ESTABLISHING THE RELATIONSHIP BETWEEN MINIMUM TEMPERATURE, RELATIV HUMIDITY AND ASTHMA CASES IN CHILDREN

CASE STUDY: CENTRAL REGION

BY

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A DISSERTATION SUBMITTED TO THE SCHOOL OF FORESTRY, ENVIRONMENT AND GEOGRAPHICAL SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELORS DEGREE IN METEOROLOGY

JUNE 2016
DECLARATION

I NANYONJO SAMALIE declare that this is my original work and has never been submitted to any institution of learning for any award. Other material, data or information obtained from other source have been dully referenced and cited.

Signature: ..............................  Date: ..............................
DEDICATION

This piece of work is dedicated to my dear husband, your all round dedicated support has brought me this far. Thank you very much
APPREOVAL

I certify that, this dissertation submitted to the department of geography, geo-informatics and climatic sciences is the original work of the above named student and has been done under my supervision. The work has never been submitted for any institution of higher learning.

Signature: .................................................       Date....../....../......

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ABSTRACT

This study investigates the relationship between minimum temperature, and relative humidity with asthma cases over districts of Kampala, Mukono and Wakiso. The asthma cases data from the Kawaala Health center III, Mukono health center IV and Entebbe grade B hospitals and is a representative of the three districts.

Weather data as obtained from Uganda National Meteorological Authority for the region was correlated with the asthma attack cases in young children below 14 years recorded at the three hospitals to establish the relationship between asthma complication with minimum temperature and humidity. It was found that although both minimum temperature and Relative humidity affect asthma attack sessions in young children, the data proved that relative humidity is more influential on asthma than minimum temperature. From graphical analysis, it was found that high humidity values of above 73% had the most Asthma attack cases. The very low temperatures were also found to be significant factors that actuate asthma attacks because from the study periods of low minimum temperatures proved to have higher number of asthma cases.

Graphical analysis was used to determine the trends of the two weather valuables and it was found that both had two major seasons when values were high annually and this had an impact in the asthma cases reported in the hospitals.
CHAPTER ONE

1.0 Introduction
This chapter presents the background of the study and idea of the study. 1.1 describes the history of asthma in relation to the weather. 1.2 is the problem statement that shows why the research had to be undertaken. 1.3 The list of the research objectives, 1.4 the null hypothesis and 1.5 the significance of the research.

1.1 Background study
Asthma is a chronic disease that damages the airways in the lungs. These airways, or bronchial tubes, allow air to come in and out of the lungs. If you have asthma your airways are always inflamed. They become even more swollen and the muscles around the airways can tighten when something triggers your symptoms. This makes it difficult for air to move in and out of the lungs, causing symptoms such as coughing, wheezing, shortness of breath and/or chest tightness (Gary & Gibbsons, 2013).

Asthma is thought to be caused by a combination of genetic and environmental factors. There are two types of asthma: allergic caused by exposure to an allergen and non-allergic caused by stress, exercise, illnesses like a cold or the flu, or exposure to extreme weather, irritants in the air or some medications (Burns & Cross, 2005).

For many asthma sufferers, timing of these symptoms is closely related to physical activity. And, some otherwise healthy people can develop asthma symptoms only when exercising. This is called exercise-induced bronchoconstriction (EIB), or exercise-induced asthma (EIA). People with a family history of allergies or asthma are more prone to developing asthma. Many people with asthma also have allergies. This is called allergic asthma (ER McFadden & Gilbert, 1994).

There is no cure for asthma but if diagnosed early and properly, and a treatment plan is in place, one is able to properly manage the condition and the quality of life will improve.

Asthma was recognized as early as Ancient Egypt. The word asthma is from the Greek ἄσθμα, asthma which means "panting".

In 2013, about 242 million people globally had asthma up from 183 million in 1990, it caused about 489,000 deaths in 2013 most of which occurred in the developing world. It often begins...
in childhood. The rates of asthma have increased significantly since the 1960s (Ataulhaq, 2016).

A 2009 study at Mulago Hospital indicates that 14% of school going children suffer from asthma. According to the study, the prevalence of asthma in children aged 6 to 14 years is 12-14%. “Secondly, a review of records at the Medical Emergency Department of Mulago Hospital revealed that asthma contributed 32% of the medical visits and 18% of the patients who needed hospitalization. In the chest clinic, asthma patients contributed 17% of total visits,” Mutungi adds (Vision Reporters, 2013)

Some of the environmental conditions that trigger asthma attacks include; pollutants and air particles, cold dry air, very high humidity for this makes inhaled air heavy to breathe and it harbors fungus, molds and dust mites that trigger asthma (Bottrell, 2014)

1.2 Problem statement
Studies by Ugandan scientists suggest about 14 percent of children between the ages of 8 and 14 living in Kampala live with bronchial asthma (Hawkes, Nakiyingi, 2014), Dr. Worodria said researchers found similar results in one of Uganda's rural districts. According to (Adeloye, et al, 2013) the World Health Organization (WHO) estimates about 250 000 deaths from asthma every year, mainly in low- and middle-income countries like Uganda and current trends suggest that an additional 100 million people may be living with asthma by 2025.

Little research and attention has been paid to asthma in children in Uganda, acute asthma as diagnosed according to the WHO criteria associated with a mortality rate of 12% in Uganda (Nantanda et al., 2014). If this problem is not addressed sooner it will greatly affect the population of the country thus the general economy.

Uganda being a tropical nation with high relative humidity values ranging from 85% to 75%, with varying daily and seasonal temperature (Trewin, 2014). It is therefore necessary to find out how far the humidity and temperature variations in this region is affecting the children with asthma complications and how they relate to the reported asthma cases.

This research focused on determining the relationship between annual minimum & maximum temperatures and humidity with triggered asthma cases in children reported.
1.3 Study Objectives

The major objective of the study was to determine the relationship between Minimum temperatures, Relative humidity with Asthma cases reported in the three hospitals.

The specific objectives included:

- To determine the trend of monthly average minimum temperature
- To determine the trend of monthly average humidity.
- Determining the trend of Asthma reported incidences over time 2005-2010

1.4 Null Hypothesis

The null hypothesis of the study was that there is no relationship between minimum temperature/ humidity variations and Asthma incidences.

1.5 Significance of the study

The results from this research will help the community especially parents and guardians with children that manifest asthma symptoms and signs to be able to detect and know which weather conditions that asthma attacks are usually triggered and prepare accordingly.

The drug supply and management body in hospitals and concerned organizations will be in position to know when to stock asthma relieving medication in order to improve the living condition of asthma patients.
CHAPTER TWO

Literature review

This chapter presents more knowledge and ideas of other scholars and researchers and the findings they have discovered about Asthma and how it is affected by the environmental and weather factors.

Asthma is becoming a global burden and is already substantial in terms of morbidity and economic cost. It increases rapidly as the world becomes more and urbanized. It is mainly affecting low and middle income countries in terms of deaths, the recent Global Burden of Disease (GBD) study ranks it as the 14th most important disorder (Masoli, et al, 2004). According to the World Health Organization (Schmidt, 2016) it’s estimated that 235 million people across the globe live with asthma and it’s the most common chronic disease among children. It further says that 80% of asthma deaths are recorded from low and lower-middle income countries.

Symptoms may occur several times in a day or week in affected individuals, and for some people become worse during physical activity or at night and during the attack. During an asthma attack, the lining of the bronchial tubes swell, causing the airways to narrow and reducing the flow of air into and out of the lungs. Recurrent asthma symptoms frequently cause sleeplessness, daytime fatigue, reduced activity levels and school and work absenteeism. Asthma has a relatively low fatality rate compared to other chronic diseases (Neuzil, et al, 2000)

Childhood asthma is not a different disease from asthma in adults, but children do face unique challenges. Asthma in children is a leading cause of emergency department visits, hospitalizations and missed school days. Unfortunately, childhood asthma can't be cured, and symptoms may continue into adulthood (Martinez, 2008). In childhood asthma, the lungs and airways become easily inflamed when exposed to certain triggers, Childhood asthma can cause bothersome daily symptoms that interfere with play, sports, school and sleep. In some children, unmanaged asthma can cause dangerous asthma attacks which can ultimately lead to death if not attended. Asthma often seen in children is a leading cause of missed school days and hospital visits for children. An allergic reaction is a key part of asthma in children. Asthma and allergies often occur together (Neil & Kaneshiro, 2015).
In children, asthma complications can be so serious and lethal but some of the hardships may include:
Severe asthma attacks that require emergency treatment or hospital care;
Permanent narrowing of the airways (bronchial tubes); severe chest pains
Poor sleep and fatigue; symptoms that interfere with play, sports or other activities (Krucik, 2014)

If the child is not well attended to the complication symptoms can ultimately result to death

There are three ways in which asthma presents:
Asthma exacerbation, commonly known as attack this is when the lumen of the tubes through which air passes is extensively narrowed. This is caused by the tightening of muscles around the airways (bronchospasm), during the asthma attack, the lining of the airways also becomes swollen or inflamed and thicker mucus more than normal is produced. All of these factors; bronchospasm, inflammation, and mucus production cause symptoms of an asthma attack such as difficulty breathing, wheezing, coughing, shortness of breath, and difficulty performing normal daily activities (Lemanske & Busse, 2003);

Persistent asthma in this group, there is narrowing of the lumen of the tubes through which air passes although it is not severe. Moderate or persistent asthma the patients has symptoms every day and need may need to use a rescue inhaler daily to treat shortness of breath. Normal activities are affected by wheezing, shortness of breath, or chest tightness. Flare-ups at night can affect your sleep and happen at least once a week (Drugs.com, 2016)

Uncontrolled asthma when asthma patients are undergoing treatment, they should not get coughs, wheezing or difficulty in breathing. However, some get symptoms of asthma despite treatment. Such patients have uncontrolled asthma (Vision Reporters, 2013)

From studies done in the United Kingdom (UK), it was noticeable that weather affects asthma attack in different ways;
Cold or damp air can enter the airways and trigger them to go into spasm, causing asthma symptoms, such as coughing, wheezing, shortness of breath and tightness in the chest (Anderson & Daviskas, 2000). Cold air especially during exercise causes bronchoconstriction which is when the airways narrow causing breathing to become different and stressful overtime breathing feels like trying to breathe through a straw stuffed with cotton, (Hauser, 2014)
A sudden change in temperature: can have the same effect - if you're in a warm house with central heating and you step outside on a cold wintery day or you walk into an air-conditioned room on a hot day in summer. Temperature changes irritate the airways for they cause inflammation in the airways as well, for most people this is not a problem because the nose controls humidity without difficulty but for asthma patients this can trigger an attack because the air ways are already this makes them more vulnerable to weather changes (Katherine, 2015).

Two common theories for humidity and asthma are: humid air increases the demand for oxygen and the change in environmental conditions like the increased mold growth, altogether trigger the asthma attack. Humid air with more water content is heavier making it hard for the asthma patients to breathe (Mark, 2016); Humid air harbors fungus, molds and dust mites that trigger asthma (Bottrell, 2014).

Hot humid air is also known to trigger asthma attacks in children because it heat and sunlight combine with pollutants to create ground-level ozone. This kind of ozone can be a strong asthma trigger (Elana & Ben-Joseph, 2014).

Exercise and other activities: that make you breathe harder can affect your asthma. Exercise especially in cold air is a frequent asthma trigger. Exercise-induced bronchoconstriction (EIB) is a form of asthma that is triggered by physical activity. It is also known as exercise-induced asthma (EIA). Symptoms may not appear until after several minutes of sustained exercise. (If symptoms appear sooner than this, it usually means you need to adjust your treatment.) With proper treatment, one does not need to limit his or her physical activity (Kaufman, 2009).

There is increasing evidence and awareness about the relationship between asthma and the environment. Since there are many non-environmental factors that contribute to asthma, there have been efforts to estimate what proportion of the asthma burden is related to the environment.

In a research done by (Mireku, et al. 2009) it was found and stated that fluctuation in temperature and humidity influenced the emergence department visits for pediatric asthma attacks. In the U.S., an expert panel estimated that 30% of asthma exacerbations among children were related to the environment this was associated with an annual cost of $2.0 billion.
Climate change also greatly affects asthma as it adversely impacts ambient temperature, air pollution levels and amounts of water moisture in the atmosphere yet these are associated with asthma exacerbation (Curson, 1993). Increase carbon dioxide concentrations and temperatures, thereby affecting the timing of aeroallergen distribution and amplifying the allergenicity of pollen and mold spores. For this reason it is important to track the impacts of climate change in Uganda as this phenomenon will continue to have an impact on asthma and other health outcomes.

Although these findings and research about Asthma have been carried out across the globe, few research regarding asthma and environment have been attempted in African developing and in Uganda to be specific. This rises the urgency to determine how and to what extent has the weather and environment contribute to asthma severity in Uganda.
CHAPTER THREE

1.0 Data and methods
This chapter presents the methods and source of data used to carry out the statistical analysis of minimum temperature, relative humidity values and asthma cases for the three regions in which the study was carried out.

3.1 Study Area
This study was carried out in three major districts as sample and these were Wakiso, Kampala and Mukono districts in randomly selected hospitals taken to represent the whole nation of Uganda.

The study was carried out in Entebbe municipality, located in Wakiso district in central Uganda. Entebbe sits on the northern shores of Lake Victoria. It lies at 0.04ON; 32.465OE. It is situated in Wakiso district, approximately 37 kilometers, southwest of Kampala, Uganda’s largest capital.

Although Entebbe sits on the Equator, Lake Victoria is 38000ft above sea level and so temperature remains mild. The average daytime temperatures in Entebbe range from 25°C - 32°C, with rain possible throughout the year.

Mukono District is a district in the Central Region of Uganda, its bordered by Kayunga District to the north, Buikwe District to the east, Kalangala District to the southwest, Wakiso District and Kira Town to the west, and Luweero District to the northwest. The town of Mukono is approximately 27 kilometers, by road, east of Kampala, the capital and largest city of Uganda.

Kawaala is bordered by Nabweru to the north, Kazo to the northeast, Makerere to the east, Naakulabye to the south, Kasubi to the southwest, and Namungoona to the west. This is approximately 5 kilometers by road, north of Kampala's central business district. The coordinates of Kawaala are 0°20'24.0”N, 32°33'00.0”E
Map of Uganda showing the study area.

Figure 1: A map of Uganda showing the Area of study

3.2 Data source
Three data sets were used during the research;

1. Average monthly minimum temperature and monthly humidity data was collected from the Uganda National Meteorological Authority ranging for 10 years from 2005 -2015. The data was already secondary data observed from the weather stations in Entebbe, Kampala and Kituuza. The data was obtained in soft copy.

2. Monthly Asthma cases for children especially acute cases was obtained from Entebbe grade B hospital, Kawaala health Centre and Mukono health center IV hospital. The data was for children under 14 years registering new asthma attack cases, and known patients registering attack episodes only. Patients visiting for normal routine checkups without attack episodes were not considered.
3.3 Quality control
The three data sets obtained in soft copy from the source bodies were already quality controlled in order to minimize the errors that could have risen in the data input process since it was already in soft copy.

3.4 Methods Used Data analysis.
The research required the use of quantitative methods for data analysis and so quantitative tools were employed to perform the tasks.

3.1 Pearson’s correlation
Pearson’s correlation coefficient is the test in statistics that measures the statistical relationship, or association, between two variables giving a value between +1 and −1 inclusive, where 1 is total positive correlation, 0 is no correlation, and −1 is total negative correlation (UWE Bristol, 2015)
The Correlation coefficient can was attained using the formula;

\[ r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{n(\Sigma x^2) - (\Sigma x)^2)(n(\Sigma y^2) - (\Sigma y)^2)}} \]

(Jennifer Thomas, 2012)

Where;

X and Y are the two variables and n is the number in the sample

Correlation was carried out on two variables at a time i.e. annual asthma totals with annual mean minimum temperatures, annual temperature totals with annual mean Relative humidity.
This equation was ran in the IBM SPSS program and the r value and the value of significance for the relationship was attained.

3.4.2 Multiple Regression
Multiple regression analysis is a powerful technique used for predicting the unknown value of a variable from the known value of two or more variables also called the predictors (Explorable.com, 2016). In this regression, every value of the independent variable \(x_1 \times x_2\ldots\) was associated with a value of the dependent variable \(y\) (Asthma cases) for this cases.
Calculated by the model;
Multiple regression:

The model is \( Y_i = \beta_0 + \beta_1 (X1)i + \beta_2 (X2)i + \beta_3 (X3)i + \ldots + \beta_K (xK)i + \varepsilon_i \)

\( Y = b_0 + b_1 (X1) + b_2 (X2) + b_3 (X3) + \ldots + b_k(Xk) \)

The Roman letters (the b’s) are estimates of the corresponding Greek letters (the β’s).

\( Y \) being the dependent variable and \( Xs \) the independent variables (Hopkins, 1999)

For the study, the two independent variable were Minimum temperature and relative humidity with the dependent variable being the asthma cases reported.

Since the research involved three variables, our regression equation would be modified as;

\[ Y = a + b_1 X_1 + b_2 X_2. \]

Where \( X_1 \) and \( X_2 \) are two independent variables and \( Y \) being the dependent variable, and the constants \( a, b_1 \& b_2 \) can be solved by solving the following three normal equations:

\[ \sum Y_i = na + b_1 \sum X_{1i} + b_2 \sum X_{2i} \]

\[ \sum X_{1i} Y_1 = a \sum X_{1i} + b_1 \sum X_{2i}^2 + b_2 \sum X_{1i}X_{2i} \]

\[ \sum X_{2i} Y_1 = a \sum X_{2i} + b_1 \sum X_{1i}X_{2i} + b_2 \sum X_{2i}^2 \]

Hence;

\( X_1 \) is the Minimum temperature variable

\( X_2 \)is the Relative Humidity variables

\( Y \) is the dependent asthma variables.

SPSS program was an alternative method of carrying out regression. It also calculated the Pearson’s correlation coefficient together with its significance values

### 3.4.3 Trends & Scatter plots

A trend is a general tendency or direction, an upward/downward trend (Stapel, 2014). These trends were illustrated in graphs drawn using the Matlab program.

Together with the scatter graphs were drawn to further illustrate the relationship were plotted using SPSS (IBM 20.0 version) program tool.
CHAPTER FOUR

4.0 Presentation of results
This chapter shows the results of trends as plotted in Matlab (4.1) showing the behavior of the Minimum temperatures, relative humidity and Asthma from 2005 to 2015 using monthly data. The comparison graphs between asthma and the weather variable to show the similarity in the trend of variables.

4.1 Trends and time series
First the time series of the three individual variables for the three region were constructed using Matlab application and the following graphs were drawn.

Minimum temperature

In figure 1 it shows the minimum temperature averaged monthly for the eleven years clearly indicating minimum temperature having a decreasing trend as a year goes by. With average shows that there exists two peaks of minimum temperature demarcating the two seasons from February to May, and September to November as seasons of higher minimum temperature.
Kampala’s minimum temperatures showed a gradually falling trend from 2005 dropping from the annual average of 18.6 to 17.0 in 2011 that recorded the lowest minimum temperature. From then a gradual increase from 2011 to 2012 later followed by a sharp increase in temperatures were recorded rising continuously up to 2015.

From 2005 minimum temperature fell gradually from 17.40 to 17.10c for three years, this then was followed by a very steep rise in minimum temperature values from 17.10c average to 17.60c in just one year (2008-2009). Then a gradual fall in temperature to 2010 followed by a steep fall in 2011 where minimum averages were recorded to be 17.30c. Minimum temperature averages then increased gradually from 17.30c in 2011 to 17.50c in 2014 later followed by a steeper rise in minimum temperature values in 2015.

The minimum temperature in Entebbe hovered throughout the entire period as shown in the graph but with a rather increasing trend over the years. With the lowest value of 16.34 in 2008, temperatures began with a decreasing tendency from 2005 to 2008. From there temperatures rose sharply and then hovered almost annually but with increasing trend shooting to its peak of 19.120c in 2012 then dropped steeply the next year where it rose again the following year.
Relative humidity

Basing on the average the RH for the central region has two wetter seasons that is in April to June and another from September to November. With Entebbe having almost constant wetter season from April to November.

From a sharp increase from 2005 to 2006 rising from average of 68% to 75%, the relative humidity followed a steep downward trend up to 2009, a slight rise the following year then a steep fall resumed up to 2011. From then, the relative humidity rose steeply in 2012 to reach average value of 72%. This was followed by a sudden steep decrease in RH in 2013 from 72 to
69% which then rose sharply thereafter to 2014 and a slight fall in 2015. Therefore general trend of RH oscillating up and down with the highest peak in 2007 and lowest trough in 2011. The Mukono RH showed an oscillating trend. Rising from 75.5 -76% from 2005 to 2006, a rather steep fall in the next two years to a RH of 74.7% in 2008. The RH then rose steadily from then back to 76% in 2011. RH fell sharply to its lowest value in 2013 (74.3%) followed by an abrupt rise from the lowest value to the highest value of 79.9% in 2014.

Entebbe RH also shows a generally increasing trend over the years, starting from its lowest value of 71% in 2005, it rose rapidly to 75% in 2007 fell abruptly to 72% in 2009 later followed by a sharp rise from then to 2011, humidity gradual fall again in 2013 then shot up steeply to reach its peak in 2014 of 77% followed by a sharp fall in 2015.

**Asthma case**

![Asthma Monthly Trends Graph](image)

**Figure 6 Monthly Asthma trends**

The above figure shows that asthma cases in children were abundant in months from Feb to May and then from Sept to November on the average from the region. Though Mukono generally had higher cases reported on a monthly basis.
Asthma cases in Kawaala hospital show a generally increasing trend from 2010 onwards with the lowest number of patients recorded in 2010 (26 patients). The following years but 2012 showed an ever increasing number of patients from 39 in 2011 to a total of 57 patients in 2015 which was the highest number recorded in regard to the research.

Asthma cases in Mukono decreased from 53 patients to 27 patients in 2006, followed by a gradual increase from 2006 -2010 peaking with 62 patients in that year. There after a sharp fall in asthma attacks in 2011 with just 24 patients further less patients in 2012 just 9 patients, the lowest numbers of patients in the 10 years of the research. An increase in asthma attacks in children was recorded then 2013 further increase in the attacks the following year with 47 patients then a fall by 13 patients in 2015.

Figure 7: Asthma Trends
4.2 Comparison Graphs
Graphically comparing the two weather variables with asthma in the three regions, the following graphs were constructed in IBM SPSS program to illustrate the similarity and difference between the trends of the dependent and the independent variable.

Kampala

From figure 4 it shows that generally shows that an increase in the independent variable (Minimum temperature) results into decrease in asthma cases.

Figure 5 also shows that an increase in RH is followed by a decrease in Asthma cases. But both show an increasing trend in both cases.
From the above graphs, it shows that an increasing trend in the weather variables (minimum temperature and Humidity) is followed by decrease in asthma cases and mostly evident in the later years of the study as both the minimum temperature and RH increased while the Asthma cases decreased.

**Mukono**

The following are the trend comparison in Mukono districts.
From all comparison graphs for Minimum temperature and Asthma cases they showed that periods of increasing minimum temperature resulted into lowering Asthma severity but for Mukono its different, in general, increasing minimum temperatures are a companied by increasing asthma cases.

In Mukono the above graph shows negative relationship between RH and Asthma where by decreasing trend in RH was followed by an increase in Asthma cases. But in the later years both cases followed an increasing trend from around 2012 and beyond.

### 4.0 Regression and Correlation analysis

Regression was carried out and computed in SPSS application and it gave the following results. The results included the spearman correlation. This analysis was carried out region per region
so correlation was carried out on between two variables in each region. The results were as follows:

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<tr>
<td>Asthma Cases</td>
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<tr>
<td>Minimum Temperature</td>
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<tr>
<td>Relative Humidity</td>
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Table 1: Descriptive statistics table summarizing the variable values

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<td></td>
</tr>
<tr>
<td>Significance</td>
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Table 2: Correlations results table generated from SPSS

From table 2 it gives Pearson Correlation between variables, it shows that there is a negative correlation between Asthma cases and Minimum temperature and RH -0.064 & -0.332 respectively. Meaning a negative correlation for both cases this mean as humidity or minimum temperature increases, asthma cases decreases.

The significance of the relationships of these variables is also shown in the table, the significance of the relationship between Asthma cases and minimum temperature is 0.426. That between Asthma and RH is 0.159.

Asthma in Kampala showed a positive correlation with Minimum temperature, simply meaning that when minimum and RH increases also asthma values increase in Kampala.

A positive correlation between Asthma and minimum temperatures, & RH in Mukono with correlation coefficient (r) of 0.42 with relationship significance of 0.451 between asthma and minimum temperature, 0.452 between asthma and RH.
CHAPTER FIVE

5.0 Discussion of results, conclusion and recommendation

5.1 Discussion of results
From the monthly analysis graphs, asthma cases in graph 6 corresponded well with the two wetter seasons of the high RH plotted in graph 4. This backs up the research results found by (Mireku et al., 2009) that humidity fluctuations affect asthma attacks in children.

In Pearson’s correlation analysis results, the correlation between minimum temperatures and Asthma Cases is -0.064. This means a negative correlation meaning that there is a relationship between the two variables but as minimum temperature increases Asthma cases decreases. This is further supported by the comparison graphs between minimum temperatures and asthma for example in figure 4 and 6, less minimum temperature are an indication of seasons with low temperatures hence cold seasons. The increase in asthma cases during this season the cold air normally affects the lungs of the children by drying the mucus membrane lining in the lungs making breathing in difficult hence triggering asthma (Hauser, 2014).

From figures 8 (minimum temperature and Asthma) this trend of both increasing minimum temperatures and asthma can be attributed to other factors that trigger asthma for example dust, animal dandruff pollutants in the atmosphere (Foundation NZ, 2016).

From figure 1 the average minimum temperature between 2007 and 2009 was very low ranging between 16.3 and 17.0 which coincide with the high asthma cases in the same period as shown in figure 4.

From comparison graphs between Asthma cases and Relative humidity, it can be observed that generally as relative humidity increases asthma cases also increase, this is evident especially in the first ten years of the study. This is because humid air is heavy to breathe due to the fact that it contains high moisture content, secondary humid air from the research harbors fungus, molds and dust mites that trigger asthma so this explains why higher humidity is associated with relatively more asthma cases especially in the young children (Siobhan, 2015). This is because the lungs of young children are relatively weaker hence more vulnerable to asthma attacks during humid conditions.
From the correlation analysis, the weather variables (minimum temperature and RH) did not have a perfect correlation with asthma reported cases for example in figure 9, the asthma trend did not conform to the expected trends probably because asthma attacks are not only triggered by weather factors. Several other factors including pollutant fumes from running engines, dust and dust mites, chemical fumes and animal dandruff among others. Mukono being an urban area, it is possible that the increase in asthma cases as RH decreases must be due to other factors that that trigger asthma attacks most of which are characteristics of urban and densely populated areas.

From figure 3 the average asthma trend in the central region (Mukono, Wakiso and Kampala) show a generally decreasing trend. This could possibly be due to the increase in the health care standards in Uganda since the government has invested much into the health of Uganda. It can also be attributed to the increased awareness and sensitization among parents to take their babies for checkup and resort to medication that keeps their children from frequent asthma attacks.

From the Pearson’s correlation analysis, it shows that asthma cases correlated more with Relative humidity than minimum temperature. With r of -0.3, 0.3 and 0.4 between asthma cases and RH in Entebbe, Kampala and Mukono respectively while the r value from analysis between asthma and Minimum temperatures are just 0.064, 0.7 and 0.04 in Entebbe, Kampala and Mukono respectively. From the above results one can conclude that RH correlates more with Asthma cases hence asthma cases are affected more by RH than Minimum temperatures. This can further be confirmed by the significance value, generally the values of significance between RH and asthma cases are lower than those between Minimum temperatures and asthma this means than the relationship between asthma and RH is more significant hence humidity is a factor to consider more than minimum temperature.

Although on average RH values from the region of study does not seem to greatly vary over time (oscillating between 73-75%) the small changes in RH caused significant changes in asthma cases because from research done in the United States of America it was found that Asthma patients would have stable breathing in environments of 40-60% RH (Mark, 2016) and humidity exceeding 75% was an environment of frequent asthma attack. The average RH in the area of study ranges between 73-76% hence it is an environment susceptible to asthma attacks especially in children that have relatively delicate internal respiratory organs.
5.2 Conclusions

It can be concluded that there are two seasons of rampant asthma cases in the year that is between Februarys to May and again from Septembers to Novembers. This was also when the RH values in the region also reached its peak so it can be concluded that RH directly affected the asthma attacks in children in the Nations central region.

From the results in the research one can conclude that both minimum temperature and humidity affects asthma attack prevalence in young children below 14 years in the region of the study that adequately represented the country. But again it can be concluded that Relative humidity is a major factor in triggering asthma attacks in children relative to minimum temperature. So more care should be given to RH variations with respect to asthma. Although on average RH doesn’t greatly vary in values, the small variations were seen to cause significant changes in the asthma trend on average.

Following the results it is advisable that if the asthma symptoms are worse and cannot be controlled it is wised to stay in air-conditioned rooms to gain control over the condition. Make sure to maintain a humidity level of 40-60 percent. It is highly dangerous for the asthmatic patients to remain in environments where the humidity levels are above 80 percent.

5.3 Recommendations

More research about how the ongoing climate change can or will worsen asthma disease in the future is needed because asthma complication may claim lives of more children if not attended to quickly. The govern of third world countries like Uganda also need to improve on awareness to parents about the asthma condition symptoms so that they can immediately report to nearby health centers in case the children show such signs. This can decrease the death in children due to asthma and also keep their health in control.

The weather forecasting body in the country (UNMA) should also strive hard to produce accurate and always updated weather forecasts in order to keep the asthma patients informed of the weather approaching so that they can prepare accordingly so as carry or take proper medical prescriptions in order to keep their medical condition under control.
REFERENCES


25


APPENDICES

Asthma Cases from Mukono Health center IV

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23rd March 2016

Dear Sir/Madam,

Re: Introduction Letter for Ms. Samalie Nanyunjo, Reg. No. 13/0/2289/05

This is to introduce Ms. Samalie Nanyunjo to your organization for assistance with research data. Samalie is a third year student pursuing a Bachelor of Science in Meteorology (BSc, Met) in our department at Makerere University. She is researching on, "Effects of mean monthly sunshine hours and humidity on Asthma prevalence in children in Entebbe Municipality" and she is currently looking for the data to enable her pursue her research. The research component is one of the requirements for her to graduate in her program at the University.

Any assistance rendered to her is greatly appreciated.

Sincerely,

[Signature]

Alex Namulinda
Coordinator
METEOROLOGY UNIT

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**Asthma cases from Entebbe grade B Hospital**

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### Asthma Cases from Kawaala Hospital Kampala

#### Table: Asthma Cases Over 3 Years at Kawaala Health Centre

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