

ANALYSIS OF THE EFFECTS OF WEATHER ELEMENTS ON THE PREVALENCE OF MEASELS AMONG UNDER-FIVE CHILDREN IN YOLA METROPOLIS, NIGERIA

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Abstract

Weather parameters such as rainfall, relative humidity, temperature and so on, have effects on infectious diseases and have been well documented for ages. The study analyze the effects of some weather parameters on the prevalence of Measles among under five children in Yola metropolis. Methods and procedures employed for the conduct of the study are hospital records on measles cases whereas for weather parameters were obtained from Nigerian Meteorological Agency (NIMET), Abuja for Yola metropolis between 2015 – 2019. Prevalence formula was used to calculate Measles cases and trend line equations were fitted to indicate changes. Time series analysis was used to analyze the trends of each of the data collected. Linear regression analysis was used to establish interaction between weather element and prevalence of measles. The analysis showed that measles slightly decreased in trend with an annual -0.003 slope. The mean monthly prevalence of measles shows highest prevalence in the months of March through April. While, temperature and relatively humidity showed decreasing trends, except of wind speed that showed increasing trend. Across the years under study (2015 – 2019), temperature showed strong contribution toward measles prevalence with 21.1%, 36.6%, 25.5%, 19.3% and 16.1% for 2015, 2016, 2017, 2018 and 2019 respectively. The study concluded that temperature and relative humidity are influence measles prevalence among under-five children in Yola metropolis, Adamawa State. The study recommended among others that the Adamawa State government and relevant agencies should enlighten people in Yola metropolis on effect of climatic change that could lead to high case of measles among under-five children.

Keywords: Weather Elements, Effects, Measles, Prevalence, Under-Five

Introduction

The spatio-temporal distributions of many infectious diseases are linked to climate. Weather parameters such as rainfall, relative humidity, temperature and among others, have effects on infectious diseases and have been well documented for ages. To Ebi and Nelson (2016), Dengue infectious disease is considered to be the most important vector borne viral disease that is transmitted to humans by mosquitoes; environmental factors associated with the transmission are rainfall, temperature and relative humidity. According to Kamruzzaman *et al.* (2015), climate and weather are important components of a complex ecosystem; climate constrains the range of infectious diseases, whereas weather affects the timing and intensity of the outbreak. The study reiterate that all infectious diseases involve an agent (or pathogen), vectors, host(s) and the environment; as such, climate can influence pathogens, vectors, host defenses and habitat. They

concluded that infectious diseases continue to be a major cause of morbidity and mortality worldwide.

In the work of Jinseob *et al.*, (2016) it was stated that climate can affect disease pattern in different ways depending on its basic characteristics such as geography, land use, demography, socio-cultural status and human behavioural patterns. Weather changes on time scale close to incubation period for most infectious diseases, so also changes in weather provides avenue for “natural experiments” which can demonstrate the possible effects of atmospheric variables on infectious diseases (Philip and Polgreen, 2017; Knutson *et al.*, 2010). Climate and risk of infectious diseases involve environmental changes that facilitate the spread of disease vectors into new regions placing new population at risk (Moideiceci *et al.*, 2017; Watts *et al.*, 2010). The effects of these climatic/weather condition shows that increase in global temperature and that of Yola in Nigeria have increased in intensity and warmer temperatures also add to the evaporation and precipitation. This may have increased the chances of more infectious disease like Measles.

Measles is one of the world’s most contagious diseases. It is an airborne virus (from the *paramyxovirus* family) transmitted by respiratory droplets from the nose, mouth or throat of an infected person usually through coughing or sneezing (Belluz, 2019). Prior to the introduction of measles vaccines in 1963 and wide spread vaccination, major epidemics had occurred with approximately 2.6 million deaths each year. In 2017, approximately 110 000 people died globally from measles with prevalence on children under the age of five years despite the availability of safe and effective vaccine (World Health Organization [WHO], 2019).

Globally, measles is a common human disease especially affecting the young. The disease burden is heaviest in South-Asia and Sub-Saharan Africa, the regions characterized by hot climate and large volumes of rainfall each year (Mirsaeidi *et al.*, 2016; Tow and Wen, 2017). Over the years, the world has experienced several measles out breaks. In 2019, there were 413, 308 confirmed cases of measles; this figure surpassed the reported cases of 2018 with 353, 236. Children under the age of five accounted for 140 000 death from measles in that year (Centre for Disease Control (CDC) and WHO, 2019). WHO Further stated that, regionally the eastern Mediterranean region recorded 15,950 cases, while the European Region is 70,449, Region of the Americas is 12,352, South-Eastern Region 14,319, Western Pacific Region 6,011 and African Region 529,611.

Nigeria is among the sub-Saharan African countries that have been experiencing increasing number of measles cases. Since the beginning of 2019, 2,064 suspected cases were reported including seven deaths. States affected include Katsina, Borno, Kaduna, Yobe, Sokoto, Kano and Adamawa, which accounted for 67% of all the cases reported. By the end of 2019, 58,916 suspected cases with 289 deaths had been recorded from 759 local Government Areas in the 36 States including the Federal Capital Territory (WHO, 2020).

The World Health Organization in Isere *et al.*, (2013) stated that Measles still remains a public health challenge and associated with high morbidity and mortality, most of the associated deaths occur in children aged five years and younger despite efforts to achieve elimination goals. Measles outbreaks follow a seasonal pattern with increasing incidence in dry Season. In the early Epidemiological Week (1-5) Disease Surveillance and Notification 2019, 52 cases of suspected Measles were reported in Adamawa State and Yola being the State capital inclusive (Adamawa State Health Sector Working Bulletin, 2019). Against this background, the aim of this research is to examine the Weather inducing factors that can trigger the emergence and incidence of Measles in Yola Metropolis, Adamawa State, Nigeria. The aim will be achieved through these objectives: examine the trend of Measles prevalence among under-five children in Yola metropolis; examine

the spatio-temporal variations of weather events in the study area; and examine the effects of weather elements on prevalence of Measles in the study area.

Conceptual Issues and Literature Review

Weather means the specific condition of the atmosphere of a place at a particular time (Spittle house *et al.*, 2008). The concept weather is also the behavior of the atmosphere at any time, it could be on a daily, weekly, or even monthly basis (Peter *et al.*, 2013). The Britannica encyclopedia (2020) defines weather as the state of the atmosphere at a particular place during a short period of time, it involves such atmospheric phenomena as temperature, humidity, and precipitation (type and amount) air pressure, wind and cloud cover. Weather has tremendous influence on human settlement patterns, food and personal comfort. Extremes of temperature and humidity cause discomfort and lead to the transmission of diseases.

Weather and diseases

Weather and climate are known as one of the direct drivers of disease risk. Both play a significant role in the transmission of many infectious diseases. History reveals much evidence on climate/weather and infectious disease. Among the researches conducted Corvalan and Campbell-Landrum (2003) revealed three (3) categories of linkage mechanism between climate/weather condition and infectious disease transmission. Firstly, past evidence on the association between climatic variability and infectious diseases such as malaria. Secondly, early indicators of already emerging infectious disease impacts and thirdly, uses the evidence to create predictive models to estimate the future burden of infectious disease.

Jonathan *et al.*, (2003) expressed that the discovery on the great link between climatic conditions and infectious diseases has been known to humans. In the early nineteenth century the river-irrigated Punjab region in India experienced periodic malaria epidemics, excessive monsoon rainfall and high humidity were a major influence on enhancing mosquito breeding and survival. Weather influences the dispersal and ambient concentrations of many pollutants while high pressure systems increase temperature and enhance the photochemical reactions that produce secondary oxidants such as ground ozone. In London the most consistent association with respiratory disease hospital admissions was observed for ozone (Engelberg *et al.*, 2000).

The US Center for Disease Control and Prevention identified an array of infectious diseases that were likely to occur following weather disasters such as the hurricane Katrina in the southern USA in 2005. There were predominantly infections of the gastrointestinal tract respiratory system, skin and open wounds, hence, after the hurricane hit, identified presumptive cases of non-infectious rash 299, respiratory infections 188, vomiting 142, fever 98, dehydration 87 and water diarrhea 55 (Anthony, 2015). A research conducted by Abdel Majid *et al.*, (2018) on a comparison of weather variables linked to infectious patterns using laboratory addresses and patient residence addresses. They paired values of daily rainfall and temperature for the laboratory versus residence postcodes were interpolated from weather stations data. Their findings were; there is significant and strong agreement between the daily values of rainfall and temperature at diagnostic laboratories with the values at the patient residence postcodes for samples containing the pathogens campylobacter or cryptosporidium. For daily campylobacter or cryptosporidium cases across England and Wales were linked to local temperature and rainfall at the residence postcodes of the patients and at the corresponding postcodes of the laboratory where the patient's specimen was tested.

In West Africa, Auwal (2014) studied climate influence on infectious diseases in north-west Nigeria. The research aimed at modelling the influence of climate on the incidence of meningitis

and cholera as well as assessing their future risk in north-west, Nigeria. Climate change models were applied to estimate the future impact. Results indicated the significant roles of both meteorological and socio-economic factors on the incidence of the diseases, further projection suggested that future temperature increases due to climate change could significantly increase disease cases. Climate and weather also have indirect effects on diseases through natural environment and human system, for example, drought may affect water, land-use and irrigation practices and population movement, in turn affect vector ecology and human exposure to infection (Diamid *et al.*, 2015; Smith 2014; Mills *et al.*, 2010).

Disease Description

'Measles' as define by WHO (2019b) as a serious viral disease that is highly contagious. It is caused by a virus in the *paramyxovirus* family and it is normally passed through direct contact and through the air. The virus infects the respiratory tract, then spreads throughout the body. Adam (2020) defines Measles as an infectious illness caused by the *rubeola* virus, characterized by fever, runny, nose, cough and a spreading skin rash. It is a potentially disastrous disease. In other words, according to Webster's dictionary (2022), Measles is defined as an acute contagious disease that is caused by a morbillivirus from the paramyxovirus family and is marked especially by an eruption of distinct red spots.

The virus is 120 to 250nm in diameter with a genome of single stranded negative sense RNA and is closely related to the rinderpest canine distemper viruses. Two membrane envelope proteins are important in pathogenesis; they are F(fusion) protein which is responsible for fusion of virus and host cell membranes viral penetration and hemolysis and the H (hemagglutinin) which is responsible for binding of virus to receptors on host cells (Paul *et al.*, 2021). When the Measles virus enters the body through mouth, nose, or eyes and most likely enters the lungs, it first of all infects immune cells known as macrophages and dendritic cells. The infected cells replicate and move to the lymph nodes where they transfer the virus to lymphocytes (type of white blood cells). Those infected cells move throughout the body and release virus particles into the blood (Upham, 2021).

Clinical Manifestation

The CDC (2021) stated that symptoms usually appear 7-14 days after exposure, however according to WHO (2021), they can take up to 23days. Symptoms include fever that is possibly up to 104°F (40°C) a cough, a runny nose, sneezing, watery eyes, body aches, small white spots in the mouth appearing 2-3days after symptoms, a red rash appearing around 3-5days after symptoms among others. The rash usually starts at the hairline and spreads down through the body. It may begin as flat, red spots with small bumps appearing on top. The spots may join together as they spread. Other symptoms of Measles may include a sore throat, tiredness, muscle pain and sensitivity to light that hurts the eyes.

Transmission and Complications

WHO describes its transmission as airborne by droplet spread or by direct contact with the nasal and throat secretions of an infected person. It is highly contagious with a basic reproductive rate of 17-20 (that is introduction of one case of Measles in a completely susceptible community generates 17-20 new cases) and incubation period is usually 8-12days. Because of its contagious nature spread from person to person is easy. For example, when someone with measles coughs or sneezes, the air containing the virus can be infected. The virus can float in the air for an hour after the infected person had coughed or sneezed or even gone; hence the virus can spread to others (San Francisco Department of Public Health, 2022).

Epidemiology

Measles occurs worldwide and it has become a leading cause of mortality among children of 0-5 years of age. Because of its heterogeneous surveillance systems worldwide incidence estimates are difficult to obtain, yet by research and records of WHO before the introduction of Measles vaccine over two million deaths occurred annually. But with the availability of the vaccination in 1963, incidences and mortality rates have reduced. Still, measles occurs but predominantly in low vaccination rates particularly in the developing countries like Africa but because of its contagious nature, the virus can be imported from unvaccinated areas like an infected traveler to other vaccinated resource-rich places (Haley, 2021).

Trend of Measles in Nigeria

Anne *et al.*, (2021) conducted a study on trend of measles incidences and vaccination coverage in Nigeria with the aim of providing a descriptive analysis of measles vaccine coverage and incidence from 2008-2018 to assess the country's progress towards measles eradication. Their findings indicated low MCV1 (immunization) coverage (54.0 % in 2018); with lower coverage in the north (mean 45.5%) of the 153, 097 confirmed cases reported over the studied period 85.5% (130, 871) were from the north. Moreover 70.8% (103, 310) of the confirmed cases were unvaccinated and incidence rate is higher among the 9-11 months (524.0 per million) and 12-59 months (376.0 per million).

A systematic review was carried out by Saleh (2016) on the trends of measles in Nigeria. The study consulted relevant literature on trend of measles. The literature was accessed from the WHO and UNICEF sites as well as Google search including case-series studies, community-based studies on age specific measles Case Fatality Ratios (CFRs) and cohort analysis of surveillance data. The review results showed that lowest measles CFR is seen among the vaccinated children and the highest seen among the unvaccinated children with a peak of transmission from October to March.

Aworabhi-Oki *et al.*, (2020) studied the trends of Measles in Bayelsa state, Nigeria. The aim was to determine trends in Measles cases in the state. They carried out a secondary data analysis of Measles case-based surveillance data for the period of January 2014 to December 2018, obtained from state ministry of health. Their results indicated that a total of 449 cases of Measles were reported. There were 245 (54.6%) males and the most affected age group was 1-4 years with 64.1% cases. Of all cases, 289 (9.35%) were confirmed and 70 (48.2%) had received at least one dose of Measles vaccine. Their study discovered that there was all-year transmission with increased peaks in May and July.

Spatio-Temporal Variations of Weather Elements in Nigeria

This study is concerned with only three (3) weather parameters; temperature, humidity and wind speed. As such reviewed literature on spatial and temporal variations of weather events in Nigeria were focused on the parameters concerned. Research on spatial and temporal temperature trends in Nigeria was carried by Philip, Babatunde and Gunnar (2012) from 1901-2000. The study presents a long-term temperature trend analysis by utilizing monthly and annual time series data of Nigeria over the last century, with the aim of evaluating, warming and cooling period and trends during the different world meteorological organization standards (WMO) period (1901-1930; 1931-1960; 1961-1990 and 1991-2000) as well as to investigate the level of control on Nigerian temperature anomalies attributable to known climate forecasting. The researchers used Mann-Kendall non-parametric test, least square linear regression (parametric test) and the residual mass curve to analyze trends. Their findings were periods between 1901-1929 and 1942-1980 exhibited

cooling trends while 1930-1941 and 1981-2000 showed warming trends. The warmest years in Nigeria were 1931, 1935, 1941 and 1987. The coolest years were 1925, 1929, 1974 and 1975. Whereas no significant trends were detected for 1901-1930 period.

Adeniyi (2020) examined the trend of temperature and relative humidity in Kwara State. The climatic data on annual mean temperature (minimum and maximum) and relative humidity for 40 years (1978- 2017) were collected from Nigerian Meteorological Agency (NIMET) Ilorin. Semi-Average method, Mann- Kendall statistics and regression method were used to analyze the trend in temperature and relative humidity. The researcher employed a Standardized Anomaly Index (SAI) to examine the changes in temperature and humidity over the period of 1978 -2017. The result indicated that temperature (minimum and maximum) and relative humidity exhibit an upward trend. This implies that temperature and relative humidity increased over the period of 1978 -2017. While the Mann-Kendell statistics values show that there is no significant difference in the values of temperature (minimum and maximum) and relative humidity.

On the other hand, Dantata, *et al.*, (2019) conducted research on the spatial-temporal variation of wind speed during harmattan season in northeastern Nigeria. The study examines the spatial and temporal variations of wind speed during harmattan season with the sole aim of ascertaining its variability, patterns and the trends from 1984-2014. They used descriptive statistics and time series analysis with ArcGIS 10.3 in examining the temporal and spatial variations of wind speed within the time frame in six synoptic stations of northeastern Nigeria. Findings showed that wind speed varied both temporally and spatially in the last three decades. The pattern of variations in the six synoptic stations shows rising trends within the study years and that latitude played a crucial role in determining the speed of the wind in the study area, as the speed of the wind increases with increasing latitude.

So also, Amadi and Udo (2015) analyzed the trends and variations of monthly mean wind speed data in Nigeria. The data used were obtained from the Nigerian Meteorological Agency, Oshodi, Lagos State 20 land anemometer stations across various ecological zones and climatic belts in Nigeria were selected for the analyses. The data length spanned from 1951–2012 with some variations in data length across the stations. Statistical techniques used for the analyses are Mann-Kendall's rank correlation tests, simple linear regression, Pearson's product moment correlations, time series plots, descriptive statistics and bar charts. The Mann-Kendall's test results indicate dominant declining trends over the period. 11 stations show downward trends, with 8 showing significant downward trends at the 1% level. 9 stations show upward trends, with 7 showing significant upward trends at the 1% level. The Pearson's product moment correlation coefficients indicate that some of the station pairs have negative correlations significant at the 1% and 5% levels. Other station pairs show significant positive correlations at the 1% and 5% levels while other station pairs show negative and positive correlations that are not significant at the chosen significance levels. The seasonal variations represented in the bar charts indicate that spring (March and April) is the windiest period in most of the stations while autumn (precisely November) dominates the calm period in most stations across Nigeria.

Effects of Weather Elements on Prevalence of Measles

The impact of climatic variables on the prevalence of Measles in Wudil town, Kano Nigeria was carried out by Muhammad and Abdulmusawwir (2019) from 2007-2016. Their research findings have shown that temperature and rainfall have a significant impact on the outbreak of diseases like Measles. The analysis revealed that there is a statistically significant relationship between weather parameters (Temperature and Rainfall) and the occurrence of measles in the study area.

Similarly, Akinboboola and Hamisu (2018) conducted a study on predicting Measles occurrence using some weather variables in Kano northeastern, Nigeria. The study sought to clarify the mechanism linking weather and Measles occurrence and examine the possibility of predicting the number of expected cases of the disease using some weather variables and the reported cases from standard government hospitals within the study area from 1997-2012. Monthly Measles cases in Kano were retrieved from Muhammad Abdullahi Wase Specialist Hospital, Kano. The weather data include monthly rainfall, relative humidity, temperature and wind speed were obtained from Nigerian Meteorological agency. They performed the Spearman rank correlation tests to examine the relationship between monthly incidence and the weather variables, and used the statistically significant variables to develop models. The monthly Measles incidence was modeled using a Poisson regression model combined with Autoregressive moving average model (ARIMA). The results showed a linear effect of maximum and minimum temperature and relative humidity on Measles incidence.

Research was carried out by Ademola and Omotosho (2010) on the meteorological factors and Measles occurrence in Akure, Ondo state Nigeria. The researchers collected monthly data of Measles patients (in and out patients) between 1990 and 2003 from Ondo state specialist hospital, Akure, as well as Monthly relative humidity, rainfall and maximum temperatures for the same years were collected from Nigeria Meteorological Agency, Oshodi, Lagos. The study found that Measles disease is more prevalent during the hot dry season and lowest during the wet season. Analysis also showed that these meteorological variables have significant correlation with the occurrence of Measles. The researchers discovered that, the disease is most prevalent when the temperatures are in range of between 32°C to 34°C and relative humidity of between 60% and 80%. Furthermore, at temperatures below 32°C and relative Humidity of less than 60%, there were very few Measles patients.

Study Area

The study area is Yola metropolis Adamawa state, Nigeria. The metropolis is made up of two Local Government Area (LGA) Yola North and Yola South, with twenty political wards namely: Adarawo, Ajiya, Alkalawa, Bako, Bole-Yolde Pate, Doubeli, Gwadabawa, Jambutu, Karewa, Limawa, Luggere, Makama 'A', Makama 'B', Mbamba, Mbamoi, Namtari, Nassarawo, Rumde, Yelwa and Toungo. Yola metropolis lies between latitudes 9°9'0"N and 9°18'0"N of the equator and longitudes 12°18'0"E and 12°36'0"E of Greenwich meridian (Figure 1.1). It is the administrative headquarters of Adamawa state and covers a land area of about 1,213 sqKm². The city is located along River Benue and bounded to the North-East by Mandara Mountains, North-West by Girei LGA and Demsa LGA, to the South-East by Fufore LGAs (Bakari and Usman, 2013). The town has a total population of 96,256 with a growth rate of 2.9% (NPC, 2006) and projected to 141,513 by the year 2020 (NPC, 2020). The dominant tribes are Fulani, Vere and Bata with small proportion of Hausa, Laka, Igbo among others.

The climate of Yola is typical of the West African Savannah. Temperature is generally high throughout the year but there is usually a seasonal change. The rainy season begins by May and ends in October, while dry season lasts from November to April with maximum and minimum temperature records of 40°C and 18°C respectively (Adebayo, 2020: Ezra *et al.*, 2021). The area is of mountainous made mostly of sedimentary deposits and it traversed River Benue, the valleys of Cameroon, Mandara Mountains, the Furo hills on the northern part, Bagale hills on the Southern part forms some of its landscape (Purakayo *et al.*, 2014). The area is generally flat to gently undulating with elevation ranged from 160-150m above sea level (Onugba and Aboh, 2010). The drainage system is well drained and made up of both large and small watershed, series of rivers

and natural drainages that drain into River Benue which serves as the major pour point (Zarma *et al.*, 2020).

The vegetation is of Sudan Savannah endowed with forest reserves. An important natural forest product available is Gum Arabic (*Acacia senegal*). Woody species found are scorpion Namosa (*Acacia nilotia*), Baobab tree (*Adonsonia digitate*) and African Palmyra Fan Palm (*Borassus aethiopum*) Akasim *et al.*, (2012). The major segment of the population are farmers; crops grown include rice, maize, guinea corn, vegetables, next to farming is keeping of livestock primarily cattle then sheep, goats, cattle in large numbers are owned by the Fulani who bred cattle under range (Umaru and Bello, 2022). In addition, the people are also engaged in fishing, carpentry, welding, metallics works, conversion of hides and skin into leather works to produce articles like armlets, handbags mallets among others (Sahabo, 2012).

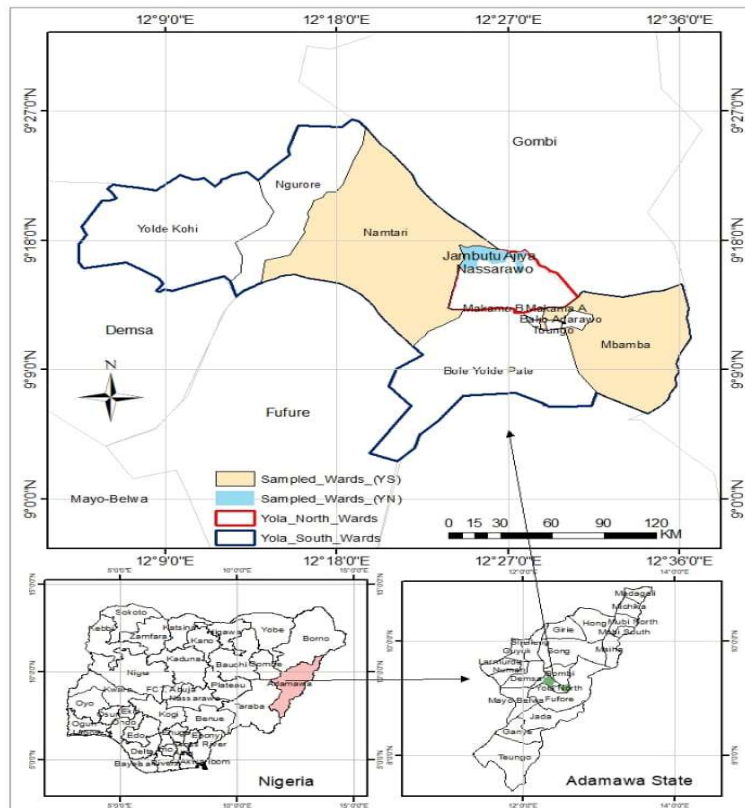


Figure 1: Map of the Study Area

Source: Modified and adapted from the Administrative Map of Yola (2020)

Methods

Clinical cases of measles incidences were retrieved from Adamawa State Primary Health Care Agency and that of weather elements from the Nigerian Metrological Agency (NIMET) Abuja. The time frame for the study is five years from 2015-2019. Using the SPSS version 2020 and Microsoft excel 2020 all data collected were computed for analysis. The medical records for five years were used to determine the prevalence of Measles cases within the metropolis using prevalence formula given as:

$$\text{Prevalence} = \frac{\text{Number of people with the disease}}{\text{Number of people measured}} \times 100 \dots \dots (1)$$

For the weather elements, the parameters chosen are: temperature, relative humidity and wind speed. The nature and variation in weather pattern was captured by subjecting the mean temperature, relative humidity and wind speed to time series analysis where graphs were plotted. Trend line and linear trend line equations are fitted to show direction of change. While the effects of weather elements on prevalence of measles, regression analysis was adopted.

Regression model given as:

$$y = \alpha + \beta_1 x_1 + e \dots \dots \dots (2)$$

Where X = independent variable (weather elements)

y = dependent variable (measles cases)

α = constant

$\beta_1 x_1$ = regression coefficient of the independent variable X

To obtain result for three independents variable $\beta_1 x_1$ (weather elements: temperature, relative humidity and wind speed) and y- dependent variable (measles cases) multiple regression was employed for analysis.

Multiple regression formula given as:

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e \dots \dots \dots (3)$$

Results and Discussions

Based on the findings of the study, the yearly trend of measles prevalence among under-five children in the study area has been fluctuating and there is a significant decreasing trend in the pattern of occurrence as indicated by the linear trend line with equation $y = -0.003x + 0.619$ over the time frame of the study (Figure 2). The highest prevalence of 0.92% was recorded in 2015 while the least at 0.33% was in 2018. This highest prevalence recorded in 2015 could be attributed to un-immunized population as a result of inadequate routine measles coverage and slow response to the pandemic on the part of the government. Whereas the least prevalence in 2018 could be attributed to adherence and adequate routine immunization. This is in line with studies carried out by Anne *et al.*, (2021) on the trend of Measles incidences and vaccine coverage in Nigeria.

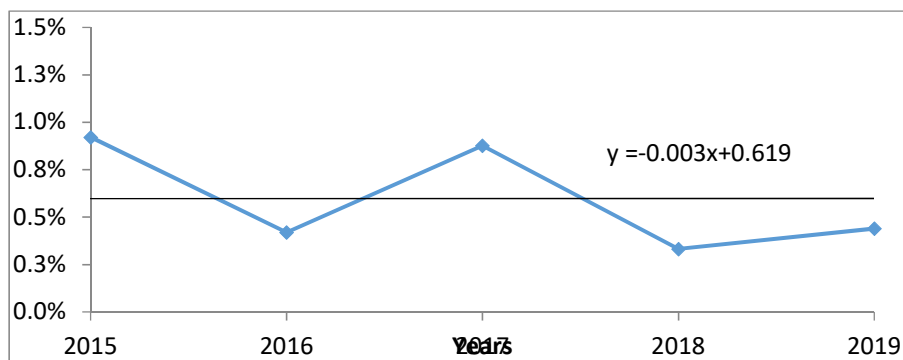


Figure 2: Trend of Measles Prevalence among Under-Five Children in Yola Metropolis

Source: Author's Computation 2020

It is evident through trend line analysis in Figure 2 that prevalence of measles among under-five children has decline. However, the slope value of -0.003 suggested that the reduction in the prevalence is minimal suggesting that the possibility of measles prevalence rising again if some variables that are likely to influence the high prevalence are not put on check. The results indicate that prevalence range between 0.33% and 0.92% and very significant disease for under-five children in Yola metropolis Adamawa state. This could be due to infection rate and possible favorable weather alongside the low level of immunity among 0 – 5 years old children. This concurs with the work of Belluz (2019) that under-five children could be highly exposed to various infectious diseases such as measles due to their low level of immunity to various diseases.

The monthly trend of Measles shows that prevalence in the study area has consistently risen from the month of October reaching peak in March with mean monthly value of 2.40% before declining consistently until reaching least value of 0.1% in September (Figure 3). The linear trend line equation $y = -0.0018x + 0.0195$ indicates that the mean monthly prevalence of Measles among under-five children expected to rise during dry season and could drop consistently in rainy season.

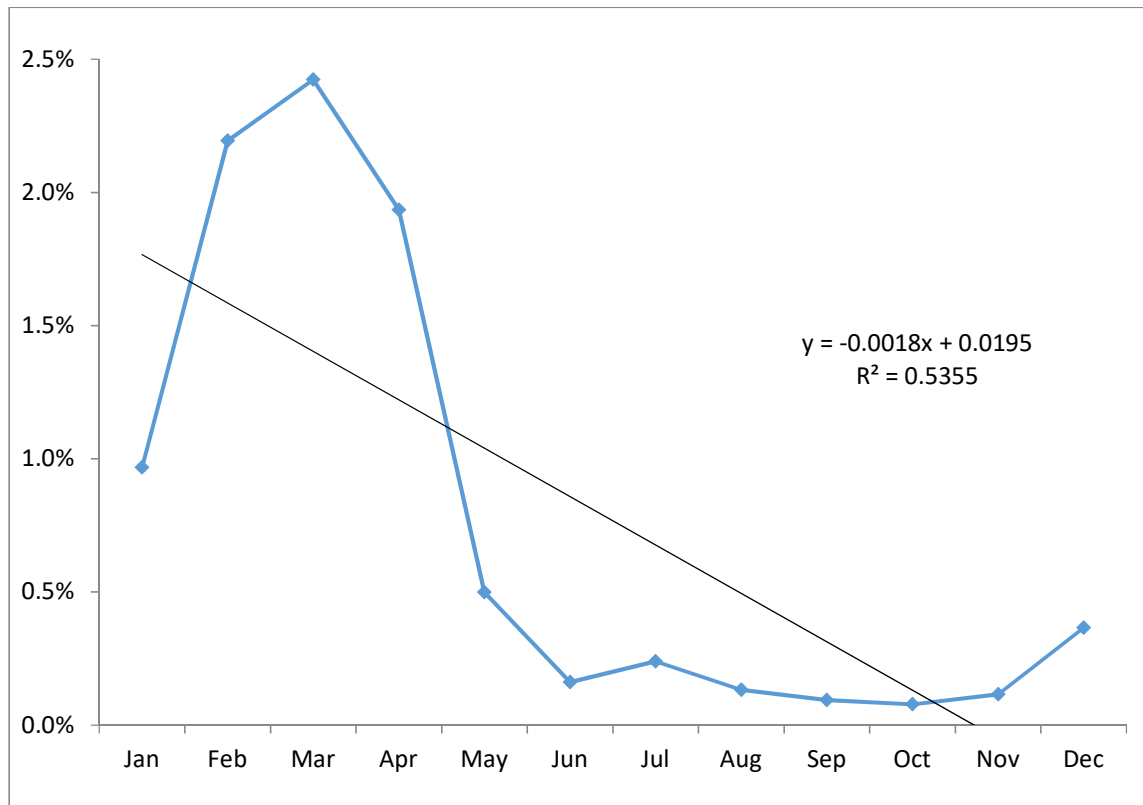


Figure 3: Mean Monthly Prevalence of Measles among Under-five Children in Study Area

Source: Authors Computation 2020

Figure 3 indicates that measles is a seasonal disease and becomes epidemic in the dry season where temperatures rise and subside with the onset of rainfall. More so, the results showed that high cases in the months of October through February before reaching peak in March; reduces gradually in the months of May, June and July till reaching least prevalence in September. This result suggests that the initial possibility of effect of temperature on cases of measles prevalent among under-five children. This result coincides with studies of Saleh (2016) on the trend of measles which indicates that transmission begins in October and reach peak in March so also in

accordance with Muhammad and Abdulmussawir (2019) which showed more prevalence in the months of February through April and less prevalence in May through October in Wudil Local Government Area, Kano state, Nigeria. Also, Peng and Xiuge (2020) found that monthly data on measles prevalence consistently high during dry than rainy season. In the study by Zhou *et al.* (2017) it was established that all months recorded measles prevalence, but most specifically those month's falls within dry periods or months with more temperature readings.

The trend of temperature distribution indicates that, the highest mean annual maximum temperature of 35.7°C was recorded in 2015, while the least maximum temperature of 32.04°C was recorded in 2019. Also, Figure 4 showed the mean annual trend of minimum temperature. It revealed that the highest minimum temperature value of 23.89°C was recorded in 2017, and the least minimum temperature value of 20.6°C was recorded in 2019. However, the trend analysis shows that both temperature readings have been fluctuating with both trend line equations $-0.64x + 1325.4$ and $-0.025x + 72.852$ for maximum and minimum temperature respectively suggested that the temperature has been decreasing over the time frame of the study.

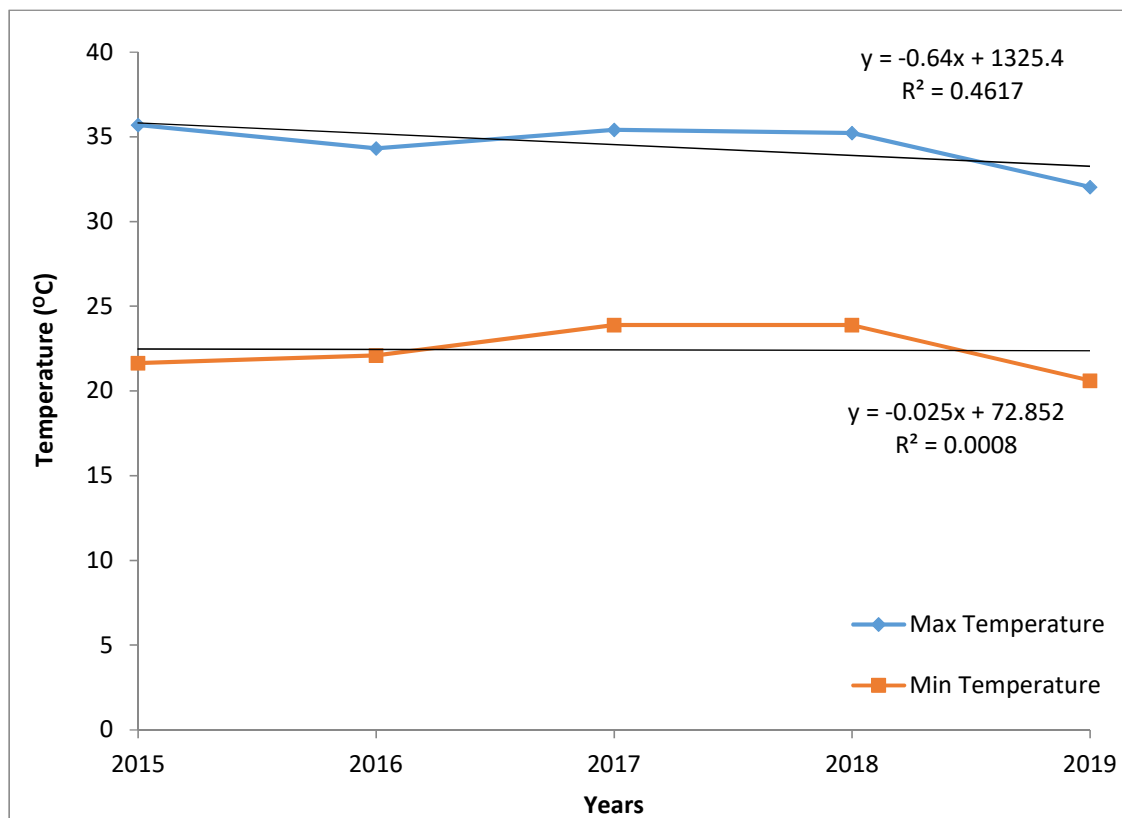


Figure 4: Mean Annual Temperature Readings (2015 – 2019)

Source: Author's computation 2020

The result on figure 4 showed that temperature is significantly related with Measles prevalence, hence temperature is one of the weather elements that influences Measles incidences. This concurs with the work by Mordeicei *et al.*, (2017) which showed that temperature relate strongly with cases of Measles. More so Liu *et al.*, (2018) found in tropics Measles outbreaks not regular associated with rainy season however, variations in temperature from extreme high to extreme low directly affect rising and dropping in Measles cases.

The trend of Relative Humidity reveals that, the highest relative humidity of 61.5% was recorded in 2016 while the least relative humidity of 48.08% was recorded in 2015. The trend analysis shows that relative humidity has been fluctuating and trend line equation $-0.15x + 355.73$ suggests that relative humidity has been decreasing over the time frame of the study which might be affiliated with climate change which includes shift in the frequency and magnitude of sporadic weather events.

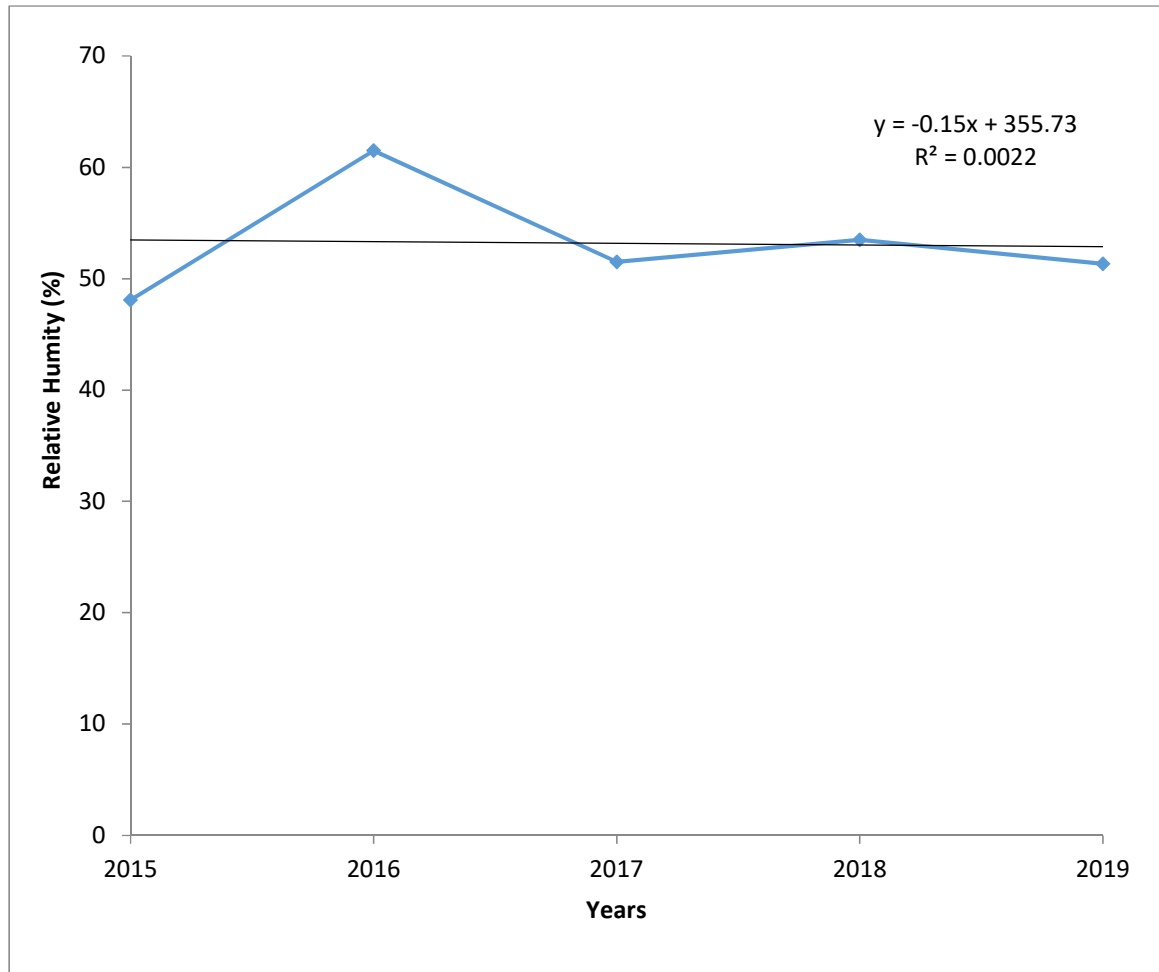


Figure 5: Trend of Relative Humidity in Yola Metropolis (2015 – 2019)

Source: Author's Computation 2020

From the analysis Relative Humidity is reducing has significantly indirectly related with Measles prevalence. This could be as results of global warming which tends to alter the climatic variable of the study area, this is in agreement with the studies by Winker (2017) and Peng and Xiuge (2020) that global warming directly impacted on the climatic variable such as temperature, rainfall and relative humidity and the findings of Adeniyi (2020) on his work trend analysis of temperature and relative humidity have established that both were increasing.

The trend of wind speed distribution indicates that, the highest wind speed of 4.9 knot was recorded in 2017 while the least wind speed of 4.17 knot was recorded in 2015. The trend analysis shows that wind speed has been fluctuating and trend line equation $0.1083x - 213.91$ suggests that the wind speed has been increasing over the time frame of the study. The increase correlates

with the work of Dan-Okoro, Hassan and Agidi (2018), as well as the work of Dantata *et al.*, (2019) which indicates rising trends as latitude plays a crucial role in determining the speed of wind in northeastern Nigeria. However, contradicts the findings of Amadi and Udo (2018) which shows a decreasing trend.

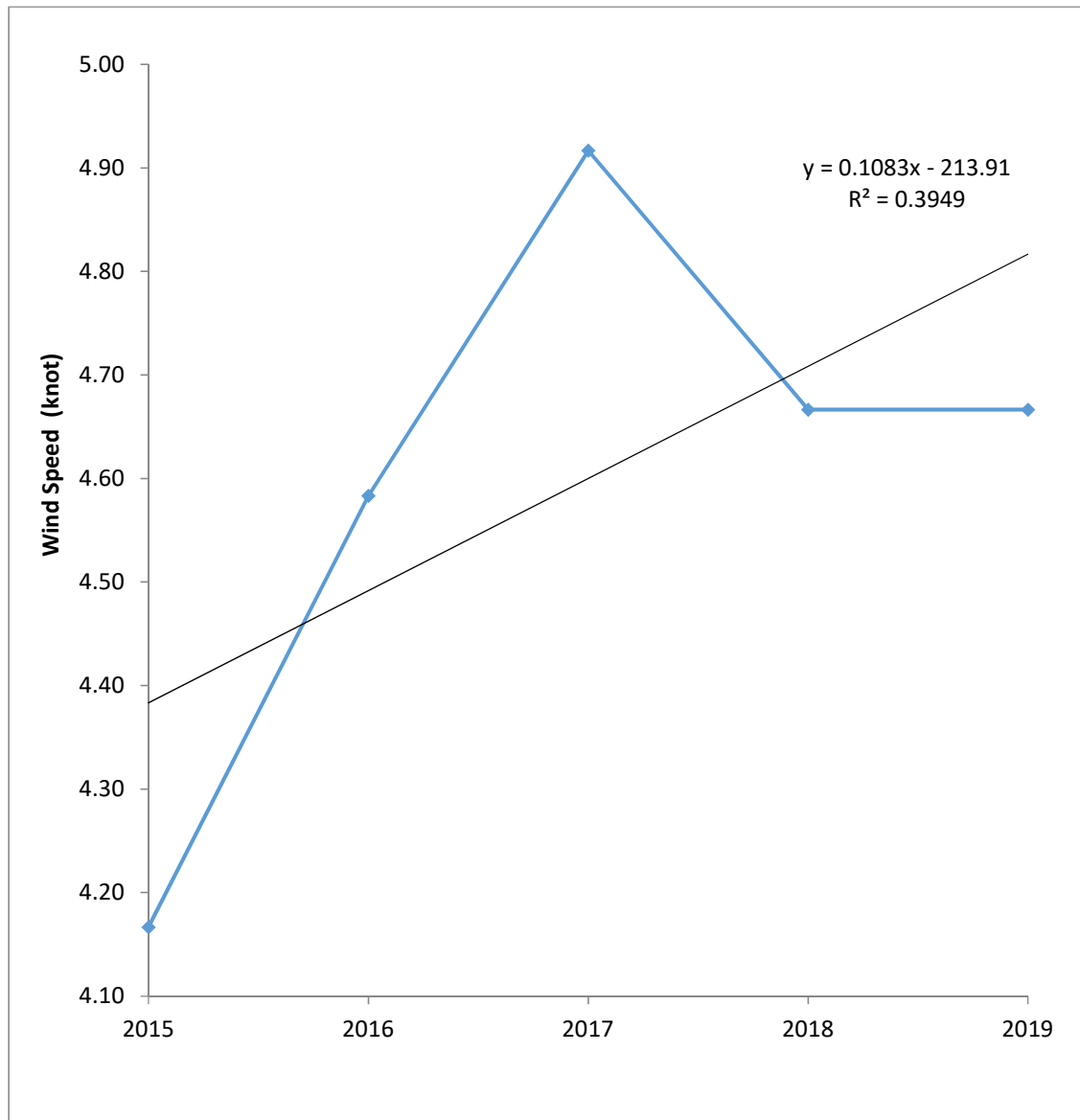


Figure 6: Trend of Wind Speed in Yola Metropolis (2015 – 2019)

Source: Authors Computation 2020

This fluctuating as the findings reveals shows a unique trend in January and February with another different trend in March to December.

Table 1: Analysis of Climatic Variables with the Overall Diseases Data from 2015 to 2019 Using Enter Method of Regression

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
2015	(Constant)	1.463	0.139		10.525	0.001
	Temperature	0.211	0.052	0.755	4.058	0.006
	Relative Humidity	0.003	0.006	0.148	0.500	0.605
	Wind Speed	0.035	0.022	0.414	1.591	0.122
2016	(Constant)	1.429	0.268		5.332	0
	Temperature	0.366	0.119	0.822	3.076	0.002
	Relative Humidity	0.001	0.003	0.012	0.333	0.957
	Wind Speed	0.168	0.074	0.511	2.270	0.051
2017	(Constant)	1.511	0.124		12.185	0
	Temperature	0.255	0.117	0.845	2.179	0.013
	Relative Humidity	0.009	0.003	0.033	3.000	0.893
	Wind Speed	-0.03	0.045	-0.159	-0.667	0.519
2018	(Constant)	1.519	0.132		11.508	0
	Temperature	0.193	0.035	0.563	5.514	0.004
	Relative Humidity	-0.107	0.023	-0.498	-4.652	0.024
	Wind Speed	0.064	0.08	0.192	0.800	0.447
2019	(Constant)	1.448	0.141		10.270	0.001
	Temperature	0.161	0.034	0.95	4.735	0.033
	Relative Humidity	-0.072	0.015	-0.152	-4.800	0.036
	Wind Speed	0.112	0.081	0.424	1.383	0.206

Source: Author's Computation (2020)

The results of regression analysis showed that across the years under studied (2015 – 2019) temperature consistently related with Measles prevalence with β -values 0.211; 0.366; 0.255; 0.193 and 0.161 respectively. This imply that temperature consistently contributed about 21.1%, 36.6%, 25.5%, 19.3% and 16.1% to prevalence of measles across 2015, 2016, 2017, 2018 and 2019 respectively. However, in 2018 and 2019, relative humidity has moderate but inverse relationship with Measles prevalence with β -values – 0.107 and – 0.072 respectively. This shows that relative humidity reduces chances of Measles prevalence, while temperature predicting chance of Measles prevalence among under-five children in Yola metropolis during period under studied (2015 – 2019). This is in harmony with studies of Ademola and Omotosho (2010), Akinboboo and Hamisu (2018), Muhammad and Abdulmussawir (2019) that there is significant relationship between weather parameters and Measles occurrence. Meanwhile, the wind speed show insignificant relationship with measles prevalence across years under study (2015 – 2019).

Summary of Findings

The results of the research indicated that Measles prevalence are influenced by two major weather elements (temperature and relative humidity) while wind speed has no significant effect at 0.05 significant level. In the trend of occurrence Measles cases are slightly declining, however, prevalence remains largely among other diseases affecting under-five children in the study as it occurs annually at varied rate. It was also, observed that Measles incidences become higher during months with higher temperature (October – April) than months with less temperature (May – September) across the years under studied. That relative humidity related inversely with

Measles prevalence while wind speed has no effect on the cases of Measles among under-five children in Yola metropolis.

Conclusion

The relational effect of weather element such as temperature, wind speed and relative humidity on prevalence of Measles among under-five children has been established in this study. Specifically, the study through its findings has established that temperature has direct and strong effect on incidence of Measles among under-five children in Yola metropolis, while relative humidity related inversely with the cases of Measles in the study area for the years under study (2015 – 2019). The wind speed has no significant relationship with cases of Measles prevalence among under-five children. Above all, this study has reiterated that the Measles prevalence being contagious diseases needed to be watched out for by the health experts and heads of households during months with higher temperature and periods when relative humidity dropped.

Recommendations

Based on the findings and conclusion from this study the following are the recommendations;

- i. The Adamawa state government, through the Ministry of Health, need to embark on various enlightenment campaigns on the need for child immunization against Measles. There is also the need to partner with relevant agencies like the primary healthcare to enlighten people in Yola metropolis on the effect of climatic change that could lead to high cases of infectious diseases like Measles among under-five children
- ii. Dedicated efforts should be channelled by school management and parents towards guiding the teachers in the early childhood schools on how to watch out for cases of Measles in those months when temperature are usually high in Yola metropolis.
- iii. During outbreak, mothers and head of family should be careful on how to prevent the virus from spreading from one child to another, especially, those with larger family size
- iv. Due to global warming children's movement within the environment during hot season should be restricted. Parents and care givers should desist from overcrowding and practice proper ventilation.
- v. Health care facilities that do not render proper medication should be reported to the relevant authorities
- vi. Once a child exhibits symptoms of Measles fever, the child should be rushed to the nearest health care Centre

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