

Geography as Destiny: A Study of the Determinants of Malaria Risk in the Bunkpurugu-Yunyoo District, Northern Ghana, 2010-2013

Abstract:

Between October 2010 and March 2013, the Anemia and Parasitemia Study (AP1-6), a series of community prevalence surveys, was conducted in the Bunkpurugu-Yunyoo District of Northern Ghana by collaborators from the CDC Atlanta, the University of Ghana and the Ghana Health Service. The surveys spanned three rainy and three dry seasons, as malaria prevalence varies depending on season. The surveys resulted in data for 11,945 children under the age of 5 years from 179 communities. Secondary data analysis was conducted to enrich the dataset with remote sensing data such as NDVI, elevation, Human Influence Index (HII) to define the geographic patterns of malaria prevalence in the study area and to use statistical tools to delineate the main drivers of malaria prevalence in the study area.

The geographic variables, NDVI, Human Influence Index (HII), ecologic zone, and elevation and were statistically significant in relation to microscopic parasitemia. The demographic and economic variables, age of child, age of caregiver, ethnicity, occupation of caregiver, education of caregiver, primary source of water, health insurance and wealth quintile were statistically significant for both the rainy and dry seasons in relation to microscopic parasitemia. Roof materials and gender were not statistically significant. The malaria control variables, indoor residual spraying (IRS), antimalarial use, and ACT use were statistically significant for both the rainy and dry seasons in relation to microscopic parasitemia. However, bed net use was not statistically significant for both the rainy and dry seasons in relation to microscopic parasitemia. Analysis showed a zonal phenomenon when comparing ecologic zones using defined areas of towns, rocky uplands, and riverine plains. Zone 4 displayed demographic and geographic variability within the district. There were distinct disadvantages in economics, wealth, microscopy rates, severe and moderate anemia, and fever history.

Findings from this study show significant geographic, demographic and economic differences in the Bunkpurugu-Yunyoo District. In an area with high malaria prevalence, the typical “one-size-fits-all” approach to malaria control will need to be altered to meet the needs of the district. Further analysis should be done to discover the best approach for malaria control.

Public Health Competencies

The Public Health Competencies covered during the internship were: epidemiology planning activities, conducting research and epidemiologic investigations, data management, analysis, and interpretation, communication, teams and systems, and community, population-level thinking. At the start of the internship a literature review was done to compare the study to other successful studies and to find a specific plan for action. Studies were used to start statistical and geographical analysis plans. I used both SAS and ArcGIS to gather, enter, and analyze the survey data. The original dataset had 11,945 observations and 246 variables. I cleaned and organized the data for Community Name consistency and added 53 variables to the dataset. I ran frequency and logistic regression analysis on the variables, creating graphs and table to show the findings and interpreted odds ratios for my internship preceptor and other colleagues. I communicated with my internship preceptor and colleagues of the Emerging Pathogens Institute, Noguchi Institute of Ghana, and the CDC Atlanta. Charts and findings were distributed to my internship preceptor and were shared to those involved with the study. I have established a working partnership with individuals in the Emerging Pathogens Institute and at the Noguchi Institute in Ghana. After the internship is completed, I will have submitted an abstract to the ASTMH Tropical Medicine Conference and will be working on multiple publications with the findings.

Public Health Significance

In Ghana, the entire population, 23 million individuals, are at risk of contracting malaria. Malaria is the leading cause of death in Ghana in children under 5, and the Ghana Health Service reports that 36% of hospitalized patients due to malaria in 2008. In children under five, there are 14,000 deaths caused by the disease. With help from the PMI and other stakeholders, Ghana has implemented multiple malaria control programs including Indoor Residual Spraying (IRS) and Insecticide Treated Nets (ITN) campaigns. These vector control methods have largely been targeted using a “one size fits all” approach. However, questions have arisen regarding the efficacy of IRS in the northern savannah based on epidemiologic and entomologic monitoring. In recent years, the Ghana Health Service and its partners, with technical guidance from the WHO, have shown interest in moving beyond the “one-size-fits-all” approach, to make more optimal use of limited malaria control resources. A CDC/Univ. of Ghana team established a study district in an IRS target area in the savannah zone of northern Ghana. During serial community anemia and parasitemia surveys in 2010-13 they found unexpectedly strong geographic heterogeneity in baseline malaria transmission within this small district. Preliminary data suggested an initial hypothesis that terrain (esp. slope), remoteness (e.g. distance from roads and health facilities), density of settlement were the main drivers, with ethnicity/cultural practices as a possibly important confounder. This discovery has potential implications both for targeting malaria control efforts and for designing impact evaluation in the savannah zone. Geographic heterogeneity in Ghana’s rural savannah environment has hitherto been little studied and under-appreciated. Using the findings from our study, malaria control approaches can be altered to fit the needs of the district.