Journal of Applied Science and Agriculture, 9(5) Special 2014, Pages: 2153-2160

AENSI Journals

Journal of Applied Science and Agriculture

ISSN 1816-9112

Journal home page: www.aensiweb.com/jasa/index.html

Climatic factors affecting asthmatic symptoms (case study: Mashhad, Iran)

Akram Sayyah, Mohammad Motamedi and Ezzatollah Mafi

Department of Geography, College of Humanities, Shirvan Branch, Islamic Azad University, Shirvan, Iran.

ARTICLE INFO

Article history:
Received 28 February 2014
Received in revised form 19 April 2014
Accepted 23 April 2014
Available online 15 May 2014

Key words:
Asthma, Climatic factors, Mashhad.

ABSTRACT

Asthma is considered as a syndrome defined by airways obstruction, wheezing and bronchospasm. Many factors including genetic parameters, different kinds of infections, environmental promoters and diet can generate asthmatic symptoms in additionally allergens, viral attacks, particular drugs and air pollution. Thus assessing the risk of the parameters that involve respiratory organs is a necessity to early warning the hazards caused by environmental conditions to human health. This study aims to investigate the relationship amongst climatic factors including temperature, relative humidity, rainfall and wind maximum velocity and asthmatic attacks at 2011-2012. We used regression linear model to determine r^2. Results showed temperature as the key effective factor resulting in the malady so that decrease in temperature, especially in winter, results in an increase in the number of patients. Furthermore it was shown that other factors such as relative humidity and wind characteristics proved weak to moderate correlations with the number of patients. Altogether, because of its particular climatic features Mashhad could not provide a proper circumstance for asthma.

To Cite This Article: Akram Sayyah, Mohammad Motamedi and Ezzatollah Mafi., Climatic factors affecting asthmatic symptoms (case study: Mashhad, Iran). ***J. Appl. Sci. & Agric.,*** *9(5): 2153-2160, 2014*

INTRODUCTION

Background:

The relationship between space and health dates back to Hippocrates, who stated that "air, water, place" all play significant roles impacting human health and history (father of western medicine) (Philo, Chris, 2009). He also claimed that one who is enthusiastic in medicine should first of all seek the influences of seasons. Then it is necessary to collect data about warm and cold wind following the quality of waters (Hooshwar, 2002). A classic piece of research in health geography was done in 1854 as a cholera outbreak gripped a neighborhood in London. Death tolls ranged around the clock and the people feared that they were being infected by vapors coming from the ground. John Snow thought that if he could locate the source of the disease, it could be contained. He drew maps showing the homes of people who had died of cholera and the locations of water pumps. He found that one pump, the public pump on Broad Street, was central to most of the victims. He figured that infected water from the pump was the culprit. He instructed the authorities to remove the handle to the pump, making it unusable. After that the number of new cholera cases decreased. Maria GraziaPerrone *et al* (2010) showed different seasonal chemical composition of PM can influence some biological properties. They showed summer PM samples had a high mass contribution of SO^{-}_{4} and were enriched in some elements like Al, As, Cr, Cu, and Zn, compared to winter PM samples. Cell viability reduction was two times higher for summer PM samples in comparison with winter ones.

Health geography is considered to be divided into two distinct elements. The first of

which is focused on geographies of disease and ill health, involving descriptive research quantifying disease frequencies and distributions, and analytic research concerned with finding what characteristics make an individual or population susceptible to disease. This requires an understanding of epidemiology (Ocaña-Riola, Ricardo, 2010). The second stream of health geography is the geography of health care, primarily facility location, accessibility and utilization. This requires the use of spatial analysis and often borrows from Behavioral economics.

Asthma was recognized in Ancient Egypt and was treated by drinking an incense mixtureknown as kyphi (Manniche L, 1999). It was officially named as a specific respiratory problem by Hippocrates circa 450 BC, with the Greek word for "panting" forming the basis of our modern name (Murray and Nadel's textbook of respiratory medicine, 2010) In 200 BC it was believed to be at least partly related to the emotions (Andrew

Corresponding Author: Akram Sayyah, Department of Geography, College of Humanities, Shirvan Branch, Islamic Azad University, Shirvan, Iran.
E-mail: Akramsayyah@yahoo.com

Harver and Harry Kotses, 2010). During the 1930s–1950s, asthma was known as one of the "holyseven" psychosomatic illnesses. Its cause was considered to be psychological, with treatment often based on psychoanalysis and other talking cures (Opolski M, Wilson, I, 2005). As these psychoanalysts interpreted the asthmatic wheeze as the suppressed cry of the child for its mother, they considered the treatment of depression to be especially important for individuals with asthma (Opolski M, Wilson, I, 2005). Jacques M. May defines geographic medicine as the study of relationships amongst pathologic symptoms and the environment factors (Ismaeli. 2011). JemsBenta claims that the issue applies many concepts including medical ecology, geographical pathology, global epidemiology and even anthropogenic ecology (Ismaeli. 2011). The aims and functions of this branch of science include getting known of the influences of geographic factors on individual and public health, getting known of the geographic patterns ofdistribution of maladies, determining the origins of diseases and the causes of the originsto get formed, determining the annual periodic pattern of the activities of the diseases and to find some applicable solutions to discredit these centers (Shakooi, 1975).

The different aspects of health conditions are undoubtedly sensitive to climatic factors e.g. cardiovascular disorders are mostly seen in individuals exposed to extreme warm or cold weather (Beigdeli, 2000). Dr. Alfred Howland for the first time, in the introductionpart of a precious study, introduced the term" geographic medicine" previously appliedtopographic medicine"(Shakooi, 1975). In the recent decades many studies called as "have investigated the relationship between climatic and environmental factors with therate of some special diseases and their distributional patterns e.g. in Iran Mirzaee *et al* (1998) in an annual survey of the number of suicides resulting from socio-psychologicalproblems in Isfahan showed that nearly 58 % of the suicides occurred at the first half ofthe year (warm seasons) and among 15-24 years old individuals. Bigdeli (2000)investigated the aforementioned relationships in a 5 years period. Her study resultsshowed a direct correlation among air pollution and temperature of Tehran and the number of heart attacks. Inanlo (2003) studied the distribution pattern of skin cancer in different provinces of Iran. He showed that this distribution depends on the height of sealevel, latitude and longitude of the locality and the degree of atmosphere transparency (i.e. air pollution). He also observed the highest rate of occurrence in those parts of the country that receive the highest rate of solar energy resulting into the highest insolation. Pourahmad and Yavar (2005) showed the highest frequency of esophagus cancer occurring at the latitudes more than 32^{o} especially at the northern strip of the country that located next to the Caspian sea. The reasons may lie behind environmental backgrounds & geographic and occupational circumstances. Mohammahi and Afshar (2006) showed a significant relationship between seasonal changes and digestive system disorders so that air conditions play an important role in digestive system bloodsheds. Ramazani (2012) investigated the pattern of stomach cancer. He could prove Molybdenum soils as the main factor creating this disorder. We in this study focused on asthma that is characterized mainly by frequent airway obstruction along with wheezing, severe coughs and a sense of asphyxia (Moeen, 2003).

Study area:

Mashhad in which this study is conducted, is the second metropolis located at the east northern part of Iran with an about 3 million residents and an area of 204 Km^2 located at 36^{o} $16^{/}$ N and 59^{o} $38^{/}$ E and an elevation of 970 meters from the sea level (Shahmohammadi, 2007) (Fig.1) The city is characterized by its arid climate as well as its cold winters and warm summers. Regarding the Coupon climatic index Mashhad is categorized as an arid to semi-arid region with a steppe plant cover. This city is surrounded by GharahGhoum desert from the north, HazarMasjed and Binaloud from north and the south respectively (Rezvani, 2005). A variety of atmospheric fronts influence the plain of Mashhad so that different parts of the plain have different types of climate e.g. Neishabour is of a cold arid climate, Ghouchan of a cold semi-arid climate. Also Binaloud and HazarMasjed mountains have a cold humid climate. Therefore, we can conclude that the plain of Mashhad has a variable climate such that totally tend to a cold arid one with dry and cold summers and humid and cold winters (Pourtoroghy, 2012).This study aims to investigate the relationship amongst climatic factors includingtemperature, relative humidity, rainfall and wind maximum velocity and asthmatic attacks at 2011-2012.

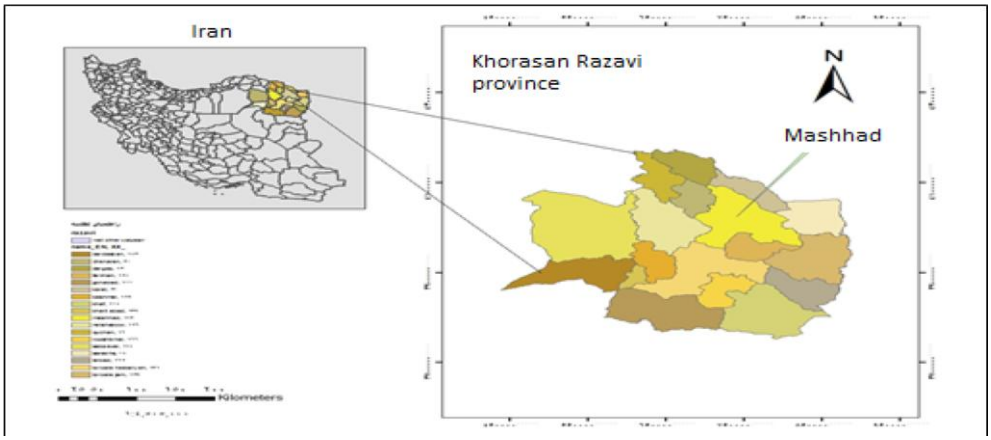

Fig. 1: location of the study area

Asthma:

Asthma is a heterogeneous disorder that is influenced by mutual interactions of genetic and environmental factors (Harrison, 2008). Asthma is a common chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversibleairflow obstruction and bronchospasm (NHLBI Guideline 2007, pp. 11–12). Common symptoms include wheezing, coughing, chest tightness, and shortness of breath (British Guideline 2009, p. 4).

Asthma is thought to be caused by a combination of genetic and environmental factors (Martinez FD, 2007). Its diagnosis is usually based on the pattern of symptoms (Lemanske RF, Bussewww, 2010), response to therapy over time and spirometry. It is clinically classified according to the frequency of symptoms, forced expiratory volume in one second (FEV1), and peak expiratory flow rate (Yawn BP, 2007). Asthma may also be classified as atopic (extrinsic) or non-atopic (intrinsic)(Kumar, Vinay; Abbas, Abul K; Fausto, Nelson *et al*., 2010) where atopy refers to a predisposition toward developing type 1 hypersensitivity reactions (Stedman's Medical Dictionary, 28 ed.).

Treatment of acute symptoms is usually with an inhaled short-acting beta-2 agonist (such as salbutamol) and oral corticosteroids (NHLBI Guideline 2007). In very severe cases, intravenous corticosteroids, magnesium sulfate, and hospitalization may be required(NHLBI Guideline 2007). Symptoms can be prevented by avoiding triggers, such as allergens and irritants, and by the use of inhaled corticosteroids (GINA 2011, p. 71). Long-acting beta agonists (LABA) or leukotriene antagonists may be used in addition to inhaled corticosteroids if asthma symptoms remain uncontrolled (GINA 2011, p. 33). The prevalence of asthma has increased significantly since the 1970s. In 2011, 235–300 million people globally have been diagnosed with asthma (World Health Organization Fact Sheet Fact sheet No 307), and it caused 250,000 deaths (GINA 2011, p. 3) We observe an increase of the disorder in 30 recent decades in developed countries but it seems that the rate of increase is getting constant and under control. However, 10-12 % of the involved individuals are adults and nearly 15% are among children. In developing countries that we previously observed a low rate of asthma. It seems that the number of the involved patients is increasing so that it is seemingly related to increasing rate of urbanization (Harrison, 2008).

Climatic factors promoting asthma:

Asthma is characterized by recurrent episodes of wheezing, shortness of breath, chest tightness, and coughing (GINA 2011, pp. 2–5). Simply climatic factors are defined as the parameters that affect directly the long-term weathering of a place. The quality of climate in a region is mainly determined by the intensity of solar energy received by a particular unit of area in the region, earth angel of declination relative to the sun, air flow (wind)and geographic factors including topography, longitude and latitude and elevation of thesea level(Fesharaki, 1995). It is also influenced by temperature (that is determined by solar radiation), humidity and plant cover. But how these parameters can promote asthma?

Many environmental factors have been associated with asthma's development and exacerbation including allergens, air pollution, and other environmental chemicals (Kelly, FJ; Fussell, JC, 2011). Smoking during pregnancy and after delivery is associated with a greater risk of asthma-like symptoms (GINA 2011, p. 6). Low air quality from factors such as traffic pollution or high ozone levels has been associated with both asthma development and increased asthma severity (Gold DR, Wright R, 2005). Exposure to indoor volatile organic compounds may be a trigger for asthma; formaldehyde exposure, for example, has a positive association. Also, phthalates in PVC are associated with asthma in children and adults (McGwin, G *et al*, 2010; Jaakkola JJ and

Knight TL, 2008; Bornehag, CG and Nanberg, E, 2010). Asthma is associated with exposure to indoor allergens. Common indoor allergens include: dust mites, cockroaches, animal dander, and mold. Efforts to decrease dust mites have been found to be ineffective. Certain viral respiratory infections, such as respiratory syncytial virus and rhinovirus, may increase the risk of developing asthma when acquired as young children. Certain other infections,however, may decrease the risk (Ahluwalia, SK and Matsui, EC, 2011; Arshad, SH, 2010; Custovic, A and Simpson, A, 2012; HK Johansen, 2008; Murray and Nadel's textbook of respiratory medicine, 2010).

MATERIAL AND METHOD

Data collection:

The objective of this study is to determine the relationship among climatic factorsincluding temperature, relative humidity, average precipitation and maximum wind velocity and the number of asthmatic events in Mashhad, Iran. To gain the objective we, first of all, gathered the data about the aforementioned climatic factors from the official responsibilities and derived the printed documentaries such as the statistical almanac published by the Meteorological Organization of the Islamic Republic of Iran collected at 2011-2012. Then the average amounts of each parameter were separately calculated for each month (table 1and 2).

Table 1: measured climatic factors (2011)

* 2011	Average precipitation (cm)	Average relative humidity (%)	Maximum relative humidity (%)	Minimum relative humidity (%)	Minimum temperature (centigrade)	Maximum temperature (centigrade)	Average absolute temperature (centigrade)	Maximum wind velocity (km/h)
March	27.6	58.5	81.2	35.8	8.1	19.4	13.7	10.0
April	35.1	54.8	78.0	31.5	13.3	26.9	20.1	12.0
May	3.5	30.4	47.3	13.6	18.3	33.6	25.9	15.0
June	1.0	23.8	37.1	10.5	21.5	37.2	29.4	15.0
July	0.0	22.2	34.9	9.5	18.7	34.7	26.7	12.0
August	2.4	24.9	39.5	10.4	14.4	30.9	22.7	11.0
September	0.5	38.1	57.8	18.4	12.8	28.6	20.7	14.0
October	8.6	46.2	68.2	24.2	4.7	19.9	12.3	9.0
November	0	42.0	63.5	20.5	1.2	17.7	9.5	8.0
December	13.1	54.3	74.0	34.6	-2.8	10.0	3.6	9.0
January	48.0	64.7	87.1	42.2	-0.8	9.8	4.5	10.0
February	22.4	67.8	87.3	48.3	0.2	10.6	5.4	11.0
Sum	162.2	527.7	755.9	299.5	109.6	279.3	194.5	136
* Months are ordered according to local calendar (spring to winter)								

Table 2: measured climatic factors (2012)

* 2012	Average precipitation (cm)	Average relative humidity (%)	Maximum relative humidity (%)	Minimum relative humidity (%)	Minimum temperature (centigrade)	Maximum temperature (centigrade)	Average absolute temperature (centigrade)	Maximum wind velocity (km/h)
March	10.1	45.1	68.8	21.4	7.6	22.0	14.8	14.0
April	15.4	46.2	67.6	24.8	15.5	30.0	22.7	15.0
May	6.4	32.1	49.6	14.5	19.4	34.4	26.9	11.0
June	0.0	23.9	36.3	11.5	20.6	36.2	28.4	12.0
July	0.0	22.1	33.6	10.6	21.3	37.2	29.2	12.0
August	2.3	32.2	48.3	16.2	15.8	30.6	23.2	11.0
September	6.6	39.6	58.9	20.2	11.1	26.7	18.9	10.0
October	57.1	72.5	90.1	54.9	4.2	12.3	8.2	9.0
November	21.5	71.1	90.9	51.3	-2.4	7.4	2.5	11.0
December	40.5	66.8	87.5	46.1	-3.7	8.5	2.5	8.0
January	42.9	70.6	89.8	51.5	-3.4	6.1	1.3	15.0
February	47.9	57.3	81.2	33.3	-0.8	11.9	5.6	17.0
Sum	250.7	579.5	802.6	356.3	105.2	263.3	184.2	145
Total (2011+ 2012)	412.9	1107.2	1558.5	655.8	214.8	542.6	378.7	281
* Months are ordered according to local calendar (spring to winter)								

Journal of Applied Science and Agriculture, 9(5) Special 2014, Pages: 2153-2160

Then, from the data gathered, the Coupon climatic index was calculated. Accordingly, the city was categorized as arid to semi-arid. On the other hand the data about total recorded asthmatic events at the data bank of the three main centers of asthmatic named as Ghaem, Imam Reza and Arya hospitals were daily collected at the same period (table 3).

Table 3: number of hospitalized patients

Year	March	April	May	June	July	August	September	October	November	December	January	February	Sum
2011	15	24	14	9	12	13	16	17	24	26	24	10	204
2012	12	16	13	13	17	12	17	26	37	36	17	16	233

Analyzing data:

We used linear regression model to separately calculate the monthly correlation coefficient (r^2) between the climatic factors (as the independent variables) and the number of recorded asthmatic events (as the dependent variable), B (beta coefficient) as well as the linear equations that determine their relationships for 24 months (α= 0.05). Microsoft Excel 2010 and SPSS statistical package v.20 were applied to analyze data and to fit the graphs.

RESULTS AND DISCUSSION

As shown in table 3 the total number of patients in 2011 and 2012 were 204 and 233 individuals respectively. Thus the sum of the patients in the study period was 437 individuals. Following we discuss the relationship between each measured parameter and the number of patients separately.

3-1- Based on a the 24 month analysis we found a significant relationship between average absolute temperature (p=0.01, r^2=0.341) (Fig2,a). According to beta coefficient (-0.625) for each unit increase in the independent variable the dependent variable will decrease for 0.625 unit (table4).

3-2- We found a significant relationship between maximum absolute temperature r^2= 0.389) (Fig2,b). According to beta coefficient (-0.624) for each unit increase (p=0.01), maximum absolute temperature the number of asthmatic patients will decrease for 0.624 unit (table4).

3-3- We found a significant relationship between minimum absolute temperature (p=0.01, r^2= 0.387) (Fig2,c). According to beta coefficient (-0.623) for each unit increase in minimum absolute temperature the number of asthmatic patients will decrease for 0.623 unit (table4).

3-4- We found a significant relationship between average relative humidity (p=0.01, r^2= 0.376) (Fig2,d). According to beta coefficient (0.614) for each unit increase inaverage relative humidity the number of asthmatic patients will increase for 0.614 unit (table4).

3-5- We found a significant relationship between maximum relative humidity (p=0.02, ^{2}= 0.354) (Fig2,e). According to beta coefficient (0.595) for each unit increase inmaximum relative humidity the number of asthmatic patients will increase for 0.595 unit (table4).

3-6- We found a significant relationship between minimum relative humidity (p=0.01, r^2= 0.384) (Fig2,f). According to beta coefficient (0.620) for each unit increase in minimum relative humidity the number of asthmatic patients will increase for 0.620 unit (table4).

3-7- We found a significant relationship between average monthly precipitation (p=0.01, r^2= 0.233) (Fig2,g). According to beta coefficient (0.483) for each unit increase in average monthly precipitation the number of asthmatic patients will increase for .483 unit (table4).

3-8- We found a significant relationship between maximum wind velocity (p=0.01, r^2= 0.245) (Fig2,h). According to beta coefficient (0.507) for each unit increase in maximum wind velocity the number of asthmatic patients will increase for 0.507 unit (table4).

Table 4: regression equation, p-value and beta coefficient between climatic factors and hospitalized patients for the 24 months of measurements

Independent variable (climatic factor)	Linear regression equation	p	Beta coefficient
Average absolute temperature	$Y=0.4747_X+25.657$ $R^2=0.391$	./001	-./625
Maximum absolute temperature	$Y=0.43.7_X+27.905$ $R^2=0.3897$	./001	-./624
Minimum absolute temperature	$Y=0.52.7_X+22.827$ $R^2=0.3879$	./001	-./623
Average relative humidity	$Y=0.2646_{X+}5.9602$ $R^2=0.3543$	./001	./614
Maximum relative humidity	$Y=0.2219_X+3.7575$ $R^2=0.3543$	./002	./595
Minimum relative humidity	$Y=0.3076_X+9.7627$ $R^2=0.384$	./001	./620
Average precipitation	$Y=0.1952_X+14.808$ $R^2=0.2331$	./01	./483
Maximum wind velocity	$Y=1.4888_X+35.598$ $R^2=0.2458$	./01	./507

However, as it is evident, although there is a significant relationship between all the measured parameters (as the independent variables) but the relationships are not so much strong. There have been many debates around definitions and domain of medical geography. However, medical geography is simply defined as the investigation of global earth phenomena and the distributional pattern of some particular diseases. Today,

Journal of Applied Science and Agriculture, 9(5) Special 2014, Pages: 2153-2160

because of various patterns of atmospheric events in various regions of the globe there is a special need for official responsibilities to get known of geographic propagation of diseases in different spatial scales(globally , regionally and locally) in order to properlypredict and manage the hygienic conditions of their own countries. Through this way, policy makers can assign an applicable early warning system and risk assessment methodologies to prevent the citizens get involved in fatal diseases. During a certain period of time after the sand-dust weather, inhalable particles keep staying in the atmosphere and people are exposed to the particles for a longer time (Meng *et al*., 2007), causing or worsening respiratory diseases. PM2.5 fraction, which was enriched in Ca++ and Mg++ (from soil dust), and Al, Fe, Zn, Ba Mn, produced cell viability reduction and DNA damage (Maria GraziaPerrone *et al*, 2010).

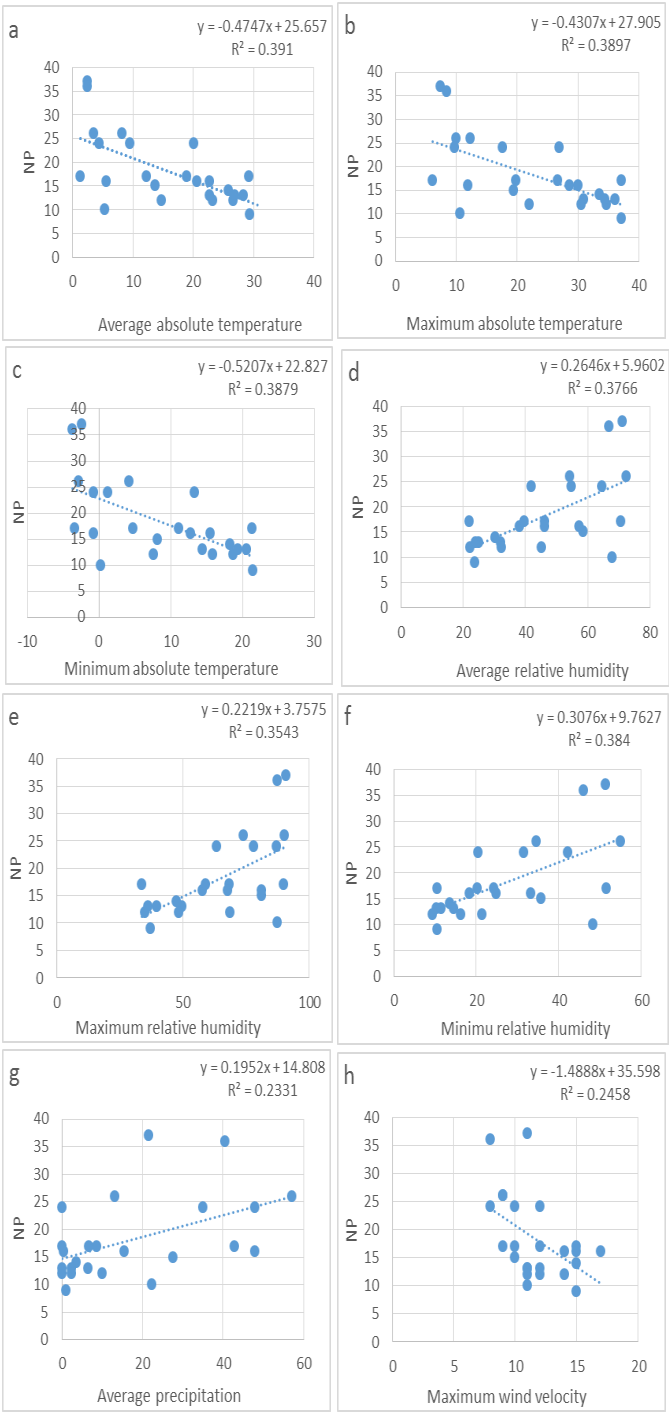

Fig. 1: regression model between climatic factors and number of hospitalized patients as the dependent variable for 24 months. Points show number of patients (NP)

In addition,sand-dust weather usually come up in the afternoon or at nightfall (Wang *et al*., 2005). Increasingly, airborne particles emitted from geologic media pose threats to human health and the environment worldwide due to expansion of infrastructure development to serve increasing population. These particles which are commonly referred to as "dust", canrange in size from 1 to 10,000 μM with a large percentage falling within the PM-10 particle size category. Dust can be generated through open-cast mining operations, civil construction operations, farming activities, and vehicle operations on un-surfaced roads. Upon generation, dust can be carried by wind into sensitive environments. A major rationale for improved effort in dealing with the dust problem is greater recognition of the spreading of ecological and human health damage risks through inter-regional and inter-continental transport of dust by wind. Although many analytical, monitoring and control challenges still remain to be searched. There is a certain association between sand-dust weather and respiratory hospitalizations, with evident lag effect. The values for all different groups of people on the lag4 day are statistically significant. In addition, there is not only gender difference but also age difference in the effect of sand-dust weather on the RR value of respiratory diseases. The aged people are least resistant to sand-dust weather (Yan Tao *et al*, 2012).

Conclusion:

Totally, this study proved that the climatic factor "absolute temperature" is the main factor causing an increase in the number of patients in the study period showing a relatively strong correlation. Also, the parameters "relative humidity" and "the maximum wind velocity" showed medium to weak correlations with the number of patients meaning that these two climatic factors have little influences on asthmatic attacks in Mashhad. In short, it is claimed that decrease in temperature particularly in winters and increase in relative humidity in Mashhad lead to an increase in asthmatic hospitalized patients. Eventually "precipitation" proved to have the weakest correlation with the number of asthmatic patients.

ACKNOWLEDGMENT

We deeply appreciate Professor EzzatollahMafi for his kind aids in preparing this paper. We also appreciate Dr. Hejazi for his guidance in clinical data collection. As well as staffs of Ghaem, Arya and Imam Reza hospitals that tried their best to prepare us the necessary data.

REFERENCES

Ahluwalia, S.K., E.C. Matsui, 2011. "The indoor environment and its effects on childhood asthma". Current Opinion in Allergy and Clinical Immunology, (2): 137-43.

Arshad, S.H., 2010. "Does exposure to indoor allergens contribute to the 32 development of asthma and allergy?" Current allergy and asthma reports., 10(1): 49-55.

Beigdeli, A., 2000. The influences of air pollution and climate on heart blocks, journal of geographic researches, (published in Persian).

Bornehag, C.G., E. Nanberg, 2010. "Phthalate exposure and asthma in children". International journal of andrology, 33(2): 333-45.

British Guideline, 2009.

Crompton, G., 2006. "A brief history of inhaled asthma therapy over the last fifty years". Primary care respiratory journal: journal of the General 45 Practice Airways Group., 15(6): 326-31.

Custovic, A., A. Simpson, 2012. "The role of inhalant allergens in allergic airways disease". Journal of investigational allergology& clinical immunology: official organ of the International Association of Asthmology (INTERASMA) and SociedadLatinoamericana de Alergia e Inmunologia., 22(6): 393-401.

Fesharaki, P., 1995. encyclopedia of geographical sciences (1thed), publicationof Amir Kabir University, Tehran, Iran (published in Persian).

GINA 2011

Gold, D.R., R. Wright, 2005. "Population disparities in asthma". Annu Rev Public Health, 26: 89-113.

Johansen, H.K., 2008. "House dust mite control measures for asthma". InGøtzsche, Peter C. Cochrane Database of Systematic Reviews, (2): CD001187.

Hooshwar, Z., 2002. pathophysiology of medical geography in Iran (2thed), publication of Jihad Daneshgahi, Tehran, Iran (published in Persian).

Impacts of dust on environmental systems and human health Journal of Hazardous Materials 132 (2006) v–vi, Editorial.

Inanlo, H., 2003. An introduction to skin cancer in Iran, journal of geographic 16 researches (1thed), (published in Persian).

Ismaeli, P., 2011. Medical geography and its role in human residential selectionthed), publication of Isfahan Jihad Daneshgahi, Isfahan, Iran (published in Persian).

Jaakkola, J.J., T.L. Knight, 2008. "The role of exposure to phthalates from 23 polyvinyl chloride products in the development of asthma and allergies: asystematic review and meta-analysis". Environ Health Perspect., 116(7): 845-53.

Kelly, F.J., J.C. Fussell, 2011. "Air pollution and airway disease". Clinical and experimental allergy : journal of the British Society for Allergy and Clinical Immunology, 41(8): 1059.

Lemanske, R.F., W.W. Busse, 2010. "Asthma: clinical expression andmolecular mechanisms". J. Allergy Clin. Immunol., 125(2): S95-102.

Manniche, L., 1999. Sacred luxuries: fragrance, aromatherapy, and cosmetics in ancient Egypt. Cornell University Press. pp: 49**.**

Maria Grazia Perrone Maurizio Gualtieri, Luca Ferrero, Claudia Lo Porto, Roberto Udisti, Ezio Bolzacchini Marina Camatini, 2010. Seasonal variations in 38 chemical composition and in vitro biological effects of fine PM from Milan,Chemosphere, 78: 1368-1377.

Martinez, F.D., 2007. "Genes, environments, development and asthma: a reappraisal". European Respiratory Journal, 29(1): 179-84.

McGwin, G., J. Lienert, J.I. Kennedy, 2010. "Formaldehyde exposure and asthma in children: a systematic review". Environmental health perspectives., 118(3): 313-7.

Meng, Z.Q., B. Lu, 2007. Dust events as a risk factor for daily hospitalization for respiratory and cardiovascular diseases in Minqin, China. Atmos Environ, 41(33): 7048-58.

Mirzaee, H., 1998. psycho- sociological reasons to commit suicide in Isfahan (1thed), research center of Isfahan University, Isfahan, Iran (published in Persian).

Moeen, M., 2003. Asthma (2thed), publication of academic sciences center, Tehran, Iran (published in Persian).

Mohammahi, H., H. Afshar, S. Barzegar, 2006. Influences of climatic factors on digestive system bleeding in Kerman, journal of geographic researches 20(2),(published in Persian).

Murray and Nadel's, 2010. textbook of respiratory medicine. (5th ed.). Philadelphia, PA: Saunders/Elsevier. pp: 38.

NHLBI Guideline, 2007.

Ocaña-Riola, Ricardo, 2010. "Common errors in disease mapping". Geospatial Health, 4(2): 139-54.

Opolski, M., I. Wilson, 2005. "Asthma and depression: a pragmatic review of the literature and recommendations for future research".ClinPractEpidemolMent Health, 1: 18.

Philo, Chris, 2009. "Medical Geography". In Gregory, Derek; Johnston, Ron; Pratt, Geraldine et. al The Dictionary of Human Geography (Fifth Edition). Oxford:Blackwell., pp: 451-453.

Pourahmad, A and B. Yavar, 2001. Geographic distribution of esophagus cancer in Iran, geographic researches 41 (published in Persian).

Ramazani, B., 2012. Geographic distribution of stomach cancer in Gilan, journal of environmental technologies 13(2) (published in Persian).

Rezvani, A., 2005. A search for municipal identity in Mashhad (1thed), the ministry of House, Tehran, Iran (published in Persian).

Shahmohammadi, Z., 2007. spatial analysis of public libraries in Mashhad based on geographic information system (GIS), M.Sc. Thesis, Ferdowsi University of Mashhad, Mashhad, Iran (published in Persian).

Shakooi, H., 1975. Research methods in medical geography (1thed), publication of Tehran University, Iran (published in Persian).

Stedman's Medical Dictionary, 2005. (28 ed.). Lippincott Williams and Wilkins.

Wang, S.G., J.Y. Wang, Z.J. Zhou, *et al*., 2005. Regional characteristics of three kinds of dust storm events in China. Atmos Environ., 39(3): 509-20.

"World Health Organization Fact Sheet Fact sheet No 307: Asthma". 2011. Retrieved Jan 17, 2013.

Von Mutius, E., J.M. Drazen, 2012. "A patient with asthma seeks medical advice in 1828, 1928, and 2012".

Respiratory diseases in spring in Lanzhou, Science of the Total Environment., 423: 8-11.

Yawn, B.P., 2008. "Factors accounting for asthma variability: achieving optimal symptom control for individual patients". Primary Care Respiratory Journal, 17(3): 138-147.

http://www.wikipedia.org