Spatial Pattern and Predictors of Malaria in Ethiopia: Application of Auto Logistics Spatial Regression

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Abstract : Introduction: Malaria is a severe health threat in the World, mainly in Africa. It is the major cause of health problems in which the risk of morbidity and mortality associated with malaria cases are characterized by spatial variations across the county. This study aimed to investigate the spatial patterns and predictors of malaria distribution in Ethiopia. Methods: A weighted sample of 15,239 individuals with rapid diagnosis tests was obtained from the Central Statistical Agency and Ethiopia malaria indicator survey of 2015. Global Moran's I and Moran scatter plots were used in determining the distribution of malaria cases, whereas the local Moran's I statistic was used in identifying exposed areas. In data manipulation, machine learning was used for variable reduction and statistical software R, Stata, and Python were used for data management and analysis. The auto logistics spatial binary regression model was used to investigate the predictors of malaria. Results: The final auto logistics regression model reported that male clients had a positive significant effect on malaria cases as compared to female clients [AOR=2.401, 95 % CI: (2.125 - 2.713)]. The distribution of malaria across the regions was different. The highest incidence of malaria was found in Gambela [AOR=52.55, 95%CI: (40.54-68.12)] followed by Beneshangul [AOR=34.95, 95%CI: (27.159 - 44.963)]. Similarly, individuals in Amhara [AOR=0.243, 95% CI:(0.1950.303],Oromiya[AOR=0.197,95%CI:(0.1580.244)],DireDawa[AOR=0.064,95%CI(0.049-0.082)],AddisAbaba[AOR=0.057,95%CI:(0.044-0.075)], Somali[AOR=0.077,95%CI:(0.059-0.097)], SNNPR[OR=0.329, 95%CI: (0.261- 0.413)] and Harari [AOR=0.256, 95%CI:(0.201 - 0.325)] were less likely to had low incidence of malaria as compared with Tigray. Furthermore, for a one-meter increase in altitude, the odds of a positive rapid diagnostic test (RDT) decrease by 1.6% [AOR = 0.984, 95% CI :(0.984 - 0.984)]. The use of a shared toilet facility was found as a protective factor for malaria in Ethiopia [AOR=1.671, 95% CI: (1.504 - 1.854)]. The spatial autocorrelation variable changes the constant from AOR = 0.471 for logistic regression to AOR = 0.164 for auto logistics regression. Conclusions: This study found that the incidence of malaria in Ethiopia had a spatial pattern that is associated with socio-economic, demographic, and geographic risk factors. Spatial clustering of malaria cases had occurred in all regions, and the risk of clustering was different across the regions. The risk of malaria was found to be higher for those who live in soil floor-type houses as compared to those who live in cement or ceramics floor type. Similarly, households with thatched, metal and thin, and other roof-type houses have a higher risk of malaria than ceramic tiles roof houses. Moreover, using a protected anti-mosquito net reduced the risk of malaria incidence.
Keywords : malaria, Ethiopia, auto logistics, spatial model, spatial clustering
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