The correspondence section is a public forum and, as such, is peer-reviewed. EHP is not responsible for the accuracy, currency, or reliability of personal opinion expressed herein; it is the sole responsibility of the authors. EHP neither endorses nor disputes their published commentary.

Ambient Air Pollution and Depressive Symptoms in Older Adults

http://dx.doi.org/10.1289/ehp.1409657

Wang et al. (2014) investigated the relationship between ambient air pollution and depressive symptoms in a prospective study of elderly people over age 65 years. We are very surprised that the authors found no association between ambient air pollution and depressive symptoms, which is inconsistent with most previous studies (e.g., Banerjee et al. 2012; Calderón-Garcidueñas et al. 2014). A study of a population of elderly men indicated one potential biological mechanism may be methylation, which was decreased after acute exposure to fine particulate matter (Madrigano et al. 2012).

We identified three issues with the study by Wang et al. (2014). First, these authors used outdoor air pollution as the exposure of interest. Long-term exposure was estimated based on residential distance from the nearest major roadway. Considering only residential distance to the nearest major roadway, without taking into account other sources of exposure, may be insufficient to accurately estimate long-term exposure to traffic pollution. Short-term exposure to ambient air pollution was estimated based on pollutant levels measured at only one monitoring site, the Harvard–U.S. Environmental Protection Agency Superstation stationary ambient monitoring site. Although the monitoring site was located <20 km from the home of any study participant, the number of monitoring sites was insufficient. Thus, participants’ exposures to ambient pollutant might be misclassified. Moreover, considering that the participants were elderly, they were less likely than other groups to spend time outdoors (Kerr et al. 2012). Hence, outdoor air pollution might not reflect their true exposures. Lacking validation of these estimated exposures, the negative conclusion is unconvincing.

Second, the Revised Center for Epidemiologic Studies Depression Scale (Eaton et al. 2004) is not the first choice for measuring depressive symptoms in the elderly; the Geriatric Depression Scale (Yesavage et al. 1982) is more suitable. The evidence from clinical diagnosis of depression shows a positive association between air pollution and depression. For example, Cho et al. (2014) found that ambient air pollution was positively associated with emergency department visits for depressive episodes among 4,985 Koreans using clinical diagnosis of depression episode as outcome. Of note, clinical diagnosis of depression is a more objective measure than depressive symptoms.

Third, Wang et al. did not address health status in their reported association. There is convincing evidence supporting the association between cardiovascular disease (CVD) and both ambient air pollution (e.g., Grahame and Schlesinger 2010) and depression (e.g., Sun et al. 2013). Hence, previous history of CVD could confound or modify the association between ambient air pollution and depressive symptoms. Stratified analysis according to health or CVD status is warranted. Without such analysis, the negative conclusion is not well supported.

The authors declare they have no actual or potential competing financial interests.

Yongqing Gao,1 Tan Xu,2,3 and Wenjie Sun1,2
1School of Food Science, Guangdong Pharmaceutical University, Zengcheng, Guangdong, China; 2School of Public Health and Jiangsu Key Laboratory of Preventive and Translational Medicine for Geriatric Diseases, Medical College of Soochow University, Suzhou, Jiangsu, China; 3School of Public Health and Tropical Medicine, Tulane University, New Orleans, Louisiana, USA.
E-mail: sunwenjie2002@hotmail.com

REFERENCES

Banerjee, M, Siddique S, Dutta A, Mukherjee B, Ranjan Ray M. 2012. Cooking with biomass increases the risk of depression in pre-menopausal women in India. Soc Sci Med 75(3):365–372; doi:10.1016/j.socscimed.2012.03.001.
Calderón-Garcidueñas L, Calderón-Garcidueñas A, Torres-Jardon R, Avila-Ramírez J, Kulesza RJ, Anguilli AD. 2014. Air pollution and your brain: what you need to know right now. Prim Care: Clin Pract Geriatr 19(1):1–17; doi:10.1016/S1937-6410(14)70012-5.
Cho J, Choi JY, Suh M, Sohn J, Kim H, Cho SK, et al. 2014. Air pollution as a risk factor for depressive episode in patients with cardiovascular disease, diabetes mellitus, or asthma. J Affect Disord 157:45–51; doi:10.1016/j.jad.2014.01.002.
Eaton WW, Smith C, Ybarra M, Munetaner C, Tien A. 2004. Center for Epidemiologic Studies Depression Scale: review and revision (CESD and CESD-R). In: The Use of Psychological Testing for Treatment Planning and Outcomes Assessment, Part 3rd (Maruish ME, ed.). Mahwah, NJ:Lawrence Erlbaum Associates.
Grahame TJ, Schlesinger RB. 2010. Cardiovascular health and particulate vehicular emissions: a critical evaluation of the evidence. Air Qual Atmos Health 3(1):3–27; doi:10.1007/s11869-009-0047-x.
Kerr J, Sallis JF, Saelens BE, Cain KL, Conway TL, Frank LD, et al. 2012. Outdoor physical activity and self-rated health in older adults living in two regions of the U.S. Int J Behav Nutr Phys Act 9:89; doi:10.1186/1749-6622-9-89.
Madrigano J, Baccarelli A, Militana MA, Sparrow D, Spiro A III, Vokonas PS, et al. 2012. Air pollution and DNA methylation: interaction by psychological factors in the VA Normative Aging Study. Am J Epidemiol 176(3):224–232; doi:10.1093/aje/kws205.
Sun WJ, Xu L, Chan WM, Lam TH, Schooling CM. 2013. Are depressive symptoms associated with cardiovascular mortality among older Chinese? A cohort study of 64,000 people in Hong Kong. Am J Geriatr Psychiatry 21(11):1107–1115; doi:10.1097/JGP.0b013e3182ae7148.
Wang Y, Elliot MN, Koutrakis P, Gryparis A, Schwartz JD, Coull BA, et al. 2014. Ambient air pollution and depressive symptoms in older adults: results from the MOBILE-SE Boston study. Environ Health Perspect 122(6):553–558; doi:10.1289/ehp.1205909.
Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M, et al. 1982. Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res 17(1):37–49; PMID:183759.

Ambient Air Pollution and Depressive Symptoms in Older Adults: Wellenius et al. Respond

http://dx.doi.org/10.1289/ehp.1409657R

We thank Gao et al. (2015) for their interest in our recent publication examining the association between ambient air pollution and depressive symptoms in a cohort of Boston-area elderly participants (Wang et al. 2014). Gao et al. (2015) suggest that the null results we found are due to excessive exposure measurement error stemming from the use of pollutant concentrations measured at a single stationary monitoring site. In this investigation we examined associations with short-term exposure to ambient fine particulate matter mass, sulfate, black carbon, and ultrafine particles measured at the Harvard–U.S. Environmental Protection Agency Superstation, which is located <20 km from the participants’ homes. Particle measurements from this monitoring site have been shown to be strong proxies for personal exposure to particles of ambient origin (Brown et al. 2009) and have been used in hundreds of prior studies. Nonetheless, as we acknowledged in our article, exposure misclassification likely resulted in wider confidence intervals for our effect estimates, but is not expected to have biased our results (Zeger et al. 2000). We also failed to find evidence of an association with long-term exposure to traffic pollution based on both residential proximity to major roadways and residential black carbon levels predicted by a spatiotemporal model (Gryparis et al. 2009). Both of these exposure metrics have been used in a large number of air pollution health effects studies in the Greater Boston area, most of which have found associations with a large spectrum of health outcomes (Hart et al. 2014; Lue et al. 2013; Suglia et al. 2008; Wellenius et al. 2012; Wilker et al. 2013).

Gao et al. (2015) further suggest that our null results might be due to excessive misclassification of the outcome because we assessed the presence of depressive symptoms using the Revised Center for Epidemiologic Studies Depression Scale (CESD-R) (Eaton et al. 2004) rather than using a scale specifically designed for the elderly or relying on clinical diagnoses of depression. The CESD-R has been validated in the general population (Van Dam and Earleywine 2011), and the Center for...
CVD or its risk factors. Thus, it does not seem likely that our null hypothesis was falsified, as the results were not materially different. We therefore did not adjust for it because 1) air pollution is believed to cause CVD, and 2) there is a well-documented association between depression and CVD. However, CVD is a downstream consequence of exposure to air pollution, and therefore, adjusting for it in analyses of air pollution health effects requires caution and appropriate caveats (Hernan et al. 2002). Nonetheless, in our paper we presented sensitivity analyses that were additionally adjusted for body mass index, physical activity, alcohol consumption, smoking, diabetes mellitus, hypertension, and hyperlipidemia, and showed that the results were not materially different. Thus, it does not seem likely that our null results are due to lack of adjustment for CVD or its risk factors.

Finally, Gao et al. (2015) suggest that our results stand in contrast to those of “most previous studies.” This may be true, but it is worth noting that there are very few other studies available for direct comparison, and thus this remains very much an open research question. Additional studies in diverse populations are clearly needed to confirm or refute the presence of an association between air pollution and depressive symptoms.

The authors declare they have no actual or potential competing financial interests.

Gregory A. Wellenius,1 Petros Koutrakis,2 and Yi Wang3

1Department of Epidemiology, Brown University School of Public Health, Providence, Rhode Island, USA; 2Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, USA; 3Department of Environmental Health, Indiana University Richard M. Fairbanks School of Public Health, Indianapolis, Indiana, USA
E-mail: gregory_wellenius@brown.edu

REFERENCES

Brown KW, Samat JA, Suh HH, Coull BA, Koutrakis P. 2009. Factors influencing relationships between personal and ambient concentrations of gaseous and particulate pollutants. Sci Total Environ 407(12):3754–3765; doi:10.1016/j.scitotenv.2009.02.016.
Eaton WW, Smith C, Ybarra M, Muntaner C, Tien A. 2004. Center for Epidemiologic Studies Depression Scale: review and revision (CESD and CESD-R). In: The Use of Psychological Testing for Treatment Planning and Outcomes Assessment (Maruish ME, ed). 3rd ed. Mahwah, N.J.Lawrence Erlbaum Associates.
Gao T, Xu T, Sun W. 2015. Ambient air pollution and depressive symptoms in older adults. Environ Health Perspect 123(5):A114; doi:10.1289/ehp.1409657.
Gryparis A, Paciorek CJ, Zeka A, Schwartz J, Coull BA. 2009. Measurement error caused by spatial misalignment in environmental epidemiology. Biostatistics 10(2):258–274; doi:10.1093/biostatistics/kxp033.
Hart JE, Chiueh SE, Laden F, Albert CM. 2014. Roadway proximity and risk of sudden cardiac death in women. Circulation 130(17):1474–1482; doi:10.1161/CIRCULATIONAHA.114.014899.
Hernan MA, Hernandez-Diaz S, Werler MM, Mitchell AA. 2002. Causal knowledge as a prerequisite for confounding evaluation: an application to birth defects epidemiology. Am J Epidemiol 155(2):176–184; doi:10.1093/aje/155.2.176.
Lue SH, Wellenius GA, Wilker EH, Mostofsky E, Mittleman MA. 2013. Residential proximity to major roadways and renal function. J Epidemiol Community Health 67(8):629–634; doi:10.1136/jech-2012-202007.
Radloff LS. 1977. The CES-D Scale: a self-report depression scale for research in the general population. Appl Psych Meas 1(3):385–401; doi:10.1177/014662167700100306.
Suglia SF, Gryparis A, Wright RO, Schwartz J, Wright RJ. 2008. Association of black carbon with cognition among children in a prospective birth cohort study. Am J Epidemiol 167(3):280–286; doi:10.1093/aje/kvm030.
Van Dam NT, Earleywine M. 2011. Validation of the Center for Epidemiologic Studies Depression Scale—Revised (CESD-R): pragmatic depression assessment in the general population. Psychiatry Res 186(1):128–132; doi:10.1016/j.psychres.2010.08.016.
Wang Y, Elliot MN, Koutrakis P, Gryparis A, Schwartz JD, Coull BA, et al. 2014. Ambient air pollution and depressive symptoms in older adults: results from the MOBILIZE Boston study. Environ Health Perspect 122(6):553–558; doi:10.1289/ehp.1200909.
Wellenius GA, Boyle LD, Coull BA, Milberg WP, Gryparis A, Schwartz J, et al. 2012. Residential proximity to nearest major roadway and cognitive function in community-dwelling seniors: results from the MOBILIZE Boston Study. J Am Geriatr Soc 60(11):2075–2080; doi:10.1111/j.1532-5415.2012.04195.x.
Wilker EH, Mostofsky E, Lue SH, Gold D, Schwartz J, Wellenius GA. 2013. Residential proximity to high-traffic roadways and poststroke mortality. J Stroke Cerebrovasc Dis 22(8):e366–e372; doi:10.1016/j.jstroke-cerebrovasdis.2013.03.034.
Zeger SL, Thomas D, Dominici F, Samet JM, Schwartz J, Dockery D, et al. 2000. Exposure measurement error in time-series studies of air pollution: concepts and consequences. Environ Health Perspect 108(5):419–426; PMID:10811568.