

# Long-term exposure to ultrafine particulate matter from wildfires and late-life cognitive decline in the KHANDLE and STAR cohorts

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## Background

- Fine particulate matter (PM<sub>2.5</sub>) is a well-established risk factor for **dementia**
- The role of **ultrafine PM (PM<sub>0.1</sub>)** remains **understudied** especially in **diverse populations**
- PM<sub>0.1</sub> penetrates deeply into the body due to its small size and can **cross the blood brain barrier**
- Wildfires (WF) are growing in frequency and severity, particularly in the expanding **wildland urban interface (WUI)**

## Methods

### Study population:

- KHANDLE**: 1,555 ethnically diverse adults aged ≥65 yrs
- STAR**: 737 African Americans ≥50 yrs

### Cognitive outcomes:

- Annual cognitive change assessed across **two domains**: verbal episodic memory, executive function
- Spanish and English Neuropsychological Assessment Scales (**SENAS**; Z-scored)

### Exposure assessment:

- PM<sub>0.1</sub> from **biomass combustion** and **WUI sources** estimated using a **chemical transport model** at 1 km
- Linked to **residential address**
- Averaged over 10 years

### Statistical analysis:

- Linear mixed effects regression** with interaction for time; **modeled separately by cohort**, and meta-analyzed
- Minimally Adjusted** models include: age, gender, background PM<sub>2.5</sub>, NO<sub>2</sub>, O<sub>3</sub>, practice effects and interview mode (in person or telephone)
- Fully Adjusted** models further include: marital status, education, neighborhood income

**Figure 1.** Association between wildfire-derived PM<sub>0.1</sub> and cognitive change, by cohort and wildfire source

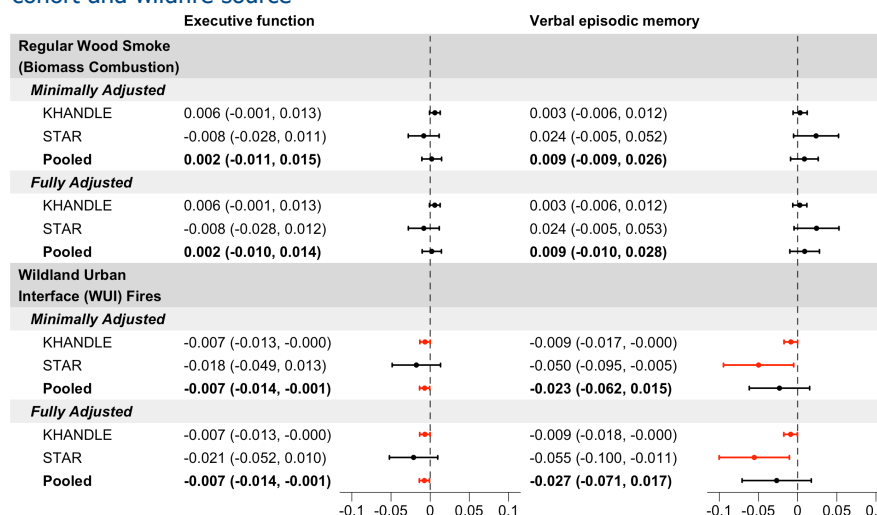


**Figure 1.** Associations between 10-year average Wildfire-derived PM<sub>0.1</sub> (Biomass combustion- and WUI-derived) and cognition (executive function and verbal episodic memory) in the KHANDLE and STAR analytic samples, and meta-analyzed ("pooled") across cohorts. Betas were calculated per SD increase in Biomass combustion- and WUI-derived PM<sub>0.1</sub> exposure, respectively. Minimally adjusted models are adjusted for baseline age, sex, average NO<sub>2</sub>, O<sub>3</sub>, and background (non-wildfire-derived) PM<sub>2.5</sub> for the same time span, time since baseline, practice effects, an indicator for interview mode, and the interaction term for PM<sub>0.1</sub> and time.

**Figure 2.** Predicted cognitive trajectories by levels of WUI-derived PM<sub>0.1</sub>

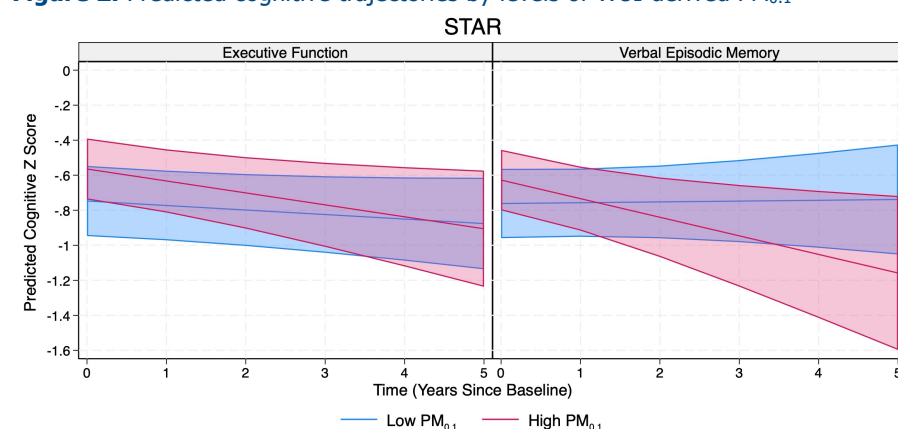


**Figure 2.** Predicted domain-specific cognitive trajectories by levels of WUI-derived PM<sub>0.1</sub> (High PM = 1 SD above the mean, Low PM = 1 SD below the mean) from fully adjusted models in STAR. Trajectories represent predicted means of z-scores for each cognitive domain (executive function and verbal episodic memory) over time, across high and low PM<sub>0.1</sub> values.

## TAKE HOME MESSAGE:

Long term exposure to ultrafine PM from WUI fires associated with decreased verbal episodic memory and executive function

## Results

### STAR

- An SD increase in 10-year average WUI-derived PM<sub>0.1</sub> was associated with an **annual decline in verbal episodic memory of 0.06 SD units (-0.10 to -0.01)**.

### KHANDLE

- An SD increase in 10-year average WUI-derived PM<sub>0.1</sub> was associated with an **annual decline in verbal episodic memory of 0.01 SD units (-0.02 to -0.001)**
- An SD increase in 10-year average WUI-derived PM<sub>0.1</sub> was associated with an **annual decline in executive function of 0.01 SD units (-0.02 to -0.001)**

### Pooled

- An SD increase in 10-year average WUI-derived PM<sub>0.1</sub> was associated with an **annual decline in executive function of 0.01 SD units (-0.01 to -0.001)**

## Discussion

- Long-term **WUI PM<sub>0.1</sub>** exposure was associated with **faster decline in verbal episodic memory and executive function**
- Long-term **Biomass combustion PM<sub>0.1</sub>** exposure was **not associated** with cognitive change

## Acknowledgments

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