

Air pollution and mental health

13th Annual BC Lung Association
Air Quality and Health Workshop

Dr. Melinda Power

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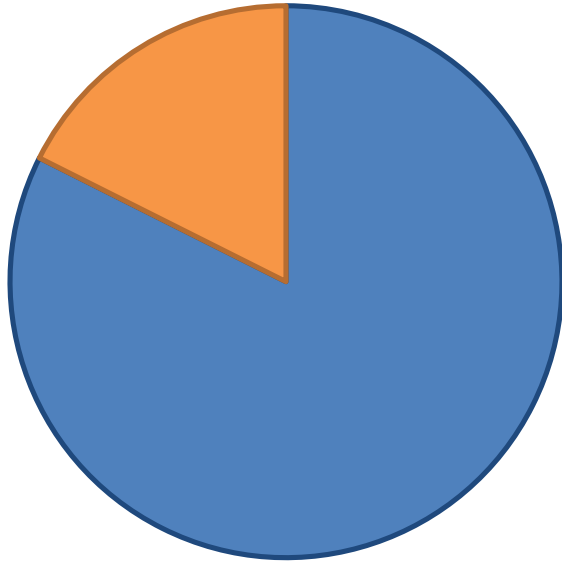
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Mental Health Disorders (Mental Illnesses)

“health conditions that are characterized by alterations in thinking, mood, or behavior (or some combination thereof) associated with distress and/or impaired functioning”

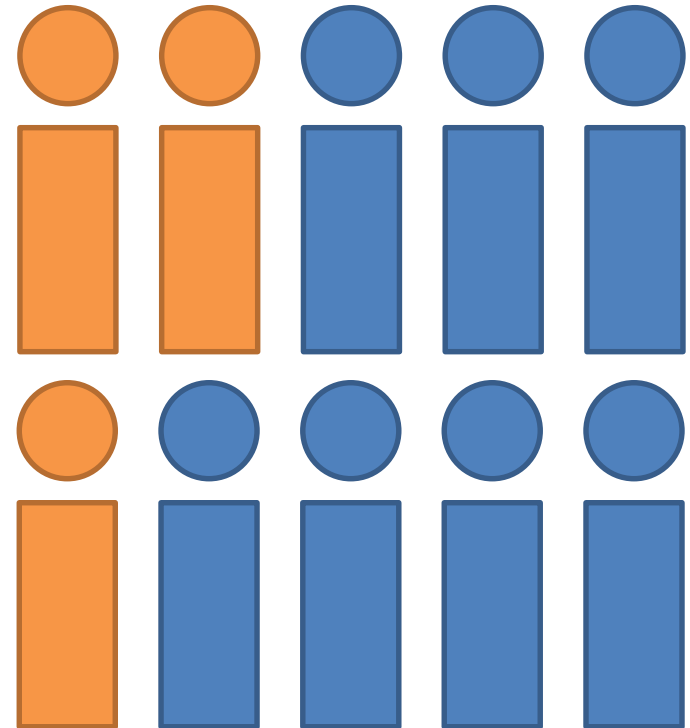
Common Mental Health Disorders

- Depressive disorders
- Anxiety disorders
- Schizophrenia
- Eating disorders
- Substance abuse disorders



Approximately 1 in 5 individuals meet criteria for a common mental health disorder in the past year

Approximately 30% have experienced a common mental health disorder in their lifetime



Global Rankings for DALYs in 2010

| Rank | Disorder |
|------|------------------------------|
| 1 | Ischemic Heart Disease |
| 2 | Lower Respiratory Infections |
| 3 | Stroke |
| 4 | Diarrhea |
| 5 | HIV/AIDS |
| 6 | Low Back Pain |
| 7 | Malaria |
| 8 | Preterm Birth Complications |
| 9 | COPD |
| 10 | Road Injury |
| 11 | Major Depressive Disorder |
| 12 | Neonatal Encephalopathy |
| 13 | Tuberculosis |
| 14 | Diabetes |
| 15 | Iron Deficiency Anemia |

In high-income North America:
(#1) ischemic heart disease
(#2) COPD
(#3) low back pain
(#4) lung cancer
(#5) major depressive disorder

Murray et al. (2012) Lancet

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Global Rankings for Causes of Death in 2010

| Rank | Disorder |
|------|------------------------------|
| 1 | Ischemic Heart Disease |
| 2 | Stroke |
| 3 | COPD |
| 4 | Lower Respiratory Infections |
| 5 | Lung Cancer |
| 6 | HIV/AIDS |
| 7 | Diarrhea |
| 8 | Road Injury |
| 9 | Diabetes |
| 10 | Tuberculosis |
| 11 | Malaria |
| 12 | Cirrhosis |
| 13 | Self Harm |
| 14 | Hypertensive Heart Disease |
| 15 | Preterm Birth Complications |

Approximately 5% of deaths among persons ages 15-49 are due to self-harm

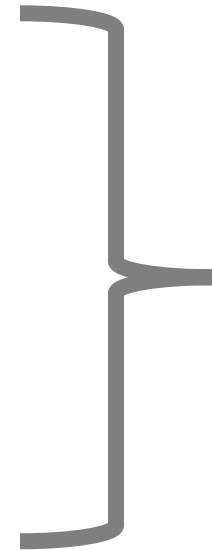
Lozano et al. (2012) Lancet

Mental health disorders are a huge public health problem

- Onset can occur at any point in lifespan
- Remission is not always possible, despite available treatments
- Stigma and other barriers prevent treatment

Common Mental Health Disorders

- Depressive disorders
- Anxiety disorders
- Schizophrenia
- Eating disorders
- Substance abuse disorders



Diagnosis is
based on
symptoms

Mental health disorders are more common in those with...

- Social disadvantage
- Stressful life situations
- Chronic illness
- Traumatic experiences
- Substance use or substance abuse
- A relative with a mental health disorder
- A prior history of mental illness

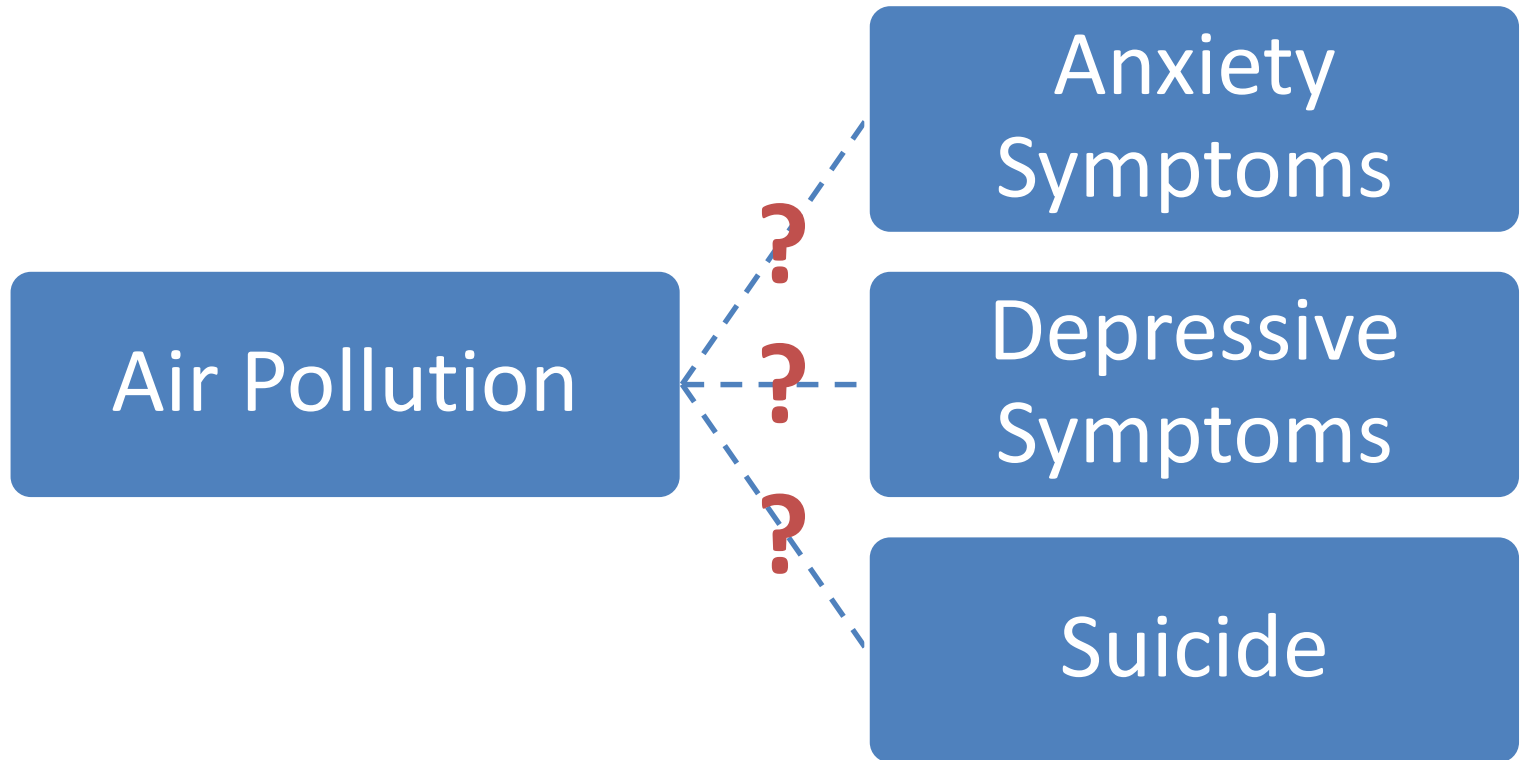
How could air pollution impact mental health?

- Psychological stress associated with knowledge of exposure

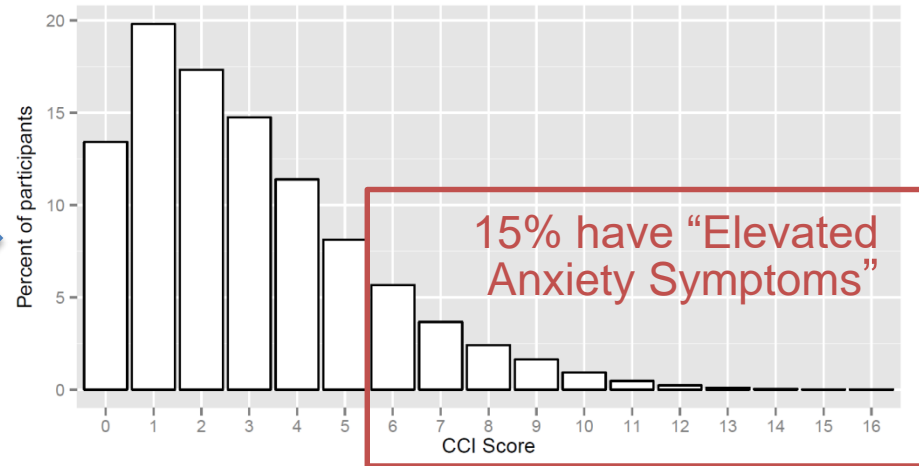
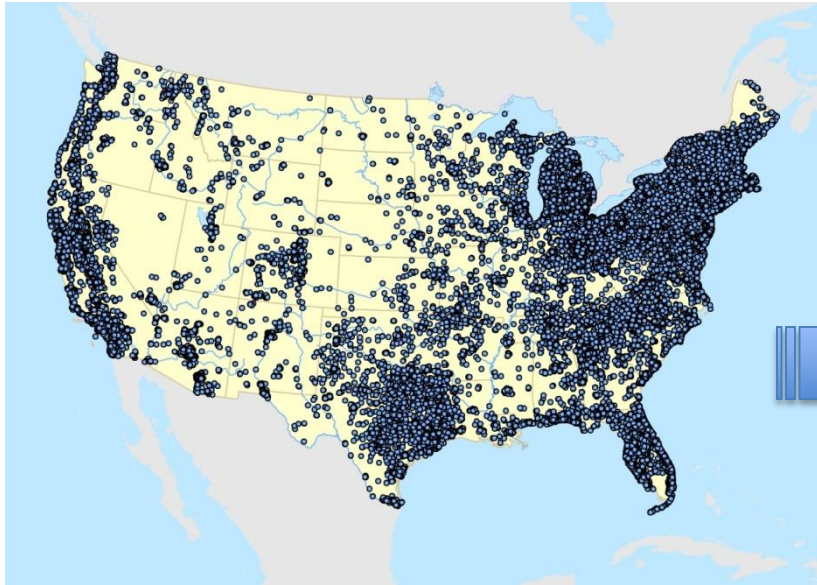
How could air pollution impact mental health?

- Inflammation and oxidative stress
 - In the brain or in the body
- Promotion of chronic disease
 - Chronic disease is a risk factor for mental health disorders
 - Symptom levels influenced by air pollution
- Modulates stress response
 - Hypothalamus-pituitary axis/glucocorticoid activity
- Impact on neurotransmission
 - Neurotransmission is often abnormal in mental health disorders

Air Pollution and Mental Health



Particulate Air Pollution and Prevalent Anxiety Symptoms



Estimated distance to a major road, $PM_{2.5}$ and $PM_{2.5-10}$ at the residential address of each Nurses' Health Study participant

Score of 6 or greater on the Crown-Crisp Index Phobic Anxiety Scale administered in 2004

Particulate Air Pollution and Prevalent Anxiety Symptoms

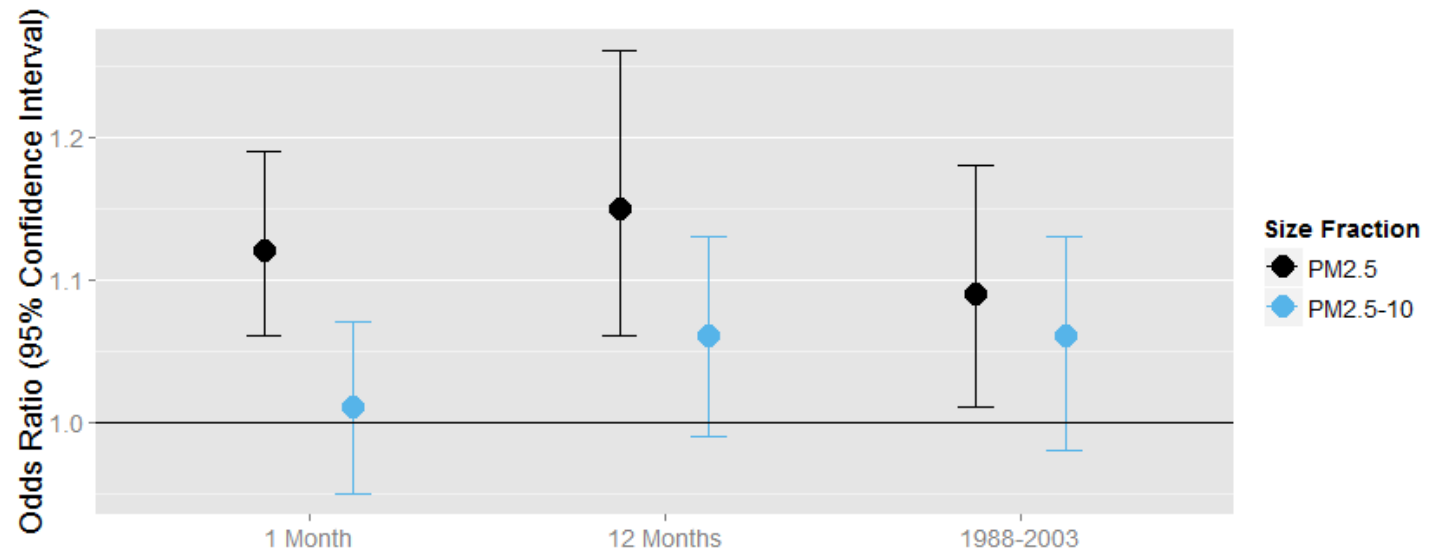
No compelling association between distance to road and elevated anxiety symptoms

| Meters from A1, A2, or A3 road | OR (95% CI) |
|--------------------------------|-------------------|
| ≤50 | 1.01 (0.95, 1.08) |
| 50 to 200 | 1.06 (1.01, 1.12) |
| >200 | 1.00 (ref) |

Adjusted for month of questionnaire return, nurse's education, husband's education, age, age squared, whether the nurse has a partner, employment status, physical activity, percent of residential census tract that is white, percent of residential census tract adults who lack a high school education, median home value of residential census tract, geographic region, residence within a metropolitan statistical area, and social support.

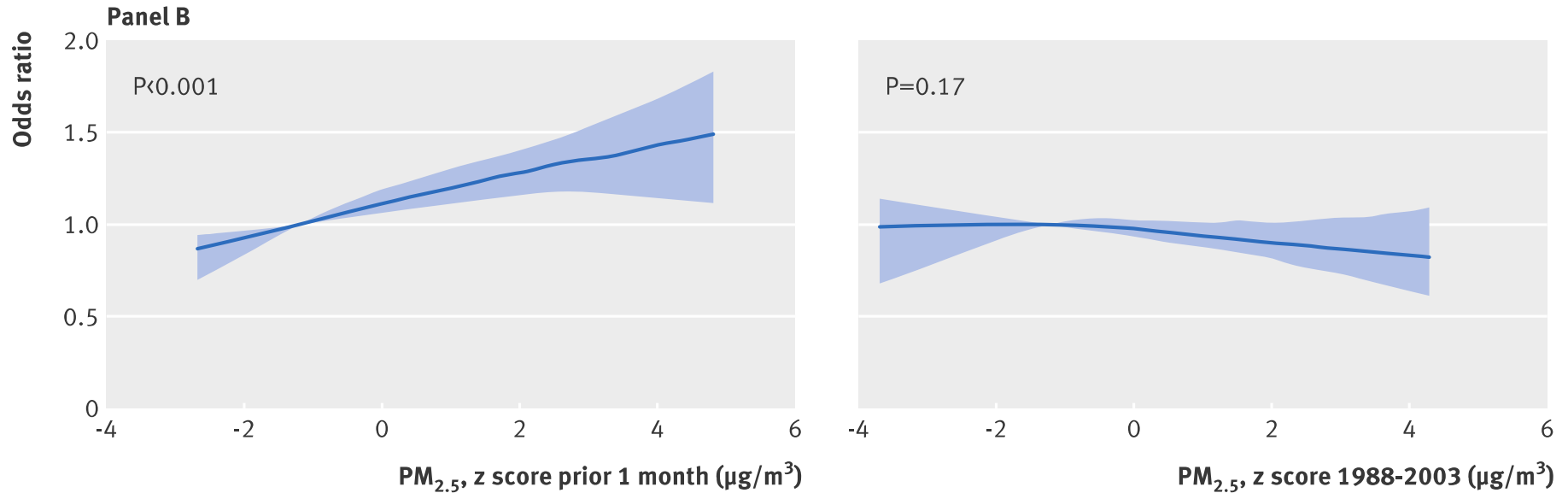
Particulate Air Pollution and Prevalent Anxiety Symptoms

PM_{2.5} is associated with increased odds of elevated anxiety symptoms



Adjusted for month of questionnaire return, nurse's education, husband's education, age, age squared, whether the nurse has a partner, employment status, physical activity, percent of residential census tract that is white, percent of residential census tract adults who lack a high school education, median home value of residential census tract, geographic region, residence within a metropolitan statistical area, and social support.

Particulate Air Pollution and Prevalent Anxiety Symptoms



Mutually adjusted models suggest recent exposures are more important than prior exposures

Air Pollution and Depressive Symptoms

MOBILIZE Boston

Distance to Road
Long-term BC

BC
Ultrafine PM
PM_{2.5}
Sulfates
Ozone
NO
NO₂
CO

Cumulative
average exposure
within 2 weeks
prior to CESD-R

Elderly in Seoul

Cumulative
average exposure
within 4 weeks
prior to SGDS-K

PM₁₀
SO₂
Ozone
NO₂
CO

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Lim et al. (2012) EHP
Wang et al. (2014) EHP

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Air Pollution and Depressive Symptoms

MOBILIZE Boston

Distance to Road
Long-term BC

BC
Ultrafine-PM
PM_{2.5}
Sulfates
Ozone
NO
NO₂ (?)
CO

Cumulative
average exposure
within 2 weeks
prior to CESD-R

Elderly in Seoul

Cumulative
average exposure
within 4 weeks
prior to SGDS-K

PM₁₀
SO₂
Ozone
NO₂
CO

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Wang et al. (2014) EHP

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Is higher air pollution associated with mental health emergencies (ED visits)?

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¹Cho et al. (2014) *J Affective Dis*
²Szyszkowicz et al. (2010) *Environmental Health Insights*

³Szyszkowicz et al. (2009) *IJOMEH*

⁴Szyszkowicz et al. (2007) *IJOMEH*

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Is higher air pollution associated with mental health emergencies (ED visits)?

| ED Visit Reason | Depressive Episode | Mental Health | Suicide | Depressive Disorder | Depressive Disorder |
|------------------------------------|--------------------------|---------------------|---------------------|---------------------|---------------------|
| Country | South Korea ¹ | Canada ² | Canada ² | Canada ³ | Canada ⁴ |
| PM ₁₀ | | | | | |
| PM _{2.5} | | | | | |
| NO ₂ or NO _x | | | | | |
| SO ₂ | | | | | |
| Ozone | | | | | |
| CO | | | | | |

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| PM ₁₀ | Yes | No | Subgroups only | Yes | Yes |
| PM _{2.5} | n/a | No | Subgroups only | No | Subgroups only |
| NO ₂ or NO _x | Yes | Subgroups only | Subgroups only | Yes | Yes |
| SO ₂ | Yes | Subgroups only | Subgroups only | Subgroups only | Subgroups only |
| Ozone | No | No | No | No (Protective) | Subgroups only |
| CO | Yes | Yes | Subgroups only | Yes | Yes |

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| NO ₂ or NO _x | Yes | Subgroups only | Subgroups only | Yes | Yes |
| SO ₂ | Yes | Subgroups only | Subgroups only | Subgroups only | Subgroups only |
| Ozone | No | No | No | No (Protective) | Subgroups only |
| CO | Yes | Yes | Subgroups only | Yes | Yes |

Cold months



Is higher air pollution associated with mental health emergencies (ED visits)?

| ED Visit Reason | Depressive Episode | Mental Health | Suicide | Depressive Disorder | Depressive Disorder |
|------------------------------------|--------------------------|---------------------|---------------------|---------------------|---------------------|
| Country | South Korea ¹ | Canada ² | Canada ² | Canada ³ | Canada ⁴ |
| PM ₁₀ | Yes | No | Subgroups only | Yes | Yes |
| PM _{2.5} | n/a | No | Subgroups only | No | Subgroups only |
| NO ₂ or NO _x | Yes | Subgroups only | Subgroups only | Yes | Yes |
| SO ₂ | Yes | Subgroups only | Subgroups only | Subgroups only | Subgroups only |
| Ozone | No | No | No | No (Protective) | Subgroups only |
| CO | Yes | Yes | Subgroups only | Yes | Yes |

Cold months, males, or males in cold months



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| PM _{2.5} | n/a | No | Subgroups only | No | Subgroups only |
| NO ₂ or NO _x | Yes | Subgroups only | Subgroups only | Yes | Yes |
| SO ₂ | Yes | Subgroups only | Subgroups only | Subgroups only | Subgroups only |
| Ozone | No | No | No | No (Protective) | Subgroups only |
| CO | Yes | Yes | Subgroups only | Yes | Yes |

Warm months



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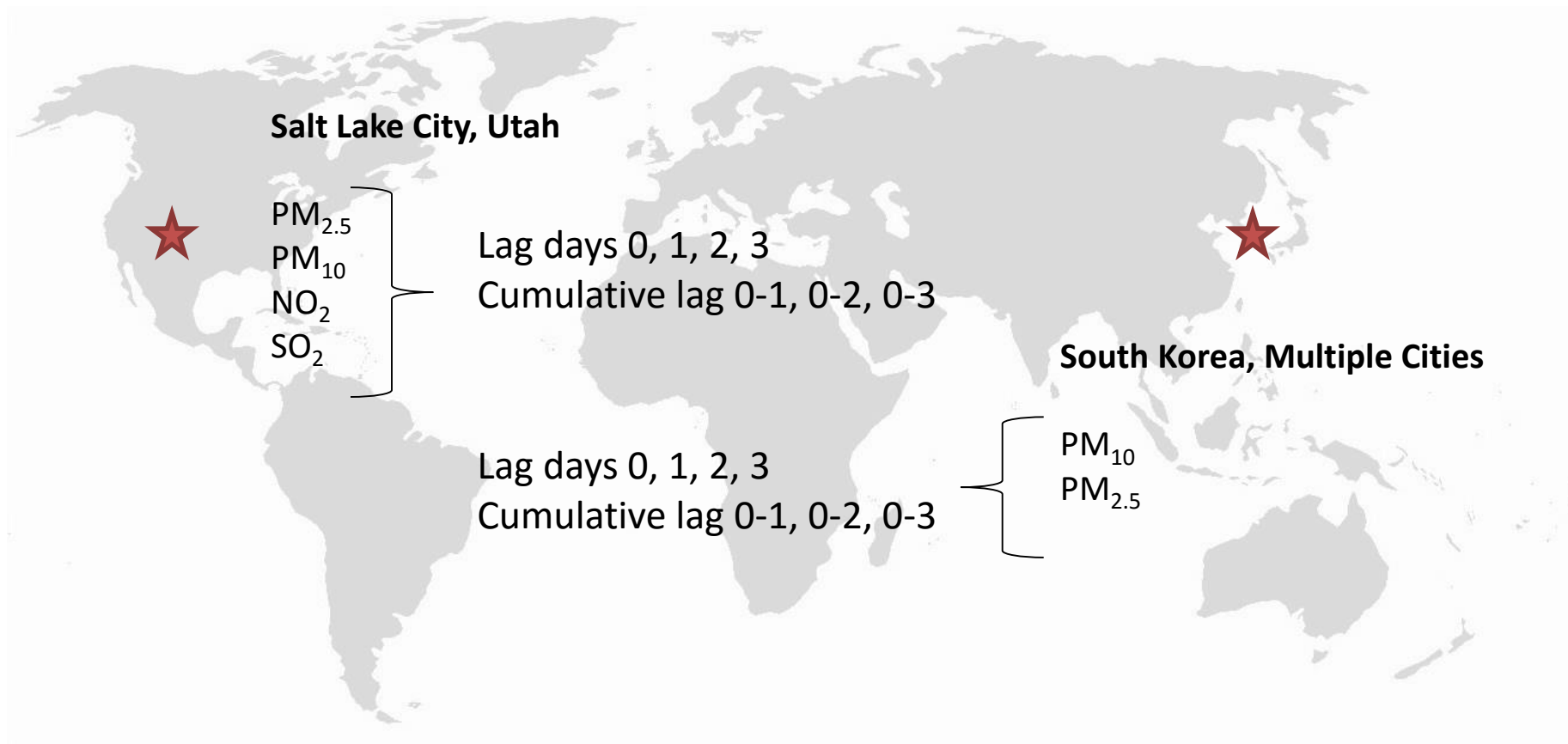
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| NO ₂ or NO _x | Yes | Subgroups only | Subgroups only | Yes | Yes |
| SO ₂ | Yes | Subgroups only | Subgroups only | Subgroups only | Subgroups only |
| Ozone | No | No | No | No (Protective) | Subgroups only |
| CO | Yes | Yes | Subgroups only | Yes | Yes |

Warm months among women (ozone)
Cold months among women (PM_{2.5} SO₂)



Air Pollution and Completed Suicide



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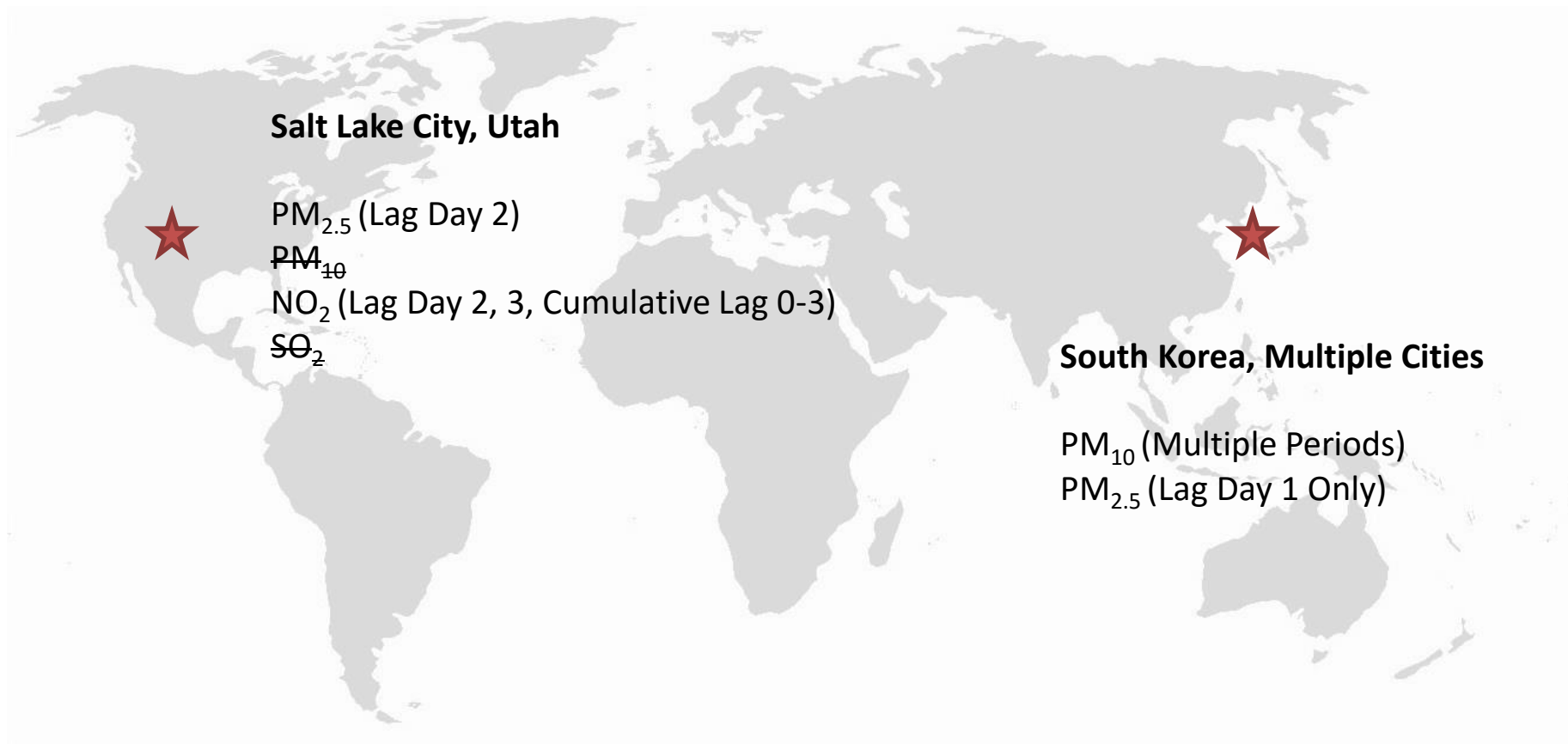
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Bakian et al. (2015) AJE
Wang et al. (2014) EHP

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Air Pollution and Completed Suicide



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Take-away

1. Mental health disorders are a huge public health problem
2. It is important to look at potential environmental causes
 - Modifiable
 - Could have big impact on population health
3. Air pollution has been linked to symptoms of anxiety and depression, including psychiatric emergency, in a handful of studies
 - Suggestive, not definitive
4. Studies need replication
 - Inconsistencies across studies
 - Address sources of bias (ecologic fallacy, confounding, etc.)
5. Emerging themes...
 - Recent exposure may be most important
 - No strong evidence to support idea association is limited to those with co-morbidities

Policy Implications

- Stay tuned...
 - Evidence is tantalizing yet inconclusive
 - More research is needed

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Thank you!

Questions?