

Evaluating health-related impacts from climate change: a summary of air pollution/heat studies

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Outline

- Overview of Epidemiologic Studies at OEHHA
- Air Pollution Studies
 - Summary
 - Vulnerable subgroups
- Temperature Studies
 - Summary
 - Vulnerable subgroups
- Wildfire Study

Root Causes of Disparities

- Greater exposures to heat and air pollution
 - Lasting effects of historical redlining
 - Disproportionate siting of sources of air pollution
 - Urban heat island effect
- Structural racism and socioeconomic inequities
 - Greater levels of chronic stress
 - Fewer resources to reduce exposures
- Inequities in access, quality, and affordability of health care
 - Lack of diversity in health care providers
 - Differential treatment

Epidemiologic Research at OEHHA

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Population

- California-specific (regions, coastal-inland, counties, zip codes, etc)
- Subgroups by age, race/ethnicity, and socioeconomic status

Primary exposures of interests

- Criteria air pollutants (particulate matter)
- Heat
- Other Climate Change-related Exposures (Wildfire)

Exposure periods

- Short-term: same day, previous day, past 7 days exposure
- Long-term: monthly, seasonal, annual averaged exposure

Epidemiologic Research at OEHHA

Outcomes

- Emergency Room Visits, Hospital Admissions, and Mortality
 - Cardiovascular diseases
 - Respiratory diseases
 - Mental health
 - Metabolic disorders
- Birth Outcomes
 - Low Birth Weight: birth weight <2,500 g
 - Preterm Birth: birth before 37 gestational weeks
 - Stillbirth
- Biomarkers (to understand biological mechanisms)

Health Effects of Air Pollution

Overview of Air Pollution Studies

Exposures

- Criteria air pollutants: $PM_{2.5}$, NO_2 , CO, and Ozone
- Constituents and sources of $PM_{2.5}$
- Traffic, distance to roadways

Data sources

- Federal, State, Air district monitoring networks
- Modeling data from research groups

Factors considered

- Geographic and meteorological factors
- Socioeconomic and demographic characteristics
- Environmental justice



Health Effects of Air Pollution

PM2.5

- ↑ respiratory diseases
- ↑ asthma
- ↑ heart attacks
- ↑ cardiovascular diseases
- ↑ preterm delivery
- ↑ low birth weight
- ↑ stillbirth

Ozone

- ↑ stillbirth
- ↑ preterm delivery
- ↑ low birth weight
- ↑ asthma
- ↑ mental health disorders

Sulfur Dioxide (SO₂)

- ↑ stillbirth

Nitrogen Dioxide (NO₂)

- ↑ stillbirth

People of color are disproportionately impacted by air pollution ¹⁰

Non-Hispanic Black people

- ↑ adverse birth outcomes from $PM_{2.5}$
- ↑ asthma from coarse PM
- ↑ mental health disorders from ozone

Hispanic people

- ↑ mental health effects from CO and NO_2
- ↑ asthma from coarse PM

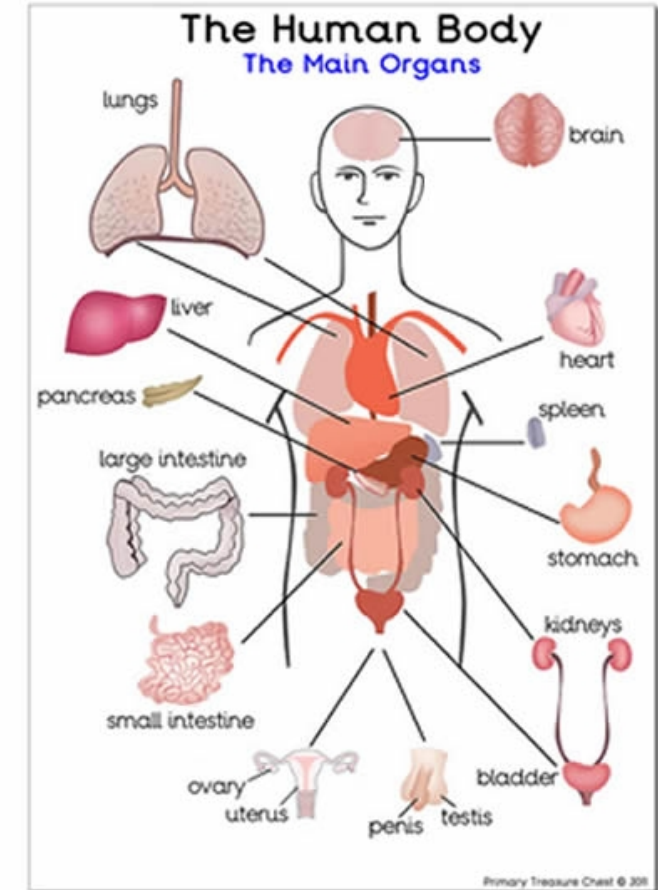
Non-Hispanic Asian people

- ↑ acute respiratory infections from ozone
- ↑ COPD from ozone
- ↑ mental health disorders from ozone

Health effects of heat

Heat affects nearly ALL organs in humans

- Heat-related illness & dehydration
- Cardiovascular disease mortality & morbidity
- Mental health
- Adverse birth outcomes
- Liver and kidney disease
- Gastrointestinal disease
- Respiratory diseases (confounded by air pollutants)
- Diabetes



Health Effects of Temperature

- ↑ heat illness
- ↑ dehydration
- ↑ acute renal failure
- ↑ intestinal infection
- ↑ all mental disorders
- ↑ pneumonia hospitalizations
- ↑ all respiratory hospitalizations
- ↑ hypotension (↓ hypertension)
- ↑ ischemic heart disease
- ↑ ischemic stroke
- (↓ hemorrhage stroke)
- ↑ cardiac dysrhythmia
- ↑ diabetes
- ↑ preterm delivery
- ↑ low birth weight
- ↑ stillbirth
- ↑ deaths

People of color are disproportionately impacted by increases in temperature

Non-Hispanic Black people

- ↑ adverse birth outcomes
- ↑ Valley Fever infections
- ↑ cardiovascular and ischemic mortality
- ↑ infant all-cause mortality

Non-Hispanic Asian people

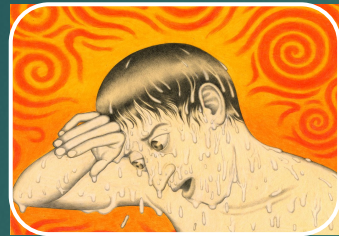
- ↑ dehydration
- ↑ diabetes
- ↑ adverse birth outcomes

Hispanic people

- ↑ preterm birth
- ↑ stillbirth
- ↑ respiratory hospitalizations
- ↑ mental health
- ↑ cardiovascular diseases
- ↑ renal diseases
- ↑ intestinal diseases

Climate change is MULTI-FACTORIAL

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• HEAT



• DROUGHT



• WILDFIRES

Wildfire Smoke And Human Health

Study of health effects from the 2017 Napa-Sonoma fires

Hospitalizations and Emergency Room Visits

- ↑ respiratory diseases
- ↑ asthma/wheeze
- ↑ chronic lower respiratory disease
- ↑ heart attacks

Hospitalizations

- ↑ diabetes
- ↓ pneumonia

Emergency room visits

- ↑ acute upper respiratory diseases
- ↓ mental health disorders

OEHHA Studies Inform National And State Climate Change-related Work

US Environmental Protection Agency

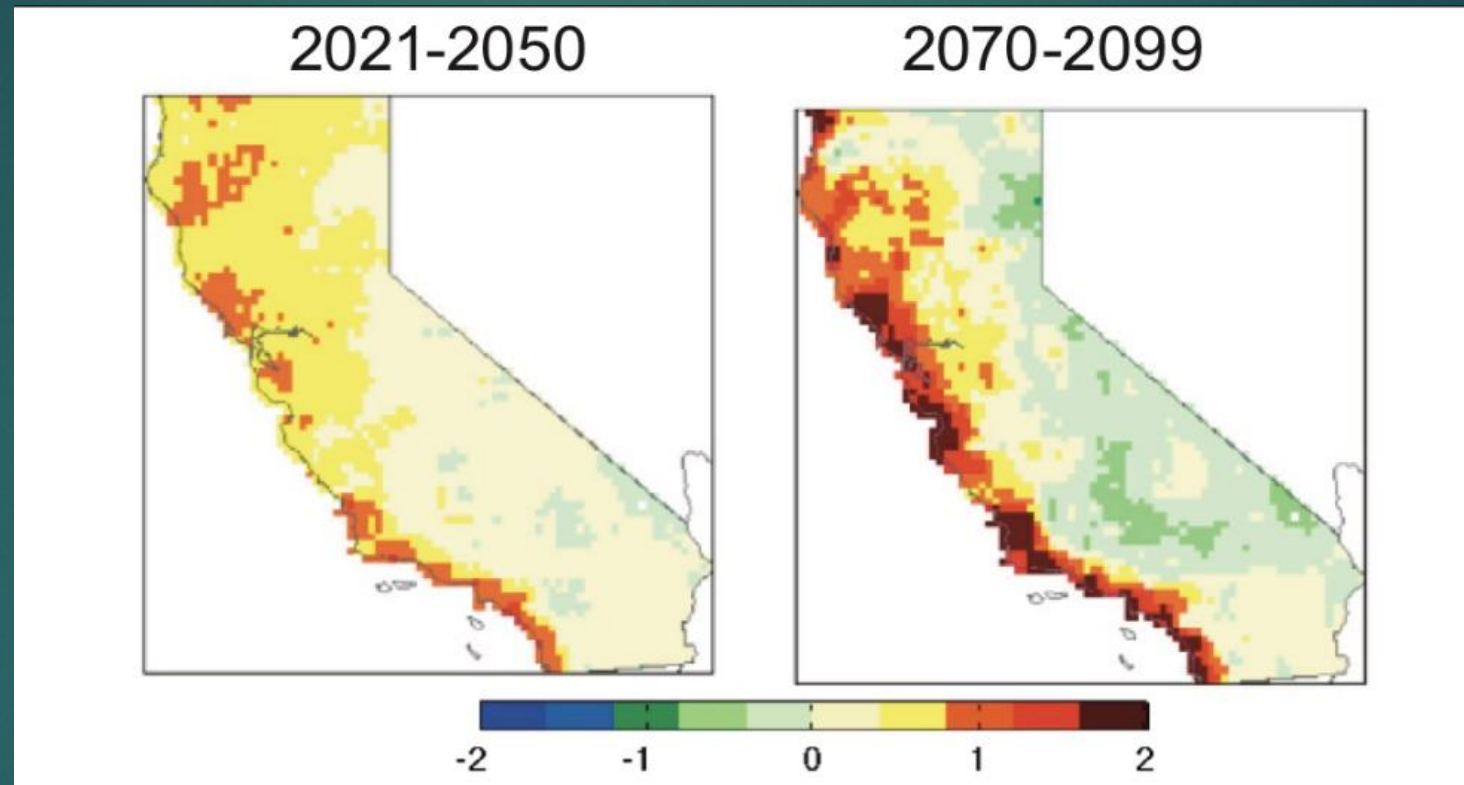
- National Ambient Air Quality Standards for criteria air pollutants
- Health impact analysis of heat-related deaths using BenMAP

State of California

- CA draft Extreme Heat Action Plan (2022)
- CA Climate Adaptation Strategy(2021)
- Preparing California for Extreme Heat: Guidelines and Recommendations (2013)
- CA Ambient Air Quality Standards
- OEHHA Climate Change Indicators Report

Prediction for More Heat Waves in Coastal Areas

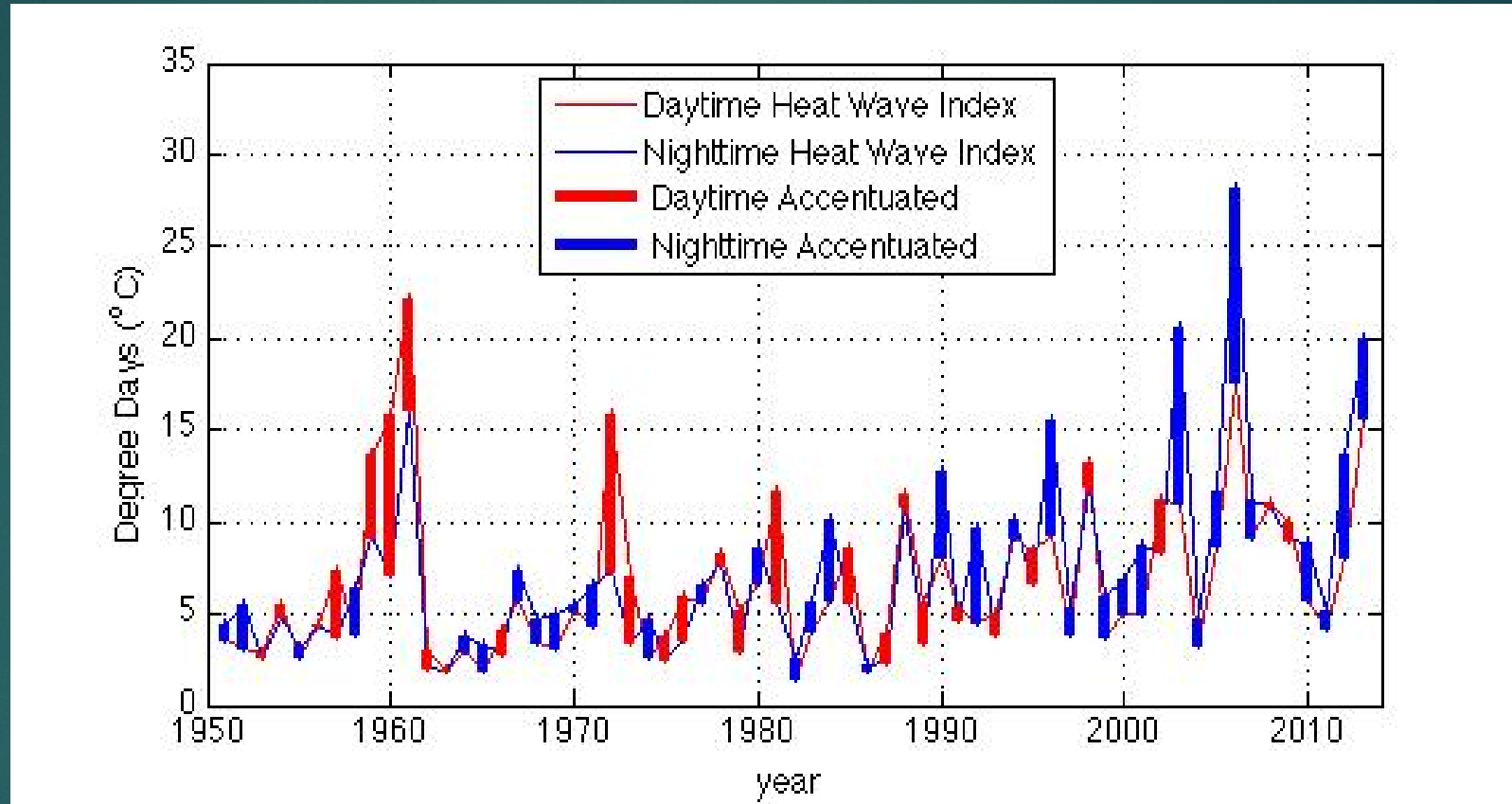
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Source: CNAP, 2015

Trend for Increasing Nighttime Heat in California

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Source: CNAP, 2015

More Future Trends in California

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- ▶ Typical summer in 2100 will be 4-5°F warmer than today (CAT, 2013)
- ▶ By mid-century, extreme temperatures could cause 2-3 times more heat-related deaths in urban areas (UCS, 2006)
- ▶ 65+ years age group increase by 145% by 2020 (California Department of Finance, 2014)
- ▶ Mortality for those over 65+ years increase by 10-fold by 2090's (Sheridan, 2011)

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Mortality

- PM sources – 8 CA sites (2018)
- PM2.5 constituents – CA Teacher Study (2010)
- PM2.5 constituents – 6 CA counties (2007, 2008)
- PM2.5 – 9 CA counties (2006)
- PM coarse – 15 CA counties (2009)
- PM coarse – Coachella Valley (2000)
- PM10 - Coachella Valley (1999)

Adverse Birth Outcomes

- PM2.5, constituents - Preterm delivery (2017a, 2017b, 2019)
- PM2.5, source, constituents, gases - Stillbirth (2015, 2018, 2020)
- PM2.5, source, constituents, PM coarse - Term low birth weight (2014, 2017, 2019)
- Traffic – Spontaneous abortion (2009)
- Systematic Review (2020, 2021)

Morbidity

Hospital admissions

- Wildfire PM2.5 – 9 Bay Area Counties (2021)
- PM2.5 – San Diego (2021)
- PM2.5 & ozone - Mental-health (2021)
- PM2.5, constituents, sources – 8 CA sites (2019)
- PM2.5 constituents – children in 6 counties (2009)
- East Bay Children's Respiratory Health Study (2004, 2008)

Emergency room visits

- CO, NO2 - Mental-health related outcomes (2018)
- Ozone – Respiratory outcomes (2016)
- PM2.5 sources – Cardiovascular/respiratory outcomes (2016)
- PM coarse – Respiratory outcomes (2013)

Review – dusty/aridity – Coccidioidomycosis (2019)

Cardiovascular biomarkers in SWAN cohort

- PM coarse (2020), CO, NO2, SO2 (2017)
- PM2.5 & ozone (2014, 2016, 2019)

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Exposure Studies

PM coarse – 19 Nonsmoking older adults with coronary artery disease residing in the Coachella Valley, CA (funded by HEI) (2003, 2006)

PM and gases – 138 African American children in central Los Angeles (1995, 2001)

PM and gases – ER for asthma in Santa Clara County (1997)

PM and gases - 321 nonsmoking adults residing in Southern California over a 6-month period 1978-1979 (1993)

OEHHA Studies of Temperature and Health

Mortality

- 9 CA county study (2008)
- Vulnerable subgroups (2008)
- Review (2009)
- 2006 heat wave (2009)
- Harvesting/mortality displacement (2011)
- Infant death (2015)

Adverse Birth Outcomes

- Preterm delivery (2010)
 - Kaiser DOR studies (2017a; 2017b)
- Stillbirth (2016)
- Term low birth weight (2018)
- JAMA REVIEW on temp, air pollution, and birth outcomes (2020)

Morbidity

- Hospital admissions
 - 9 county study (2010)
 - Air conditioning use as a modifier (2010)
 - Heat waves with Scripps (2014)
 - Heat wave vs hospitalizations with Scripps (2017)
 - Liver and Kidney disease (2019)
 - Heat/health disparities in San Diego (2020)
 - Heat waves, ozone, and respiratory disease (2021)
- Emergency room visits (2012)
 - Mental-health related outcomes (2018)
- Biomarkers in SWAN cohort (2017)
- Review of Valley Fever (2019)
- Hand, foot and mouth disease (2020)

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Studies of Women's Health Across the Nation (cohort with 6 sites)

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THANK YOU FOR YOUR ATTENTION

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