A geostatistical analysis of snakebite risk in Kenya

P2-B5

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Geostatistical analysis supports prediction of snakebite risk distribution in Kenya, where routine surveillance data is incomplete.
Covariate associations dominate risk predictions from community survey data, with small-scale spatial correlation seen.

BACKGROUND

- Approximately 138,000 snakebite deaths/year globally
- High-quality burden data lacking:
  - Routine surveillance data low quality/incomplete
  - Community surveys expensive and difficult to conduct
- Spatial analysis techniques an alternative to estimating risk distribution: effective in understanding disease epidemiology in areas with data availability challenges.

METHODS

- Snakebite risk data was collected from contrasting settings in Kenya
- Cluster-sampled survey: Turkana and Kitui Counties
- Full-population survey: Siaya County
- Household residents screened for history of snakebite
- Model based geostatistics, using environmental, climatic and sociodemographic explanatory factors, was used to assess the spatial variation in snakebite risk.

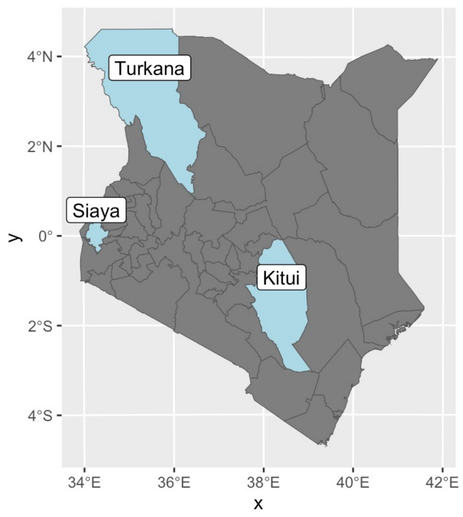

Fig. 1. Community survey locations

RESULTS

Table 1. Key survey outcomes

	Any episode	Snakebite only	Snake spitting in eye only	Total sampled
Turkana	839 (7.9%)	782 (7.5%)	60 (0.6%)	10,494
Kitui	571 (3.7%)	317 (2.1%)	267 (1.7%)	15,307
Siaya	896 (0.4%)	-	-	211,180

- Lifetime risk positively associated with poverty and distance to cultivated land and herbaceous areas
- Survey site statistically significant
- Residual spatial correlation found at small spatial scale (~ 2.5km).

Table 2. Binomial geostatistical model output for joint analysis

Regression parameter	Estimate	Standard error	P value
Intercept	-4.7177	0.3203	<0.001
Siaya county	-2.7897	0.3283	<0.001
Poverty	2.1636	0.4436	<0.001
Distance to herbaceous area edges	0.0324	0.0147	0.0277
Distance to cultivated areas	0.0298	0.0136	0.0290
Log (sigma^2)	-0.8133	0.2247	
Log (phi)	7.8541	0.2316	
Phi (metres)	2,576		
Log (tau^2)	-2.2478	0.7841	

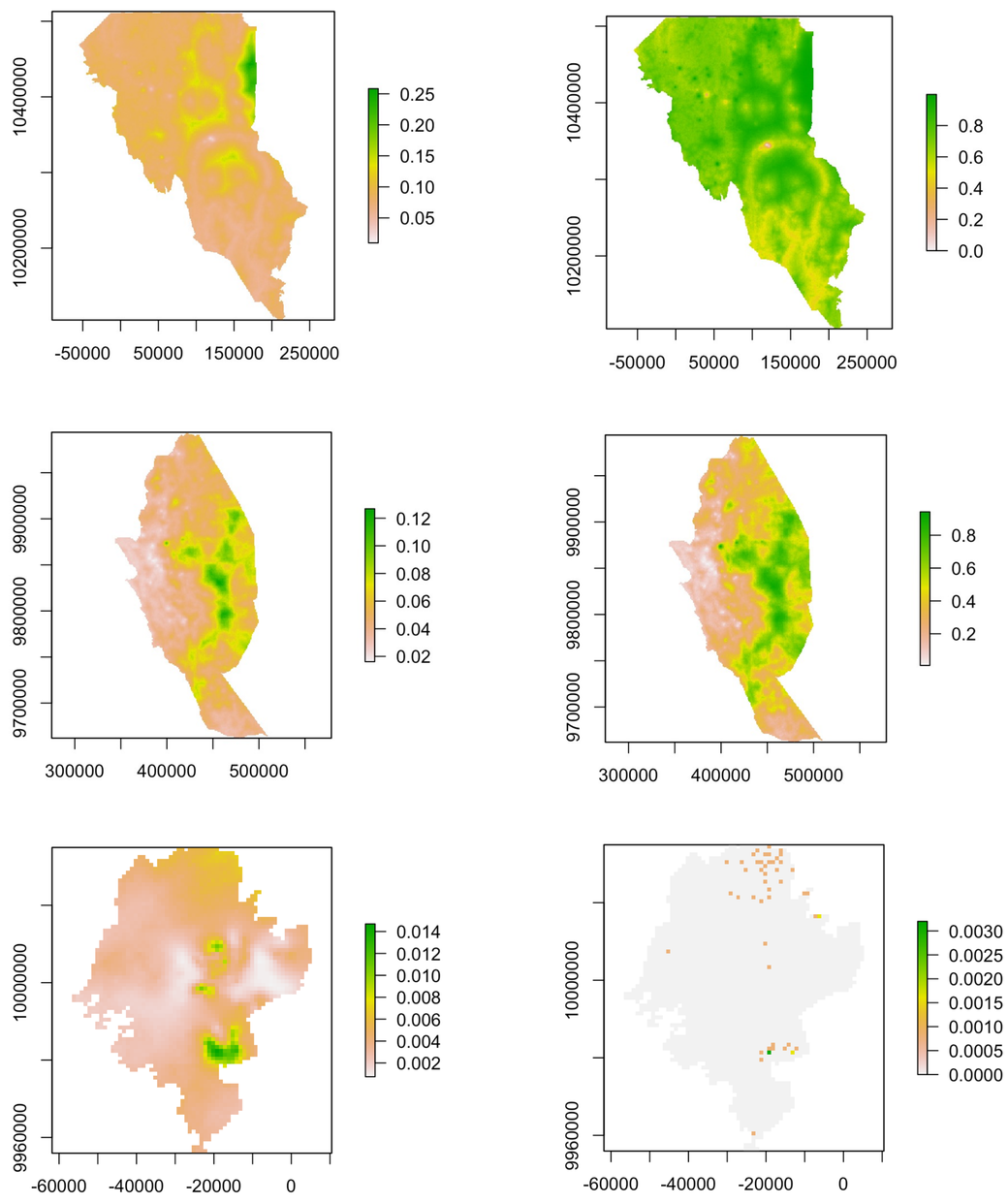

Fig. 2. Predicted lifetime risk of snakebite. Predictions derived from geostatistical model. Left: predicted lifetime prevalence; right: exceedance probability (5% threshold). Top. Turkana; Middle. Kitui; Bottom. Siaya.

CONCLUSIONS

- Importance of poverty across counties as a predictor of risk
- Small-scale (village/group of villages-level) spatial variation: potential importance of specific local non-spatial factors on risk
- Enables potential prediction of risk across counties where health system is weaker and routine data less unreliable
- Further analysis from contrasting settings (different snake habitats and sociodemographic environments) needed to refine predictions

ADDITIONAL KEY INFORMATION

- Email: shelui.collinson@lstmed.ac.uk
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