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Exploration of spatiotemporal heterogeneity and socio-demographic determinants on COVID-19 incidence rates in Sarawak, Malaysia

Piau Phang^{1*}, Jane Labadin¹, Jamaludin Suhaila², Saira Aslam¹ and Helmy Hazmi³

Abstract

Background In Sarawak, 252 300 coronavirus disease 2019 (COVID-19) cases have been recorded with 1 619 fatalities in 2021, compared to only 1 117 cases in 2020. Since Sarawak is geographically separated from Peninsular Malaysia and half of its population resides in rural districts where medical resources are limited, the analysis of spatiotemporal heterogeneity of disease incidence rates and their relationship with socio-demographic factors are crucial in understanding the spread of the disease in Sarawak.

Methods The spatial dependence of district-wise incidence rates is investigated using spatial autocorrelation analysis with two orders of contiguity weights for various pandemic waves. Nine determinants are chosen from 14 covariates of socio-demographic factors via elastic net regression and recursive partitioning. The relationships between incidence rates and socio-demographic factors are examined using ordinary least squares, spatial lag and spatial error models, and geographically weighted regression.

Results In the first 8 months of 2021, COVID-19 severely affected Sarawak's central region, which was followed by the southern region in the next 2 months. In the third wave, based on second-order spatial weights, the incidence rate in a district is most strongly influenced by its neighboring districts' rate, although the variance of incidence rates is best explained by local regression coefficient estimates of socio-demographic factors in the first wave. It is discovered that the percentage of households with garbage collection facilities, population density and the proportion of male in the population are positively associated with the increase in COVID-19 incidence rates.

Conclusion This research provides useful insights for the State Government and public health authorities to critically incorporate socio-demographic characteristics of local communities into evidence-based decision-making for altering disease monitoring and response plans. Policymakers can make well-informed judgments and implement targeted interventions by having an in-depth understanding of the spatial patterns and relationships between COVID-19 incidence rates and socio-demographic characteristics. This will effectively help in mitigating the spread of the disease.

Keywords COVID-19, Spatiotemporal heterogeneity, Socio-demography, Spatial lag, Spatial error model, Geographically weighted regression

*Correspondence:

Piau Phang

pphang@unimas.my

Full list of author information is available at the end of the article



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