Evaluating Spatiotemporal Dynamics of Snakebite in Sri Lanka

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Snakebite data has shown spatial and temporal variations in many countries and regions. Yet, no study has evaluated spatiotemporal patterns of snakebites across a country in detail. We used data from the National Snakebite Survey (NSS), which sampled 0.8% of the national population (165665 people) living in 1118 clusters representing all the provinces. Explanatory variables of previously published spatial and temporal models for the NSS data were considered as candidate explanatory variables for our spatiotemporal models. Spatial prediction models for snakebite incidence was a geostatistical binomial logistic model and the temporal prediction model was a Poisson log-linear model, which predicted snakebite incidence at the national level. These spatial and temporal models could not explain locally varying temporal patterns in the country. Therefore, we constructed spatiotemporal models at the provincial levels. The NSS was conducted for 11 consecutive months, and different clusters were surveyed in each month. Therefore, the NSS can be considered as a set of 11 repeated cross-sectional surveys at different locations. NSS captured bite events that occurred in the survey month and in the 12 preceding months. Hence, each individual provided information regarding the number of bites experienced in each of 13 months. In the NSS data, the location of each sampled individual was fixed at the cluster centroid and the data contain the month of each recorded bite, if any, over a 13 month period covering the survey month and each of the preceding 12 months. We modelled the data from each cluster as an inhomogenous Poisson process with cluster-level explanatory variables and estimated the model parameters by maximising the pooled log-likelihood over all. The fitted cluster-level spatiotemporal models were aggregated so as to predict the province-level monthly bite incidence rates in Sri Lanka. Snakebite incidence showed complex spatiotemporal patterns in Sri Lanka. Models fitted for Southern, North Central, Uva and Sabaragamuwa provinces showed both spatial and temporal variation in snakebites. The geographical extent of the high-risk areas (i.e. hotspots) in these provinces dynamically changed over a period of a year. The remaining five models (i.e. Western, Central, North Western, Northern and Eastern) did not show any spatio-temporal interaction, in risk, i.e. the geographical extent of the hotspots persisted throughout the year. Southern, Sabaragamuwa and North Central provinces showed triannual seasonal trends. High snakebite incidences in Southern and Sabaragamuwa provinces were noticed in April followed by December and August to September. Peak incidences in North Central province were seen in November and another two smaller peaks were observed in April and July. Uva province showed a biannual trend with highest incidences in June followed by December. These findings can inform healthcare decision-making at local level, taking account of the seasonal variations in order to prevent and manage snakebites in Sri Lanka.

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