Assessing the Spatial Influence of Deforestation on Malaria Incidence in Pará State, Amazon Region, Brazil, 2008 - 2019

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Background: Malaria transmission is prevalent in tropical regions and is heavily influenced by environmental factors such as deforestation, which is particularly significant in the Brazilian Amazon, especially in Pará state. The interplay between malaria transmission, forest cover, and deforestation is intricate, directly affecting all transmission components; vector, host, and the environment.
Objectives: This study aimed to assess the relationship between deforestation indicators and malaria incidence across all 144 municipalities in Pará.
Methods: Using municipal-level data from 2008 to 2019, the study applied Geographically Weighted Regression (GWR) to analyse spatial relationships between malaria incidence and deforestation metrics. These metrics included forest cover loss from the previous year, pastureland, forest cover, fragmentation, urbanisation, and water levels, analysed over three distinct 4-year periods. The study also incorporated poverty levels to examine their influence on municipalities with high malaria risk.
Findings: During the study period, the total deforested area in Pará was 30,000 km² accounting for approximately 2.5% of the state's total area, with 679,846 malaria cases reported, including 566,014 cases of *P. vivax* (83%), 94,564 cases of *P. falciparum* (14%), 10,319 mixed infections (2%), and 8,949 cases caused by other malaria parasites (1%). Malaria incidence rates varied across municipalities, with stable rates in high-risk areas, and were linked to pastureland, forest loss, fragmentation, and forest cover. The GWR models explained 31%, 29%, and 46% of the variance in malaria incidence rates across three temporal periods. The GWR models effectively captured spatial heterogeneity in these interactions.
Main Conclusions: Malaria incidence was associated with areas of the Pará state experiencing significant forest loss and fragmentation, indicating that changes in forest composition and configuration influence malaria risk.