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Revisiting COVID-19 Maps with Bayesian Hierarchical Modelling: Socioeconomic Insights from Istanbul

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Objectives: This study explores the spatial disparities in COVID-19 incidence across neighborhoods in Uskudar, Istanbul, and examines the relationship between these disparities and neighborhood-level socioeconomic status.

Methods: This ecological study analyzed cumulative COVID-19 case data for 33 neighborhoods in Uskudar, collected up to 31 December 2020. Socioeconomic status was assessed using the Socioeconomic Development Index (SEDI) scores from Istanbul Metropolitan Municipality. Spatial analysis included Moran's I statistics and Local Indicators of Spatial Association (LISA) cluster analysis. Bayesian Hierarchical Modeling with the Besag-York-Mollie (BYM) model was employed to decompose spatially structured and unstructured variations, adjusting for SEDI scores and their sub-components. Model validation involved convergence diagnostics and Monte Carlo error assessments.

Results: A total of 29,834 COVID-19 cases were identified, with an incidence rate of 56.1 per 1000 residents. Spatial analysis revealed significant clustering of high incidence rates in peripheral and inner city neighborhoods. Moran's I statistic for COVID-19 incidence was 0.331 ($p = 0.003$), indicating positive spatial autocorrelation. SEDI scores were also spatially autocorrelated (Moran's $I = 0.293$; $p = 0.005$) and negatively correlated with COVID-19 incidence ($r = -0.570$; $p = 0.001$). Bayesian hierarchical models confirmed the association between lower socioeconomic status and higher COVID-19 incidence, even after adjusting for spatial autocorrelation.

Conclusions: The study highlights significant spatial and socioeconomic disparities in COVID-19 incidence in Uskudar, Istanbul. Lower socioeconomic status is associated with higher COVID-19 incidence, underscoring the need for region-specific public health strategies that consider socioeconomic factors. These findings can guide future interventions to mitigate the impact of the pandemic on vulnerable populations.

Key messages:

- Study reveals COVID-19 incidence in Uskudar is significantly influenced by socioeconomic status, highlighting need for targeted health interventions.
- Positive spatial autocorrelation found in COVID-19 cases and socioeconomic index suggests clustering in specific Uskudar neighborhoods.