

From River to Residence: Inter-scalar Environmental Determinants of Typhoid in Central Division, Fiji.

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Background: Interactions between distal ecological conditions and proximal conditions of the lived environment and the microbiological and physicochemical characteristics of residential settings deserve greater attention for their potential to influence the risk of typhoid transmission.

Methods: We calculated burden and spatiotemporal nature of enteric fever attributable to *Salmonella* Typhi in Central Division, Republic of Fiji, and defined level of disease incidence and recurrence at a sub-catchment scale. We used quantitative analysis to explore relationships between subcatchment environmental characteristics and incidence and recurrence of typhoid (January 2013 - July 2015). Using a case-control design at residential scale, we investigated bacterial contamination and chemical composition of water and soil as vehicles of exposure, complementing these data with observational analysis of residential living conditions and spatial analysis of household position at case and control locations.

Results: There were 236 confirmed typhoid fever cases in 18 of 23 inhabited sub-catchments (370, 570 population) over the study period. Average incidence per sub-catchment was high at 205.9/100,000, with cases recurring each calendar year in 26% of sub-catchments. The most parsimonious models for incidence and recurrence included total high erosion risk area ($p=0.034, 0.05$), % area highly erodible ($p=0.028, 0.09$), connectivity between road and river networks ($p=0.063, 0.11$) and riparian forest fragmentation ($p=0.026, 0.13$) as predictor variables. At residential scale typhoid exposure risk was significantly associated with phosphate (OR 4.235, $p=0.042$) and *E. coli* concentrations (OR 2.248, $p=0.029$) in toilet drainage soil and external (OR 3.712, $p<0.001$), drinking water (OR 2.732, $p=0.003$) and sanitary (OR 1.973, $p=0.031$) factors with mechanistic connections to determinants at subcatchment scales.

Conclusions: This study suggests that anthropogenic alteration of land cover and hydrology at distal and proximal scales increases risk of exposure where sediment yields increase following runoff and combines with practices associated with faecal contamination of residential spaces facilitating increased transmission of typhoid fever.