

MED/OP/02

Spatial Distribution and the Ecological Drivers of Lung Cancer Incidence in Sri Lanka

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Background: Cancer is a growing public health burden in Sri Lanka with lung cancer ranking the second most common cancer in Sri Lankan males. Furthermore, the burden of cancer is disproportionately distributed over space and the detection of high-incidence areas can help targeted cancer prevention.

Objective: This ecological study explored the spatial distribution of lung cancer incidence in Sri Lanka for 2016-2021 and assessed spatial relationships with land cover, fine particulate matter (PM_{2.5}), and selected socioeconomic factors.

Methods: Five-year cumulative lung cancer incidence in each of the 25 districts, from the National Cancer Registry, as a percentage of district and sex-wise population, and socioeconomic data from the Department of Census and Statistics were used. Land cover data from the Moderate-Resolution-Imaging-Spectroradiometer (MODIS) and district-wise PM_{2.5} concentrations estimated using satellite-based aerosol-optical-depth data from MODIS, MISR, and SeaWiFS, processed via the GEOS-Chem chemical transport model and spatially averaged to the district level, and downloadable in the Google Earth Engine were used. Spatial clustering was assessed by Global Moran's I (Queen's continuity). Local clusters were identified using Local Moran's I. Ordinary Least Squares (OLS) regression was used to assess associated ecological drivers.

Results: Significant global spatial correlation was observed for lung cancer across 25 districts in males (0.384, $p=0.006$) and females (0.319, $p=0.010$). Males exhibited high incidence clusters in Gampaha, Kalutara, and Kurunegala. Female high-incidence clusters were in Gampaha, Kalutara, and Kegalle. The best OLS model for males (adjusted- $R^2=0.636$) retained PM_{2.5} ($\beta=3.899$, $p=0.004$), urban land cover ($\beta=1.258$, $p<0.001$), elderly population ($\beta=4.615$, $p=0.012$), and per capita income ($\beta=0.001$, $p=0.052$) as positive predictors, and water cover ($\beta=-4.158$, $p<0.001$) as a negative predictor. The 5-year-PM_{2.5} concentration for females had positive coefficient ($\beta=4.75$, $p=0.065$).

Conclusion: Findings reveal significant spatial heterogeneity in lung cancer incidence, with sex-specific patterns and ecological drivers. PM_{2.5} exposure was a significant predictor.

Keywords: Ecological factors, Lung cancer, Spatial analysis, Air pollution