Unequal Exposure to Air Pollution A Spatial Analysis of Vienna

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Background

Air pollution has a strong impact on the health and well-being of societies. According to the European Environment Agency, it poses the greatest environmental health risk in Europe (EEA,2021).

Environmental inequality hypothesis
"Pollution is unequally distributed across space and different social groups"

Theoretical mechanisms

- Selective siting
  Polluting sites and streets are built in high-minority neighbourhoods
- Selective migration
  Minority groups have different likelihoods of escaping from and moving into polluted neighbourhoods

Large body of evidence shows that inequality in air pollution persists between socioeconomic groups (e.g., Hajat et al., 2015; Neier, 2021; Glatter-Götz et al., 2019, Rüttenauer, 2018).

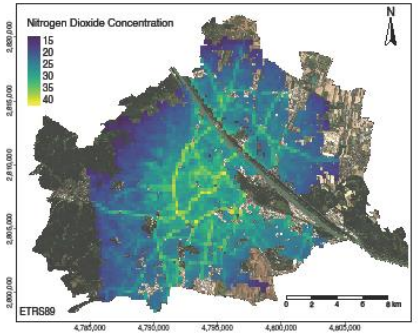
Existing studies are limited in terms of quality of data and/or methodological framework.

Research aim

The aim of our study is to investigate how the burden of air pollution is distributed across the city of Vienna (Austria). Are minorities/ socioeconomically disadvantaged groups more exposed to excessive pollution than others?

Data and Method

Combination of socioeconomic and pollution data
Spatial resolution: 250-meter grid
Time: 2019



NO_2 concentration in µg/m³
ensemble tree-based simulation (Lu et al., 2020) using:
station measurements, information from remote sensing instruments, meteorological measurements, the location of roads and industrial areas as well as population density

Socioeconomic data
Statistics Austria/ WIGeoGIS GmbH

Spatial lag model (250-meter grid)

$$Y_i = \beta M_i + \delta X_i + \rho \sum_{k=1}^{N} W_{ik} Y_k + \xi_d + \varepsilon_i$$

Y_i µg/m3 of NO_2
M_i % Minorities (non-Austrian/German origin)
X_i Vector of controls (population density, % 65+, income, I(% minorities, income)
ξ_i District fixed effects

Results

	Spatial autoregressive model			
	(1)	(2)	(3)	(4)
% Minorities	0.116***	0.112***	0.112***	0.121***
	(0.008)	(0.010)	(0.010)	(0.010)
Population		0.015	0.012	0.003
		(0.009)	(0.009)	(0.010)
% 65+		0.011	0.011	0.012
		(0.008)	(0.008)	(0.008)
Income		−0.015*	−0.016**	−0.053***
		(0.008)	(0.008)	(0.012)
I(% Minorities, Income)			−0.007	−0.021***
			(0.007)	(0.007)
District FE	No	No	No	Yes
(Pseudo) Rsq	0.779	0.780	0.780	0.788
Rho	0.87	0.86	0.86	0.82
N	3,201	3,201	3,201	3,201
AIC	4,256.7	4,254.4	4,255.2	4,180.9
Note:				*p<0.1; **p<0.05; ***p<0.01

> **We find a significant positive correlation between NO_2 concentration and the share of minorities at the 250-meter grid level across all models.**

Sensitivity and robustness analysis Our results are robust to changes in the specification of our main explanatory variable (e.g., % low SES countries as defined by Neier (2021), only non-Austrian origin) and different spatial aggregation levels (addressing the modifiable areal unit problem e.g., 500-meter grid, 1000-meter grid, district level).

Conclusion

Main findings We find robust evidence of environmental inequality in Vienna. A positive correlation between NO_2 pollution and minority share exists for different spatial aggregation levels and specifications.

Policy implications Urban planning (e.g., green space availability, transportation planning) can be a tool to reduce excessive exposure to air pollution for minority groups in intra-urban areas.

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