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Temporal Analysis Of The Impact Of Temperature On Malaria Transmission In Kafanchan Town Jema'alocal Government Ar Of Kaduna State

[1]BONOH FRIDAY, [2]JOYCE ADAMS

[1,2]Department of Geography Kaduna State College of Education Gidan Waya. Nigeria.
bonohbonohf@gmail.com

Abstract

This study is on the temporal analysis of the impact of temperature on malaria transmission in Kafanchan town Jem a'a Local Government Area of Kaduna State. Data for the studies were collected from Nimet headquarters Maitama Abuja and the Monitoring and evaluation unit, General Hospital Kafanchan. The data collected were analyzed through the use of correlation analysis, regression analysis and time series analysis. The results revealed that there is a strong positive correlation between temperature and the occurrence of malaria in the study area and that as temperatures are gradually increasing in Kafanchan especially in the months of March and April and it has a potential on human health and as a factor in transmission of diseases like malaria. Hence this research recommends a review and upgrade contingency plan for hospitals and clinics and the need to build up their capacities to cope with meteorological variables that are health threats in Kafanchan town, the training and sensitization of the health workforce and health professionals on the health implication of malaria in the study area, the need to develop targeted Weather Warning Systems (WWS) to facilitate self – help and care behaviours in Kafanchan town during extreme temperature days, the need to introduce tighter regulations and guidelines on community greening, spaces and natural ventilated building in the study area and the need to support cross – discipline research on meteorological variables and their impact on health because this can have practical in implications in the study area.

KEY WORDS: Temporal; Malaria, Transmission; Health and Community Greening.

Introduction

Malaria is a parasitic infection spread by the female Anopheles mosquito and is responsible for 660,000 deaths globally and over 219 million cases of infection annually (World Health Organization, 2017). High-income countries (HICs) have been able to eliminate malaria, while many parts of low- and middle-income countries (LMICs) are still struggling to deal with malaria and vector control. In 2015, out of the 104 malaria endemic countries, 79 countries are in the malaria control phase, ten are in the pre-elimination phase, ten are in the elimination phase, and five are focusing on the prevention of re-introduction. A number of factors account for the existing malaria burden in developing countries including climate change, infrastructure, emerging drug and insecticide resistance, massive population and demographic shifts, and costs of containment and therapy (World Health Organization, 2017).

Malaria is a major public health problem in Africa with over 200 million clinical episodes and nearly one million deaths occurring annually (WHO, 2016). However, the risks of morbidity and mortality associated with malaria, particularly in semi-arid and highland regions, vary temporally. In semi-arid and highland regions of Africa, malaria is unstable and epidemic malaria is a common problem, causing an estimated 12.74 million clinical episodes and 155,000–330,000 deaths annually (WHO, 2017). In Nigeria, Malaria is the leading cause of morbidity and mortality

accounting for over five million cases and thousands of deaths annually (Bureau of Statistics 2015). The risks of morbidity and mortality associated with malaria are characterized by spatial and temporal variation across the country. Malaria is a complex disease and its transmission and prevalence is influenced by many factors, amongst which is the changing weather and climate which are considered to play a major role. With increasing weather variability and ability to forecast weather, there is an interest in developing systems for malaria forecasting that incorporate weather related factors as explanatory variables. Many studies in various parts of the world have linked malaria time series to weather variables such as rainfall, temperature and humidity. For instance, Teklehaimanot *etal* (2014) found that malaria was associated with rainfall and minimum temperature (with the strength of the association varying with altitude) in Ethiopia. Meteorological/climatic factors like ICUC9 - 9th International Conference on Urban Climate jointly with 12th Symposium on the Urban Environment temperature, rainfall, relative humidity etc have been widely associated with the dynamics of malaria vector population and, therefore, with spread of the disease. However, at the local scale, there is inadequate systematic quantification of the effects of these factors on the transmission of this disease. Furthermore, most attempts to quantify these effects are based on proxy meteorological data acquired from the satellites or interpolated from different scale. This had led to controversies about the contribution of changing weather and climate to malaria prevalence.

There are existing interventions for malaria prevention, which include Indoor Residual Spraying (IRS), Intermittent Preventive Therapy (IPT), presumptive treatment, and education. Yet malaria remains a major public health problem in Kafanchan town of Jema'a local government area of Kaduna state.

Health issues in Nigeria are of great and serious concern to the Governments and individuals. Studies like that of Lye and Kamal (2011); Trape (1996); Bi (2003) revealed that there is a close link between weather and the occurrences /severities of some diseases. Climate Change affects the social and environmental determinants of health; clean air, safe drinking water, and sufficient food and secure shelter (Whyndham, Morrison, Williams, Bredel, Peters and Von Rande, 2012).

The World Bank provided $180 million for the Malaria Booster Program that supports seven states and some national-level activities. The World Bank provided an additional $100 million for this program in 2009. The UK Department for International Development (DFID) initiated the Support to Nigeria Malaria Programme which was a $100 million, five-year program to control malaria in 2008. The Global Fund provided a $500 million Round 8 Malaria grant that began in 2009 and lasted until 2014. Yet, malaria is the second leading cause of death from infectious diseases in Nigeria after HIV/AIDS (Osagie, 2017). Malaria has the greatest prevalence, close to 50%, in children ages 6-59 months in northern Nigeria and the cause of almost 1 out of 5 deaths in children under 5 in northern Nigeria is due to malaria. Malaria is a risk for 97% of northern Nigeria's population. The remaining 3% of the population live in the malaria free highlands. Malaria is a major public health problem in northern Nigeria where it accounts for more cases and deaths than any other part of the country. Malaria contributes to an estimated 11% of maternal mortality in northern Nigeria. Malaria accounts for 60% of outpatient visits and 30% of hospitalizations in northern Nigeria (WHO, 2017).

World Health Organization (WHO, 2009) reported that a quarter of the world's disease burden is due to adverse weather elements experienced in a place over a period of time which sometimes affect shelter, air, water, soil and food through contamination. This poses a big problem to man. Anything, that affects shelter, soil, air, water and food is not only a threat but also an enemy to man. This is highly noticed in the tropics especially in the northern region of Nigeria.

The impact of rainfall and temperature induced diseases is noticed in the northern part of Nigeria as diarrhea, influenza, measles, cerebrospinal meningitis, malaria, asthma, cardiovascular and other respiratory diseases (Whyndham *et al,* 2012) . The occurrence of rainfall and temperature induced diseases has become a persistent problem to human health in northern Nigeria as well as threatening their health dream.

A lot of studies have been carried out globally on weather induced diseases. Such studies are that of Bi (2003) at China who studied climate variables and transmission on malaria, Burke, Hsiang and Solomon (2015) at England who focused on quantifying the influence of climate on health conflict and Nwoke and Ukpai (2009) at Owerri who worked on the Effect of climate on human health and some adaptive strategies.. There is none of these studies that are carried out in the study area which is Kafanchan town in southern part of Kaduna state in northern Nigeria. Thus, this study focuses on temporal analysis of the impact of temperature on malaria transmission in Kafanchan town. This is an attempt to fill this gap in knowledge that has been left untouched

The objective of this study is to examine the relationship between temperature and malaria transmission in Kafanchan town, of Jema'a local government area of Kaduna state, identify the pattern of temperature in the study area, determine the season that malaria is more prevalent/ severe in the study are and identify pattern of malaria occurrence in the study area.

In recent years, there has been a remarkable interest in environmental issues especially in sustainable development and management of both human and natural resources within the geo-environment (Glasson, Rikki, and Chadwick, 2014; Cornfold, 1997). The environment is constantly changing (Kandzewicz, 2012) and irrespective of the development that is going on in science and technology, it requires a dynamic rather than a static analysis for better understanding of this changing environment and human health (Aremu, 2004). The Federal Government of Nigeria's campaign of health for all by 2020 cannot be achieved except if serious attention is given to how each weather element has contributed to the outbreak of epidemics and diseases. Currently, the issue of climate change is believed to further worsen the situation globally. This is what makes this study timely and of great significance, in that attention and emphasis is now placed on weather and climate vis-à-vis the environment and human health.

Also, this study will be of great significance to the health sector of the country. The outcome will provide a health guide for the country. This will aid prompt intervention to whenever and wherever such diseases occur so as to combat it immediately. It will also provide a baseline for national planning, health policy formulation, management and also aid in controlling the effect of the occurrence of weather related diseases such as malaria and serve as a bedrock for further studies.

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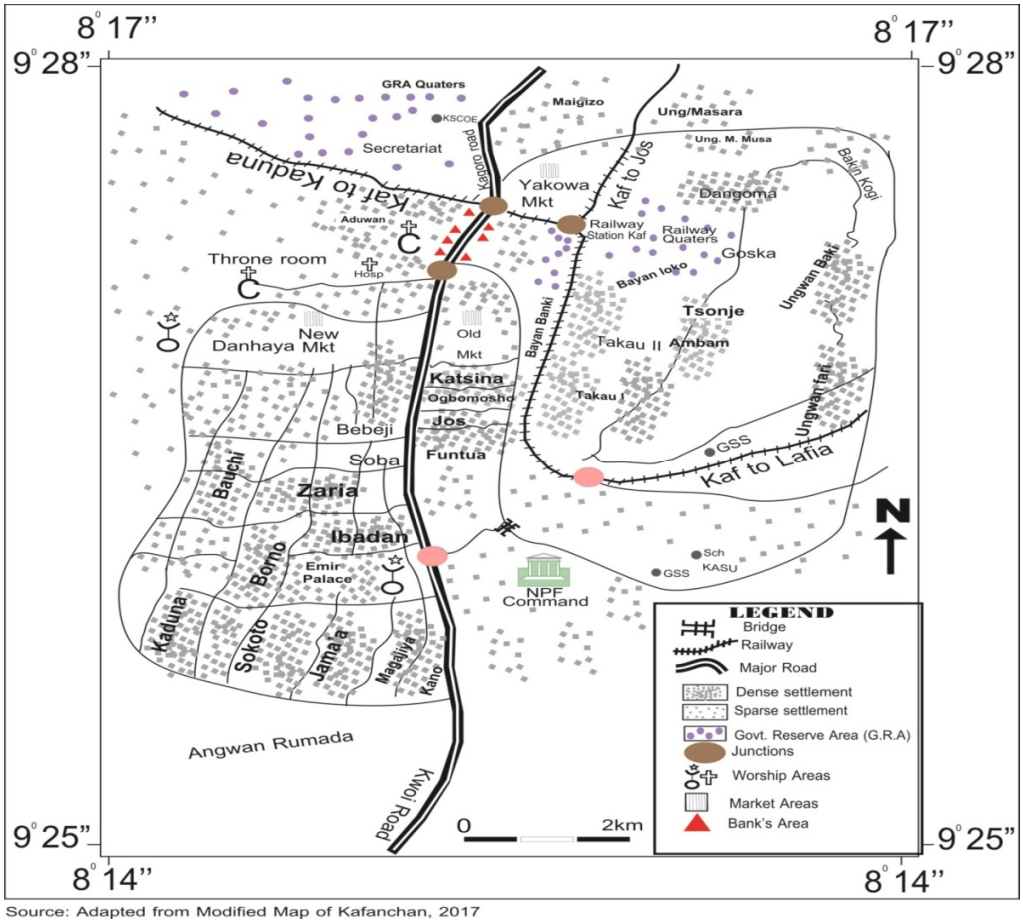
Study Area

The study area is Kafanchan town in the southern part of Kaduna State. Kafanchan town is the headquarters of Jema'a Local Government Area of Kaduna state. It is one of the oldest Local Government Area out of twenty three (23) Local government areas in the State.

The study area is located between Latitude 9^0 08' N and 10^0 04' N of the equator and Longitude 7^0 15'E and 7^0 50'E of the Greenwich meridian (Soladoye, 1997). It is bounded in the north by Ugwan Rimi in Zongon Kataf local government area, in the south by Kagoro in Kaura local government area as a natural boundary (fig 1)



Source: Adapted from Modified Map of Kafanchan, 2017

Fig.1: Modified Map of Kafanchan Town

The area has a population of about 1.003 million, (National Population Commission NPC. 2006) with major ethnic groups as Bajju, Ham, Ikulu, Oegworok, Attakar, Adara, Koro,Chawai, Fantswam, Ninzom, Gbagy, Adara, igbo,Yoruba Gwandara Hausa and Atyap. Crop cultivation, fishing, rearing of animals, hunting and commercial activities form the thrust of the economy of the study area, which engage well over 75% of the working population

of the area.

MATERIAL AND METHODS

The types of data used for this study are basically of a secondary source. They are mean monthly temperature data (^{0}C) and mean monthly record of Malaria, data of the study area. To represent the study area, which is Kafanchan town, quantitative temperature and malaria occurrence data is used for this study for a period of ten years. The mean monthly temperature for the period of ten years (2008 – 2017) is obtained from the Nigerian Meteorological Agency [NIMET] Maitama Abuja for Kafanchan town. The mean monthly data on malaria occurrence for the period of ten years (2008 – 2017) is obtained from the Monitoring and Evaluation Unit, Ministry of Health, Kafanchan General Hospital. Consequently the statistical tools of analysis used here are the ones that allow for the drawing of inferences on related variables. These are the time series analysis, correlation analysis and regression analysis.

PRESENTATION OF RESULTS

Table: 4. 2 is the result of Pearson moment correlation (r) between temperature and malaria transmission in Kafanchan town Jema'a Local Government Area of Kaduna State. The result reveals the existence of a positive correlation (r) of +.388 between temperature and Malaria transmission in Kafanchan town

Table 4.2 Pearson Moment Correlations

		MAIZE	RAINFALL
MALARIA	Pearson Correlation	1	+.388
	Sig. (2-tailed)		.268
	N	10	10
TEMPERATURE	Pearson Correlation	+.388	1
	Sig. (2-tailed)	.268	
	N	10	10

***Correlation is significant at 0.5 levels (2 tailed)**

Source: Author's Field Work, 2018

From table 4.3 is the summary of regression model measuring the degree of influence of temperature on malaria transmission in Kafanchan town Jema'a Local Government Area of Kaduna State. The result revealed that temperature influence malaria transmission for only about .075 (table 4.3). These imply that temperature is accounting for 75% influence on malaria transmission in Kafanchan town Jema'a Local Government Area of Kaduna State.

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Table 4.3 Summary of Regression Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics	
					R Square Change	F Change
Malaria	.388[a]	.750	.044	78254.34021	.750	2.417

a. Dependent Variable: Malaria

b. Predictor: (constant), Temperature

Source: Author's Field Work, 2017.

The coefficient table indicates a t-value of -.746 and the significant levels of 0.477 which is less than 0.5 significant level set as acceptance criterion for this study. The low coefficient means that, the null hypothesis which states that there is no significant relationship between temperature and malaria transmission in Kafanchan town in Jema'a Local Government Area is rejected, while the alternative hypotheses which state that there is a significant relationship between temperature and malaria transmission in Kafanchan town in Jema'a Local Government Area is therefore accepted (table 4.4).

Tabel 4.4: Coefficients of Variationin Malaria Transmission

Model	Unstandardized Coefficients		Standardized Coefficients	t-values	Sig.
	B	Std. Error	Beta		
Malaria	-554505.539	743399.489		-.746	.477
(constant)	631.057	530.213		1.190	.268
Temperature			.388		

a. Dependent Variable: Malaria

Source: Author's Field Work, 2018

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Temperature in the study area within the period under review revealed that temperature is generally high in the months of March, April, May, August, September and October (Fig 2). The highest is recorded in the month of April with 38.1°C. Temperature is observed to be low in the months of January, November and December. The lowest is the month of December with 22.1°C.

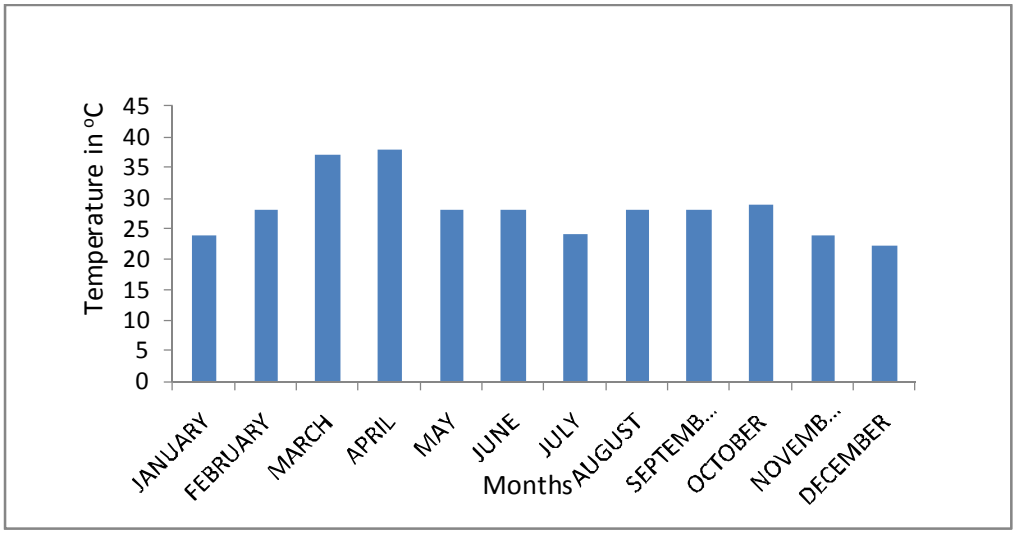

Fig 2: Mean Monthly Temperature for 2008-2017

Source: Author's Field Work, 2018

On the temporal occurrence of malaria in Kafanchan town, fig 3 revealed high incidence of malaria in the months of March, April, July, August and September. The highest incidence is recorded in the month of September with over 400 reported incidences per 1,000 population (Fig:3). The lowest incidence is recorded in the months of January,February, November and December.

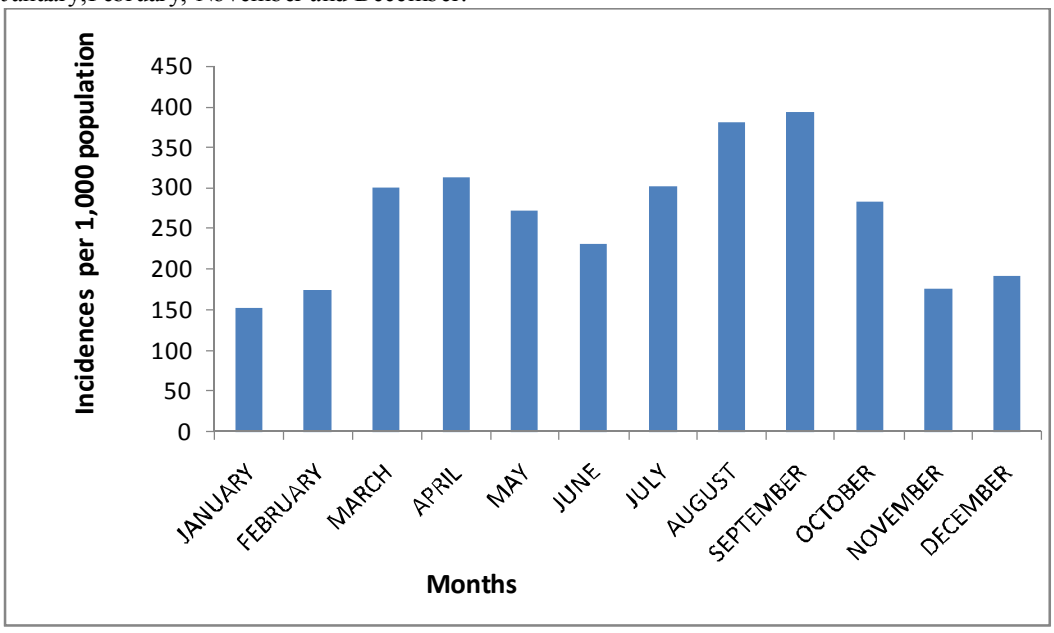

Fig 3: Mean Monthly Incidence of Malaria for 2008-2017

Source: Author's Field Work, 2018.

Discussion of Results

The research findings revealed that temperature in Kafanchan town is generally on the increase, characterizing temporal patterns of malaria occurrence and providing insight into important drivers of malaria. Meteorological variables such as temperature influence the seasonal pattern and the long term trends of malaria occurrence. This confirmed the fact that this meteorological variable has a strong relationship with the prevalence of diseases such as malaria, measles and cerebrospinal meningitis in the study area.

As temperatures are gradually increasing in Kafanchan especially in the months of March and April, the potential impact of this on human health and as a factor in transmission of diseases like malaria. These agree with Paul (2001) at Ado Ekiti who stated that elementary models suggest that higher temperatures will enhance the transmission rate of diseases and extend their geographic ranges. Increase in temperature is estimated to consistently extend the distribution of malaria, also making mosquitoes and other diseases vectors pathogen to increase.

Findings revealed that the health of many people in Kafanchan town is impacted each year by increase in temperature and it affects the basic requirement for health and increases the transmission of malaria. Increase in temperature in Kafanchan town has been more promoted and has enabled malaria vector mosquito to find a new and more favourable habitat for increase. This may have resulted in the high frequency and severity of malaria and other diseases observed in this research's in the study area. This is in line with the work of Rasha and Ayman (2011) at Sudan who observed that the geographic landscape and the rise in meteorological variables (rainfall and temperature) are considered as the environmental factors for the increased risk of malaria because of their impact on the mosquito vectors' activities and plasmodium incubation rate. It also agrees with Ali *et al* (2008) who opined that the rise in rainfall and temperature provide favourable breeding sites for mosquito in Sudan and the main vector involved in transmission is the mosquito plasmodium falcipram which is the main parasite for the majority of the infection (90%) with other species.

Generally in Kafanchan town, incidence malaria is observed by this research to be high in the months of March and April (that is late dry season when temperature in the study area high) and high in the months of August and September when the rains is at its peak. The severe occurrence of malaria in the months of March and April may be as a result of the fact that when the vector lives in an environment of mean temperature an increase in temperature may result in the increase in development, incubation and replication of the pathogen. Temperature may modify the growth of disease carrying vectors by altering their birthing rates as well as affect vector population dynamics and alter the rate at which they come in contact with human. Also disease carrying vectors may adapt to extreme changes in temperature by changing geographical distribution or it may undergo an evolutionary response to adapt to increased temperatures. This concurred with Patz *et-al* (1999) in Brazil who observed that there is recent evidence to suggest that mosquitoes which are diseases carrying vectors, may undergo an analogous micro evolution which would allow adaptation to altered seasonal pattern associated with global climate change or that mosquitoes can adapt genetically to survive and remain active with the lunar growing seasons associated with climate change.

The high and continued occurrence of Malaria in the rainy season as observed in this research is not a surprise because variability in rainfall may have a direct consequence on disease out breaks. Increase in rainfall may increase the presence of disease vectors by expanding the size of existent larval habitat and creating new breeding grounds. In addition increase in rainfall may support a growth in food supplies which in turn supports a greater population of vertebrate reservoirs.On the other hand, the low incidences of Malaria in the Months of May, June and July as this research revealed may be as a result of the fact that heavy rainfall may cause flooding and decrease vectors population by eliminating larval habitats and creating unstable environments for vertebrate reservoirs. This is in line with Brucich *et-al* (2015) at Thailand who assessed parasites and vectors in causing Malaria, observed that unseasonably heavy rainfall can cause flooding and make the environment unsuitable for vectors and therefore reduce the likelihood of vectors exposed to human contact or reduce stagnant pools that are vector breeding habitats.

Conclusion

However, biologicalknowledge such as the study of diseases pathogens and technical knowledge such as the use of mosquito treated nets are needed to control malaria in Kafanchan town. Additional requirements to control malaria in Kafanchan town include the political will, financial resources, and national stability. A successful move toward the eradication of malaria, need an unwavering national commitment.To mitigate these diseases of malaria, a successful policy-focused assessment of the potential health impacts of temperature should include a multidisciplinary assessment team, responses to questions asked by all stakeholders; evaluation of risk management planning options, identification and prioritization of key research gaps, characterization of uncertainties and their implications for planning, decision-making; and tools that support decision-making processes.

Recommendations

From the research evidence, temperature has a major impact and health threat to populations in Kafanchan town. Effective public health protection measures and an overall technical health system frame work is needed to overhaul the current situation because emphasis on the health sector alone is not able to address all climate related health impacts, so multi-disciplinary collaboration and action to address climate related health issues is recommended. Further research should be conducted on weather induced diseases, because aside temperature which induces outbreak of malaria, other factors causing malaria include rainfall low humidity, wind, extreme cold and so on. This study only concentrated on temperature, thus more studies are still expected.

Hence this research recommend:-

1. A review and upgrade contingency plan for hospitals and clinics and the need to build up their capacities to cope with meteorological variables that are health threats in Kafanchan town.
2. The training and sensitization of the health workforce and health professionals on the health implication of malaria in the study area.
3. The need to develop targeted Weather Warning Systems (WWS) to facilitate self – help and care behaviours in Kafanchan town during extreme temperature days.

4. To introduce tighter regulations and guidelines on community greening, spaces and natural ventilated building in the study area.
5. The need to support cross – discipline research on meteorological variables and their impact on health because this can have practical in implications in the study area

References

Alahmari, A. D; Alex J M; Anant R; Patel. C Beverly S; Kowlessar R; Simon E B, James P A, Jadwiga A. W; and Gavin C. D (2015) Influence of Weather and Atmospheric Pollution on Physical Activity in Patients, *Respiratory Research* 16 (71) Pp12931-12958

Akinyemi, G. O; Olusegun, O; Andreas, M; Clement, O A (2011) *A Study of Weather Related Respiratory Diseases in Eco-climatic Zones*. Meteorological Institute, Albert-Ludwigs-University, Freiburg, Germany

Aremu, J. K. (2004) Analysis of Extreme Rain Events in Northern Nigeria: Implications for Agricultural Planning. Unpublished Ph.D Thesis Department of Geography Federal University of Technology Minna.

Baba, J. M. (1994) Sustainable Development and the Nigerian Environment *Nigerian Geographers Journal News Series.*57, Pp. 82-88

Bi, P (2003) Climate Variables and Transmission on Malaria: A 12 years Data Analysis in Suchen Country, *China Research Articles.*Pp.1-8

Burke, M; Hsiang, S, Solomon, M Miguel, E (2015), Quantifying the Influence of Climate on Human Conflict, *Science* 341 (6151): Pp1235367-1235368.

Brusich, M; John, G; Naomi, P; Rungarun ,T; Wanapa, R; Theeraphap, C; Nicole, A (2015) Targeting Educational Campaigns for Prevention of Malaria and Dengue Fever: An Assessment in Thailand, *Parasites and Vectors*, 8 (43) Pp456-479

Cartography Department (2017) School of Environmental Design Kaduna Polytechnic, Kaduna

Clark, W.C and Holling, C. S. (1985) "The Perception of Natural Hazard in Resource Management, *Natural Resource Journal*, 3 (3) Pp123-154

Clement, J and Vercauteren. J. (2009). Relating Increasing Hantavirus Incidence to Changing Climate: The Mast Connection. *International Journal For Health Geographic`s* 8. Pp 124-126

Cornfold S.G. (1997) "Human and Economic Impacts of Weather Events In 1996" *World Meteorological Bulletin*. 46 [4] Pp.351

Daniel, .R.M and Paul C.S. (2006) *An Introduction to Scientific Method in Geography,* Thousand Oaks: California.

Darwin, .C. 1859) Origin of Species: In Stoddart; D [1966]. Darwins impact on Geography. *Annals of Association of American Geographers* Vol. 56 Pp 683 – 698.

Ehrlich; P. R., Ehrlich, A .A.H. and Holden J.P. (2008). Population, Resources, Environment. *Ecoscience Journal*.39, Pp.127-131

Glasson, J. Rikki. T and Chadwick, A (2014) *Introduction to Environmental Impact Assessment* U.C. L .Press, London.Pp.313

Jimoh, H. I. (1995)"Erosion Studies in a Nigerian City: A Methodological Approach". *Environmental Issues* vol.1 Pp.46-54

Jimoh. H. I. (1997) Individual Rainfall Events and Sediment Generation on Different Surfaces in Ilorin, Nigeria Unpublished Ph.D Thesis,Department of Geography University of Ilorin.

Kalkstein, L S; Davis, R. E; Skinddlov, J. A and Valimont, K. M (1986a). The Impact of Human Induced Climatic Warming upon Human Mortality. A New York City Case Study *Proceedings of the International Conference on Health and Environmental Effects of Ozone Modification and Climate Change*, Pp 168 – 174.

Kandzewicz, W. (2012). Climate Services and Water Resources Management, *World Meteorological Organization Bulletin*, 46.Pp. 37-40

Katayama, K. and Momiyama-Sakamoto, M (1970): MD`s S.B Thacker, MD; and The Field Investigation Team, (1982): Risk Factors For Heatstroke: As Case Control Study. *Journal of the American Medical Association* 247 Pp 3332-3336

Kilbourne, E. M; Choi MD.R; Jones T.S and Thacker, MD, S.B. (1982) The Risk factor For Heatstroke: *Case Control Study*., 18 (7). Pp. 3332-3336.

Lewthwaite, G. (1966). Environmentalism and Determinism: A Search For Clarifications, *Annals of Association of American Geographers* vol.56.Pp. 1- 23

Lucey, T (2002). *Quantitative Techniques,* (6th Ed)International, U.K

Lye, M and Kamal A. (2011). The Effects of a Heat Wave on Mortality Rates in Elderly inpatients, *The Lancet*, 1.Pp.529-531

Mack, M. (1985). Influence of Precipitation on Fatal Automobile Accidents in Connecticut Unpublished M.Sc Thesis, Department of Geography, University of Delaware.

Nwoke, B. E. B; Nwoke E. A and Ukpai O. M (2009). Effect of Climate Change on Human Health and Some Adaptive Strategies-A Review*Bayero Journal of pure and Applied Sciences*, 2 (1):Pp.168-172.

Ogah, A. O ; Ezeonwumelu, J. O; Okoruwa, A .G; Adiukwu, C. P; Ajayi A. M and Akib, S (2009*). Manifestations of Severe Malaria among the Under-five Children Attending Kampala International University Teaching Hospital, Bushenyi, Western Uganda: Pilot Study,* Kampala International University Press, Bushenyi, Uganda

Onyiriuka, A. N (2011). Clinical Profile of Children Presenting with Measles in a Nigerian Secondary Health-Care Institution, *Journal of Infected Diseases Immunization* 2(3) Pp112- 126

Osagie, E (2017) Meningitis Outbreak Death Estimate Rises to 489 in Nigeria, *Vanguard News paper,* April 12th 2017

Paul, R. (2001). Climate Change and Mosquito Bone Diseases *Environmental Health Perspective,*109 (1) Pp141 – 161

Rehana, A .S; Jai K .D; Zohra, S. L; Zulfiqar A. B (2003). Impact of Community-Based Interventions for the Prevention and Control of Malaria on Intervention Coverage and Health Outcomes for the Prevention and Control of Malaria, *Journal of Tropical Medical Hygiene* 1(8) Pp 84:108

Robine, J. M (2008). Death Toll Exceeding 70,000 in Europe during the summer of 2003, *Les Comptes Rendus Series. Biologies*, 331 (3) Pp171-178

Rogot, E. (2013) Association of Cardiovascular Mortality with WeatherChicago1967.*Proceeding of the ASHRAE Symposium on Air-conditioning, Climatology and Public Health, 22nd-25th August, 1971*

Sakamoto, M. M and Katayama R (1971) Statistical Analysis of Seasonal Variation in Mortality, *Journal Meteorological Society of Japan*, 49.(1)126-138

Sameera, K; Amar K (2013) Global Health Impacts Due to Infectious Diseases and Climate Change: A Narrative Review, *GJMEDPH* 2, (2) Pp 2277-9604

Sanders, J. L. and Brizzilara, M. S (1982) Relationship between Weather and Mood, *The Journal of General Psychology*, 107, Pp.155-156

Semple, E. C. (1911). Influences of Geographic Environment In Agnew. J. (1966) *Human Geography: An essential Anthropology,* London: Blackwell Publishers.

Soladoye, E. E. (1977). *Nigerian Atlas,* Thomas Nelson and sons Ltd, Lagos

Steven, M. B (2003),Weather and Climate Effects on Disease Background Levels. *Johns Hopkins Applied Technical Digest,* 24, (4) Pp234-258

Taylor, G. (1951). *Australia.* Sixth Edition, London. Methuen, New York.

The Holy Bible (1979*), Today's English version*. United bible society Publications, India.

Thom, E. C. (2014), The Discomfort Index, *Weatherwise,*12, Pp.57-60.

Trape, J. F. (1996), The Spread of Tick-Borne Boreliosis in West Africa and It Relationship to Sub-Sahara Drought. *Weatherwise,* 21 (2) Pp156 – 161

Tromp, S.W. (1980). *Medical Biometeorology*, Elsevier, New York

Wolfson, L. J; Grais, R. F; Luquero,F. J; Birmingham, M. E, Strebel, P. M (2009). Estimates of Measles Case Fatality Ratios: A Comprehensive Review of Community-Based Studies, *International Journal of Epidemiology*, 38 (3) Pp192-205.

World Health Organization (2016) *Official Record*, No.2.Pp.100

World Health Organization (2007) *Health Report*, No.8 Pp.67.

World Health Organization (2017) Cerebrospinal Meningitis Outbreak in Nigeria, Situation Report as at 17th April 2017.

World Meteorological Organization (2008) IMO/WMO *Conference Proceeding Technical Note* No.130, WMO No.370. Geneva, Pp 79-86

Whyndham, C. H; Morrison, J. F ; Williams, C. G; Bredel, G. A. G; Peters, J. and Von Rande M. J. E (2012). Physiological Reactions to Cold of Caution Females,*Journal of Applied physiology*, 19, Pp.877-880

Zhou, N. (2008). Potential Impact of Climate Change on Schistosomiasis Transmission in China, *American Journal of Tropical Medicine and Hygiene,* 2008, 78, Pp.79-86