



Intra Urban Variation in Climate Change Related Diseases among Children in Abuja Municipality, Nigeria

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Abstract: Healthy children today become the healthy adults tomorrow, *ceteris paribus*. This assertion is not farfetched considering the fact that man's existence and well-being is greatly influenced by an amalgam of his economic, social, psychological as well as physiological environment. This spawned the interest in studying the influence of climate related diseases among children with particular reference to their variation across the wards in Abuja municipality. In carrying out this study, health records were obtained from the National Hospital, Abuja (NHA), while the Nigerian Meteorological Agency (NIMET) supplied data on temperature and rainfall pattern from 2004 to 2014. Using Chi-square test of homogeneity at alpha level 0.05, a significant difference was observed in the incidence of diseases among the various age groups. Also analyzing the statistical variation in the incidences of these diseases across the wards in the study area, the Analysis of Variance (ANOVA) computed with respect to this affirms that only the incidence of malaria (with $F=14.924$ and alpha value (α) =0.05) varies significantly. The incidence of diarrhea and measles (with $\alpha= 0.207$ and 0.204 respectively) on the other hand do not vary significantly across the wards. The observed differences in their incidence are merely due to chance. Suggested mitigating measures towards improved state of health among children include: environmental education, environmental responsibility and other management practices.

Key words: *Urban, Climate, Climate change, Disease*

1. Background to the study

Suffice to say that 'healthy children today become the healthy adults tomorrow, *ceteris paribus*'. This is so because the amalgam of influence man's environment including; economic to social, physiological and psychological is very crucial to his existence and wellbeing (Marx and Frederick, 1972). This premise is supported by (McMichael, Woodruff & Hales, 2006), who opined that the long-term good health of populations depends on continued stability and functioning of the biosphere's ecological and physical systems, often referred to as life-support systems. More so, the World Health Organization (2008b) estimated that 34% of all childhood illness in the world (compared to 24% of all age illness) and 36% of deaths in children under age 14 are due to modifiable environmental factors. In the light of this, man is shaped by his environment and the yet developing nature of children's physiology increases their vulnerability to these changes.

The United States Environmental Protection Agency (2007) described the term climate change to mean any significant change in measures of climate parameters

(such as temperature, precipitation, or wind among others) lasting for an extended period i.e. a decade or more. Climate change may result from natural factors, such as changes in the sun's intensity or slow changes in the earth's orbit around the sun; natural processes within the climate system (such as changes in ocean circulation); human activities that change the atmosphere's composition (through burning of fossil fuels) and the land surface (deforestation, reforestation, urbanization, desertification, etc.). These changes affect the average weather conditions that one is accustomed to. Warmer average temperatures will likely lead to hotter days and more frequent and longer heat waves. This could increase the number of heat-related illnesses and deaths. It might as well increase the frequency or severity of extreme weather events such as storms, flooding, high winds, and other direct threats to people and property. This further increases the concentrations of unhealthy air and water pollutants, leading to the spread of some diseases e.g. asthma which increases as the exposure of the ozone layer increases (Katherine and Sophie, 2008).

Although climate change potentially places all people at risk, its health effects vary among individuals and communities, just as ill-health varies with age,

geography, income, health care availability and quality, nutrition, occupation, genetics and environment (WHO, 2000). The health effects of changing climate are expected to be more severe for elderly people and people with infirmities or pre-existing medical conditions. The groups who are likely to bear most of the resulting disease burden

are children and the poor, especially women (WHO, 2000). The major diseases that are most sensitive to climate change are diarrhea, vector-borne diseases like malaria, and infections associated with under nutrition are most serious in children living in poverty.

Table 1.1: Eight Infectious Diseases that are Sensitive to Climate Change

Diseases	Significance of Climate Change as a factor in Determining Epidemics	Existing Global Burden (millions of DALYs lost)	Countries Affected
Malaria	Primary	33.98	Africa, South America, Asia
Cholera	Primary	Pandemic Potential	Africa, Asia, Russia, South America
Dengue	Important	0.67	Africa, Europe, South America, South East Asia
Meningitis	Important	1.43	Worldwide
Leishamianiasis	Important	1.97	Africa, Asia, Europe, India, South America
Influenza	Significant	Pandemic Potential	Worldwide
Diarrheal diseases	Significant	72.78	Worldwide
Schistosomiasis	Significant	1.71	Africa, East Asia, South America

Source: WHO (2000), Smith (2008)

In developing countries like Nigeria, climate change is evident in shift in temperature, down pour and other severe weather conditions which disrupts and pose serious threat to children’s wellbeing (WHO, 2008a). Having known that children are more sensitive to harm from environmental (climate) change or hazards, owing to their physical, physiological and cognitive immaturity, this study aims at evaluating the variation in the incidences of climate related diseases among children in the various wards in Abuja Municipality. It further provides answers to the following research questions:

- i. What are the climatic changes experienced in the study area?
- ii. What are the prominent climate-related diseases in the study area?
- iii. How does the incidence of these diseases vary among children in the different wards in Abuja Municipality?
- iv. Which ages are mostly affected?

While the effects of climate change may pose unique and increased risks to children’s health, the risk can be reduced through preparation, planning, and surveillance by our public health agencies at the federal, state and local levels (USEPA, 2007). As a result, the study further suggest preventive and adaptive mechanisms that can be put in place to effectively address the health impacts of climate change among children.

2. Literature Review

There is a widely held scientific consensus that the earth’s climate is warming rapidly and at an alarming rate. Human activities, primarily the burning of fossil fuels, are very likely (>90% probability) to be the main cause of this warming (American Academy of Pediatrics, 2007). Emission rates for the most important anthropogenic greenhouse gas, CO₂ have been raised 120-fold in the past 150years. Deforestation and other land use changes which erstwhile used to be the major factor responsible for climate change in the 19th century are now overtaken by combustion of fossil fuels. A direst product of industrialization and emissions now amount to 6billions tons of carbons a year, or around 1 ton of carbon per head of the world’s population. These emissions are uneven all over the world, with North America having the highest emission rate. Her emission is about 18 times that of Africa, nine times that of Asia and 23 times that of Europe (IPCC, 2007). Unless the world curbs growing CO₂ concentrations in the air, global warming will likely double by 2080 and may warm the world by 30°C. Climate models predict that land areas will warm twice as the oceans, high latitude will warm more quickly in winter, and there will be substantial changes in precipitation, especially in the tropics (IPCC, 2007).

This change in the world climate poses a wide range of health risks to population and this has been predicted to increase to critical levels in future decades if global climate change continues in its currents trajectory.

The report of the WHO commission on social determinants of health points out that the less privileged communities are likely to shoulder a disproportionate share of the burden of climate change because of their increased exposure and vulnerability to health threats. Over 90 percent of malaria and diarrhea deaths are borne by children aged 5 years or younger, mostly in developing countries (WHO, 2008b). The primary challenge facing the world community is therefore the ability to achieve sufficient reduction in greenhouse gas emissions so as to avoid dangerous interference in the climate system which can be harmful to human health, particularly children (McMichael, Woodruff & Hales, 2006).

Climate change affect most of the fundamental pre-requisites for good health: clean air and water, sufficient food, adequate shelter and freedom from disease. The global climate is now changing faster than at any point in human civilization, and many of the effects on health are acutely felt. The most severe risks are to developing countries, with negative implications on the achievement of the health-related Millennium Development Goals and for health equity (WHO, 2008a). For instance, extreme air temperatures and air pollution are hazardous to health. Heat-waves are direct contributor to deaths from cardiovascular and respiratory disease, particularly among elderly people. High temperatures also raise the levels of ozone and other air pollutants that worsen cardiovascular and respiratory diseases e.g. asthma.

Secondly, floods, droughts and contaminated water increase disease risk. Lack of fresh water compromises hygiene, thus increasing rates of diarrheal disease. Too much water, in the form of floods on the other hand causes contamination of freshwater supplies and also creates opportunities for breeding of pathogens e.g. mosquitoes.

Thirdly, climatic effects on agriculture threaten increasing malnutrition. Rising temperatures and changing patterns of rainfall are projected to decrease crop yields in many developing countries. For populations that depend on subsistence farming, or do not have sufficient income to buy food, this situation is expected to translate directly into wider prevalence of malnutrition which subsequently increases the severity of many infectious diseases, particularly among children.

Furthermore, climate change brings new challenges to the control of infectious diseases. Many of the major killer diseases transmitted by water and contaminated food and by insect vectors are highly sensitive to climatic conditions and weather extremes. Climate change threatens to slow, halt or reverse current progress against many of these infections.

Lastly, not all of the effects of climate change will be harmful, but juxtaposing the benefits and ills, the latter outweigh the former. The negative effects are concentrated on poor populations that already have compromised health prospects, thus widening the inequality gap between the most and the least privileged (WHO, 2008b).

3. Study Area and Methodology

The scope of the study is within Abuja Municipal Area Council, which consists of 12wards; City centre Wuse, Gwarinpa, Garki, Kabusa, Gui, Jiwa, Gwagwa, Karshi, Orozo, Karu, and Nyanya constituencies. The Federal Capital Territory was deemed fit for the study as a result of considerable changes in climatic parameters over the years and the fact that it duly represents the nation, Nigeria. Health records and climate data obtained from the National Hospital, Abuja (NHA) and Nigeria Meteorological Agency (NIMET) respectively constitute the backbone of the research. The admission and discharge records units of the NHA provided the needed data on incidences of climatic related diseases including: malaria, typhoid, asthma, respiratory diseases, pneumonia, skin diseases, diarrhea, measles, and meningitis among children between the ages of four months and thirteen years. This data was obtained for years 2004, 2006, 2008, 2010, 2012 and 2014. The choice of these diseases was based on WHO's (2008) record.

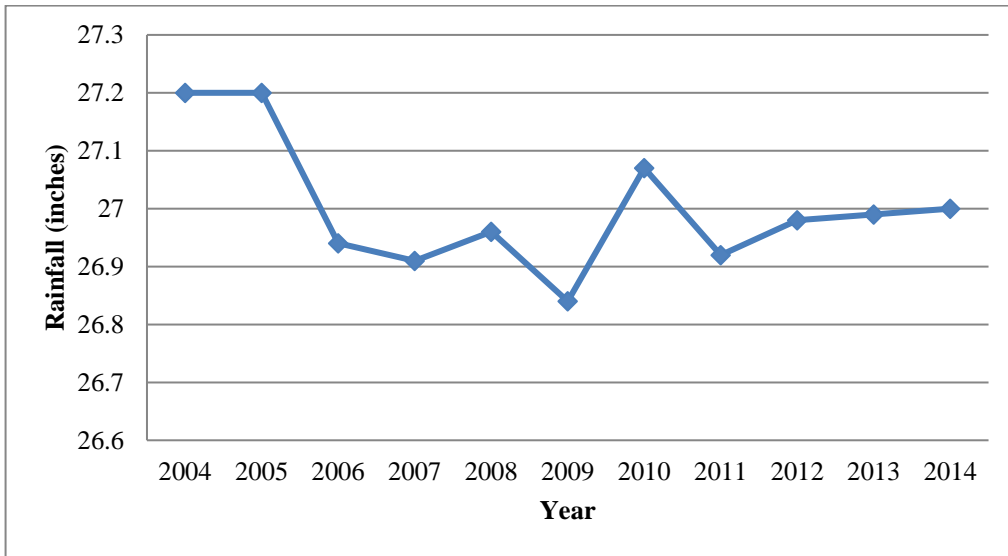
NIMET however supplied data on the temperature and rainfall pattern from 2004 to 2014. Descriptive statistics including charts and graphs were used to explain the measures of climatic parameters and incidence of climate related diseases for the years considered. Chi-square (X^2) was used confirm if a significant difference exist in the incidence of climate related diseases among the various age groups, while ANOVA was used to determine the intra-urban variation in the incidence of climate-related diseases among the children in the various wards.

4. Findings and Discussions

4.1. Pattern of Rainfall and Temperature

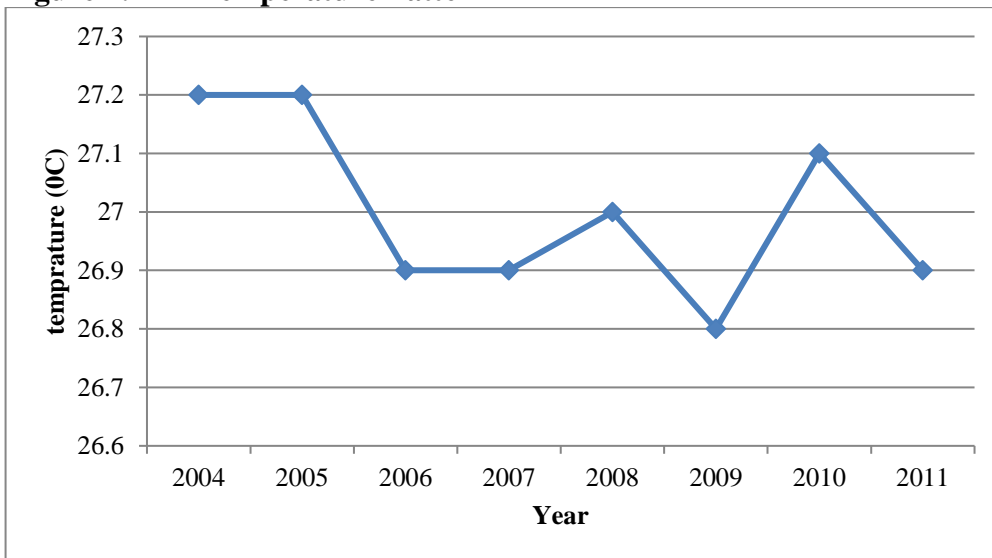
Data on two climate parameters were obtained from the Nigeria Meteorological Agency. From the data obtained, it was observed that series of increase and decline had been experienced in the pattern of rainfall and temperature in the study area. There seem to be a close relationship between the two climate parameters considered. The maximum level of temperature and rainfall was experienced between 2004 and 2005. This later reduced significantly in 2006. A significant increase was however experienced in 2009 before the incidence dropped and later maintained a relatively steady level from 2012 to 2014.

Figure 1: Rainfall Pattern



Source: Authors' Field Survey (2014)

Figure 2: Temperature Pattern



Source: Authors' Field Survey (2014)

4.2. Incidence of Climate Change Related Diseases

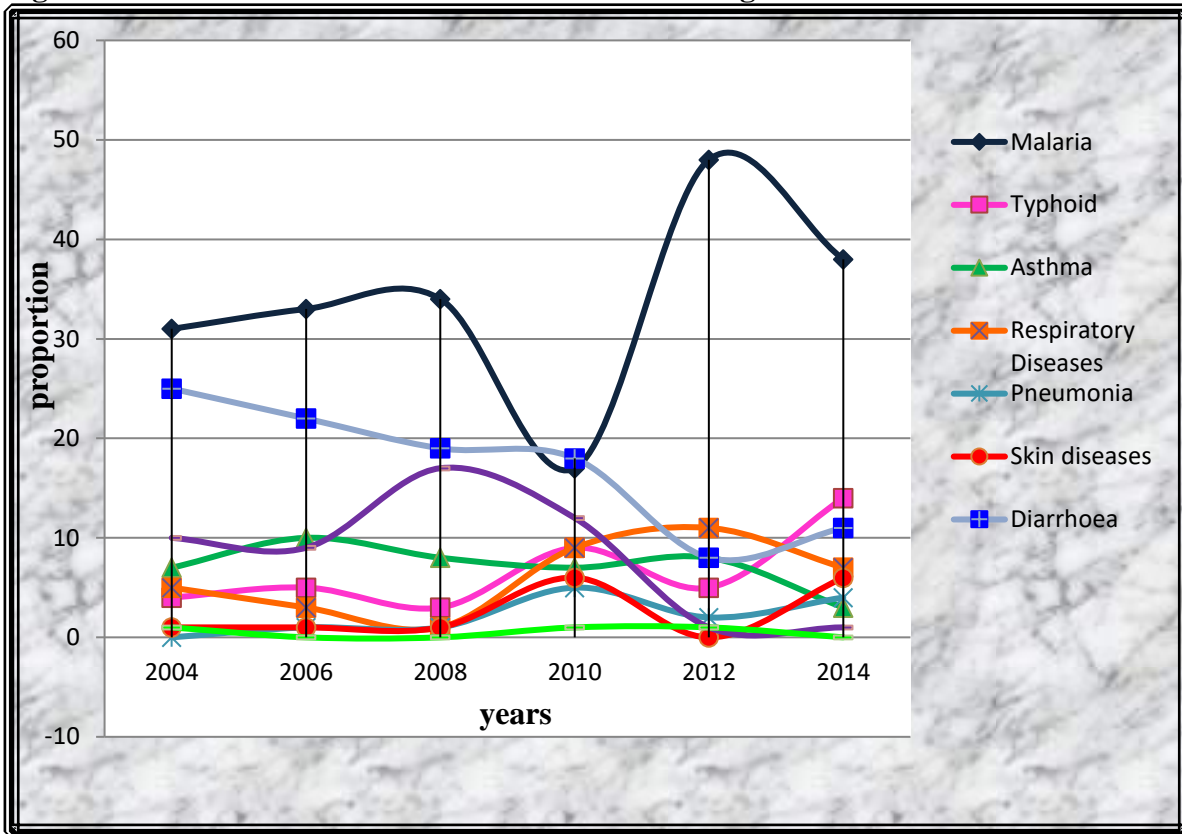
Figure 3 shows trend of the entire climate relate diseases investigated in the study from 2004 to 2014. Malaria, which is the most prevalent, increased gradually from 2004 to 2008 when it later dropped to its minimum in 2010 (17 cases). The incidence of this disease later rose to a gargantuan level in 2012 with a total number of 48 cases. Also there was a decline in incidence in the years that followed. This decline could be attributed to increased subsidy on malaria drugs as well as awareness of the people on how to prevent the disease vector.

In the case of typhoid, there was a staggering increase in the total number of the cases observed from 2004 to 2014. A sharp increase was observed in 2010 and the reverse was the case in 2012. The incidence of the

disease later rose appallingly in 2014. Concerning asthma, Figure 3 indicates that there was an increase in the total number of cases observed in 2004 to 2006. The highest number of cases was observed in the year 2006, while there was a decline in the number of observed cases from the year 2006 to 2010, and a serious decline in the year 2014.

The variation in the incidence of respiratory diseases showed that in 2012, the incidence of respiratory diseases was on the high side and this can be attributed to the reduction in the temperature in the area of study during that time. There was a gradual decline in the incidence of respiratory diseases from the year 2004, 2006, and 2008 having a case record of 5, 3 and 1 daily respectively. There was no record of pneumonia cases in the year 2004 and there was little or no record from the 2006 to 2008 and an increase from 2008 to 2010.

Figure 3: Trend in the Incidence of Climate Change Related Diseases



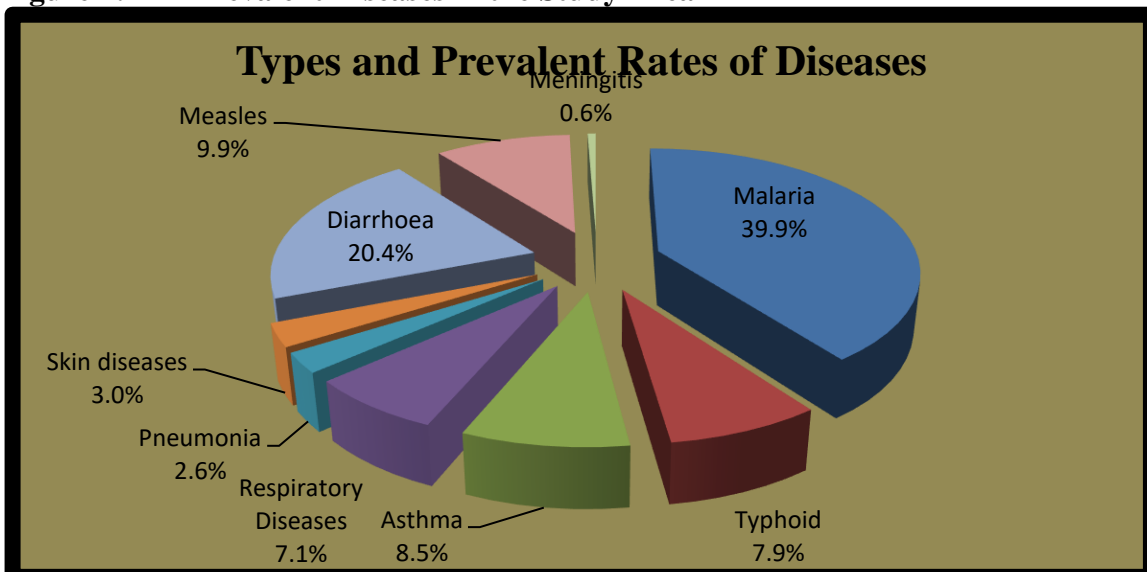
Source: Authors' Field Survey (2014)

4.3. Prevalence of Climate Related Diseases among Children

Cases reported among the children in the study area include malaria, meningitis, measles, asthma, diarrhea, typhoid and other respiratory diseases e.g. cough and catarrh. The three most prevalent diseases are malaria (39.9%), diarrhea (20.4%), and measles (9.9%) (See

Figure 2). The presence of these diseases account for more than 70 percent of the estimated incidence of diseases in the study area. Other diseases recorded to constitute the remaining 30 percent are asthma (8.5%), typhoid (7.9%), respiratory diseases (7.1), skin diseases e.g. ringworm (3.0%), pneumonia (2.6%) and meningitis (0.6%).

Figure 4: Prevalent Diseases in the Study Area



Source: Authors' Field Survey (2014)

In a bid to ascertain the susceptibility of different age groups to climate related diseases, the children were divided into four age groups according to the American Academy of Pediatrics (2007).

- i. **Infants** i.e. children between three months and one year ($4\text{months} \leq \text{children} \leq 1\text{year}$)
- ii. **Toddlers** i.e. children between one year and three years ($1\text{year} < \text{children} \leq 3\text{years}$)

- iii. **Preschoolers** i.e. children between three years and six years (3years<*children* ≤ 6years)
- iv. **School-age** i.e. children between six years and thirteen years (6years<*children* ≤ 13years)

Figure 4 shows that the incidence of malaria is directly proportional to the group as it increases with increasing age. Hence, school-age children (7yrs – 13yrs) are the most affected class. Incidence of typhoid and

asthma is similar to this. However the reverse is the case with respect to measles, meningitis and other respiratory disease. Skin diseases on the other hand seem to be at equilibrium among the various age groups. Using Chi-square test of homogeneity at 0.05 alpha level, a significant difference was observed in the incidences of the diseases among the various age groups.

Table 4.1: Cross Tabulation of Disease and Age Group

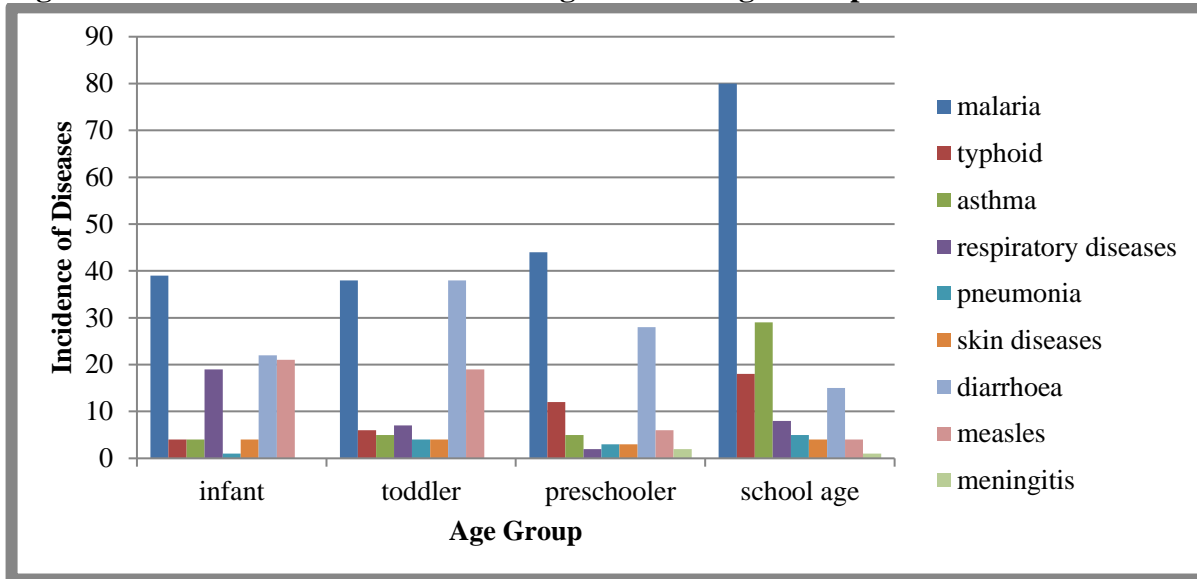
		Age Group				Total
		Infant	Toddler	Pre-Schooler	School-Age	
Malaria	Count	39	38	44	80	201
	% Within Disease	19.4%	18.9%	21.9%	39.8%	100.0%
	% Within Age group	34.2%	31.4%	41.9%	48.8%	39.9%
	% of Total	7.7%	7.5%	8.7%	15.9%	39.9%
Typhoid	Count	4	6	12	18	40
	% Within Disease	10.0%	15.0%	30.0%	45.0%	100.0%
	% Within Age Group	3.5%	5.0%	11.4%	11.0%	7.9%
	% of Total	0.8%	1.2%	2.4%	3.6%	7.9%
Asthma	Count	4	5	5	29	43
	% Within Disease	9.3%	11.6%	11.6%	67.4%	100.0%
	% Within Age Group	3.5%	4.1%	4.8%	17.7%	8.5%
	% of Total	0.8%	1.0%	1.0%	5.8%	8.5%
Respiratory Diseases	Count	19	7	2	8	36
	% Within Disease	52.8%	19.4%	5.6%	22.2%	100.0%
	% Within Age Group	16.7%	5.8%	1.9%	4.9%	7.1%
	% of Total	3.8%	1.4%	0.4%	1.6%	7.1%
Pneumonia	Count	1	4	3	5	13
	% Within Disease	7.7%	30.8%	23.1%	38.5%	100.0%
	% Within Age Group	0.9%	3.3%	2.9%	3.0%	2.6%
	% of Total	0.2%	0.8%	0.6%	1.0%	2.6%
Skin Diseases	Count	4	4	3	4	15
	% Within Disease	26.7%	26.7%	20.0%	26.7%	100.0%
	% Within Age Group	3.5%	3.3%	2.9%	2.4%	3.0%
	% of Total	0.8%	0.8%	0.6%	0.8%	3.0%
Diarrhoea	Count	22	38	28	15	103
	% Within Disease	21.4%	36.9%	27.2%	14.6%	100.0%
	% Within Age Group	19.3%	31.4%	26.7%	9.1%	20.4%
	% of Total	4.4%	7.5%	5.6%	3.0%	20.4%
Measles	Count	21	19	6	4	50
	% Within Disease	42.0%	38.0%	12.0%	8.0%	100.0%
	% Within Age Group	18.4%	15.7%	5.7%	2.4%	9.9%
	% of Total	4.2%	3.8%	1.2%	0.8%	9.9%
Meningitis	Count	0	0	2	1	3
	% Within Disease	0.0%	0.0%	66.7%	33.3%	100.0%
	% Within Age Group	0.0%	0.0%	1.9%	0.6%	0.6%
	% of Total	0.0%	0.0%	0.4%	0.2%	0.6%
Total	Count	114	121	105	164	504
	% Within Disease	22.6%	24.0%	20.8%	32.5%	100.0%
	% Within Age Group	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	22.6%	24.0%	20.8%	32.5%	100.0%

Source: Authors' Field Survey (2014)

Chi-Square with value 0.001 (p>0.05) shows that there is a significant relationship

between incidence of climate-related diseases and age groups of children.

Figure 5: Incidence of Disease among Different Age Groups



Source: Authors’ Field Survey, (2014)

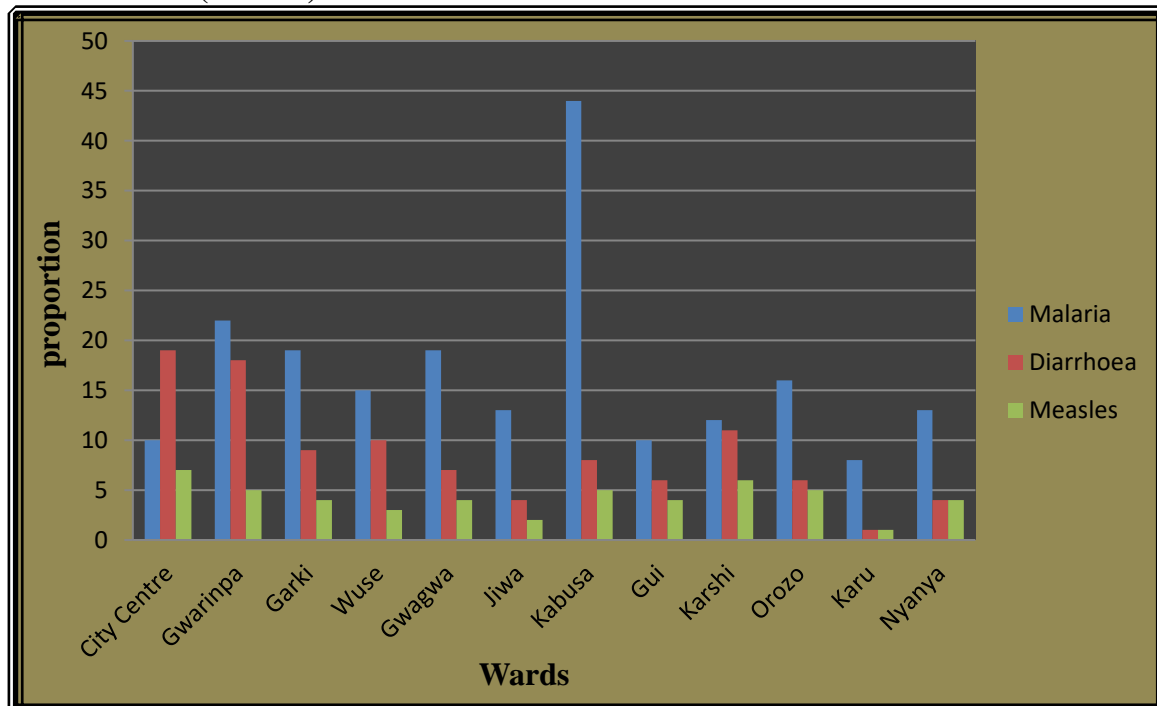
4.4. Intra-Urban Variation in the Incidence of the Most Prevalent Diseases

Malaria, typhoid and measles are the most preponderant climate related diseases in the study area. Examining the spatial variation of these diseases across the wards as shown in Figure 5, it was observed that; malaria is most prominent in Kabusa (44 cases) while the least incidence of malaria was experienced in Karu (8 cases). Other wards have varying degrees of the diseases within this range. While that is the case of malaria, diarrhea differs, having the highest and lowest incidence of the disease in the City-center and Karu respectively. With regards to measles, the maximum number of cases (7) was recorded to be from City-center and the least was also from Karu just like the case of the two other diseases.

It could therefore be inferred that. City-center being the core of the Abuja Municipal Council is most susceptible to these diseases. Karu on the other hand, which has the least record of this incidence, was observed to be well organized and moderately populated. Invariably, it suggests that aside the fact that changing climate influence the incidence of these diseases, the environmental condition in terms of sanitation also influences its livability to a great extent.

Analyzing the variation in the incidences of these diseases statistically across the wards, using ANOVA, only the incidence of malaria with F value of 14.924 and alpha level of 0.05 varies significantly. Diarrhea and measles F=0.207 and 0.204 respectively does not.

Figure 5 Intra-Urban Variation in Incidence of the Prevalent Diseases in Abuja Municipal Area Council (AMAC)



Source: Authors’ Field Survey (2014)

Conclusions and Recommendations

Today, there are few areas of the world that are not being impacted by climate change and these changes pose serious threat to children's wellbeing (UNICEF, 2006, 2008). In a bid to enhance the ability to further cope with these challenges, environmental education needs to be fortified so as to enhance peoples understanding of the implications of their actions and inaction and as well equip them with the knowledge to salvage the future environment through environmental friendly actions of the present. Their willingness to rise to the challenges of fluctuations in climate stands a chance of being effective if the following recommendations are adhered to:

Some of the observed causes of climate change are related to change in temperature which finds its roots in seasonal variation, desertification and encroachment into forested land and accumulation of GHGs. Tree planting initiatives should therefore be encouraged in order to forestall these impacts. This will enhance the capacity of the earth to further sink carbon-dioxide, which is a major green-house-gas (GHG) that increases global warming. Also, this will further strengthen the campaign against indiscriminate felling of trees and fuel wood gathering. For efficiency, compliance may be rewarded and appreciated and non-compliance may be prosecuted.

Secondly, the major way out of the challenges of climate change is to get the general public educated on issues pertaining to causes, evidences and problems emanating from human induced activities. Reminiscent to other developed countries of the world, this could be achieved by possibly introducing nature and/or environmental management studies into the school's curriculum. This will not only enhance adequate information on climate change issues, but will also equip every individual with detailed understanding of what to do in order to cope with the challenges of climate change (at the worst) and/or with ability to forestall the problems emanating in the present or in the nearest future.

Furthermore, government policies to promote mitigation activities that have strong co-benefits in health and other developmental needs should be formulated.

In the health sector, Pediatrics should serve as role models in the promotion of sustainable environment, encourage and lead in the adoption of newly emerging concepts in sustainable environmental management. They should as well

help in educating parents and guardians on how to protect the health of their children and wards. Furthermore, they should be dedicated to the protection of children's health by advocating comprehensive local and national policies on climate change so as to improve the health of children now and in the future.

In addition, conservation, development control practices and natural resources management activities which are major tenets of urban and regional planning should be embraced. Emphasis in these areas should include prohibition of gas flaring, bush burning, and deforestation that can further worsen the impact of climate change.

Finally, Planners need to ensure that properties are well landscaped as alternative to greeneries being wiped off. The landscape will not only beautify the scenery but also provide the environment with good fragrance and capacity to sink carbon-dioxide.

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