Kasus Malaria Lokal yang Dipengaruhi Iklim: Faktor Prediktor dan Analisis Komparatif Global di Afrika, Asia, Amerika Utara, dan Amerika Selatan (2015-2023)

Chengetai, Chitambwe Tadius

Abstrak

Malaria tetap sangat sensitif terhadap perubahan iklim dan lingkungan, namun jalur yang menghubungkan variabilitas iklim dengan risiko penyakit berbeda di berbagai wilayah. Studi ini meneliti peran sensitivitas lingkungan, kapasitas adaptif, faktor demografis, dan heterogenitas regional dalam membentuk kejadian malaria endemik di 46 negara endemik di Afrika, Asia, Amerika Utara, dan Amerika Selatan dari tahun 2015 hingga 2023, menggunakan data panel sekunder yang dikumpulkan dari World Health Organization Global Health Observatory (WHO-GHO), World Health Organization Global Health Expenditure Database (WHO-GHED), World Health Organization and United Nations Children's Fund Joint Monitoring Program for Water Supply, Sanitation and Hygiene (WHO/UNICEF JMP), World Bank World Development Indicators (WDI), National Aeronautics and Space Administration Moderate Resolution Imaging Spectroradiometer (NASA MODIS), European Center for Medium-Range Weather Forecasts Fifth Generation Land Reanalysis (ERA5-Land), and Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS). Dengan menggunakan pendekatan data panel, regresi efek tetap digunakan untuk menilai efek iklim langsung, sementara analisis mediasi dan moderasi meneliti jalur tidak langsung dan kapasitas adaptif. Stratifikasi regional dan Indeks Kerentanan Malaria (MVI) komposit melengkapi analisis tersebut. Suhu dan curah hujan menunjukkan efek heterogen di berbagai wilayah. Indeks Vegetasi Perbedaan Normalisasi (NDVI) dan akses air bersih menunjukkan efek mediasi parsial, tetapi umumnya lemah. Faktor sosioekonomi dan demografi menunjukkan moderasi terbatas dalam analisis gabungan, tetapi interaksi spesifik wilayah yang signifikan muncul setelah stratifikasi. Akses ke air minum bersih merupakan prediktor terkuat di Afrika, sedangkan faktor iklim, ekonomi, dan urbanisasi lebih berpengaruh di Asia. Amerika Utara menunjukkan beberapa efek langsung yang signifikan, sementara Amerika Selatan menunjukkan efek moderasi yang lebih kuat. Studi ini menyimpulkan bahwa kerentanan masyarakat adat terhadap malaria bersifat multidimensional dan bergantung pada konteks, dengan faktor iklim, lingkungan, kapasitas adaptasi, dan demografi yang menunjukkan pengaruh heterogen di berbagai wilayah endemik.Malaria remains highly sensitive to climatic and environmental changes, yet the pathways linking climate variability to disease risk differ across regions. This study examined the roles of environmental sensitivity, adaptive capacity, demographic factors, and regional heterogeneity in shaping indigenous malaria incidence across 46 endemic countries in Africa, Asia, North America, and South America from 2015 to 2023, using secondary panel data compiled from the World Health Organization Global Health Observatory (WHO-GHO), World Health Organization Global Health Expenditure Database (WHO-GHED), World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (WHO/UNICEF JMP), World Bank World Development Indicators (WDI), National Aeronautics and Space Administration Moderate Resolution Imaging Spectroradiometer (NASA MODIS), European Centre for Medium-Range Weather Forecasts Fifth Generation Land Reanalysis (ERA5-Land), and Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS) datasets. Using a panel-data approach, fixed-

effects regression was employed to assess direct climate effects, while mediation and moderation analyses examined indirect and adaptive-capacity pathways. Regional stratification and a composite Malaria Vulnerability Index (MVI) complemented the analyses. Temperature and rainfall showed heterogeneous effects across regions. The Normalised Difference Vegetation Index (NDVI) and safe water access exhibited partial, but generally weak, mediation effects. Socioeconomic and demographic factors showed limited moderation in pooled analyses, but significant region-specific interactions emerged after stratification. Access to safely managed drinking water was the strongest predictor in Africa, whereas climate, economic, and urbanisation factors were more influential in Asia. North America exhibited multiple significant direct effects, while South America demonstrated stronger moderation effects. The study concludes that indigenous malaria vulnerability is multidimensional and context-dependent, with climatic, environmental, adaptive capacity, and demographic factors exhibiting heterogeneous effects across endemic regions. <hr />