

Original research

Pattern of Climate Change and the Related Health Diseases in Ondo State, Nigeria

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Abstract:

The recent spread of infectious diseases at the pace of extreme weather events as the world's climate changes is becoming worrisome. This study focused on identifying the variation status of observed weather elements and determining their relationship with the pattern of selected diseases in Ondo State, Nigeria. Data on malaria, asthma, typhoid, and pneumonia occurrence were obtained from the Ondo State Specialist Hospital along with temperature (maximum and minimum), rainfall, and relative humidity at the Ondo State Agro-climatological Office between the periods of 2011 and 2021. Descriptive and correlation coefficient statistics were used for data analysis. Results revealed the spread of malaria, asthma, typhoid, and pneumonia as influenced by variations in temperature, rainfall, and relative humidity in the study areas. Malaria exhibited a strong correlation ($r > 0.7$) with the weather pattern. However, the study showed that malaria and pneumonia were more prevalent than typhoid fever and asthma. The study recommends ameliorating the impacts of observed weather elements on the insurgence of malaria, typhoid, asthma, and pneumonia in the study area through public cautioning strategies on climate adaptation. The public should also be informed of the prevalence of malaria and pneumonia during the months of June, July, and November, along with mitigation measures for sustainable, healthy living.

Keywords: Climate, health, weather, temperature, diseases

1- Introduction

Health crisis has been a common issue from the time immemorial. In the recent times, the topic of environment and health has become a commonly debated issues in the research arena. The widely discussed issue on both local and global scale is climate change. The increase and decrease in temperature as well as shifts in precipitation pattern, and an observed extreme weather system have constituted serious concern as relates to changing in human health. Luber, et.al., (2014) revealed that warmer average temperatures usually lead to hotter days and more frequent and longer heat waves. These changes usually lead to an increase in heat-related deaths.

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The influence of man on environment is becoming detrimental to the extent that global climate changes in the global atmosphere have probably started to change world climate (PCC, 2007). This Global climate change has enormous effects on human health and these can be in a more complex scale and direction. The observed positive and negative trend would be felt globally, while the negatives are expected to predominate significantly. Direct health impacts of climate change may involve changes in exposure to weather extremes that come with cold and heat waves, especially as it may relate to those that are due to increased production of major air pollutants and those with increase in other extreme weather events like floods, cyclones, storm surges, and droughts. In another way, climate change is capable of inducing transmission of infectious disease and regional production of cereal grains and other food crops. As it stands, the indirect impacts of climate on human health has probability of higher influence over the direct impacts.

As noted by Sheffield et. al, (2011), there are certainties that climate change will increase the impacts of weather-related diseases and rates of mortality for a number of vulnerable people who suffer from the effects of trauma, infectious illness, heat waves, and air pollution effected by the events of extreme weather. The severity, duration, or frequency of human health problems in places or populations where they have not previously occurred can as well be influenced by climate change.

Studies show that extreme weather events are more obvious than ever before and the impacts are becoming noticeable in the spread of infectious disease (Olabode, 2015; Zbigniew, 2016). Meteorological factors such as temperature and precipitation are related to water/food-borne infectious diseases as prompted by climate change (Thindwa et al, 2019; Wang, et al 2019; D'Souza, 2004; Robert, 2004). Paritosh (2007) in her reports noticed that the coastlines along the Pacific Ocean and the Indian Ocean and in sub-Saharan Africa will be at higher risk of enduring the health effects of climate change.

At this juncture, it's obvious to observe variable changes on health cases in the developing nations rapidly based on increased changes in temperature and rainfall patterns. On this premise, this study considered carrying out statistical analysis of reported cases of climate related health conditions in Ondo State, South western Nigeria, between year 2011 and 2021. The specific objectives found out the variation status of observed weather elements, and determined relationship between climate variation and pattern of distribution of the diseases in the study area.

2- Materials and Methods

Study area

Ondo State, where the study falls, is among the Southwestern States in Nigeria. It is located on longitude 4.944055°E and 5.82864°E, and latitude 7.491780°N and 6.96375°N (Figure 1). The State covers an estimated land area of 14,793 square kilometers with its administrative capital at Akure.

The climate of the study area is characterized by lowland tropical rain forest type. It has a distinct two seasons - wet and dry, over the year, which spread between April and October, November and March respectively. As a result, the mean monthly temperature is estimated at 27°C, while the mean relative humidity is (75%). However, the amount of annual rainfall received was calculated between 2,000mm and 1,500mm.



Figure 1: Ondo State showing study area (inset: Nigeria showing Ondo State)

Methods

Data for the study were collected through secondary sources. Climate data and recorded cases of climate related diseases, between the periods of 2011 and 2021, from selected urban regions in Ondo State, Nigeria; were collected and used. These data included monthly rainfall, temperature, relative humidity and reported cases of malaria, asthma, typhoid and pneumonia, and were sourced from the Ministry of Agriculture Development Project and State Specialist Hospital respectively. All statistical analyses were performed using IBM SPSS Statistics version 20 (SPSS Inc., Chicago, IL, USA). Data were analyzed using Pearson's correlation analysis.

3- Results and Discussions

Rainfall Variability

The monthly distribution of rainfall in Akure and Ikare-Akoko were presented in Figure 2. It was revealed that the mean monthly rainfall increased from January and peaked in September then declined in October through to December. The lowest rainfall in Akure and Ikare occurred in December (less than 10mm) and was highest (above 200mm) in October. The months within the dry season (November – February) generally recorded lower rainfall below 40mm. Furthermore, rainfall appeared to start earlier in Akure than Ikare, except in April, August and October. Monthly rainfall values generally showed higher rainfall in Akure than Ikare within the study period.

Relative Humidity and Temperature

The mean monthly distribution of relative humidity and temperature (minimum and maximum) were presented in Figure (3) where relative humidity was high in both study areas throughout the year, however, higher humidity was recorded in May and June, with declining trend in November through to March. Minimum relative humidity was about 60% in January and the highest was 88% in August (Gao et al., 2021).

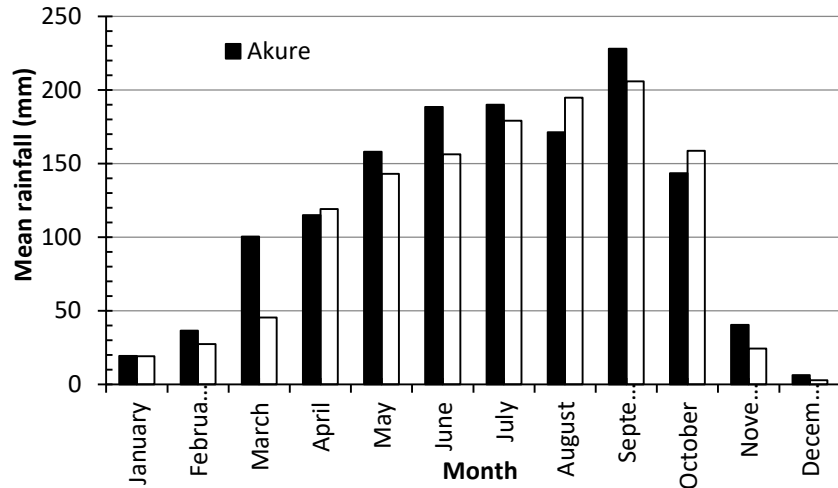


Figure 2: Mean monthly variation in rainfall in the study areas between 2011 and 2021.

This humidity level is above normal of 30% to 50%. Relative humidity in Akure was slightly higher than that of Ikare-Akoko at most months of the year. The reason could be as a result of higher rate of evaporation that produces recorded rainfall amount.

In the selected study areas, the study indicated maximum temperature slightly higher in both regions on monthly basis (Figure 3). Maximum temperature is often used to describe the period when temperature is highest, usually suitable for between 3 and 4 pm in the day while minimum temperature is often considered as the coldest period, especially in the midnight in the tropics (Ojo, 2003). Maximum temperature is higher at Akure through November to March. However, minimum temperature was higher at Ikare Akoko from November to April. The consequence of this is however not yet known, but the pattern suggested that Akure is relatively warmer than Ikare Akoko. Increased warming phenomenon is nonetheless a significant future of urban areas (Akinbode et al., 2008).

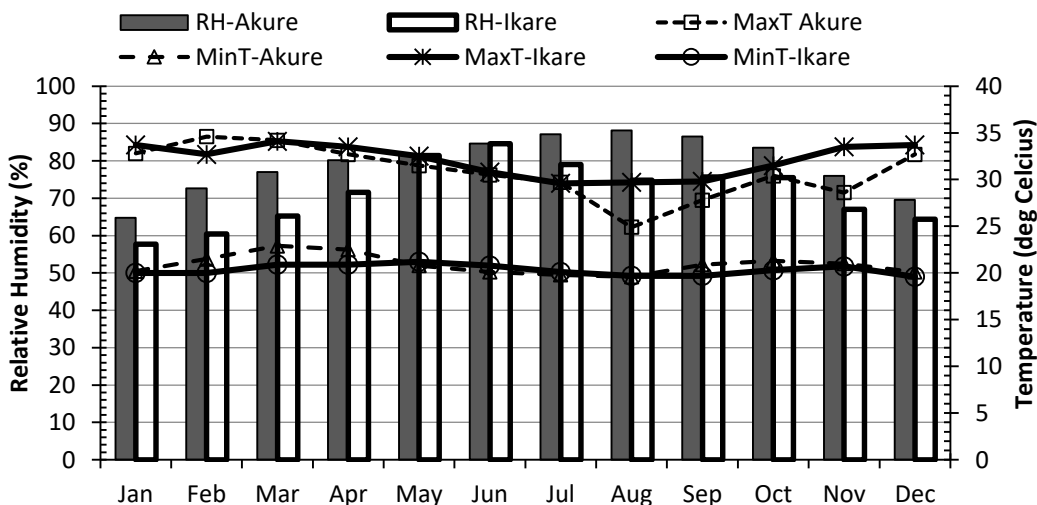


Figure 3: Mean monthly variations of relative humidity, minimum and maximum temperature in the study area between 2011 and 2021.

Reported cases of selected sicknesses in the study area

The reported cases of weather-related sickness considered in the study including, malaria, asthma, typhoid and pneumonia.

Malaria

It is evident in this study that climate change may increase malaria outbreak in most of tropical regions of Africa like Nigeria. Moreover, cases of malaria were reported more in Akure than Ikare Akoko throughout the months of the year. There was also higher frequency of malaria cases reported in the rainy season in Akure. Similar pattern was reported for asthma and pneumonia.

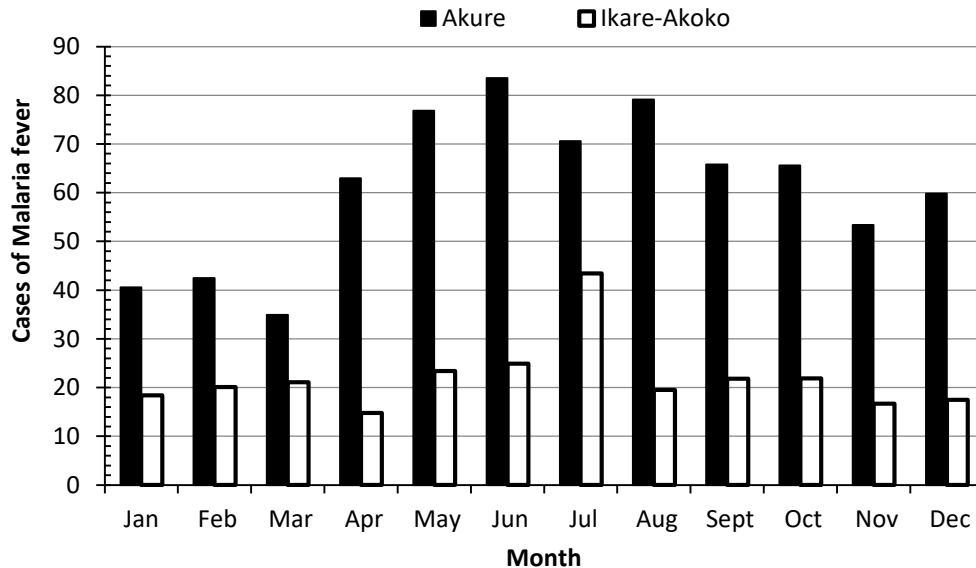


Figure 4: Variations in reported cases of malaria fever in the study area between 2011 and 2021.

However, the lower number of malaria cases in some areas were connected with heavy rainfall that washes out mosquitoes new breeds and reduces the malaria incidences. Accordingly, Hoshen and Morse (2004), summarized that variation in climatic conditions, such as temperature, rainfall patterns, and humidity, contributes to increased lifespan of mosquito, which invariably leads to high breed of malaria parasites from the mosquito and, subsequently, induces malaria transmission. Moreover, in Southern Africa, WHO, (2002) reported that malaria epidemics have been on high increase following unusual rainfall in the country.

Typhoid fever

Wang, et al. (2012) indicated that high temperature was positively allied with a higher risk of typhoid fever in Guizhou, Southwestern China. Meanwhile, Yi et. al., (2019) disclosed that temperature and rainfall variation could influence the speed of disease transmission. In another view, Gao, et al. (2020) observed that temperature and rainfall could be used as an early forecasting indicator for typhoid fever.

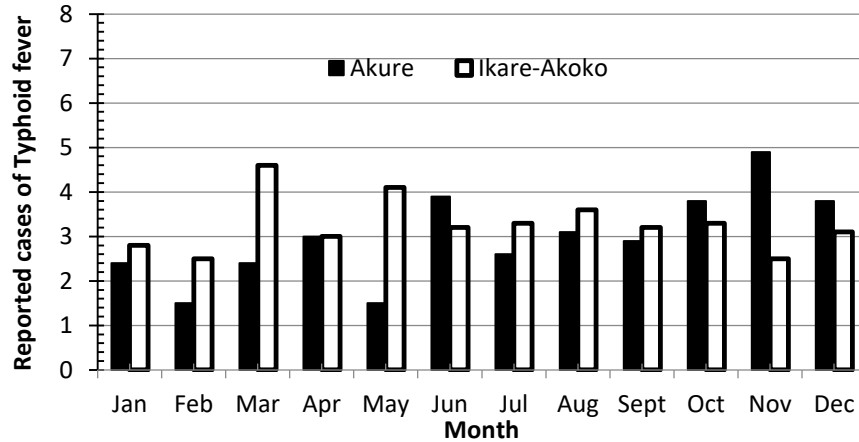


Figure 5: Monthly variations in reported cases of typhoid fever in the study area between 2011 and 2021.

In the present study, it is obvious that the higher occurrence of typhoid recorded in Akure could be linked with poor sanitation, instigated by inadequate access to clean water, especially in the period of water deficit. It was further observed that typhoid fever was prominent in the month of March with 42%, and with 50% in the month of November (Figure 5). However it is generally observed that typhoid fever was recorded all around the year at diverse level of occurrence in the study area. This is a similar trend of typhoid in India as noted by John et al. (2016).

Pneumonia

High cases of pneumonia is induced by both cold and wet weather (Felix and Chioma (2019). This study disclosed highest record of Pneumonia cases in June, July and November. The periods of June, July and November are related to dry and raining seasons in Nigeria. In accordance to this current study, Ojo (2003) observed that weather parameters are major factors that influence incidences of pneumonia in the following ways. Firstly: human body are resisted by the weather parameters, hereby subject it to attack by diseases. Secondly: weather parameters contribute to the growth, multiplication and outspread of diseases. Tania et al. (2018) reported that the effect of carbon monoxide and nitrogen oxide can intensify spread of cardiovascular diseases, breathing difficulty, respiratory disease, lung vexation and changes in the defence system of lungs.

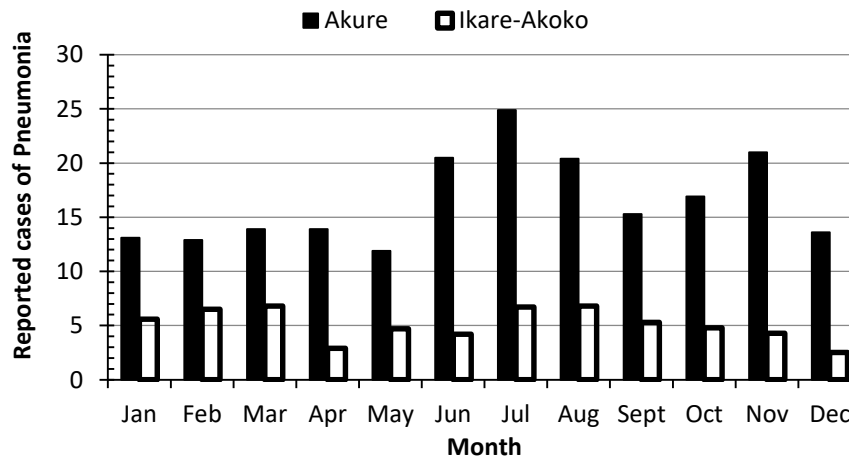


Figure 6: Reported cases of pneumonia between 2011 and 2021.

Asthma

As noted by Eman and Mana (2019), asthma could be easily affected and tripped by weather conditions, which is associated with series of events that have to do with changes in weather pattern. Some of the recorded impacts of the changes is related to temperature, humidity, air pressure, rain and wind. These parameters trigger asthmatic attacks and contribute to its worsening symptoms (Zhang et al., 2020. and Zhang et al., 2014). The current study has displayed the effects of relative humidity on asthma during the month of June, August and October, as it reflects highest occurrence of asthma in these months.

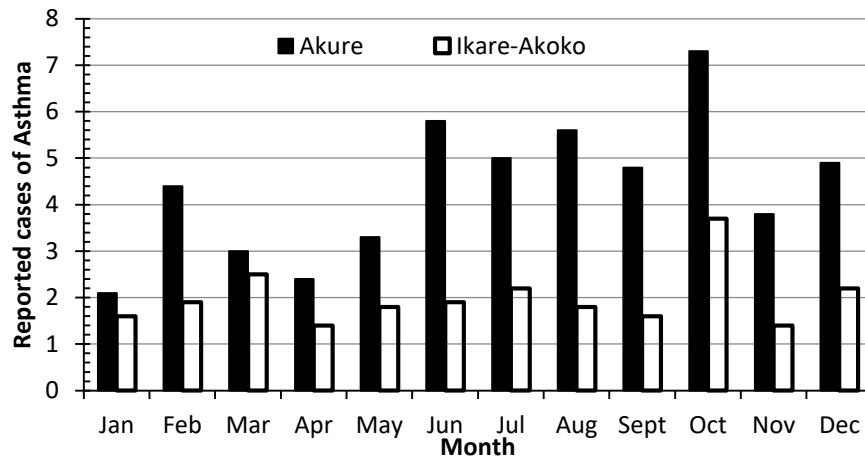


Figure 7: Monthly cases of asthma between 2011 and 2021.

Relations between climate variables and reported cases of sicknesses

Table 1 shows results of the Pearson correlation coefficient between frequency of reported cases of malaria, pneumonia, asthma, typhoid fever and the selected climate variables of the study area. Reported cases of malaria, exhibited high and direct relationship with rainfall and relative humidity but inversely with minimum and maximum temperature. This suggests that reported cases of malaria will increase with increase in rainfall and relative humidity but would decrease as temperature increases. The study of Akinbode et al. (2008) approved with the current study where relationship between malaria and increased temperature are inversely correlated. On the other hand, relative humidity and rainfall have low correlation on malaria. Maximum temperature has negative on all the diseases with significant relationship on malaria and pneumonia. However, the minimum temperature has positive relationship with typhoid. The implication of this is that temperature contribute significantly to mosquitoes breeding, which invariably induces malaria prevalence in the study area. The malaria prevalence will become prominent as a result of changes in temperature, humidity and rainfall, and can influence spatio-temporal distribution of the disease. As noted by Reiter (2001), temperature and rainfall are major climatic factors that could cause diseases, of which a slight change in temperature and rainfall will lead to significant impacts on the spread of diseases.

Asthma has strong relationship with relative humidity in Akure, indicating high level of spread of the disease in the location. In the same vein, pneumonia is positively influenced by relative humidity; while it has negative correlation with maximum temperature. It was revealed, however, that typhoid has no relationships with the selected weather parameters. Relative humidity exhibited strong relationship with asthma, pneumonia and malaria. Generally, this study showed malaria as the prominent disease followed by pneumonia, asthma and typhoid fever in the study areas.

Table 1: Correlation Coefficient between frequency of reported cases of sicknesses and climate variables in the study area

Sickness	Rainfall		Relative Humidity		Maximum Temperature		Minimum Temperature	
	Akure	Ikare-Akoko	Akure	Ikare-Akoko	Akure	Ikare-Akoko	Akure	Ikare-Akoko
Malaria	0.71**	0.46	0.75**	0.49	-0.64*	-0.60*	-0.54*	-0.05
Asthma	0.42	0.13	0.54*	0.12	-0.47	-0.09	-0.40	-0.03
Typhoid	-0.07	0.30	0.09	0.35	-0.41	-0.02	-0.17	0.38
Pneumonia	0.42	0.21	0.56*	-0.07	-0.64*	-0.37	-0.47	-0.18

“**” “*” significant relationship

Conclusion

This study has examined the selected cases of malaria, asthma, typhoid fever and pneumonia alongside the climatic elements that included rainfall, relative humidity, minimum and maximum temperature of Ondo State Nigeria. It was established that occurrence of the diseases are usually a catalyst of climate variation in the study area. Significant relationships were further established between the weather pattern and outbreak of the weather related diseases. The study generally indicated malaria and pneumonia as most prevalent weather induced diseases in the study area. The study recommends significant efforts to ameliorate the impacts of observed weather elements on insurgence of malaria, typhoid, asthma and pneumonia in the study area through public cautioning strategies on climate adaptation. Also, the public should be informed of the prevalence of malaria and pneumonia during raining season and the months of June, July and November respectively with adequate precautions to mitigate possible effects on human life.

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