HEI

STATEMENT

Synopsis of Research Report 221

HEALTH EFFECTS INSTITUTE

Evaluation of a Program to Replace Old Diesel-Powered School Buses

BACKGROUND

Air pollution accountability research evaluates the extent to which policies aimed at improving air quality produce the intended reductions in pollutant concentrations and improvements to public health. A major challenge in this research field is isolating changes that can be attributed to the policy in question from changes that might be due to other unrelated regulations or long-term trends. This challenge is a particular concern when policies target numerous pollutant sources, affect large geographic regions, and take several years to fully implement.

Dr. Sara D. Adar of the University of Michigan and colleagues proposed to evaluate a United States Environmental Protection Agency program for funding to replace or retrofit old school buses that was implemented under the Diesel Emissions Reduction Act. This nationwide program, which was piloted in 2012 and continues in various forms to date, provides rebates to replace or retrofit older and more polluting diesel school buses. The use of school buses with newer technologies is intended to reduce the exposure of students and other people living in the community to air pollution with the intent of improving student health and educational performance. Funding is awarded to applicants based on a lottery system. The investigators used the random allocation of funding for applications submitted to school districts in the continental United States between 2012 and 2017 to assess whether this program improved student health and educational performance and community air quality, all at the school district level.

What This Study Adds

- This accountability study evaluated a program for replacing old diesel school buses with new, lower-emitting buses across the United States.
- The investigators compared student educational performance, school attendance, and respiratory emergency department visits among children in school districts that were selected for funding via a lottery mechanism with those in districts that were not selected for funding.
- Student educational performance and school attendance improved in districts that were selected for funding to replace old buses and improved the most in districts that replaced the oldest (pre-1990) diesel-powered school buses. There was no clear effect on emergency department visits.
- Community-level fine particle air pollution concentrations improved in school districts that had been selected for funding with the largest gains in districts that replaced the oldest buses, although it was not clear to what extent those improvements were driven by the new school buses.
- As electric school buses and other lower-emitting technologies become more widely available, additional benefits from continuing efforts to replace older school buses are expected and should be assessed.

APPROACH

Adar and colleagues evaluated the effects of the school bus replacement program by comparing school districts that were randomly selected in a lottery to those that entered the lottery but were not randomly selected (see **Statement Figure**). To see whether being selected for funding affected student health (based on school attendance and respiratory emergency department visits) or student performance (based on standardized tests of math and reading, writing, and related skills [hereafter referred to as *reading*]), the investigators compared these outcomes during the school year in which the school district entered the lottery to the following school year, when new school buses were expected to be in use.

To make the comparisons, the investigators collected information on lottery application details via a Freedom of Information Act request to the United States Environmental Protection Agency. They collected information on absenteeism and other school district characteristics from federal and state departments of education and on math and reading standardized test scores for children in grades 3–8 from a harmonized national dataset. They also obtained data on respiratory emergency department

This Statement, prepared by the Health Effects Institute, summarizes a research project funded by HEI and conducted by Dr. Sara D. Adar at the University of Michigan School of Public Health and her colleagues. The complete report, *Assessing the National Health, Education, and Air Quality Benefits of the United States Environmental Protection Agency's School Bus Rebate Program: A Randomized Controlled Trial Design*, ©2024 Health Effects Institute, can be downloaded from *www. healtheffects.org/publications*. **ADAR 221**

visits of school-aged children from low-income (i.e., Medicaid) health insurance records and on fine particulate air pollution for each school year from a publicly available dataset from air quality modeling.

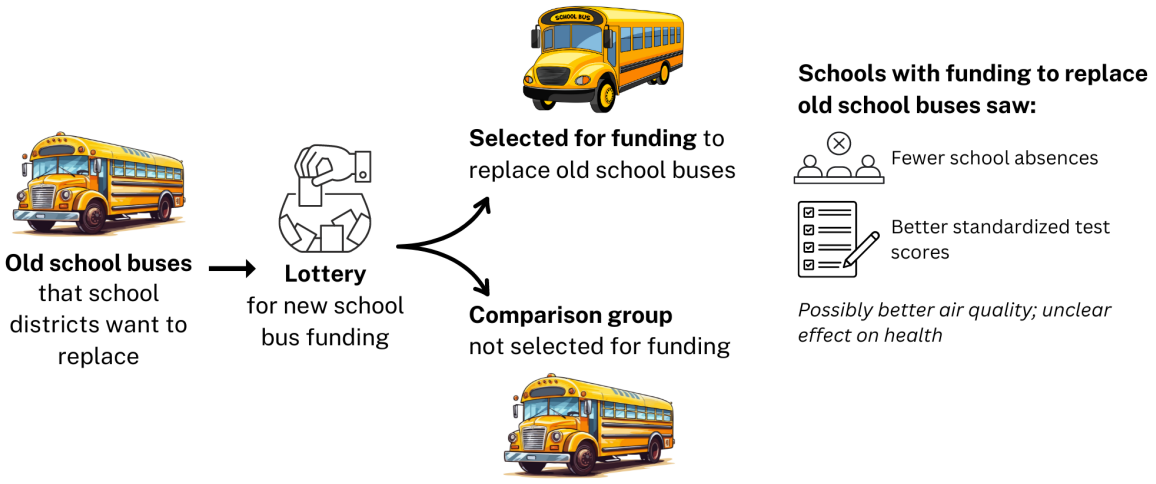
In their comparisons, Adar and colleagues accounted for student educational performance and health prior to the lottery, the region of the country in which the school district was located, and other school district characteristics. They tested the robustness of their results in many ways. For example, they compared results for school districts based on the ages of the school buses slated for replacement because larger gains would be expected the older the age (and therefore the higher the emissions) of the school bus being replaced.

KEY RESULTS

Adar and colleagues included 406 school districts that were selected for funding and 2,613 school districts that were not selected for funding in their analyses. School districts that were selected for funding had similar size, student demographics, and family incomes to those that were not selected for funding. Compliance with the intervention was high; 91% of school districts that were selected for funding documented the purchase of new school buses and scrappage of old school buses to receive the funding. Not all selected school districts had information available on what type of new school buses they purchased (if any), but in most cases where such information was available, old diesel school buses were replaced with new, less polluting diesel school buses. Few school districts that were selected for funding reported purchasing school buses that ran on other fuels, only one school district reported retrofitting a bus with emissions control technologies, and no school districts reported purchasing an electric school bus. No information was available on whether school districts that were not selected for funding also purchased new school buses or retrofit their existing school buses.

Adar and colleagues reported that in the year after the lottery, student test scores and school attendance improved the most in school districts that replaced the oldest (pre-1990) diesel school buses with newer school buses. There was also some indication of standardized test score and school attendance improvements in school districts where school buses slated for replacement were 1990s model years. The investigators indicated that the size of the effects on school attendance and test scores was comparable to those of typical interventions to reduce class size. They estimated that replacing pre-2000 model year buses through the program resulted in about 350,000 additional student-days of school attendance, presumed to be because of improved health, that otherwise would have been absences.

There was also a decrease in community-level, outdoor fine particle concentrations (i.e., a 1-μg/m^3 reduction) observed in the year after the lottery in districts where pre-1990 school buses were replaced. The magnitude of this decrease surprised the investigators because typical total outdoor fine particle concentrations in the United States are about 8 μg/m^3 and there are many other sources of air pollution. They could not identify any alternative explanations for these findings because the results did not change when they analyzed the data in different ways, for example, by looking at the change in outdoor fine particle concentrations instead of the concentrations themselves. They also showed that the outdoor fine particle concentration results did not change when accounting for potential differences or changes in school district characteristics or missing and excluded applications. Changes in emergency department visits for respiratory outcomes between communities selected for funding and not selected for funding were inconsistent and did not appear to be related to whether the school districts were selected for funding.



Statement Figure. Overview of the study by Adar and colleagues to assess a policy that provided funding to replace old school buses via a lottery mechanism. (Adapted from Investigators' Report Figure 1.)

HEI REVIEW COMMITTEE EVALUATION AND CONCLUSIONS

In its independent evaluation of the study, the Review Committee appreciated that Dr. Adar and colleagues brought together disparate datasets to conduct a novel and useful accountability study of a program to allocate funding for the replacement of old diesel school buses. Specifically, the Committee liked the approach to comparing school districts based on whether they were randomly selected for funding assuming they had replaced the school buses that they intended to replace, similar to how patients are randomly assigned treatments and the data are analyzed in trials of new medications. They agreed with the investigators that being selected for funding appeared to improve student educational performance and school attendance, especially when the intent was to replace pre-1990 school buses, and that the results for emergency department visits were less clear. The magnitude of the observed effect of being selected for funding on community-level, outdoor air pollution was larger than the Committee and the investigators expected, but the results were robust to sensitivity analyses (see above) and an alternative explanation could not be found. It was not clear how changing out a relatively small number of school buses could affect air quality in a school district so much. The Committee thought that the main results for school attendance and standardized test scores were well supported by the evidence.

In summary, selection for funding to replace or retrofit old school buses as part of the United States Environmental Protection Agency's program appears to have improved school attendance and standardized test scores, with the largest benefits for the replacement of the oldest (i.e., pre-1990) diesel school buses. The effects on emergency department visits for school-aged children and air quality are less clear and need further research. Results of the current study provide evidence of benefits of funding for school bus replacement programs by federal and state agencies. Additional focus on disadvantaged school districts and the adoption of new technologies like electric buses are also expected to reduce emissions from some of the oldest and highest emitting school buses. Therefore, it would be valuable to update the analyses in the future to evaluate the effects of programs to replace more of the older diesel school buses with newer and lower-emitting technologies. This work will be important to support the health and educational performance of schoolchildren and communities.

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