Climate Change, Social Well-Being and Disease Pattern in Urban Nigeria

Dr. Yemi Adewoyin
Department of Geography
University of Nigeria, Nsukka, Nigeria
and
Schools of Public Health and Social Sciences,
University of the Witwatersrand, South Africa
yemiadewoyin@yahoo.com

and

Prof. Aina Thompson Adeboyejo
Department of Urban and Regional Planning
Ladoke Akintola University of Technology,
Ogbomoso, Nigeria
thompsonadeboyejo@yahoo.com

Abstract

As most disease eradication drives dwell more on controlling the proximal causes of diseases, this study investigates the impact of climatic parameters and the population's social well-being on disease prevalence on the premise that these conditions promote the preponderance of the proximal causes. Data on rainfall and temperature, socioeconomic indices and malaria prevalence were analyzed using Standard Deviation, Kurtosis, Pearson Product Moment Correlation and Multiple Regression. The results show an increase in malaria prevalence while changes in the climatic parameters and socioeconomic conditions accounted for 78.6% of the variations in malaria prevalence ($R2 = 0.786$, $P \leq 0.001$). The regression equation was used to project the incidence of malaria in the study area from 310 cases per 1,000 Population in 2016 to 366 cases per 1,000 Population in 2050. Greater attention should be paid to improving the socioeconomic conditions of the population for improved urban health.

Keywords: Climatic parameters, Socioeconomic Conditions, Health and Disease, Malaria, Temporal Patterns, Urban Nigeria

Introduction

This study investigates the impacts of the changes in climatic parameters and socioeconomic conditions on disease prevalence in Nigeria using malaria as a case study. Malaria is a leading cause of mortality in Nigeria with over 225,000 deaths annually from an estimated 100 million cases (Nigeria, 2013). The Nigerian National Malaria Control Programme (NMCP) puts Nigeria's annual economic loss to Malaria at N132bn in the form of treatment costs, prevention and loss of man-hour among others (NPC, NMCP and ICF, 2012; LASG, 2013). Climate change causes increase in temperature, rainfall, and humidity thereby increasing the reproduction capacities of mosquitoes (malaria vectors) and results in increase in malaria transmission (Jetten, et al, 1996; Reiter, 2001; Oluleye and Akinbobola, 2010; Zacarias and Andersson, 2011; Adeboyejo et al, 2012). Malaria has also been shown to be a disease of poverty (Worrall et al, 2003; Sachs and Malaney, 2002, Gallup and Sachs, 2001) as only 0.2% of global malaria deaths are found in the world's richest population quintile while 57.9% of global malaria deaths are concentrated among the world's poorest population quintile (Gwatkin and Guillot, 2000).

In answering the research question on what the individual and joint contributions of variations in climatic and socioeconomic conditions on malaria prevalence in the study area are, this study provides another vista to diseases eradication and prevention. This is in line with the United Nations Post-2015 Development Agenda that recognizes the need to address the social, economic and environmental determinants of health and their interrelationships and not just the proximal causes of illness and diseases (UN Task Team on the Post-2015 UN Development Agenda, 2012) for the achievement of health-related Sustainable Development Goals (SDGs).

Methodology

Population and Sampling

Malaria mortality rate among the children under the age of 5 is highest (50.3%) in the South-West region according to the Nigerian National Malaria Elimination Programme (NMEP, 2014) where the general prevalence rate is between 40% and 70% (NMCP, 2009). Ibadan, the erstwhile regional capital of the South-West region and the headquarters of Oyo State was purposively selected for the study due to the high malaria mortality rate in the region and for the availability of reliable records on clinically-diagnosed cases of malaria for the 30-year period of investigation.

Data Types and Analysis

Secondary datasets were employed for the study. The climatic data employed are the mean maximum temperature (MMT) and the mean annual rainfall (MAR) of Ibadan. The socioeconomic indices used are national inflation rate (INF), national unemployment rate (UNM), national poverty level (PVT), as well as capital expenditure on health as a quotient of national budget (HCE). Data on clinically-diagnosed cases of malaria was also employed. All the data sets were obtained for the 30-year period 1985 to 2014 to allow for an extensive temporal analysis and to date back a year before the outset of the prevailing national economic policy which is expected to have fully impacted on national economic development and the population's social well-being.

The 1985 - 2014 data on clinically-diagnosed cases of malaria was analyzed preliminarily for consistency and reliability using statistical measures of Standard Deviation and Kurtosis. The Pearson Product Moment Correlation technique was thereafter used to analyze the trend in the data set as well as in the climatic and socioeconomic data. The datasets were thereafter employed as input data for a multiple linear regression analysis where malaria prevalence data was the dependent variable and the climatic and socioeconomic indices were the independent variables. The resulting regression equation was thereafter used for a linear projection of future incidence of malaria from year 2014 to 2050 using the re-computed predicted values of malaria prevalence between 1985 and 2014.

Results

The highest number of malaria cases recorded between 1985 and 2014 was 3,671 in the year 2000 followed by 3,067 in the year 2006 while the lowest was 1,036 in 1993. The trend analysis indicates that over the years, the incidence of malaria has not reduced but witnessing a gradual and almost negligible increment (r = 0.17). The highest volumes of mean annual precipitation recorded in the study area were 151.24mm in 1999, 148.95mm in 2011 and 133.55mm in 1985 while 1998, 1992 and 1997 were the driest years with a mean annual precipitation of 84.83mm, 90.72mm and 91.43mm respectively. Mean maximum temperature in the study area ranged between tween 31.15^{o}C and 33.27^{o}C. While the lowest temperature was recorded in 1985, the highest was in 1998. The apparent fluctuations in rainfall notwithstanding, the trend analysis shows that precipitation in the study area has increased minimally (r = 0.06) over the years. Ditto for temperature (r = 0.03).

From 5.5% in 1985, the national inflation rate went to as high as 57.2% in 1993 and declined to 8.00% at the end of 2014. Unemployment rate was in single digit between 1985 and 1998 and oscillated between 19.9% and 27.4% in the period 1999 to 2013. It dipped to 6.4% at the end of 2014. The national poverty level was at its highest points of 72% and 71.5% in 1999 and 2014 respectively and stood at 33.1% in 2013. The national poverty level represents the percentage of Nigeria's total population living on the equivalent of less than $1.00 a day. Capital expenditure on health-care in Nigeria has largely been less than 1% of the country's annual budget each successive year since 1985 except for a few instances. It was a paltry 0.18% of total budget in 1993 and 0.20% in 1992. The trend from 1985 to 2014 has oscillated between 0.43% and 1.91%. Of all the socioeconomic variables, unemployment rate recorded the highest increase (r = 0.70) over the successive years.

The result of the regression analysis between climatic parameters and socioeconomic variables, and malaria prevalence shows a Coefficient of Determination (R^2) value of 0.786 and a standard error of the estimate value of 0.044. This implies that the six independent variables collectively accounted for 78.6% of the variation in the incidence of malaria in the study area with a 4% margin of error. This high Coefficient is indicative of the fact that the six independent variables employed in the regression analysis are a good predictor of the dependent variable. The result is also statistically significant ($P \leq 0.001$). Of the six independent variables, inflation rate (INF) with a beta coefficient of -0.620 contributed the highest to explaining the variance in malaria prevalence in the study area, closely followed by mean annual rainfall (-0.516) and mean maximum temperature (-0.436). Capital expenditure on health had a coefficient of 0.151 while unemployment rate and poverty level had coefficients of 0.115 and -0.030 respectively. Based on the results of the correlations and collinearity statistics coefficients as well as the variance inflation factor (VIF) values, the variables employed were appropriate for the regression analysis with respect to the multicollinearity assumptions in regression. The regression equation is thus written as;

y = 6.184 + [(-0.620)(INF)] + [(-0.516)(MAR)] + [(-0.436)(MMT)] + [(0.151)(HCE) + [(0.115)(UNM)] + [-(0.030)(PVT)].

The projection of future distribution of malaria incidence in Ibadan was done using the predicted values of the malaria prevalence data. The predicted values were computed from the original prevalence data while running the regression analysis. The values are derived by employing the regression equation to re-compute the initial values of malaria incidence by including the error term and factoring-in the contributions of each of the six independent variables. Using the predicted values rather than the absolute values for the projection of future distribution of malaria prevalence is therefore more appropriate as the influence of the six predictors that accounted for nearly 79% of the variations in malaria prevalence have been taken into account. The method of projection employed is the linear projection method using the trend pattern of malaria incidence between 1985 and 2014.

As the malaria prevalence data employed was from a single health facility but indicative of the general trend in the study area, the data was converted to rates to enable a generalization and allow for situational comparison in the future. The study employed hospital catchment figure as the denominator in converting the prevalence data to prevalence rates. With the projected population of Ibadan being 1,722,318 as at 2014 and the number of hospitals being 234 according to the records of the Oyo State Ministry of Health, the computed hospital catchment population for hospitals in Ibadan is 7,360. Following from this, the prevalence rate of malaria in Ibadan in 2014 was 299 cases per 1,000 Population (or 29.9%). By the year 2050, the projected rate is computed to be 366 cases per 1,000 Population (or 36.67%) if the contributory factors were not controlled.