Air pollution and depressive symptoms: Current knowledge and future directions

Dr. Erika Manczak
University of Denver
PACT Act Symposium
May 3, 2023
Depression is a major health problem.

Depression is the leading cause of disability worldwide.

Depression increases risk of suicide, substance use, and physical health problems.
Veterans are at increased risk

• Depression (along with PTSD) is one of the most common psychiatric diagnoses in military veterans
  • 1 in 3 veterans visiting primary care clinics experienced some depressive symptoms

• Critical to understand what may contribute to risk
Identifying contributors to depression

- Multi-determined disorder
  - Genetics
  - Stress exposure
  - Differences in brain structure and function
  - Differences in peripheral stress biology
However, we often overlook the *physical* environment

- Airborne toxicants as one set of potential risk factors

- Connections between air quality and *physical health* outcomes are well established
  - Air pollution accounts for 6% of all deaths in France, Switzerland, and Austria
Many exposures covered by the PACT Act pertain to inhalation of uncommon toxicants.

But understanding associations in common exposures can provide a model of potential risk.
Air quality and depression

- Ozone is a ubiquitous exposure and a primary component of air quality indicators

- Ozone is known to activate several biological pathways previously implicated in depression
  - Immune activation
  - Cardiovascular risk
  - Neurodevelopmental processes
• Higher use of antidepressants has been found in locations with higher ozone

• Suicides and emergency department visits for mental health covary with the seasonality of ozone exposure

• Associations between other air pollutants and measures of depressive symptoms
Gaps in the literature

Little research examining:

- *Individual level* depressive symptoms
- Change over time
- Sensitive periods/populations
Why studying teenagers may be relevant to other groups

- Population at greater risk for the onset of depressive symptoms
- Spend more time outside than adults
- May be more biologically-sensitive to exposures
How might exposures to air pollution predict depressive symptoms over time?
Study 1: What we know
  • Results from a completed study of adolescents in California

Study 2: Where we’re going
  • Overview of study in progress of families in Colorado
Ozone and trajectories of depressive symptoms
Overview

- 213 adolescents (ages 9-13)
- 57% female, 47% White
- Age at baseline = 11.37 years
  - Prepubertal at T1, postpubertal at T2 & T3

Levels of ozone in sample:
- $M = .0344$ ppm, $SD = .0039$; range: .0296-.0531 ppm
  - Less than national air standard of .07 ppm
Measures

Symptoms:
- Child Depression Inventory (CDI; Kovacs, 1992)
- Youth Self Report (Achenbach & Rescorla, 1991)
  - Primary: Withdrawn/Depressed & Anxious/Depressed subscales
  - Secondary: All other subscales

Covariates:
- Total severe stressful life events (structured interview; Ford et al., 2002)
- Neighborhood disadvantage: % below 2x poverty line, % < HS diploma, % unemployed
- Sex, age, household income, and minority status
EPA Data 2012-2014

Neighborhood covariates

Ozone

Demographic covariates

Stressful life events

Psychopathology symptoms

Overlapping

~2 years

T1

Psychopathology symptoms

T2

~2 years

T3

Psychopathology symptoms
Results: Depressive Symptoms (CDI)
Results: Depressive Symptoms (YSR)
Results: Anxiety Symptoms (YSR)
• Not accounted for by sex, age at baseline, minority status, income, parental education, number of stressful life events, or neighborhood disadvantage

• Exploratory analyses of other YSR subscales did not reveal any significant associations between ozone and symptom trajectories
Summary

• Census tract ozone predicted trajectories of depressive symptoms, but no evidence for other types of psychopathology symptoms
  • Consistent with a neuroimmune mechanism

• Effects emerged above and beyond many potentially confounding community and personal factors
Conclusions

• Proof-of-concept for correlations between ozone and adolescent depression risk

• Importance of change over time
Unanswered questions

• How do air pollutants relate to depressive symptoms across other developmental periods?

• What resolution of air pollution exposure provides the best data, both physically and temporally?

• Through what mechanisms does air pollution exposure relate to depression risk?

• What other common air pollutants are related to depressive symptoms?
Ongoing study

• Funded by NIEHS and Brain & Behavior Research Foundation

• 120 families with teens in metro-Denver area

• Collaboration with scientists at the National Center for Atmospheric Research (NCAR)

• Creating residence-specific models of air pollution exposure at different timescales
  • One year, 6-months, 1-month, 1-week

• Following families for 6-months with repeated assessments of depressive symptoms and immune markers
Anticipated outcomes

• Examine associations between pollutants and changes in depressive symptoms in both adults and adolescents
  • Identify dose: response across different timescales

• Test changes in pro-inflammatory cytokines as mediator of associations between pollution and depression
  • Alternative immune models (e.g., shifts in Th1/Th2)

• Determine whether patterns differ for adults versus adolescents or on the basis of demographic factors
What does this mean for Veterans?

- Provides proof-of-concept for associations between inhalable toxicants and depression
- Although ozone alone can cause health problems, it can also intensify the toxicity of other pollutants
- If ubiquitous exposures are related to risk, provide model for other airborne contaminants
We are grateful to all the participants and researchers who have made this research possible.