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Title

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Permalink

<https://escholarship.org/uc/item/2xt2c4bq>

Journal

Alzheimer's & Dementia, 18(S11)

ISSN

1552-5260

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Publication Date

2022-12-01

DOI

10.1002/alz.067256

Peer reviewed

Air pollution and dementia using longitudinal electronic health record data from the Indian Health Service

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Abstract

Background: Air pollution has been identified as an important risk factor for dementia in previous studies. As a unique population with a history of colonization, American Indians have long been disproportionately affected by air pollution. However, few studies have investigated the effects of air pollution on the risk of developing dementia in American Indians. This study aims to address this important knowledge gap.

Method: County-level average air pollution data in 2003-2007 were downloaded from the land-use regression models developed by the Center for Air, Climate, & Energy Solutions (CACES) and merged with data from the Indian Health Service (IHS) National Data Warehouse and related electronic health record databases between fiscal year (FY) 2007-2013. We assigned air pollution exposure to IHS users based on their county of residence and calculated 5-year averages of PM_{2.5}, O₃, CO, and NO₂ in each county. A total of 14,910 American Indians who were 65+ years old in FY2007, used IHS services at least once each year, and were dementia free between FY2007-2009 were included in the main analysis. Cox proportional hazard models with age as the time scale were employed to examine the association of air pollution with dementia incidence, adjusting for potential confounders.

Result: The PM_{2.5} levels in the IHS counties were lower than those in all US counties during 2003-2013, while the levels of other air pollutants were similar to the US (Figure 1). More dementia incident cases were found in IHS counties with higher O₃ levels (Figure 2). In multivariable Cox regression models (Table 1), we found a significant positive association between dementia and O₃ with a hazard ratio (HR) of 1.26 (95% CI: 1.02-1.55) per 1 ppb standardized O₃, while the associations between dementia and PM_{2.5}, and CO were not statistically significant. We found similar results in sensitivity analyses using longer lags between air pollution and dementia or replacing CO by NO₂ in the regression model.

Conclusion: Our study suggests that exposure to O₃ is associated with the higher risk of dementia in American Indians. Future efforts to reduce exposure to air pollution might help lower dementia risk in American Indian communities.

Table 1. Adjusted association between air pollution and dementia risk

	Hazard Ratio (HR)	95% CI
PM _{2.5}	0.84	0.67-1.05
O ₃	1.26	1.02-1.55*
CO	1.00	0.93-1.09
Male	0.97	0.84-1.12
Depression	1.71	1.49-1.97***
Diabetes	1.15	1.00-1.32
Hypertension	1.12	0.97-1.29
CVD	1.13	1.02-1.25*
Medicaid	1.38	1.21-1.57***
Private insurance	1.01	0.84-1.21



Figure 1. Yearly average air pollution levels of PM_{2.5}, O₃, NO₂, and CO in all 3,109 US counties vs. 192 IHS counties in this study.

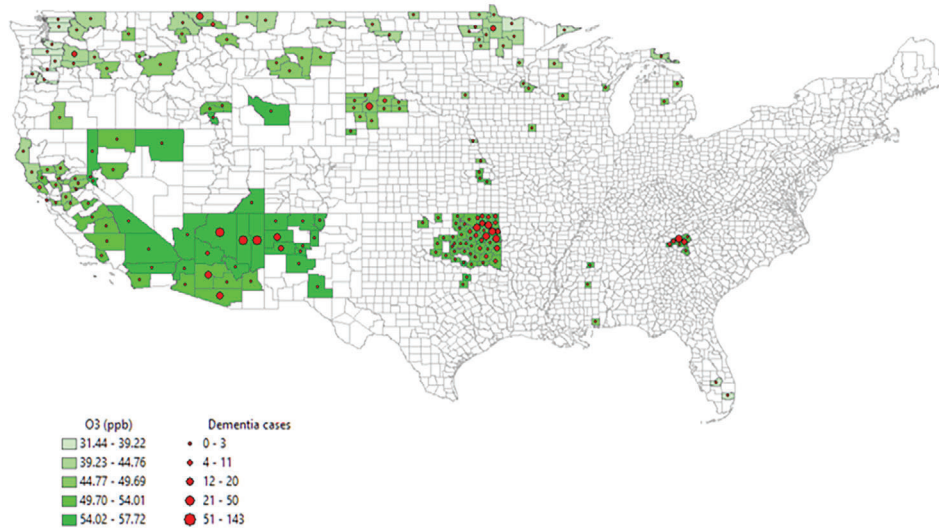


Figure 2. Average O₃ levels in 2003-2007 and number of dementia incident cases in 2010-2013 in 192 IHS counties.