Climate Change Effects on Infantile Pathology in Pediatric Environment

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Abstract

The purpose of the study is to determine the effects of climate variability and changes on children healthcare in Pediatrics B Department of the National Hospital of Niamey. Data from Pediatrics B Department, 2012 were used. The study population is composed of children hospitalized for respiratory affections in Pediatrics B Department. An eligible sample of 1,698 children was included in the analysis. The study was proceeded through a two-step analysis made of a descriptive phase and an analytical one. The correlation test was used to measure the intensity of the relation between the dependent variable and the predicators. This measurement of the relationship intensity is made with the correlation coefficient R. The respiratory infection is the second motive for hospitalization after the malaria but is the first cause of death. Visibility contributes for 25.26% to the variability of pneumonia cases; temperature accounts for 49.9% of the variability of asthma cases; wind accounts for 23.34% of the variability of broncho-pneumopathy cases; the variability of serious pneumonia cases is due, for 62.5 %, to the association of wind and temperature; once the three (03) climatic variables are potentialized, they account for 90.90% of the variability of pleurisies cases. Cooperation strengthening between meteorology and health scientific communities services is essential to ensure the integration of updated, precise and relevant information about weather and climate in public health management.

Keywords: Climatic variability, Climate change, Respiratory infections, Hospital, Niamey

Introduction

Climatic variability is the evolution of climate parameters around means and climate change is the evolution of these means over at least several decades. The effects of climate change can be defined as the modifications of the physical environment or of the biotes, which modifications are due to climate changes and exercise significant harmful effects on the composition, the resistance or the productivity of the natural and developed ecosystems, on the functioning of the socioeconomic systems or on man's health and wellbeing (Ozer 2005**)**. Climates play a significant role in people's health. Changes in climate affect the average weather conditions that we are 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.

The impacts of climate change on health will depend on many factors. These factors include the effectiveness of a community's public health and safety systems to address or

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prepare for the risk and the behavior, age, gender, and economic status of individuals affected. Impacts will likely vary by region, the sensitivity of populations, the extent and length of exposure to climate change impacts, and society's ability to adapt to change (United States Environmental Protection Agency 2010),. Climate change affects the social and environmental determinants of health clean air, safe drinking water, sufficient food and secure shelter (World Health Organization 2014). In Niger the climate change like cold atmospheres can cause breathing problems which could affect the lower respiratory tracts. The number of the cases of the different respiratory affections (pneumonia, asthma, bronchopneumonia, bronchitis, and acute pneumonia) recorded at the National Hospital of Niamey are highly.

This climate change is more and more accepted worldwide. For a great many specialists its repercussions on health (mortality and loss of quality of life) could surpass all the other effects, and health related impacts are nowadays part of the most dreaded impacts, particularly in developing countries. The World Health Organization recently estimated that 34% of all childhood illness in the world (compared to 24% of all aged illness) and 36% of deaths in children under age 14 are due to modifiable environmental factors (Pruss and Corvalan 2007).

Currently we experience a sudden increase in the frequency and the severity of extreme climatic phenomena such as the storms strength, heat waves, droughts and flooding, whose consequences will be sorely felt. Developing countries will be the first ones and the most severely affected ones and this will come along with negative incidences that will hence compromise the reaching of the Millennium Development Goals (MDG No2) related to health and health wise equity (Perrin et al 1995)

Therefore, it is vital to redefine the struggling periods and the bioclimatic zones. It is in this framework that falls in line this analysis of the relations between variability, climate changes, and the occurrence of respiratory infections taken care of children at the Pediatrics B Department at the National Hospital in Niamey, in order to better back the epidemiologic monitoring, planning, and the struggling strategies for controlling this plague so as to propose a respiratory diseases warning and prevention system of children.

Materials and Methods

In this study the Pediatrics B department of the National Hospital of Niamey was used children suffering from respiratory affections (this Departments deals with patients who are 2-15 years old). In addition, we used the services of the National Meteorology Department to collect climate parameters reports. These climates related data concern the reports that cover the Urban Community of Niamey.

In order to carry out this work we conducted a retrospective and descriptive study aiming at an analytical process in order to determine the effects of climate variability and changes on respiratory illnesses.

The study population is composed of children hospitalized for respiratory affections in Pediatrics B Department. The series of studied patients covers the period from 2003 to 2012.

All the two 2 to 14 years old male and female in-patients hospitalized in the Pediatrics B Department during the period of 2003 -2012, patients for whom the diagnosis of respiratory affections was made and their files being exploitable were included in this study. The diagnosis taken into consideration is the one indicated when the patient left the hospital.

At the level of the National Meteorology Department; we collected the following climate parameters: air temperature (minimum and maximum) in degree Celsius, air humidity (minimum and maximum), wind speed and visibility that translate the daily importance of the phenomena that hinder vision.

To analyze the data thus collected, the dependent variable is composed of the respiratory illnesses (pneumonia, pleurisy, asthma, bronchopneumopathy, bronchitis, and acute pneumonia) and the predicators are: temperature (minima and maxima) in degree Celsius, and air humidity (minima and maxima), wind speed, and visibility.

The study was proceeded through a two-step analysis made of a descriptive phase and an analytical one.

The correlation test was used to measure the intensity of the relation between the dependent variable and the predicators. This measurement of the relationship intensity is made with the correlation coefficient R.

R does not have a unit and it varies between $-1< R < +1$

$0.75 \leq R \leq +1$ corresponds to a strong relationship

$0.5 \leq R < 0.75$ corresponds to a moderate relationship

$0.3 \leq R < 0.5$ corresponds to a weak relationship

$R \leq 0.3$ corresponds to a trifling relationship

The R sign shows the sense of the association

$R < 0$ is a negative association

$R> 0$ is a positive association

The Systat version 10.2 and Stata version 11.1 software types allowed us to determine the appropriate modals that explain the effect of certain climate variables on the onset or worsening of respiratory affections; the considered statistical significance is $P = 0.05$.

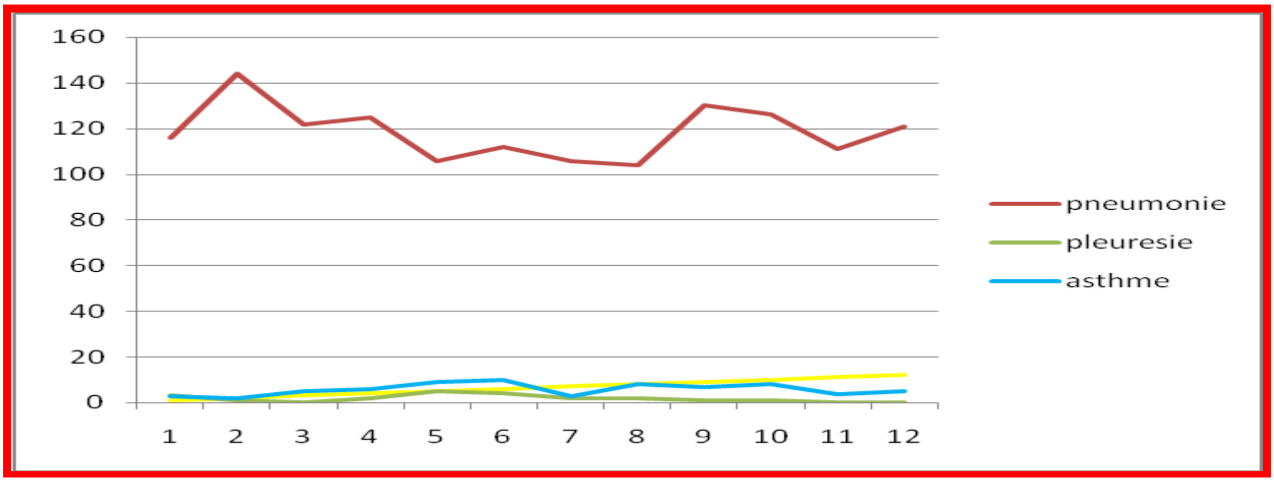
Findings of the Study

A list was made of 55.94% of the male subjects; children under 5 years of age represent 51.47%, or equal one (01) child out of two (02). The mean age is six (06) years (SD 3.09). The main respiratory illnesses we came across are the simple pneumonia 83.80% and the acute pneumonia 07.48%.

Over the 1,698 surveyed cases, 93.58% of the subjects were cured and 06.42% died. It is noticed that 97% of the subjects stayed in the hospital from two (02) to twenty (20) days and 3% of them went over a twenty-day stay. The stay mean duration is seven (07) days (SD 4.66).

Seasonal variations analysis of pneumonia, asthma, and pleurisy cases

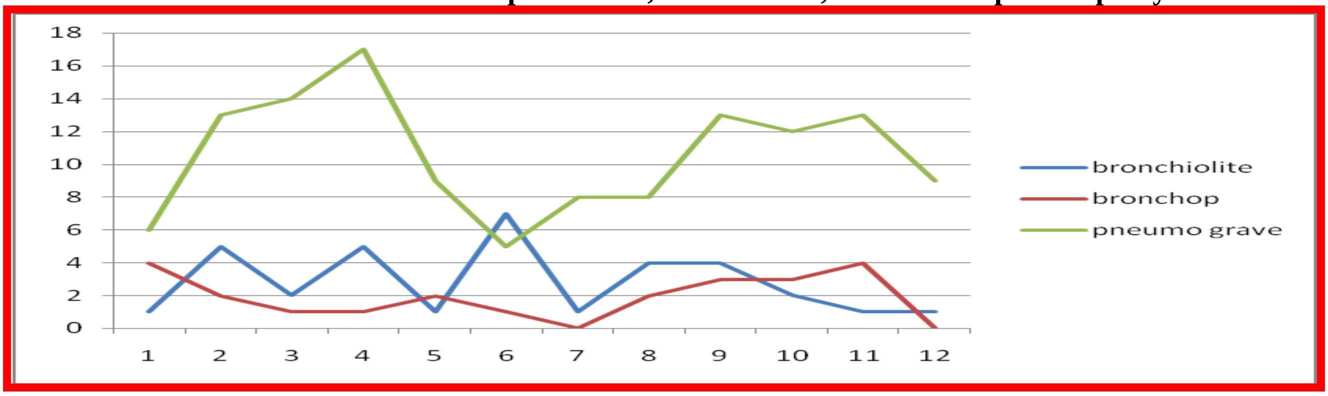
The incidence of pneumonia varied from one (01) month to the other with a peak during the months of February-March and the September, October, and November month’s periods: they are periods of minimum temperatures and humidity.



<u>Graph N°1</u>: Seasonal variations of pneumonia, asthma, and pleurisy cases recorded at the National Hospital of Niamey (NHN/HNN) over the 2003-2012periods.

As far as asthma is concerned, we observed a peak during the month of June that corresponds to a period of maximum temperature and wind. It is during the months of December, January, and February the cold weather period that the highest incidences were recorded and the morbidity due to pneumonia augmented in a near linear way as the temperature decreased.

Seasonal variations of the cases of acute pneumonia, bronchiolitis, and bronchopneumopathy



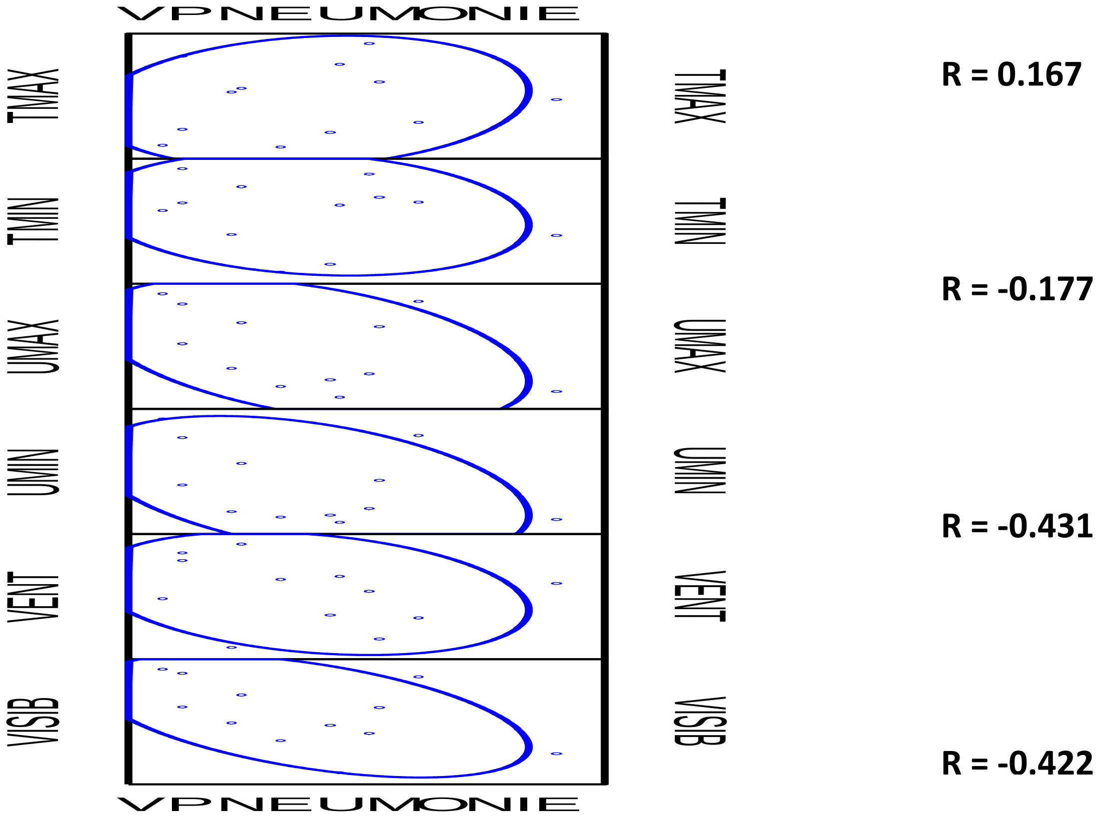
<u>Graph N°2</u>: Seasonal variations of bronchitis, bronchopneumopathy, and acute pneumonia cases recorded at the National Hospital of Niamey (NHN/HNN) over the 2003-2012 period.

We observed an incidence of very high acute pneumonia during the periods of February, March, April, September, October, and November: periods of minimum temperature and low humidity.

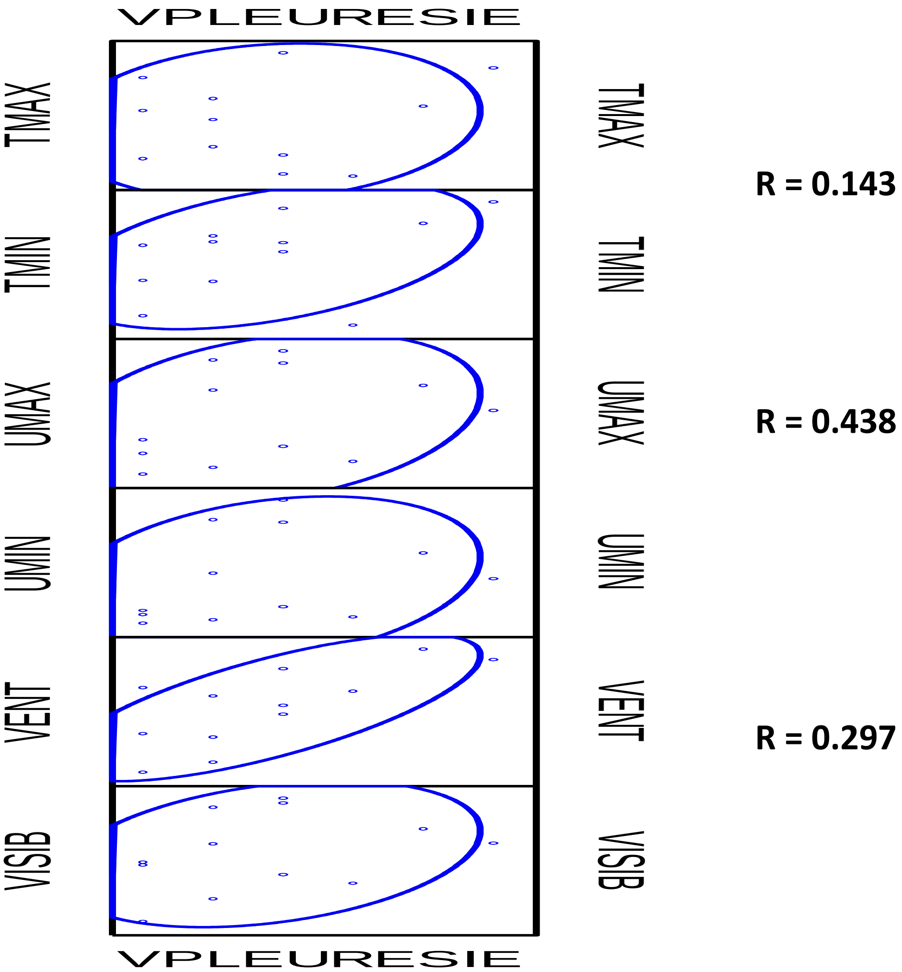
Bronchitis has a high incidence during the months of June during which the temperature reaches the maximum and is generally accompanied with wind and dust.

Associations of respiratory illnesses with climatic variables.

The R correlation test allowed us to notice that:

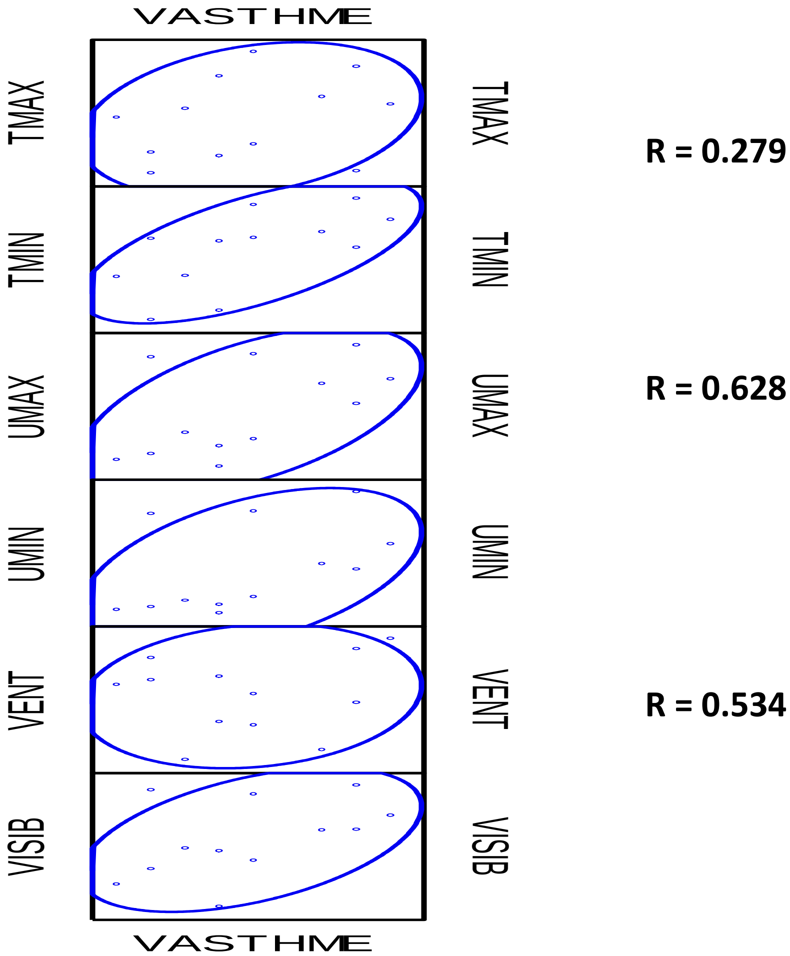


There is a trifling relation between pneumonia and the maximum temperature (0.167 < 0.3) despite a positive correlation, the more the temperature increases, the more cases of pneumonia do so as well. As regard the other climate parameters the relationship is negative.



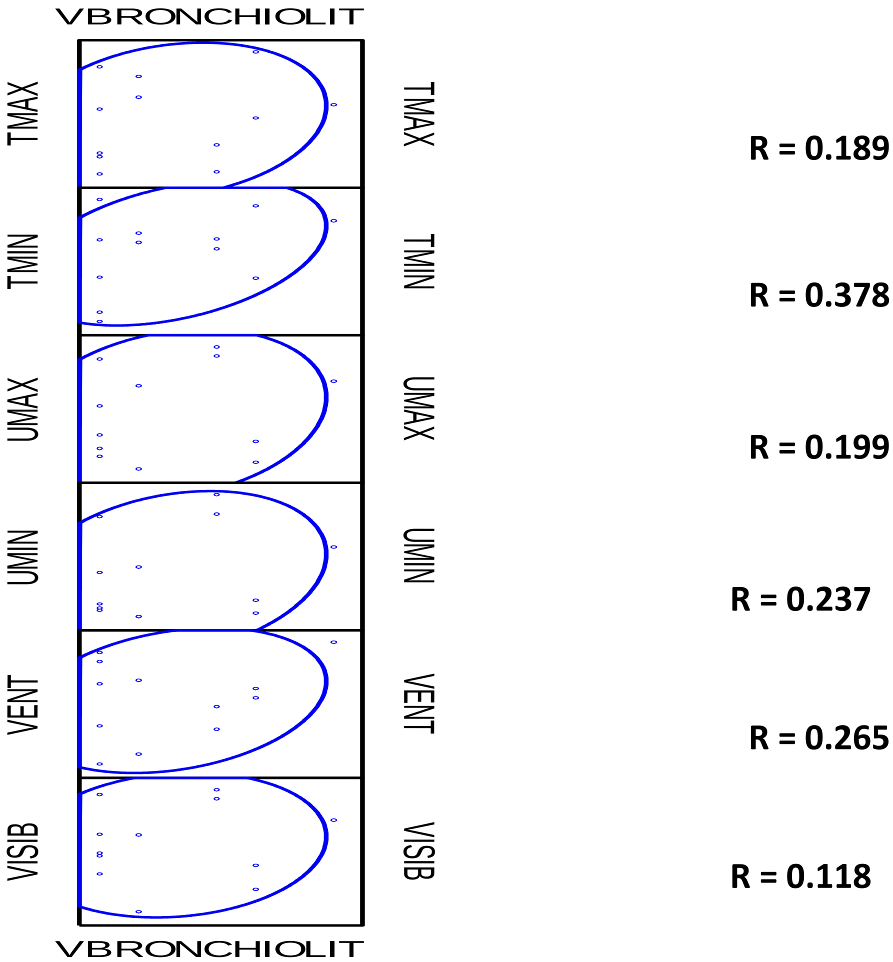
GRAPH N°3: Correlation between the incidence of pleurisy and climate variables recorded at the National Hospital of Niamey over the 2003-2012 period.

There is no correlation between pleurisy and the climate variables. The correlation is positive between pleurisy and all of the other climate parameters. There also exist a strong and positive correlation between pleurisy and wind, a weak and positive relation with the other climate parameters.



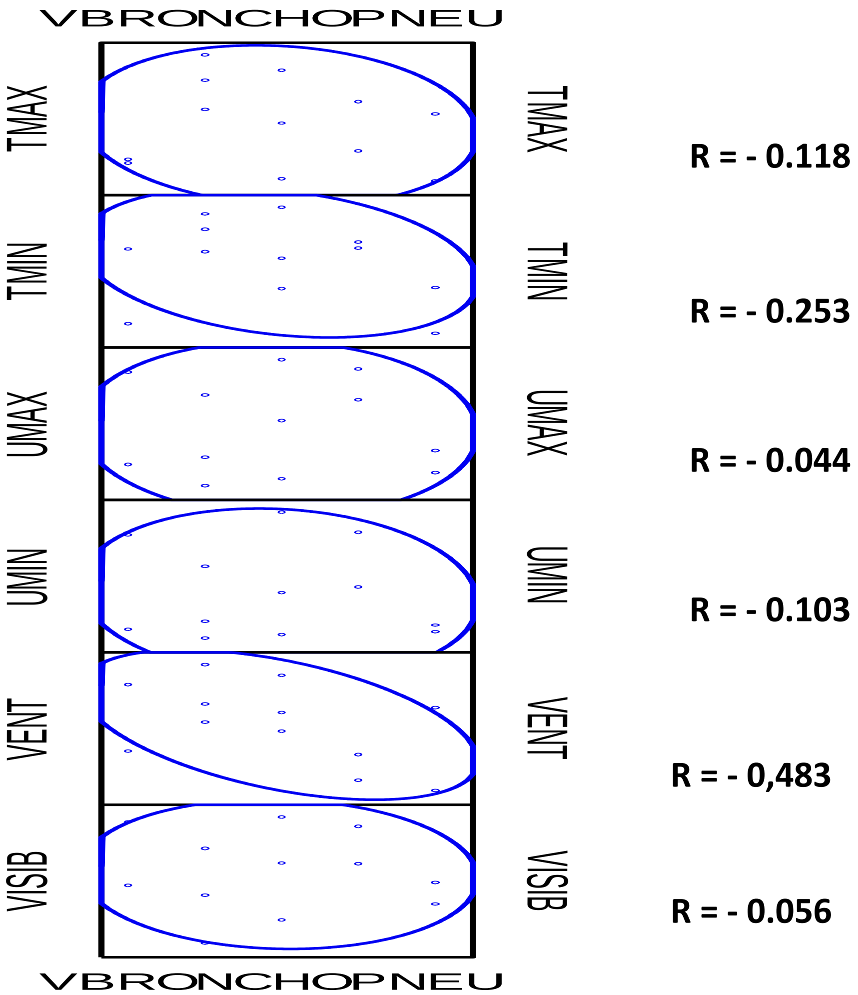
Graph N°4 : Correlation between the incidence of asthma and climate variables recorded at the National Hospital of Niamey over the 2003-2012 period.

The correlation between asthma and the other entire climate variables is positive. The relation with minimum temperature and maximum temperature is positive and moderate. With wind, visibility, minimum humidity, and maximum temperature the relation is trifling.



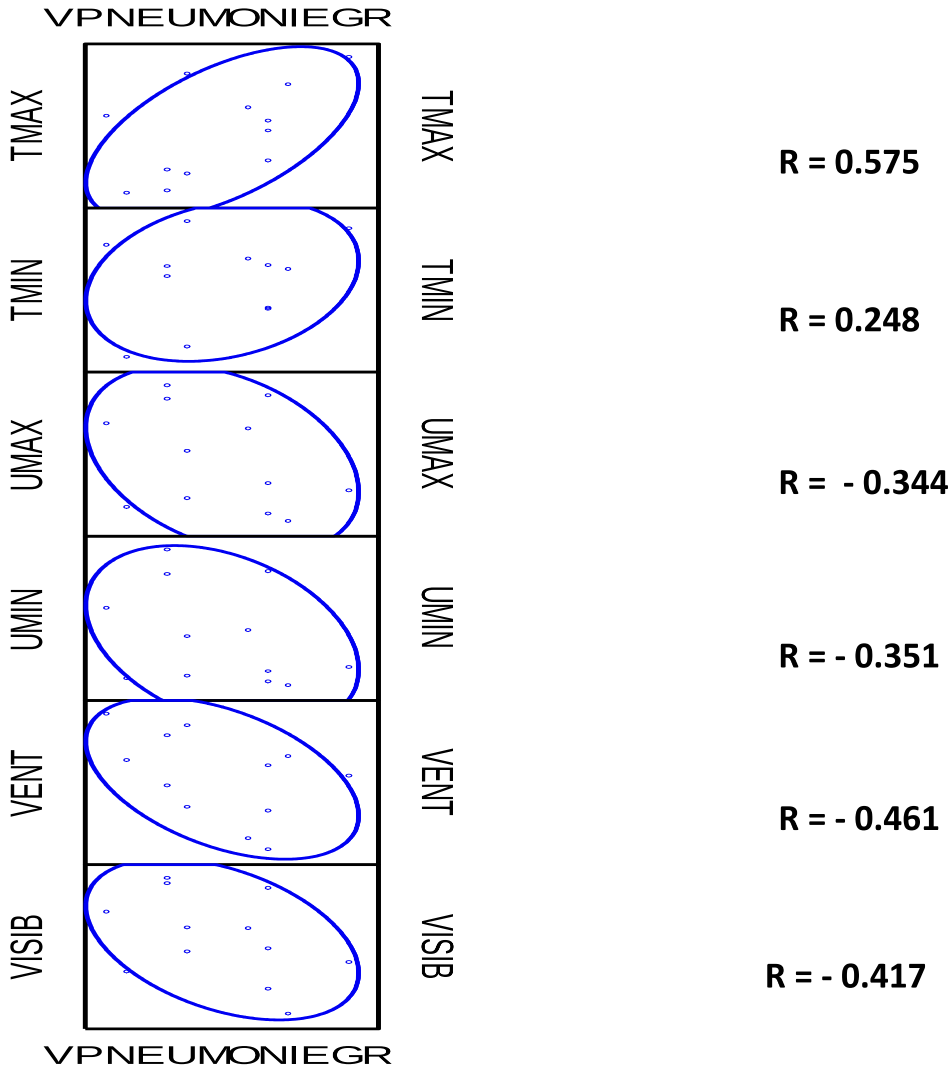
Graph N°5: Correlation between the incidence of bronchitis and climate variables recorded at the National Hospital of Niamey from 2003 to 2012.

The correlation between bronchitis and all of the other climate parameters is positive but trifling.



Graph N°6 : Correlation between the incidence of bronchopneumopathy and climate variables recorded at the National Hospital of Niamey from 2003 to 2012.

We observe a trifling and negative correlation between bronchopneumopathy and the climate parameters.



<u>Graph N°7</u> : Correlation between the incidence of acute pneumonia and climate variables recorded at the National Hospital of Niamey from 2003 to 2012.

The correlation with the maximum temperature is positive and weak; the correlation with the minimum temperature is positive. The correlation with the maxi/mini humidity, the wind and the visibility is negative.

Analysis of the relations between climate variables and respiratory illnesses

At this level, what the matter is that of the Relation between air temperature, humidity, wind speed, and visibility (monthly average)with reference to the 2003-2012 period superimposed on the number of the cases of the different respiratory affections (pneumonia, asthma, bronchopneumonia, bronchitis, and acute pneumonia) recorded at the National Hospital of Niamey. This analysis results in what follows:

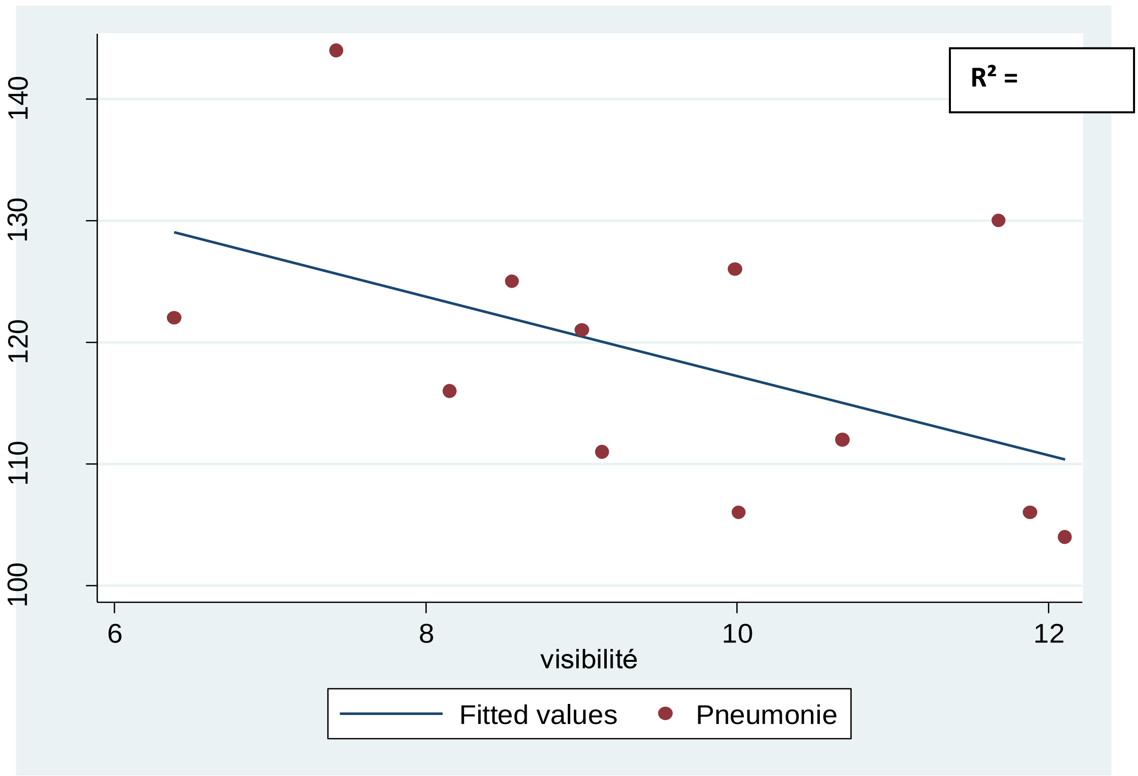
Pneumonia:

Table 1 : Relation between climate variables and cases of Pneumonia recorded at the National Hospital of Niamey from 2003 to 2012

Climate variables	Coefficient	P value
TMAX	0.167	0.605
TMIN	-0.17	0.582
UMAX	-0.42	0.161
UMIN	-0.42	0.172
WIND	-0.29	0.398
VISIBILITY	-0 .503	0.096

Table 2 Relation between climate variables and Pneumonia cases

Pneumonia	Coefficient	Pvalue	IC 95%
Visibility	-3.267	0.096	[-7.22 0.69]
Constant	149.890	0.000	[111.33 188.44]
Square R	25.26%		



Graph N°8 Dispersion chart of Pneumonia cases according to horizontal visibility established from data recorded at the National Hospital of Niamey over the 2003-2012 period.

Over the six (06) climate parameters that are included, visibility is considered to have an R^2 determination coefficient equal to 25.26% [R^2 = 25.26%] and an insignificant p (p = 0.09). The visibility in accordance with the obtained modal accounts for 25.26% of the variability of pneumonia cases.

Thus, cases of pneumonia increase if visibility decreases.

- **Asthma:** Among the six (06) climate parameters, maximum temperature is considered by the modal with an R^2 determination coefficient equal to 49.9% [R^2 = 49.9%] and a significant p (p = 0.022< 0.05 MAXT);
  Minimum temperature accounts for 49.91% of the variability of asthma cases.
- **Bronchopneumopathy:** Among the six (06) climate parameters, wind is considered with an R^2 determination coefficient equal to 23.34% [R^2 = 23.34%] and an insignificant p (p = 0.11). Wind accounts for 23.34% of the variability of bronchopneumopathy cases.
- **Acute pneumonia:** Among the six (06) climate parameters, the wind and maximum temperature association is considered with an R^2 determination coefficient equal to 62.5% [R^2 = 62.5%] and a significant p (p = 0.01 and p = 0.02). In accordance with the obtained modal, the wind and maximum temperature association accounts for 62.5% of the variability of acute pneumonia.
- **Pleurisy:** Among the six (06) climate parameters, wind and humidity are considered with an R^2 determination coefficient equal to 90.90% [R^2 = 90.90%] and a significant p (p = 0.001 and = 0.05 < 0.05) and for MINU p = 0.08>0.05. The potentialized three (03) climate variables account for 90.90% of the variability of cases of pleurisy. Wind alone accounts for 51.65% of the variability of pleurisy cases.

Discussions

The main difficulty relating to this study is the fact that there is a shortage of similar studies. Despite the availability of a growing literature about climate change few studies about the effects of this phenomenon on respiratory illnesses have been published. In fact, a Belgian-African team examined closely two hundred and thirty scientific articles dealing with climate impacts on health in West Africa, mainly those on respiratory affections. Only three (03) studies that is to say 1.3% of the entire articles dealt with climate and respiratory illnesses. Temperature is the essential variable of climate change. The Global average temperatures increase brought about extreme meteorological phenomena such as flooding, droughts, and stronger and more frequent storms.

In Sfax, a study about the impact of the variable intensity of the cold atmospheres on bronchopneumopathy medical consultations from 1995 to 2005 revealed that the number of bronchopneumonia cases went from 99 to 131 cases/day in February, and from 115 to 128 cases/day in December (Perrin et al 1995). These recorded results show a maximum correlation, respectively r = 0.87 for wind against 0.48 and r= 0.93 for UMIN /MINU against 0.10. In accordance with the conclusions of this study, a breathed air characterized by coldness and low humidity can cause breathing problems which could affect the lower respiratory tracts. That is why a thermal drop and the acceleration of wind speed combined effect favors the increase of medical consultations for predominantly viral bronchopneumopathies **(**David2007). In a study carried out in 2004 in the city of Nouakchott, over the 836 cases interviewed, 28.0% of respiratory infections resulted from the combination of minimum temperature with wind (R =0.72). The cold, on the contrary, constitutes an advantage since the life expectancy of a virus augments when the temperature decreases. This strengthens the infectious power of the virus (De Longueville et al., 2013**)**. The storms following a fine weather disperse and break to pieces grains of pollen when throwing them against hard surfaces (trees, walls, and grounds). This frees very fine allergenic particles that penetrate in depth into lungs and trigger true epidemic (Perrin 1995).

If temperature is its essential variable, all of the climate parameters (humidity, nebulosity, rainfalls, and atmosphere content in carbon dioxide [CO2]) can be concerned.

In Benin a study carried out in collaboration with the University of Namur (Belgium) and the University of Parakou (Benin), titled “Potential Relations Between Lower Acute Respiratory Infections and Weather Conditions in Benin” reveals that in a hospital environment there is a correlation between climate variables and respiratory illnesses. In the North Center of Benin the correlation between humidity and respiratory infections resulted in a negative coefficient (R = -0.53) whereas in this study the correlation coefficient is -0.42 (UMAX/ MAXU). So, when humidity diminishes, one can observe an outbreak of cases and vice versa. In the south center part of the country a high rate of correlation coefficient was recorded (R = 0.75) with the TMIN / MINT and Wind whereas in this study R is negative and negligible: TMIN/MINT (R = -0.17) and Wind (-0.26) (Mounir2012).

The team of the Department of Environmental Health at the National Institute of Public Health of Kuopio (Finland) assessed the relation between asthma and humidity. This team selected two hundred and forty-one (241) children aged one (01) to seven (07) years in whom asthma had just been diagnosed. The authors of this study analyzed this causality link between humidity and asthma in accordance with the age of the children. Finding: up to one (01) over five (05) infantile asthma could originate from that link (Chaari 2009).

This study concluded that risk increases with the humidity degree and the presence of visible molds in homes, particularly in rooms. Doctors should from now on keep this cause in mind when they will be looking for the origin of infantile asthma. The researchers concluded that these results reinforce the hypothesis that humidity and molds can be risk factors conducive to asthma in young children (Chaari 2009).

In Togo, over one hundred and twenty (120) subjects, under 15, exposed to dusts, twenty percent (20%) had respiratory allergic signs. Conjunctivitis (14.3%) and rhinitis (08.5%) appeared the most frequently. Twenty-eight (28) subjects (04.6%) showed asthma equivalent symptoms against 04.12% of the cases recruited for carrying out this study. Rhinitis was associated with the presence of asthma symptoms in 45% of the cases (David 2007).

In partnership, the World Health Organization (WHO) and the Ministry of Environment and Living Environment conducted a study about air quality from November 2006 to March 2007in Ouagadougou, Burkina Faso. This study revealed that the yearly mean concentration of dust particles in Ougadougou was about 176µ/m^3, a daily peak often being around 600 µ/m^3 whereas the WHO indicated norm for a healthy environment is 70 µ/m^3. The study shows that every year lung diseases linked to dust represent ten (10) to fourteen (14) percent of cancer related deaths in Ouagadougou (Health Nutrition and Urbanisation OUAGADOUGOU, 2007).

At the Yalgado Hospital in Ouagadougou, fifteen percent (15%) of the 8,000 patients hospitalized every year in the ward of respiratory diseases suffer from air pollution related diseases: sore throat, sinusitis, larynx infection, bronchitis, pneumonia, and deafness, as well as allergy related illnesses such as asthma (Health Nutrition and Urbanisation OUAGADOUGOU, 2007).

Conclusion

From the fact of observed or expected effects on the natural, economic, and human systems, climate changes raise scientific, technological, and political challenges to the whole humanity. They must be dealt with in a global perspective of sustainable development. The strengthening of the cooperation among meteorology and health communities is essential to ensure the integration of precise and relevant updated information about weather and climate into the management of health at the international, national, and local levels.

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