Climate Change and Skin: Part 1

- Skin Basics
- Air Pollution and Skin
- Heat Illnesses and Skin

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Why Skin?

• THE Environmental Organ
  • Keeps the Outside World Out
  • and the Inside World In

[Image of a child holding a small object]
Stratum corneum = Environmental interface
Permeability Barrier:

- Based upon layers of fatty (lipid) membranes
- Prevents outward movement of water
- Also excludes ingress of foreign chemicals
  - Especially effective against water soluble ones
  - Less effective against fatty compounds (lipids)
Pollution: Fellow-Traveler of Climate Change
Industry Wildfires

$\text{CO}_2$, PM w/ polycyclic hydrocarbons, $\text{NO}_x$, $\text{SO}_2$ $\xrightarrow{\text{UV, Heat}}$ $\text{O}_3$
Air Pollution From Fossil Fuels and Wildfires: Particulate Matter (PM) fine (<2.5 µm) and ultrafine (<0.01 µm)

- ↑ Asthma attacks
- ↑ Heart attacks
- Destabilizing pts with chronic lung and cardiac disease
- Lung cancer
- Miscarriages, premature labor, low birthweight, fetal distress

From: Guanieri & Balmes. Lancet 2014; 383:1581

DE Schraufnagel. The health effects of ultrafine particles. Experimental & Molecular Medicine 52: 311, 2020
Skin is also exposed to air pollution

Air Pollution:
Particulate Matter (PM) fine (<2.5 µm) and ultrafine (<0.1 µm)

- ↑ Asthma attacks
- ↑ Heart attacks
- Destabilizing pts with chronic lung and cardiac disease
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- Very little PM$_{2.5}$ penetrates SC
  - But polycyclic hydrocarbons coating particles do

- PM$_{2.5}$ do access via hair follicles
- Ultrafine PM$_{0.1}$ can penetrate SC
Skin Effects of Air Pollution: **Skin Aging & Pigmentation**

Linked to exposure to air borne particulate matter


Skin Effects of Air Pollution: Acne


https://dermnetnz.org
Skin Effects of Air Pollution: Eczema

• Atopic dermatitis
  • ~20% children
  • Asthma/hay fever

• Air Pollution
  • Flares
    • PM, SO$_2$, NO$_2$
  • Risk of developing
    • NO$_2$

Association of Wildfire Air Pollution and Health Care Use for Atopic Dermatitis and Itch

Raj P. Fadadu, MS; Barbara Grimes, PhD; Nicholas P. Jewell, PhD; Jason Vargo, PhD; Albert T. Young, BA; Katrina Abuabara, MD, MA, MSCE; John R. Balmes, MD; Maria L. Wei, MD, PhD

Figure 1. Environmental Conditions and Clinic Visits for Atopic Dermatitis (AD) and Itch Before, During, and After the Camp Fire
Skin Effects of Air Pollution

Skin Aging & Pigmentation

Acne

Atopic dermatitis
Itch & other eczemas

Others?
- **Cellulitis**
  - (Szyszkowicz In J Envir Res Public Health 7:4078, 2010)
- **Systemic Sclerosis**
Dermal Absorption May Be Most Important Route For Many Toxins and Pollutants

- Semi-volatile Organic Compounds
  - phthalates

- Flame retardants
  - bisphenol A
  - Polybrominated diphenyl ethers (PBDEs)

- Organophosphate pesticides
  - chlorpyrifos
“Global Warming”

- The **20 warmest years in the global record** have all come since **1995**
- The **10 warmest years** have all come in the last 20
- The **5 warmest years** have all come in the last 10
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More, Longer and Hotter Heat Waves

Heat waves = #1 cause of deaths due to extreme weather events

https://earthobservatory.nasa.gov/images/147256/california-heatwave-fits-a-trend
Global Warming: Can Skin Keep Us Cool?

- Cutaneous vasodilation
  - Facilitates convection/conduction
  - Can = 60% of cardiac output
  - Only effective if cooler outside

Sweat
- \( \text{H}_2\text{O} \) and \( \text{NaCl} \)
- Most effective means of heat dissipation
Heat-Exhaustion/Heatstroke = Skin Failure

- Impaired skin vasodilatation
  - Diabetes, elderly, obesity, cardiac failure, hypertension
- Impaired evaporation of sweat
  - High humidity
  - Clothing
- Impaired sweat response
  - Higher T set point to onset; less output
  - Infants and children, elderly, obesity, diabetes

- Anhidrosis
  - Skin disorders: genetic and non-genetic forms
  - Disorders of Sympathetic Nervous System

- Pharmacological inhibition
  - Anticholinergics
    - Antihistamines
    - Seizure meds
    - Antipsychotics & antidepressants
    - Antiemetics
    - Bladder antispasmodics
  - Diuretics
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What Can We Do?

- Identify patients at increased risk for heat stress
  - Counsel on strategies to “stay cool”
- Recognize drugs that affect thermoregulation

http://www.mygreendoctor.org