HEI

STATEMENT

Synopsis of Research Report 188

HEALTH EFFECTS INSTITUTE

Air Pollution and Adverse Reproductive Health Outcomes in Pregnant Women

INTRODUCTION

There is growing epidemiologic evidence of associations between maternal exposure to ambient air pollution and adverse birth outcomes, such as preterm birth (PTB). Recently, a few studies have also reported that exposure to ambient air pollution may also increase the risk of some common pregnancy complications, such as preeclampsia and gestational diabetes mellitus (GDM). Research findings, however, have been mixed. These inconsistent results could reflect genuine differences in the study populations, the study locations, the specific pollutants considered, the designs of the study, its methods of analysis, or random variation.

Dr. Jun Wu of the University of California–Irvine, a recipient of HEI's Walter A. Rosenblith New Investigator Award, and colleagues have examined the association between air pollution and adverse birth and pregnancy outcomes in California women. In addition, they examined the effect modification by socioeconomic status (SES) and other factors.

What This Study Adds

- Wu and colleagues conducted a comprehensive nested case–control study of air pollution and adverse birth and pregnancy outcomes using birth certificate data in California from 2001 to 2008.
- The study documented associations between increases in various air pollution exposure metrics and increased risks of preterm birth. The evidence was weaker overall for term low birth weight, and many negative associations were found for preeclampsia and gestational diabetes mellitus. Underreporting, especially in groups with lower socioeconomic status, and poor geocoding were listed as potential explanations, but those issues were not fully explored.
- The very large data set and the extensive exposure assessment were strengths of the study.

APPROACH

A retrospective nested case–control study was conducted using birth certificate data from about 4.4 million birth records in California from 2001 to 2008. Wu and colleagues analyzed data on low birth weight (LBW) at term (infants born between 37 and 43 weeks of gestation and weighing less than 2500 g), PTB (infants born before 37 weeks of gestation), and preeclampsia (including eclampsia) of the mother during the pregnancy. In addition, they obtained data on GDM for the years 2006–2008. In the analyses, all outcomes were included as binary variables.

Maternal residential addresses at the time of delivery were geocoded, and a large suite of air pollution exposure metrics was considered, such as (1) regulatory monitoring data on concentrations of criteria pollutants NO_2, $PM_{2.5}$ (particulate matter ≤ 2.5 µm in aerodynamic diameter),

This Statement, prepared by the Health Effects Institute, summarizes a research project funded by HEI and conducted by Dr. Jun Wu at the University of California–Irvine and colleagues. The complete report, *Adverse Reproductive Health Outcomes and Exposure to Gaseous and Particulate-Matter Air Pollution in Pregnant Women* (© 2016 Health Effects Institute), can be obtained from HEI or our Web site (see next page).

and ozone (O_3) estimated by empirical Bayesian kriging; (2) concentrations of primary and secondary $PM_{2.5}$ and $PM_{0.1}$ components and sources estimated by the University of California–Davis Chemical Transport Model; (3) traffic-related ultrafine particles and concentrations of carbon monoxide (CO) and nitrogen oxides (NO_x) estimated by a modified CALINE4 air pollution dispersion model; and (4) proximity to busy roads, road length, and traffic density calculated for different buffer sizes using geographic information system tools. In total, 50 different exposure metrics were available for the analyses. The exposure of primary interest was the mean of the entire pregnancy period for each mother.

For the health analyses, controls were randomly selected from the source population. PTB controls were matched on conception year. Term LBW, preeclampsia, and GDM were analyzed using generalized additive mixed models with inclusion of a random effect per hospital. PTB analyses were conducted using conditional logistic regression, with no adjustment for hospital. The main results—adjusted for race and education as categorical variables and adjusted for maternal age and median household income at the census-block level—were derived from single-pollutant models.

MAIN RESULTS AND INTERPRETATION

In its independent review of the study, the HEI Health Review Committee concluded that Wu and colleagues had conducted a comprehensive nested case–control study of air pollution and adverse birth and pregnancy outcomes. The very large data set and the extensive exposure assessment were strengths of the study.

The study documented associations between increases in various air pollution metrics and increased risks of PTB, whereas the evidence was weaker overall for term LBW; in addition, decreases in many air pollution metrics were associated with an increased risk of preeclampsia and GDM, an unexpected result.

The investigators suggested that underreporting in the registry data, especially in lower-SES groups, might have caused the many negative associations found for preeclampsia and GDM. In addition, poor geocoding was listed as a potential explanation, affecting in particular the results that were based on measures of proximity to busy roads and traffic density in the smallest buffer size (50 m). However, those issues were not fully explored. In general, the Committee thought that the analysis of road traffic indicators in the 50 m buffer was hampered by the lack of contrast and that the results are therefore difficult to interpret.

Some other issues with the analytical approaches should be considered when interpreting the results. Only a subset of controls was used, to reduce computational demands. Hence, some models did not converge, especially in the subgroup analyses.

Most of the results in the report were based on analyses using single-pollutant models, which is a reasonable approach but ignores that people are exposed to complex mixtures of pollutants. The Committee believed that the few two-pollutant models that were run provided important insights: these models showed the strongest association for $PM_{2.5}$ mass, whereas components and source-specific positive associations largely disappeared after adjusting for $PM_{2.5}$ mass. This study adds to the ongoing debate about whether some particle components and sources are of greater public health concern than others.

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