035-04: MODELLING SPATIOTEMPORAL PATTERNS OF VISCERAL LEISHMANIASIS INCIDENCE IN INDIA USING ENVIRONMENT, BIOCLIMATIC AND DEMOGRAPHIC DATA, 2013-2021

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Visceral leishmaniasis (VL) is a vector-borne disease caused by *Leishmania donovani* and transmitted through infected female *Phlebotomus argentipes* sandflies. In India, VL has been endemic in 633 subdistricts (blocks) spread over 54 districts in four states (Bihar, Jharkhand, Uttar Pradesh and West Bengal) affecting nearly 150 million people. As of 2020, the National Kala-azar Elimination Programme has achieved VL elimination (<1 case / 10,000 population/year in each 'block') in 596 blocks. There is a need for sustaining the elimination level in these blocks, while a more targeted approach is necessary to achieve the WHO 2030 target in those blocks where elimination has not been reached. In an earlier publication, applying a statistical model on surveillance data collected from the states of Bihar and Jharkhand in India, we forecasted monthly VL incidence at the block level. The model predictions may be used to help the programme for logistics management in advance. In this study, we have improved the predictive power of the model incorporating (i) environmental, bioclimatic and

demographic factors that influence VL transmission dynamics, and (ii) spatial, temporal and spatiotemporal random effects to minimize the variability unexplained by the above factors. We modelled the spatiotemporal distribution of reported VL cases for a 9-year period (2013-2021) in the states of Bihar and Jharkhand and its association with environmental, bioclimatic and demographic factors using non-parametric models with space-time interactions. A negative binomial distribution was assumed to describe the block level monthly VL cases. Initially, we fitted 46 models to a training data set (2013-2018) using the Bayesian inference via Integrated Nested Laplace Approximation (INLA) approach. The best fitting model was selected based on deviance information criterion (DIC) and was validated with a test data set (2019-2020). The model was further used to forecast VL incidence beyond the period of observations (2021-2022). We found that minimum temperature, enhanced vegetation index, population density and, isothermality played a positive role in VL occurrence. Conversely, precipitation, maximum temperature and soil moisture were negatively associated. During both training and testing periods, model predictions agree with the observed declining trends in many blocks both above and below the elimination threshold. Predictions beyond the period of observations (2021-2022) showed that the annual incidence is more likely to exceed the elimination threshold in the blocks where the reported VL incidence was > 6 per 10,000 population in 2013. Our spatiotemporal modelling framework with environmental, bioclimatic and demographic factors could better explain spatiotemporal patterns in VL incidence at block level and therefore may be used to forecast trends in incidence during post-elimination. Model predictions for 2022 highlighted the need for targeted control measures in blocks where the annual incidence was > 6 per 10,000 population in 2013 to achieve elimination.

Keywords KALA-AZAR; LEISHMANIASIS; SPATIOTEMPORAL TRANSMISSION; FORECASTING; INDIA

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