

Ozone & Asthma Hospitalizations Amongst Adolescents in Los Angeles, US

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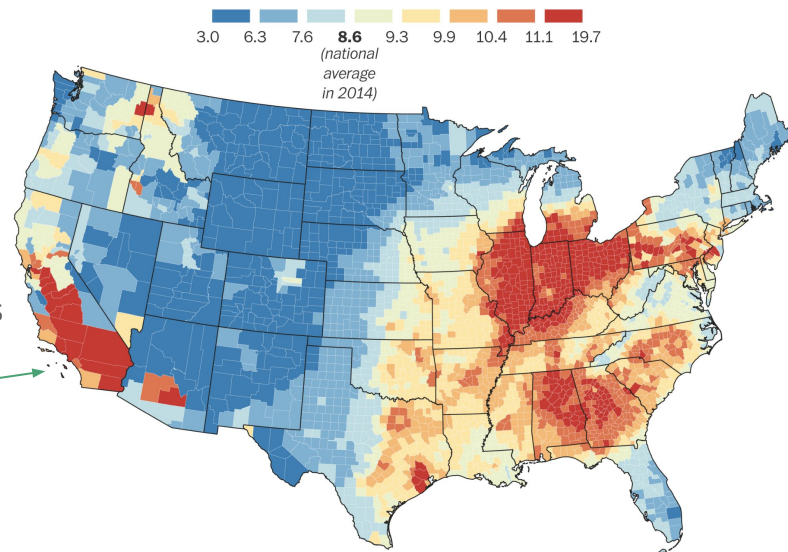
Is there an association between
exposure to ozone and *hospital visits due
to asthma* in *adolescents* (aged 13-18
years old) in *Los Angeles*, USA?

Background and Motivation

- Why adolescents? ([Silverman & Ito, 2010](#))
 - Age-related association
 - Age: significant effect modifier for asthma hospitalizations
- Why Los Angeles, CA? ([Moore et al., 2008](#))
 - Time trends study
 - High density + intense weather
- Why ozone vs. asthma? ([Moore et al., 2008](#), [Schwarz et. 2021](#))
 - Time trends study
 - O_3 – main pollutant associated
 - Contributing living factors study
- Why this study?
 - Focus on Los Angeles' extreme heat and high air pollution
 - Focus newly on ozone-linked asthma hospitalization in adolescents, not just children

The map of American air pollution

Daily average small particulate matter (PM2.5) concentration in 2014



Source: Robert Wood Johnson Foundation County Health Rankings

THE WASHINGTON POST



Asthma and Biomarkers

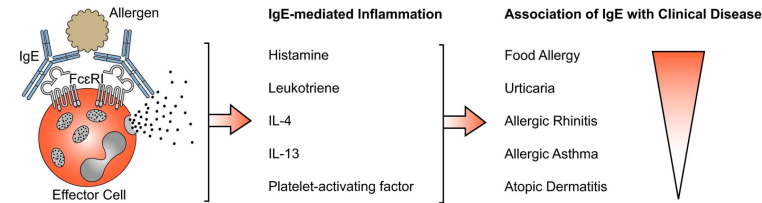
- Condition in which airways inflamed, narrow, swollen; extra mucus, difficulty breathing
- Symptoms vary from person to person

Ozone and asthma

- Ozone demonstrated to worsen airway inflammation
- Increases airway response to inhaled allergen
- Increases nonspecific airway responsiveness

IgE and asthma

- High serum IgE was observed in patients with asthma
- IgE - immunoglobulin, mediates type 1 hypersensitivity reactions, plays a key role in pathogenesis of allergic asthma
- Increase allergen sensitivity, leading to thickening of the bronchial wall and exacerbating the symptoms



Study Design

Retrospective case-control analysis of a cohort in Los Angeles, USA

- Adolescents aged 13 to 18 in Los Angeles, USA from 2022-2032
- Recruitment:
 - 500 asthma participants (cases)
 - Cases will participate as cases and controls in case-crossover
 - 500 non-asthma participants (controls)
 - Have blood samples drawn from all patients every half year
 - Asthma patients have additional blood samples drawn every time they have an attack

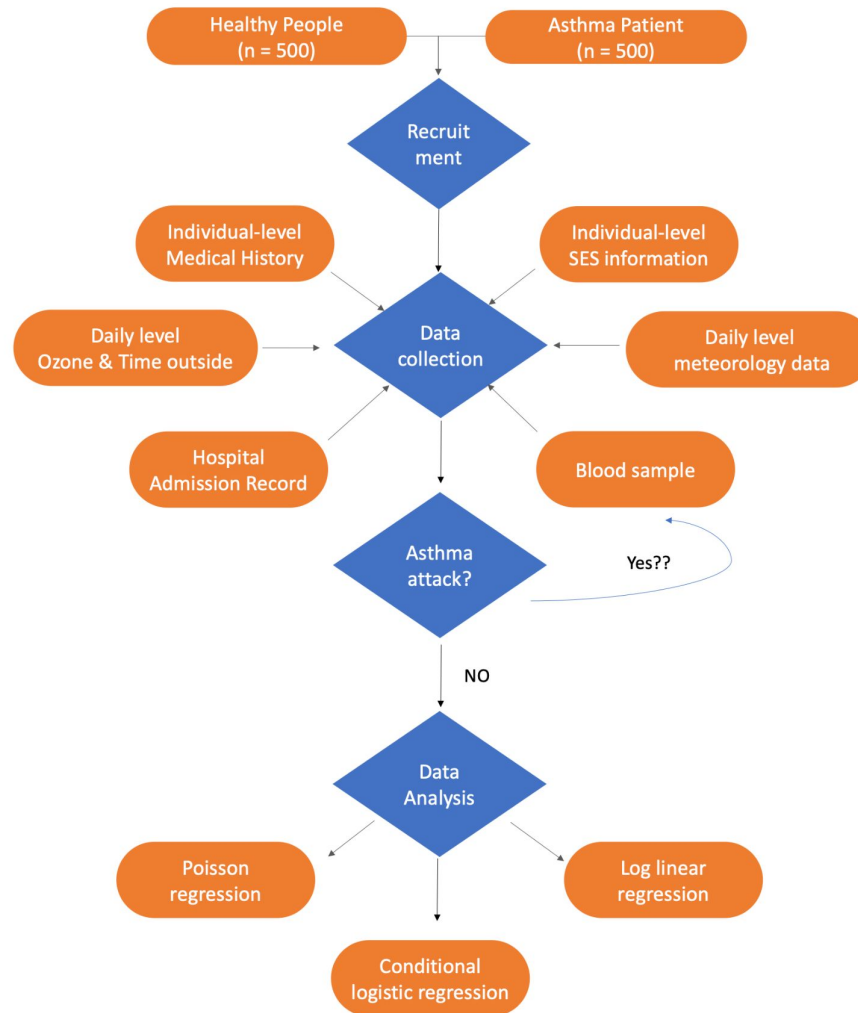


Study Design

- Ozone concentration and hospital admissions
 - Total number of hospital visits per day
 - Occurrence of asthma attack for each individual
- Ozone concentration and biomarker levels
 - IgE levels between different groups
 - Healthy
 - Asthma w/o attack
 - Asthma w/ attack



Flowchart



Data Sources

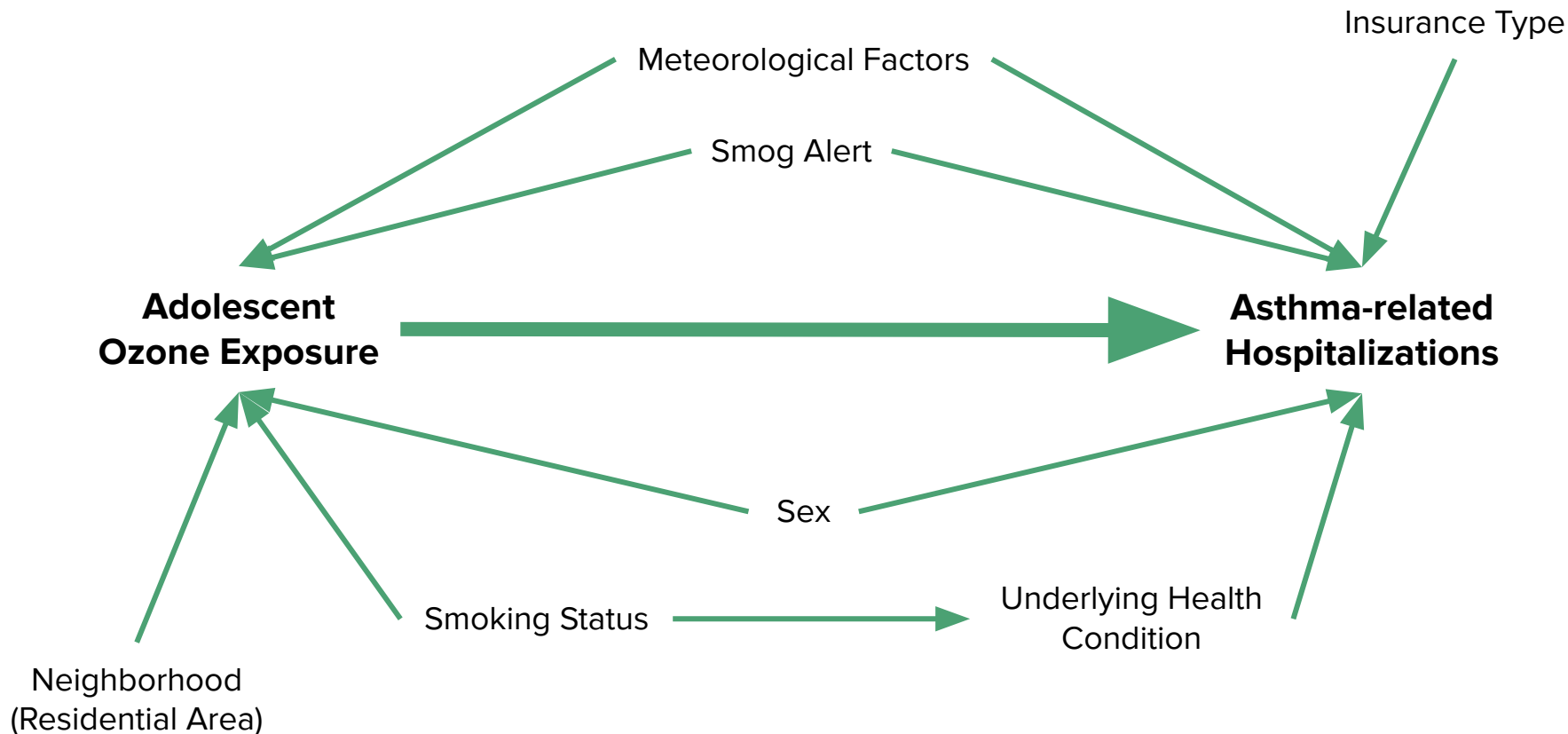
- Air pollution and weather data
 - Daily pollution - ozone concentration data and pollutant standards index (PSI), smog alert from SCAQMD (South Coast Air Quality Management District) monitors in Los Angeles city limits.
 - Weather data -obtained from the National Climatic Data Center
- Medical history and personal information data
 - Hospital admission history
 - Enrollment questionnaire for all participants' information
- Data on time spent outside
- Factors that shift the amount of time spent outside:
Air quality forecasts and smog alerts
 - Questionnaire on average daily outdoor time



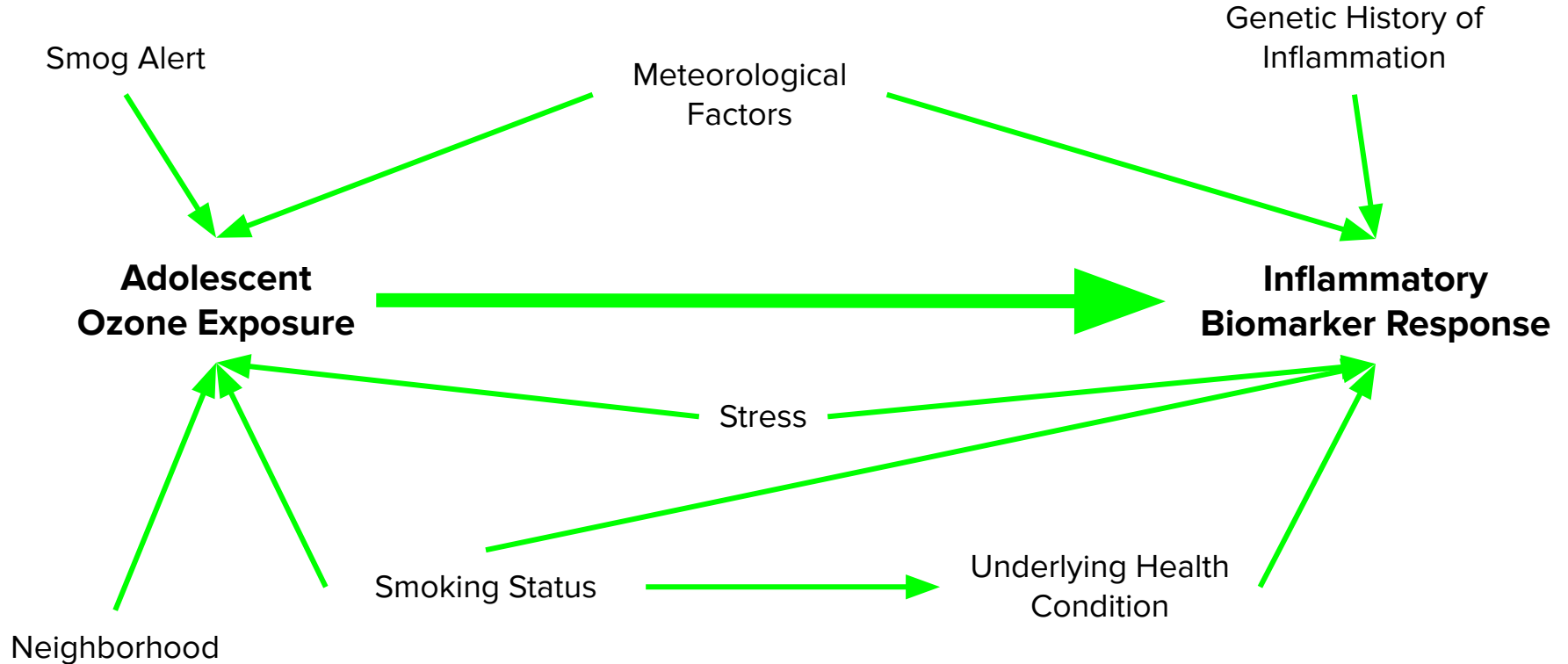
Key Variables

- Exposure
 - Daily maximum 8-hour average concentration of ozone exposure in adolescents (13-18 yo)
- Outcome
 - Hospital Admission due to Asthma
 - Inflammatory biomarker-IgE levels
- Potential Covariates and Confounders
 - Issuance of smog alert (via PSI index)
 - Socioeconomic factors
 - Meteorological factors
 - Underlying Health Conditions
 - Behavioral factors

DAG for Asthma-Related Hospitalizations



DAG for Inflammatory Biomarker Response



Analytical Approach – hospital admissions

- Ozone concentration and hospital admissions

- Poisson regression model for population level data
 - $Y_i = e^{(\beta_0 + \beta_1 * Ozone + \beta_2 * PSI + \beta_3 * Met)}$
- Conditional logistic regression model for individual level data
 - $\log\left(\frac{Y=1}{Y=0}\right) = \beta_0 + \beta_1 * Ozone + \beta_2 * Outdoor + \beta_3 * Ozone * Outdoor + \beta_4 * PSI + \beta_5 * Met + \beta_6 * SES + \beta_7 * MH$
- Sensitivity analysis
 - Lag effect models
 - 1 day, 2 days, 3 days, 7 days lag
 - Unnested models for covariates
 - Depending on variable

Analytical Approach – targeted biomarker

- Ozone concentration and inflammatory biomarkers

- Univariate analysis: ANOVA for IgE levels
 - G1: w/o asthma vs G2: w/ asthma & w/o attack vs G3: w/ asthma & w/ attack
 - Post-hoc analysis for multiple comparison adjustment
- Multivariate analysis: Log-linear regression
 - $\log(I_{IgE}) = \beta_0 + \beta_1 * Group + \beta_2 * Ozone + \beta_3 * Outdoor + \beta_4 * Ozone * Outdoor + \beta_5 * PSI + \beta_6 * Met + \beta_7 * SES + \beta_8 * MH$
- Sensitivity analysis
 - Ordinal logistic regression
 - Flip $\log(I_{IgE})$ and group to see if $\log(I_{IgE})$ can be a good predictor of outcome

Study Assumptions

- Any missing data from our identified sources is truly missing, where organizations were unable to collect that information
 - Missingness does not have further implications
- No deadline post-study to finalize analytical results
- Unlimited budget
 - Hiring research assistants
 - Providing generous incentives to study participants



Sources of Error & Other Challenges

Sources of Error	Other Challenges
<ul style="list-style-type: none">● Information Bias<ul style="list-style-type: none">○ National Climatic Data Center Sources○ SCAQMD Air Pollution Monitors○ Medical History (not included pass respiratory diseases)○ Biomarker measurement● Selection Bias<ul style="list-style-type: none">○ Loss to follow-up● Confounding<ul style="list-style-type: none">○ Additional variables not identified in our assumptions● Recall Bias	<ul style="list-style-type: none">● External Validity to the greater US● Collaboration with Hospitals and Air monitoring center

Questions?

References

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