ORIGINAL ARTICLE

Correlation between the Number of Outdoor Visits and Climate Variables for Asthmatics in a Developing Country: A Retrospective Study

SYED HAIDER HASAN ALAM, ZOHAIB YOUSAF, ZEESHAN BUTT, *SAIRA AFZAL*

ABSTRACT

Background: Seasonal variations in the frequency of asthma visits and admissions are recognized widely, but there is a dearth of studies that associate the seasonal variation with the asthma visits in the pediatric age group in Pakistan.

Methods: The study was conducted on electronically compiled data of 19,712 patients from a period of 6 years (2004-2009) who came to the asthma clinic. The percentages of asthma outdoor visits per month were calculated and compared over the 6 year period. Pearson correlation was used to analyze the relation between the number of outdoor visits, and the Mean Monthly Temperature and Mean Monthly Humidity.

Results: Out of the total 19,712 visits, 55.9% were male patients and 44.1% were female patients. A 13-fold rise in the number of asthma visits was seen in 2009 as compared to 2004. The highest number of asthma visits was in September through December (winters). The temperature in these months was low and the humidity high. The number of visits was at their lowest in May (summer) when the temperature was high and the humidity low. This pattern was not affected by age group or gender. A negative correlation was seen between the number of outdoor visits of asthma patients and the Mean Monthly Temperature (-0.03), and a positive correlation (0.15) was seen between the number of outdoor visits of asthma patients and the Mean Monthly Humidity, but overall it was not significant (p=0.83 and p=0.21 respectively).

Conclusions: The number of asthmatics is on the rise in Pakistan. A negative correlation was seen between the number of outdoor visits and the Mean Monthly Temperature, and a positive correlation was seen between the number of outdoor visits of asthma patients and the Mean Monthly Humidity.

Key words: Asthma, outdoor visits, variables

INTRODUCTION

Asthma is a common, chronic condition of varying severity linked to constitutional and environmental factors affecting a wide range of age groups and both sexes[1,2,3]. There have been numerous advances in the diagnosis and treatment of asthma[4], yet many of the potential factors that cause and exacerbate it have not been clearly delineated. The constitutional factors such as age, sex, family history and the presence of an atopic disposition are inherent to the individual and as such cannot be modified by intervention. The role of modifiable and/or avoidable environmental factors such as viral infections, air pollutants, specific allergens (pollen, moulds spores, dust mites), and seasonal variability have been studied in researches in order to establish an association[5,6]. Studies have recognized the seasonal patterns in asthma related outdoor visits and hospital admissions, and they have indicated an increase in such patients in winter months[5,6,7,8,9].

K E Medical University/ Mayo Hospital, Lahore, Pakistan
Correspondence to Dr. Syed Haider Hasan Alam
Email: haider235@hotmail.com

The study by Khot et al reported a decrease in admissions in August followed by a peak in Autumn[10], and the study by Pendergraft et al showed an increase in asthma-related hospitalizations in winter months and a nadir in summer months[11]. The number of asthma sufferers has been on the rise as well[12]. According to the World Health Organization (WHO) report, the prevalence of US children with asthma was 3.6% in 1980 and it increased to 9% on 2001[13]. The exploration of the seasonal factors seems prudent since Pakistan is a developing country, and an increase in asthma cases create a economical burden. A delineation of the seasonal factors is done in this study to help inform the policy makers about the possible affects on climate change on occurrence of asthma cases, as this will help to create specific strategies to decrease the harmful effects of such changes, and also help the policy makers establish adaptive measures. This will also help to set up effective surveillance and public health training programs to reduce the impact of seasonal changes on asthma.

The objectives are 1) to quantify the monthly outdoor visits of asthma in a Tertiary care centre in Lahore over a period of 6 years (2004-09), 2) to correlate the number of visits with variations in temperature and humidity, 3) to find out the demographic variables (age and sex) of the asthma patients.

METHODS

A retrospective study was designed with electronically retrieved data, obtained from the asthma clinic of Children Hospital Lahore, a Government-funded tertiary care center located in the city downtown. This is the largest hospital for the pediatric population in the whole province of Punjab. The data included 19,712 patients from a period of 6 years (2004-2009) with a principal diagnosis of asthma. The patients were under 12 years of age. Every case receiving a diagnosis of asthma at the clinic was considered as a unique episode while the data was compiled by he hospital authorities. The meteorological data was obtained from Pakistan Meteorological Department Government of Pakistan. The data was entered into SPSS 20. The information collected regarding the monthly number of outdoor visits was separated into two age groups (below 5, and from to 12) and into both genders (male, female). The mean number and percentage of outdoor visits in every month across the six year period was calculated. The correlation was calculated for the number of outdoor patients and the mean monthly temperature and the mean monthly humidity, using Pearson correlation. The p value of <0.05 was considered significant. The only available information to the researchers in this retrospective study was the total number of patient visits in a specific month, and their age group and gender. The data was collected from the hospital's pooled electronic database which did not have the names of the patients or any of their personal information such as their private addresses. Therefore, in such a case consent was not necessary. This study has been approved by the Institutional Review Board of both King Edward Medical University and Children Hospital Lahore. The IRBs waived the need for consent under the guideline: "...individual consent requirement does not arise when the materials used in the research are not personally identifiable (meaning that, by definition, the individuals concerned would be unknown to the researcher and hence could not be contacted to obtain consent)" [page 21-22 of the 'International Ethical Guidelines for Epidemiological Studies' by Council for International Organizations of Medical Sciences CIMOS/ WHO, Geneva, Feb 2008].

RESULTS

During the 6 year period (2004-09) a total of 19,712 patients visited the asthma clinic of Children Hospital. The number of males were 11031 (55.9%) and the number of females were 8681 (44.1%) . The number of patients in the age group less than 5 years was 7620 (38.7%) and the number of patients from 5 to 12 years was 12092 (61.3%). The total number of patients that visited in the year 2004 were 175, and in the year 2009 the number was 2332; this represents a 13-fold increase. The highest number of visits in the 6 years occurred in the period September-December (10.46-11.68 %). The declining rates for the total number of patients seen in the clinic begin in January (6.08%), and remain low till July (6.08-6.59%), being at their lowest number in May (5.92%). These trends are the same if seen separately for both males and females. Both age groups below 5 years and from 5-12 years also follow these trends.

Tables 1-3 show the correlation coefficients between the frequency of outdoor visits, and the MMT and MMH. In children less than 5 years of age there was a general trend of negative correlation between the number of outdoor visit and MMT (-0.01 for 2004-09) but it was not statistically significant (0.93). In children less than 5 years of age there was a general trend of positive correlation between the number of outdoor visit and MMH (0.16 for 2004-09) but it was not statistically significant (0.17). But a negative correlation (-0.59) was found between the number of visits and MMH in the year 2005 (p value 0.04). In children more than 5 years of age there was a general trend of negative correlation between the number of outdoor visit and MMT (-0.05 for 2004-09) but it was not statistically significant (0.65). In children more than 5 years of age there was a general trend of positive correlation between the number of outdoor visit and MMH (0.12 for 2004-09) but it was not statistically significant (0.31). But a negative correlation (-0.58) was found between the number of visits and MMH in the year 2005 (p value 0.04). In all the children (both less than 5 years and 5-12 years) there was a general trend of negative correlation between the number of outdoor visit and MMT (-0.03 for 2004-09) but it was not statistically significant (0.83). In all the children (both less than 5 years and 5-12 years) there was a general trend of positive correlation between the number of outdoor visit and MMH (0.15 for 2004-09) but it was not statistically significant (0.21). But a negative correlation (-0.59) was found between the number of visits and MMH in the year 2005 (p value 0.04)

Table 1: The correlation coefficients between the frequency of outdoor visits and the MMT and MMH for the age group 5-12 years. CI= Correlation Coefficient, P= p value.

Year	MMT						MMH					
	Males >5		Females > 5		Total >5		Males > 5		Females> 5		Total > 5	
	CI	P	CI	P	CI	P	CI	P	CI	P	CI	P
2004	0.16	0.62	0.36	0.25	0.28	0.38	-0.41	0.19	-0.52	0.08	-0.52	0.09
2005	0.11	0.72	0.37	0.24	0.25	0.43	-0.49	0.10	-0.63	**0.03**	-0.58	**0.04**
2006	0.29	0.36	-0.04	0.91	-0.11	0.59	0.19	0.56	0.16	0.62	0.18	0.56
2007	0.32	0.30	0.31	0.33	0.37	0.23	-0.06	0.85	-0.09	0.78	-0.09	0.78
2008	-0.22	0.48	-0.18	0.58	-0.22	0.48	0.55	**0.06**	0.47	0.12	0.56	**0.05**
2009	-0.29	0.35	-0.44	0.15	-0.39	0.21	0.48	0.11	0.42	0.17	0.49	0.10
2004-09	-0.07	0.55	-0.03	0.81	-0.05	0.64	0.14	0.22	0.08	0.51	0.12	0.31

Table 2. The correlation coefficients between the frequency of outdoor visits, and the MMT and MMH for the age group less than 5 years. CI= Correlation Coefficient, P= p value.

Year	MMT						MMH					
	Males < 5		Females < 5		Total < 5		Males <5		Females <5		Total < 5	
	CI	P	CI	P	CI	P	CI	P	CI	P	CI	P
2004	-0.24	0.46	-0.28	0.39	-0.28	0.38	0.25	0.42	0.24	0.45	0.28	0.38
2005	0.11	0.74	0.36	0.25	0.26	0.41	-0.46	0.14	-0.64	0.02	-0.59	**0.04**
2006	-0.14	0.65	-0.15	0.65	-0.18	0.57	0.55	**0.07**	0.49	0.10	0.67	0.02
2007	0.56	**0.06**	0.33	0.29	0.48	0.12	0.02	0.95	0.02	0.95	-0.05	0.87
2008	-0.04	0.90	0.03	0.93	-0.04	0.90	0.44	0.15	0.47	0.12	0.51	0.09
2009	-0.20	0.53	-0.26	0.41	0.24	0.44	0.39	0.21	0.29	0.35	0.38	0.23
2004-09	0.01	0.96	-0.01	0.96	-0.01	0.93	0.17	0.14	0.14	0.26	0.16	0.17

Table 3. The correlation coefficients between the frequency of outdoor visits, and the MMT and MMH for all the children (both age groups). CI= Correlation Coefficient, P= p value.

Year	MMT						MMH					
	Males		Females		Total		Males		Females		Total	
	CI	P	CI	P	CI	P	CI	P	CI	P	CI	P
2004	0.07	0.82	0.28	0.38	0.19	0.55	-0.30	0.34	-0.44	0.15	-0.44	0.16
2005	0.11	0.72	0.37	0.24	0.25	0.43	-0.49	0.11	-0.63	**0.03**	-0.58	**0.04**
2006	-0.26	0.42	-0.10	0.75	-0.20	0.54	0.44	0.15	0.36	0.25	0.44	0.15
2007	0.54	0.07	0.34	0.27	0.47	0.12	-0.02	0.95	-0.03	0.92	-0.03	0.93
2008	-0.14	0.66	-0.11	0.74	-0.14	0.67	0.54	0.07	0.50	0.09	0.56	**0.06**
2009	-0.25	0.42	-0.37	0.24	0.33	0.30	0.45	0.14	0.37	0.23	0.45	0.14
2004-09	-0.03	0.79	-0.02	0.88	-0.03	0.83	0.17	0.16	0.11	0.35	0.15	0.21

DISCUSSION

Our study has identified findings which will be discussed and compared to the findings of previous studies. A 13-fold rise has been seen in the patients diagnosed with asthma in 6 years (2004 to 2009). This rising trend has also been reported by Centers for Disease Control and Prevention[34], and it shows that the number of asthma sufferers was 20 million 2001 and 25 million in 2009. A seasonal variation in the number of patients with a peak seen in fall and winter and trough seen in summer months.

The frequency of patients diagnosed with asthma is high with high MMH and low MMT, and it is low with low MMH and high MMT, though overall this was not significant. The above trends are also observed in the same fashion for both sexes, and also for both the age groups (under 5, and from 5 to 12). A pattern of asthma admission with such a seasonal variation has also been observed and described in United States[11], England and Wales[8], Canada[5], New Zealand[9], Australia and Japan[15], and Costa Rica[14]. This pattern observed in our study may be due to the association of aeroallergens derived from mites and fungi with certain meteorological factors such as humidity[16]. The trends in frequency may also be due to variation in air pollutants with changes in climate[17], the reason of which can be the accumulation of such pollutants at ground level with certain climatic factors[18]. Rossi et al[19] has described an association between asthma exacerbations and the level of pollutant NO_2 in the air; further, this rise in NO_2 is correlated with the period of winters. Studies

have indicated higher frequencies of asthma in polluted than in non-polluted regions[20,21,22].. Rising SO_2 concentrations have been shown to exacerbate asthma symptoms[23,24]. Other reasons can be the seasonality of viral infections, increased proliferation of pathogens due to climate changes, and the ability of pathogens to increase resistance and mutations to combat low temperatures and increased humidity levels[25,26]. The level of air borne pollen also varies with the climate, and could also explain the results, but unfortunately such data is not available for Pakistan and further explanation of variation with pollen can not be attempted. However, in Austria, the symptoms of asthma in children have been shown to increase with the amount of pollen in the air[28]. Climate changes also affect the airway inflammatory response to irritants and allergens[29,30,31]. This study observed the association between asthma and seasonality over a period of 6 years; however more conclusive results including the significance of association may be drawn if the time period of the study is extended, possibly to 2 decades. There is also limit to the data on the socioeconomic status, history of any concurrent or recent viral illnesses, and a past history of any atopic conditions, and the availability of such data and the study of such associations would have been valuable. In Pakistan, a few people especially from the lower socioeconomic group tend to get their children treated at homeopathic and herbal health centers and places that are not endorsed or supported by the medical health care community. This would have affected the number of patients showing up at the asthma clinic. Data should be collected and studied with climate variables from multiple smaller geographical regions like the study done by Crystal-Peters et al[32]; this however poses difficulty due to lack of data in rural areas and in many of the urban areas in Pakistan too.

The manifold increase in asthma over the past 20 years[33] makes it crucial to identify the climatic factors that affect the symptoms of asthma and its exacerbation. An accurate delineation of such factors will be useful in alerting asthmatic individual of periods of high risk and may also help in modification of the drug therapy. Such a clairvoyance in predicting the onset of symptoms can help in adjusting the doses and thus decrease the symptoms, thereby reducing patient morbidity and economic burden.

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