News Release

FOR RELEASE May 18, 2015, 9:30 a.m. MDT

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Session B46: Health Effects of Air Pollution and Nanoparticles
Monday, May 18, 2015, 9:30 a.m. – 4:15 p.m.
Location: Colorado Convention Center

Air Pollution and Impaired Lung Function Prove Independent Risk Factors for Cognitive Decline

Studies have shown that both air pollution and impaired lung function can cause cognitive deficits, but it was unclear whether air pollution diminishes cognition by reducing breathing ability first or whether air pollution represents an independent risk factor for cognitive deficit. Now a new study conducted by German and Swiss researchers has answered that question: air pollution directly affects cognition and is not mediated by lung function.

The researchers, who analyzed data from a study of 834 elderly German women, will present their findings at ATS 2015 in Denver, May 15 to 20.

"Our findings disprove the hypothesis that air pollution first decreases lung function and this decline, in turn, causes cognitive impairment by releasing stress signals and humoral mediators into the body," explains Mohammad Vossoughi, a PhD student at the Leibniz (Germany) Institute for Environmental Medicine, who led the study.

Mr. Vossoughi adds that the findings suggest other hypotheses about how air pollution affects cognition, including the possibility that particulate matter and other pollutants are translocated to the central nervous system via our sense of smell and that leads to mild cognitive impairment.

To reach their conclusions, the team of German and Swiss researchers used data from the cohort Study on the influence of Air pollution on Lung function, Inflammation and Aging, or SALIA. The researchers first tested the association between impaired lung function and cognitive impairment. They measured change in lung function through force expiratory volume in one second (FEV1) and forced volume capacity (FVC). They measured cognitive changes using

tests from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD), a neuropsychological battery used to study Alzheimer's progression.

After adjusting for risk factors known to affect lung and/or cognitive impairment, including age, body mass index, smoking status, education, and the presence of a gene variant implicated in Alzheimer's disease (the ApoE ε4 risk allele), they found the strongest association between impaired lung function and cognitive decline in the test that measures visuo-spatial ability. At baseline: one liter lower FVC resulted in an absolute decline in cognition of -0.3583 (p=0.007); one liter lower FEV1 resulted in a decline of -0.3075 (p=0.048). This association persisted at follow-up.

Next, the group applied a mediator analysis to test the influence of lung function on the air-pollution-cognitive-decline association. They looked at both particulate matter (PM) and nitrogen dioxide (NO2), factors known to reduce lung health. After studying changes in FEV1 and FVC as a result of an interquartile increase in both from baseline, they could not find a corresponding decrease in visuo-spatial ability: PM10 (β= -0.3158; p < 0.001 to β= -0.3082; p < 0.001); NO2 (from β= -0.3111; p=0.003 to β= -0.3018; p=0.004).

Although Mr. Vossoughi says that their study was "fairly comprehensive," he believes further studies are warranted to confirm the findings in populations including men and those who are not elderly and "to elucidate the mechanisms underlying impaired lung function, air pollution and cognitive decline."

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Please note that numbers in this release may differ slightly from those in the abstract. Many of these investigations are ongoing; the release represents the most up-to-date data available at press time.

Abstract 64451

The Roles of Lung Function and Air Pollution on Cognitive Decline: Predictor and Mediator?
Type:
Scientific Abstract
Category:
06.02 - Clinical Epidemiology of Environmental Health (EOPH/BSHSR/PC)
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Abstract Body

Background: Air pollution exposure leads to impaired lung function as well as to decline in cognitive function. Further, cognitive decline is highly prevalent in people with impaired lung function.

Objective: To evaluate whether impaired lung function is not only a risk factor for cognitive decline but also a mediator on the pathway from air pollution exposure to cognitive decline.

Methods: We used data from the Study on the influence of Air pollution on Lung function, Inflammation and Aging (SALIA). Multiple regressions modelling adjusted for potential risk factors was used in 834 women. We first tested the association between impaired lung function (FEV_1, FVC, and the average of the measurements during follow-up) and cognitive decline (subtests of the CERAD plus test battery) adjusting for a set of potential confounders. Next, we applied a mediator analysis to test the influence of lung function on the air pollution-cognitive decline association. Particulate matters (PM) and nitrogen dioxide (NO_2) extrapolated back to the baseline period of the study were used for analyses.

Results: In the adjusted analysis impaired lung function at baseline was significantly stronger associated with decline in visuo-spatial ability than the other cognitive tests. This association was stronger for one litre lower FVC (β= -0.3583; p=0.007) than for one litre lower FEV_1 (β= -0.3075; p=0.048). Using the average lung function decline between baseline and follow-up, the association with visuo-spatial ability was again strong for FVC (β= -0.4114; p=0.004) compared to FEV_1 (β= -0.3477; p=0.042). No association could be detected with the ratio FEV_1/FVC and any of the cognitive tests. The mediation analysis showed that lung function was not a mediator between the association of air pollution and decline in cognition. For example, additional adjustment FVC changed hardly the association of NO_2 (from β= -0.3111; p=0.003 to β= -0.3018; p=0.004) or PM_{10} (β= -0.3158; p < 0.001 to β= -0.3082; p < 0.001) with visuo-spatial ability for one interquartile range increase of air pollution und could not be considered as mediator.

Conclusion: Our study offers a relatively comprehensive perspective of impaired lung function-related cognitive deficits and their association with air pollution. Lung function throughout adulthood appears to be a predictor for the development of cognitive impairment in the elderly, however, air pollution and impaired lung function are independent predictors for cognitive decline. Future studies are required to elucidate the mechanisms underlying impaired lung function, air pollution, and cognitive decline.