



Invited Commentary

Invited Commentary: The Power of Preterm Birth to Motivate a Cleaner Environment

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This commentary reflects on a natural experiment reported by Casey et al. (*Am J Epidemiol.* 2018;187(8):1586–1594) that tested the association between living near a coal or oil power plant and preterm birth. They found that retiring power plants resulted in a significant reduction in preterm birth, with larger effects observed for late preterm birth and among non-Hispanic black mothers and infants. Natural experiments, in particular the Utah Valley Steel Mill closure, have played a prominent role in the evidence base for air pollution regulation due to their demonstrated impact on cardiopulmonary effects in adults. Reproductive health, including infant mortality and preterm birth associated with poor air quality, has generally received less attention. Even small reductions in preterm birth can have a large population health impact, both in terms of preventing mortality in the short-term and in preventing life-long disability among affected infants.

air pollution; environmental epidemiology; mortality; natural experiment; preterm birth

Abbreviation: PM_{2.5}, particulate matter with an aerodynamic diameter less than or equal to 2.5 μm.

The publication by Casey et al. (1) in the current issue of the *Journal* is important on many levels. They take advantage of a “natural experiment” opportunity, examining changes over time in preterm birth rates relative to the retirement of coal and oil power plants in California. Natural experiments can provide compelling evidence to motivate change. For the interventionists among us, it is particularly satisfying to see an improvement in population health related to a large-scale change in exposure, whether it occurs by circumstance or policy—for example, the precipitous drop in nationwide blood lead levels that was associated with the removal of lead from gasoline (2, 3). In this natural experiment relating power plants and preterm birth, the authors used a difference-in-differences approach to control for secular changes over time, and they conducted a series of sensitivity analyses to assess the likelihood that their findings were due to other factors. Their work is appealing as what used to be called “shoe leather” epidemiology, with strong methods and creative application of those methods to an important problem. These strategies are limited by data collected for another purpose and often lack the precision and resolution needed for a more definitive analysis. In short, imperfect population-based observational

data are used to estimate the magnitude of a suspected risk. In this case, the authors do an excellent job of testing alternative explanations for the observed associations and examining social factors that might increase vulnerability.

Often studies of a point source, such as a power plant, will rely on relatively simplistic circles drawn around the point to measure the likelihood of exposure. We know that most environmental exposures do not migrate off site with perfect dispersion in all directions, but it is relatively straightforward to draw those perimeters and assume that the resulting misclassification will bias results to the null. This paper goes a step further to consider women who were downwind of the plants, with likely higher exposure, and also notes the changes over time in modeled particulate matter with an aerodynamic diameter less than or equal to 2.5 μm (PM_{2.5}) and nitrogen oxides emissions in the study area. Although the downwind estimates were underpowered and not statistically significant, it did appear that women living downwind and <5 km from the power plants experienced a greater estimated reduction in preterm birth than those upwind. Controlling for the economic downturn in the mid-2000s using data on home foreclosures adjusts for some

aspects of the social context that can influence both childbearing decisions and preterm birth risks. The authors also evaluated differences in timing of delivery (effects for early and later preterm births) and differences due to maternal race/ethnicity, education, and neighborhood poverty. Finally, conducting a “negative control” analysis using power plants that did not actually close, was a brilliant stroke. Accordingly, with respect to exposure, they provide fairly convincing evidence that retirements of the power plants were the key change in the local environment associated with preterm birth. As the authors note, the natural experiment is probably the closest we will get to a randomized trial of environmental exposures. If the pregnancies in the underlying population are not changing in a systematic way in synchrony with the closing power plants, the reduction in preterm birth observed can be attributed to the plant closure, to the lower levels of air pollution. The effects were stronger for later preterm births and among non-Hispanic black and Asian mothers.

Unfortunately, preterm birth remains relatively common, and it is reasonably well measured on the population level using birth certificate data. Preterm birth is also a leading cause of infant mortality both in California (4) and nationwide (5), surpassed only by deaths due to congenital malformations, which may also be increased by poor air quality (6). In addition, as the authors note, a persistent and substantial racial disparity in preterm birth rates exists in the United States, with a disproportionate impact on non-Hispanic black mothers and infants. The rationale for studying preterm birth in relation to the power plant closures is tied to the levels of ambient air pollution they emit. A current review of the literature (7) suggests a 3% increase in preterm birth associated with each interquartile-range increase in PM_{2.5}, and a recent California report (8) adds to that picture by reporting increased risks associated with several constituents of PM_{2.5}. Casey et al. have added more evidence to this building literature.

The question I keep coming back to is this: Why doesn't concern about preterm birth motivate a cleaner environment? If there were a treatment or medical practice that could lower preterm birth from 7.0% to 5.1% in a population, would we not want to see that implemented? If that treatment or practice also had the potential to reduce disparities with a greater benefit seen in non-Hispanic black and Asian populations, would we not be excited about it? As a field, we've spent more than half a century trying to reduce the rates of preterm birth and eliminate the disparity. It is not that we have made no progress, but our efforts to date have not gone far enough.

Natural experiments, such as the Utah Valley Steel Mill closure, provided key data to support clean air regulations based on cardiopulmonary effects (9). However, the findings of reduced preterm birth in Utah Valley (10) had arguably less influence. We know that air pollution is a major contributor to the global burden of disease (11) and a substantial cause of cardiovascular (12) and pulmonary (13) hospitalizations and mortality, but still relatively little attention is given to the impact of these exposures on the most vulnerable pregnant women and infants.

We all breathe. Even small increases in mortality due to ambient air pollution have a large population health impact. At the relatively low levels of exposure experienced in most American communities, families still experience premature adult deaths due to cardiovascular and pulmonary disease. In addition, preterm birth and the consequent death and disability experienced

by preterm infants and their families are increased by this preventable, modifiable exposure. Of course, we need electricity, and there are costs and benefits to all energy decisions, but at some point we should recognize that our failure to reduce air pollution results in the death and disability of American infants and children. Casey et al. have shown us that retiring older coal and oil power plants can result in a significant reduction in preterm birth and that these benefits also have the potential to lower what has been one of our most intractable health disparities. Perhaps this is the time for the health of our children to be the impetus behind reducing the common sources of ambient air pollution. Their lives depend on it.

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