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Access to education and clean air: Urban policies in Warsaw primary schooling

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This work addresses the following topic(s) from the Call for Contributions:
(Please check at least one box)

☐ Placemaking to integrate urban spaces and mobility
☒ Promoting sustainable mobility choices in metropolitan regions
☐ Governing responsible mobility innovations
☒ Shaping the transition towards mobility justice
☒ System analysis, design, and evaluation
☐ other: _____

Extended Abstract

Problem statement

Childhood conditions, especially those related to education and health, play a pivotal role in determining well-being throughout one's life. Historically, the significance of outdoor air quality at educational institutions was given little attention in public education regulations across numerous countries. In Poland, despite children being entitled to compulsory education and health protection, there is a notable lack of systematic monitoring of inequalities in access to public education by local authorities responsible for compulsory schooling. Furthermore, school air quality monitoring is largely absent.

Research objectives

Our objective is to examine the relationship between access to public primary education and clean air in Warsaw primary schools. To address this, we investigate possible inequalities in public school performance, air pollution levels (specifically PM2.5 and NO2), and access to public schools by public transport. We group our research questions and, consequentially, the methods and results into three segments: relating to primary schools' performance, to primary schools and clean air, and to primary schools and public transport.

Hypothesis 1: There are inequalities in school performance between different districts and inner and outer districts in Warsaw.

Hypothesis 2A: There are significant inequalities in the annual average levels of PM2.5 and NO2 between schools in different districts and between Warsaw's inner and outer districts.

Hypothesis 2B: Implementing street closures around schools will decrease inequality in air pollution levels and an overall reduction in pollution around schools.

Hypothesis 3: Public transport in Warsaw does not provide equal access to public schools.

Methodological approach

Our study introduces a method to assess inequalities in air quality, school performance, and access to schools via public transport for all children starting compulsory primary education and living in Warsaw. There is no information at the municipality level of linking home and school addresses of students in compulsory education in Warsaw, and we do not know which child attends which school. However, we have data on home addresses on all 11 023 children pre-school age in Warsaw, provided by the city council, and we can model, which child (which address) attends which schools. We model primary school choices by considering three main criteria identified in a survey study, namely: the school's average results in the final exams, its proximity to a child's residence, and the school's capacity constraints.

Our environmental models provide detailed information on air quality around all primary schools in Warsaw. These concentrations were produced with a modelling setup that includes the Weather Research and Forecasting Model (WRF) to produce the 2019 meteorological fields for the EPISODE Air Quality (AQ) urban dispersion model. The emissions are from the Polish Institute for Environmental Protection. Moreover, with the use of the same models, we can simulate the air quality around schools upon three hypothetical interventions: no school-related private car traffic on the school street, reduced accessibility of the school street for cars, and no private car traffic at the school street.

We model transportation times based on all publicly available data. The information system used for the calculation of travel times from home to school is based on the Open Trip Planner (OTP), and we compute the travel times for both private cars and by public transport.

(Expected) results

Our analysis indicates that Warsaw's public transport system provides school connections of up to 24 minutes for approximately 90% of the first-grade children. In the inner districts, the average travel time to school for households with first graders is 9 min. 20 sec. In the outer districts, the respective time is 15 min. 30 sec. (66% more). At the same time the pollution is higher in the outer districts, because of higher car use and private home heating systems.

On average, schools witness 80 days annually where PM2.5 levels surpass the recommended threshold set by the WHO. While school street interventions can yield localized improvements in air quality, the broader negative externalities remain considerable without a comprehensive reduction in private car traffic.

Intriguingly, we observed minimal disparities in both academic outcomes and outdoor air quality across schools. These findings underscore the need for targeted urban policies to mitigate environmental hazards while ensuring equitable access to quality education.

The method developed in this study allows predictions and ex-ante planning for the optimization of public transport as well as the primary school network, based on the official permissions granted for houses and flats developments in Warsaw by the city officials. Such information can be used to predict the distribution of the school-age population, taking into account future newly developed areas where families with school-age children will prevail.

Furthermore, the presented algorithm enables scenario-based analyses of the consequences of novel transportation policy instruments. This can be achieved even when specific data on school selection remains safeguarded by the relevant data authorities.