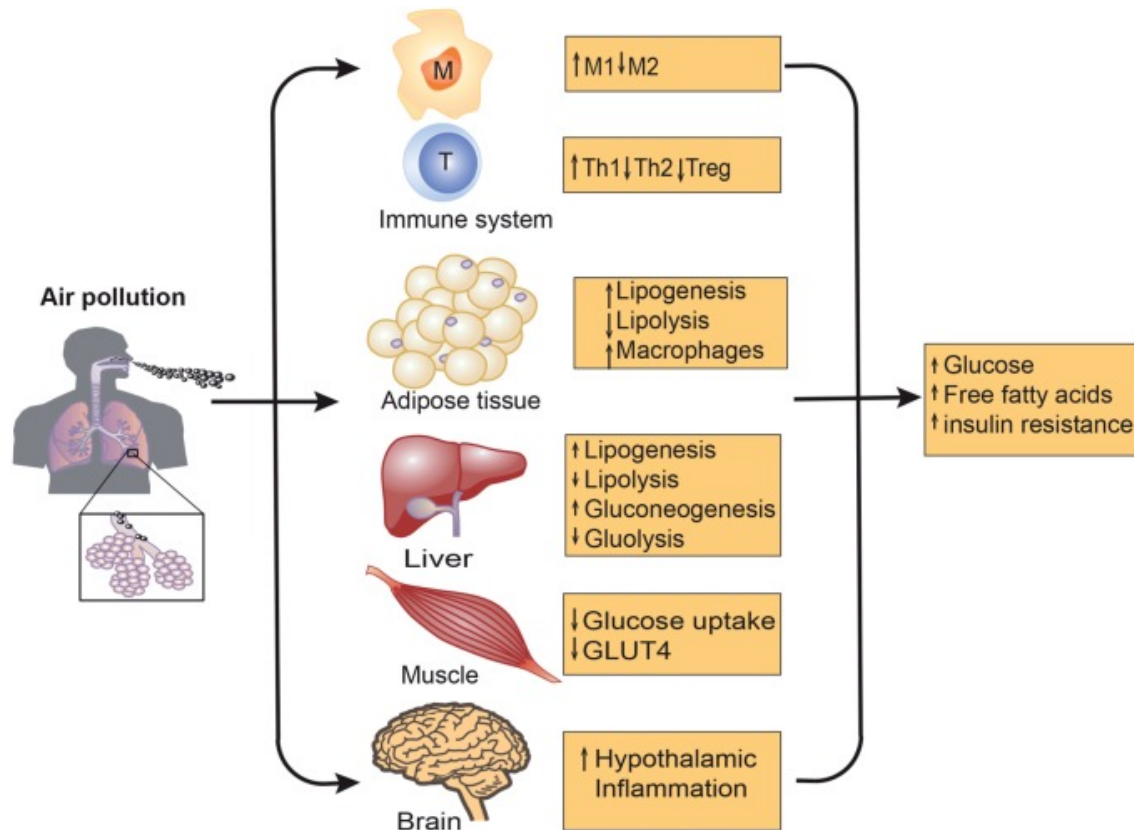
BPA Impacts Many Pathways Related to Obesity



Why do we care about Air Pollution?

- Coughing/Wheezing
- Bronchitis, COPD
- ↓ Lung Development
- Asthma
- ↑ Blood Pressure
- Arteriosclerosis
- Heart Attack
- Ischemic Heart Disease
- Stroke
- Autism, IQ
- Cancer
 - Lung
 - Nasopharyngeal
 - Laryngeal
- Liver, Kidney Damage
- ↓ Birthweight, ↑ Birth Defects
- Neurodegenerative Disorders
 - ALS, Alzheimer's Disease

Ambient Air Pollution and Diabetes

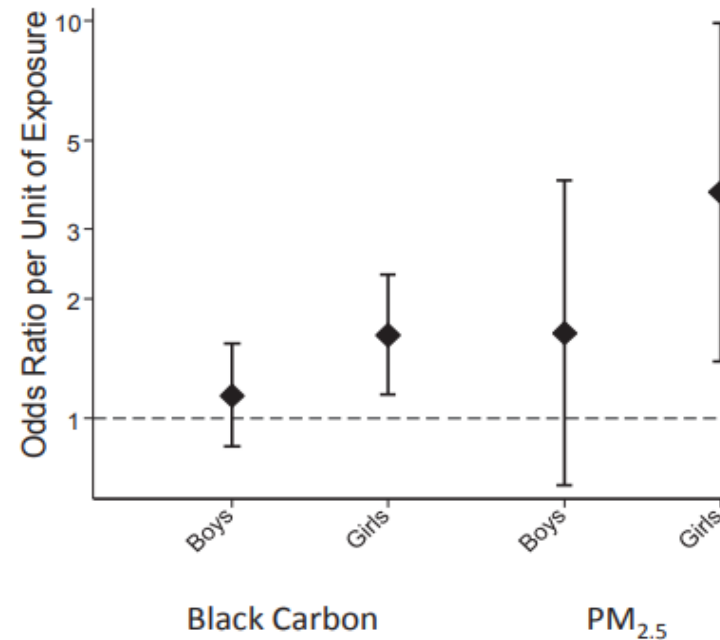


Susceptible populations include people with obesity and metabolic dysfunctions

Ambient Air Pollution and Asthma

- Living closer to major roads (<200m) associated with increased incidence and persistence of asthma
(Bowatte et al., 2018, Environ Int)
- Higher lifetime exposure to traffic-related pollution during childhood, not just early life exposure, increases risk of asthma
(Brunst et al., 2015, Am J Respir Crit Care Med)
- Among girls, but not boys, lifetime exposures to black carbon and PM_{2.5} were each associated with greater odds of asthma
(Rice et al., 2018, J Allergy Clin Immunol)

Early asthma/Reactive Airways (Age 3-5)



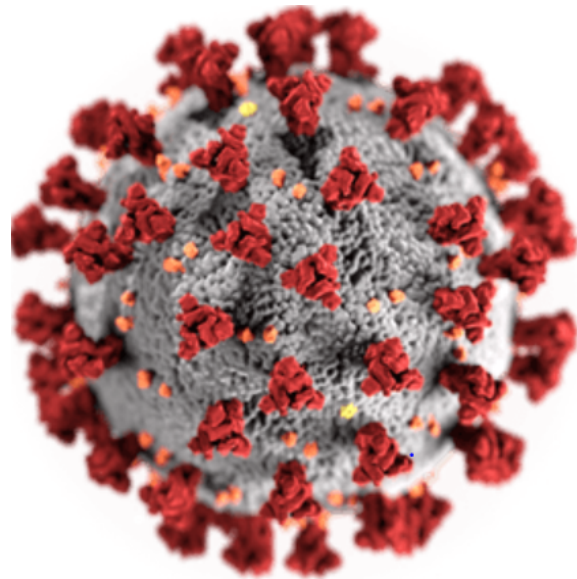
Wildfire health effects

- Acute respiratory problems
- Headaches
- Worsen asthma
- Irritation of eyes and throat
- Worsen chronic respiratory and heart problems



Risks for COVID-19 and Pre-Existing Conditions

- [Adults 65 and Over](#)
- [Chronic Lung Disease](#)
- [Immunocompromised People](#)
- [Heart Disease](#)
- [Diabetes](#)
- [Liver Disease](#)
- [Chronic Kidney Disease](#)
- [Obesity](#)
- [Neurological Disorders](#)



THANK YOU!