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Area-based structural indicators of pneumococcal vaccine uptake in older individuals – an ecological study

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Abstract

Background
Older adults are a high-risk population group for life-threatening invasive pneumococcal diseases. For this reason, the German Standing Committee on Vaccination (STIKO) at the Robert Koch Institute recommends pneumococcal vaccination for individuals aged 60 and older. However, vaccine uptake in this age group remains low. In addition to individual-level factors, regional and contextual characteristics also play a role in the utilization of preventive measures, including vaccinations. The aim of this study was to identify regional indicators associated with low pneumococcal vaccine uptake.

Methodology
We designed an ecological study at the level of districts (n=400). Based on nationwide outpatient claims data collected according to §295 of the German Social Code Book V (SGB V) from the year 2023, as well as publicly available data from the INKAR dataset (Indicators and Maps for Spatial and Urban Development) from the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), the study examined whether there were associations between vaccine uptake among individuals aged 60 to 67 (n = 8,187,263) in 2023 and regional indicators. This was first analyzed using global linear regression. Subsequently, geographically weighted regression (GWR) was used to examine whether and how these associations varied regionally.

Results
Of the total 8,187,263 insured individuals aged 60 to 67, 4.14% (99% confidence interval [CI]: 4.12–4.16%), corresponding to 338,848 individuals, received a pneumococcal vaccination in 2023. In a global linear regression model, four variables were identified as statistically significantly associated with vaccine uptake. The strongest association was observed for East-West affiliation of the districts: the proportion of vaccinated individuals was 1.8 percentage points higher in eastern than in western districts ($p<2\times10^{-16}$). The second strongest association showed unemployment rate: a 1% increase in this rate was associated with a 0.19 percentage point increase in the proportion of vaccinated individuals ($p=5.43\times10^{-9}$). Conversely, a 1% increase in the proportion of individuals with a lower secondary school certificate was associated with a 0.07 percentage point decrease in the proportion of vaccinated individuals ($p=5.25\times10^{-11}$). Population density showed a marginal but statistically significant negative association ($\beta=-0.0003$; $p=0.0005$). The multivariable model explained 62% of the regional variation in pneumococcal vaccine uptake. The local GWR model showed that the observed associations varied regionally.

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Conclusions
The findings of the study can serve as a basis for regionally tailored vaccination programs. To promote vaccine uptake, structural area-level factors should be considered in addition to individual barriers to vaccination.

Keywords

Geographically weighted regression, regional indicators, ecological study, pneumococcal vaccine uptake, statutory health insurance physician care

Citation

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