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Impact of weather conditions on childhood admission for wheezy chest and bronchial asthma

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Abstract

Background: Climate change represents a possible threat to patients with bronchial asthma. The purpose of this study was to investigate any association between specific meteorological conditions and the rate of hospital admission for bronchial asthma and wheezy chest.

Methods: A retrospective study was conducted to observe the effects of changes in some meteorological variables on children aged 1-13 years with bronchial asthma and wheezy chest. Data were obtained from hospital registries for the study period involving all patients admitted with the diagnosis of wheezy chest and bronchial asthma. The meteorological data were obtained from the Iraqi World Meteorological Organization and Seismology and consisted of the mean monthly values of humidity, rain, temperature, dust, wind, and thunderstorms. The correlation between the mean monthly admission for bronchial asthma and changes in weather variables were investigated.

Results: There were 1043 admissions for asthma or wheezy chest (7.76%). Out of all asthma cases, 75% (n=783) were 1-5 years, while 25% (n=260) were 6-13 years. Male patients predominate 67.8%, with a male to female ratio of 2:1. Hospital admissions for asthma and wheezy chest showed a seasonal variation especially for younger children. Higher monthly admission rates were associated with high relative humidity, rain, increase in wind speed, and lower temperature, whereas rising dust and thunderstorms did not show notable effects on children's admission for asthma.

Conclusion: The findings suggested that changes in weather conditions, especially high relative humidity and cold weather, may trigger asthma attacks especially in younger children, and thus protective measures are recommended for at risk children.

Keywords: Childhood asthma, Climate change, Wheezy chest

Conflicts of Interest: *None declared*
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Introduction

Bronchial asthma is a disease syndrome with a global increase in prevalence (1), affecting an estimated 4% to 7% of the people worldwide. Childhood bronchial asthma varies widely from country to country. At the age of 6 to 7 years, the prevalence ranges from 4% to 32% (2, 3).

Apart from being the leading cause of hospitalization for children, bronchial asthma is one of the most important chronic conditions causing elementary school absenteeism (2, 4, 5). Asthma is a chronic disorder of the bronchial tree, characterized by completely or partially reversible airway obstruction, which may improve spontaneously or may subside only after specific therapy (6, 7).

Bronchial obstruction is a result of bronchial muscle constriction, acting through the β-receptors, as well as

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↑What is "already known" in this topic:
Climate change represents a possible threat to patients with bronchial asthma. Literature reports show the relationship between the development and exacerbation of asthma attacks and the meteorological observations. However, no previous study was done in Basra to show this relationship.

→What this article adds:
This study showed that changes in weather conditions, especially high relative humidity, rain, and cold weather, can trigger or worsen asthma attacks, especially in younger children. Thus, applying protective measures required.

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mucosal edema and increased airways secretions resulting from airways inflammation, all of which contribute to reducing airway flow. The obstruction to airway flow is reflected in reduced lung function and classical symptoms such as wheezing, dyspnea, and coughing (8). Asthma not only does harm to children's physical and mental health but also results in a heavy burden to patients' family and society (9, 10).

The risks of developing asthma depend on a complex interaction of hereditary and environmental factors. Risk factors are as follow: genetic predisposition (family history of atopy or asthma); perinatal factors (low birth weight, prematurity); exposure to allergens; infections (respiratory infections, especially those caused by respiratory syncytial virus); environmental air pollution; tobacco smoke; diet; and obesity (11, 12).

The association between asthma morbidity and meteorological conditions is well documented (13). There is clear evidence that the climate is changing at an increasing rate. Global average temperature has increased by more than 0.7 Co over the past 100 years. Extreme weather events, such as heat waves, heavy precipitation, and thunderstorms, are also predicted to increase over the next few decades (14).

Many literature reports show the relationship between the development and exacerbation of asthma attacks and the meteorological observation (14-16). However, it is not clear to what extent more specific meteorological variables are implicated in triggering asthma exacerbation (13).

There is evidence that changes in temperature, barometric pressure, rising dust, and relative humidity have some influence on the worsening of asthmatic symptoms (13), as triggers for deterioration and admission to hospital. Therefore, the objective of this study was to investigate any association between specific meteorological conditions and the rate of hospital admission for bronchial asthma and wheezy chest.

Methods

This retrospective study was conducted to observe the effects of changes in some meteorological variables on children with bronchial asthma and wheezy chest.

Patients: All children aged 1-13 years who were admitted to the pediatric ward of Almawani hospital in Basra who were diagnosed with asthma and had a history of recurrent attacks of breathlessness and wheezing, and young children with recurrent wheeze were selected during January 2014 to December 2016. The participants were classified into 2 groups according to their age: 1-5 and 6-13 years. Infants and patients with acute bronchiolitis were excluded from the study.

Data collection: Patients' data were obtained from hospital registries of Al Mawani hospital for the study period which included age, sex, date of admission, and diagnosis. The meteorological data were obtained from the records of the Iraqi World Meteorological Organization and Seismology and consisted of mean monthly values of meteorological variables, including mean temperature (T), relative humidity (RH), rising dust, wind, rain, and thunderstorm.

Results

The total number of pediatric admissions during the study period was 13 425, out of them 1043 admissions were for asthma or wheezy chest (7.76%). Also, 75% (n=783) of the participants were 1-5 years old, while 25% (n=260) were 6-13 years old. Of the patients, 67.8% (n=708) were male, with male to female ratio of 2:1. Mean monthly values of childhood hospital admission for asthma and wheezy chest and mean monthly values of the meteorological variables for each year of the study period were studied. Admissions varied. The variation of the mean monthly hospital admission rates for the 3 age groups is shown in Figure 1.

Variations of monthly hospital admission rates for the 3 age groups and the association with the variation in the mean relative humidity mean temperature, rain, and wind speed are shown in Figures 2, 3, 4, and 5.

A descriptive summary of the mean monthly values of admission and meteorological variables is presented in Table 1. The results of Pearson's correlation between the mean monthly admission for asthma or wheezy chest for each age group and the meteorological variables are demonstrated in Table 2.

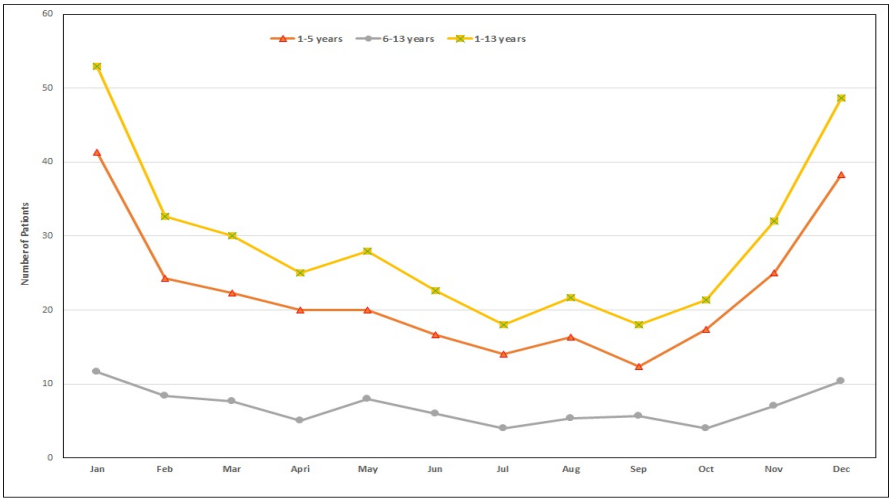

Fig. 1. Seasonal variation of mean monthly values of hospital admission for asthma of the 3 age groups

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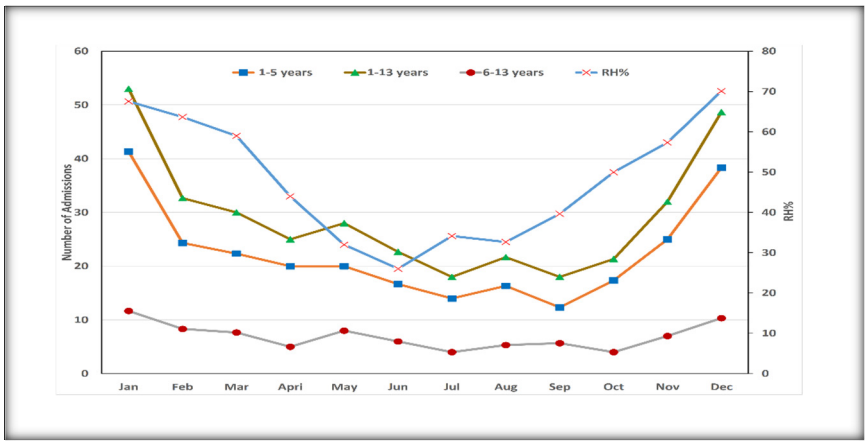

Fig. 2. Mean monthly admission rates of the 3 age groups and mean monthly relative humidity

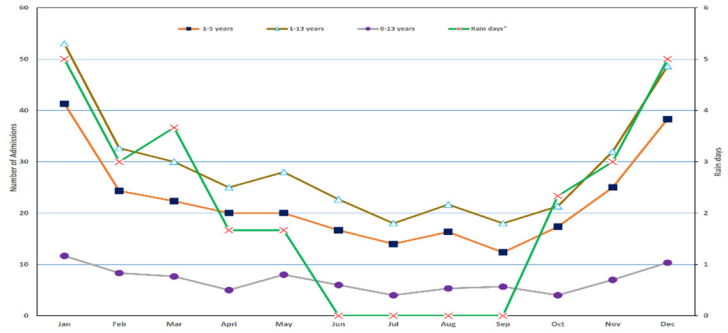

Fig. 3. Mean monthly admission rates of the 3 age groups and mean monthly rainy days

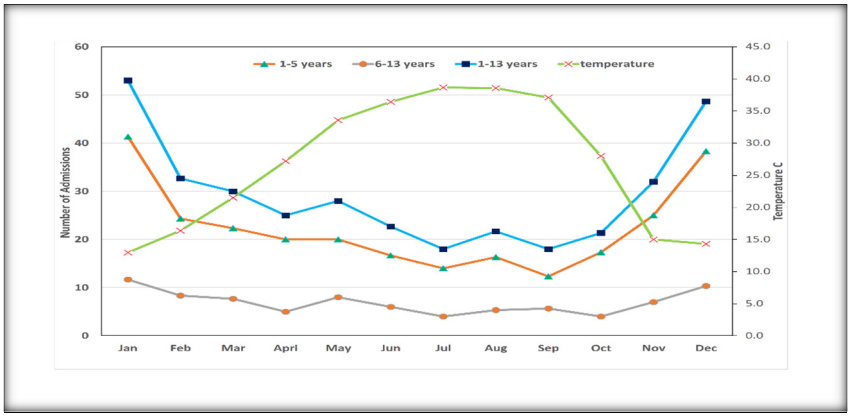

Fig. 4. Mean monthly admission rates of the 3 age groups and mean monthly temperature

Discussion

Based on the results of this study, hospital admissions for childhood asthma and wheezy chest showed a seasonal variation, with late autumn and early winter peak. This variation was more evident in children aged 1-5 years than older children (Fig. 1). Literature reviews have shown that seasonal variation has not been reported previously in childhood admission for asthma in Basra. In a study done in Athens, Greece, a notable pattern of seasonal variation of asthma admission, which was associated with weather conditions, was shown (13).

In the present study, the mean monthly rates of childhood admissions for bronchial asthma and wheezy chest was found to be associated with changes in certain weather variables.

The role of weather (pressure, temperature, and humidity) on the initiation and/or exacerbation of respiratory allergic symptoms in predisposed individuals is still poorly understood. Weather affects asthma directly by acting on the airways, or indirectly, by airborne allergens and pollutant levels (14).

In the present study, variation in the mean monthly ad-

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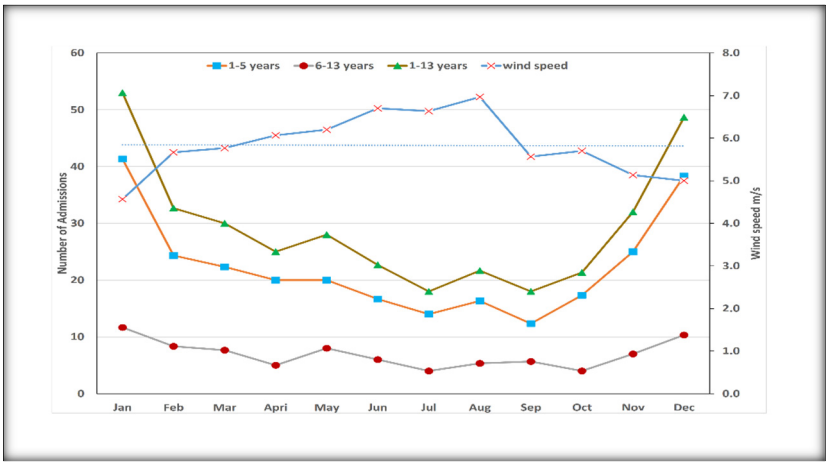

Fig. 5. Mean monthly admission rates of the 3 age groups and mean monthly wind speed

Table 1. Descriptive statistics

	Mean	Std. Deviation	N
Total Admission	29.33	11.316	12
Temperature	26.650	10.2196	12
Number of Rain Days	2.17	1.899	12
Wind Speed	5.842	0.7229	12
Relative Humidity	48.08	15.335	12

Table 2. Pearson's correlation coefficients between the mean monthly hospital admission rates for asthma and the meteorological variables by age group

Age		Temperature	RH	Rainy days	Wind Speed
1-13 years	Pearson Correlation	-0.837**	0.795**	0.890**	-0.763**
	Sig. (2-tailed)	0.001	0.002	0.000	0.004
1-5 years	Pearson Correlation	-0.847**	0.800**	0.894**	-0.770**
	Sig. (2-tailed)	0.001	0.002	0.000	0.003
6-13 years	Pearson Correlation	-0.729**	0.686*	0.811**	-0.717**
	Sig. (2-tailed)	0.007	0.014	0.001	0.009

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

mission rates for asthma and wheezy chest was found to be associated with the seasonal variation in relative humidity and rain, and more admissions were associated with high humidity and rainy days (Figs. 2 and 3).

Pearson's correlation between the mean monthly hospital admission rates for asthma and the meteorological variables showed that the mean monthly admission rates have a positive association with high humidity and more rainy days and were more significant in young age group (Table 2). In Greece, the results of a study showed that relative humidity was an implicated meteorological variable for younger asthmatic children (13). Also, a study in Turkey found that asthma, wheezing, and allergic rhinitis was associated with higher mean yearly outdoor humidity among school children (17).

Rain or humidity may induce hydration and fragmentation of pollen grains, which releases allergenic biological aerosols into the atmosphere (14). Fungal spore counts of Cladosporium in the atmosphere are correlated with relative humidity, and their concentration has been reported to account for a significant proportion of the asthma exacerbation in children (13, 18, 19).

The growth of house dust mites is strongly associated with relative humidity as mites thrive in humid environments (20).

In this study, it was also observed that low temperatures had effects on hospital admission for asthma. When the mean temperature was relatively low, the number of asthma hospital admissions was higher and had a peak in the cold months of the year (November, December, and January) (Fig. 4). The mean monthly admission rate for asthma was inversely correlated with the mean temperature, which is consistent with the finding of a study by D, Hervása et al. They observed that the mean temperature was inversely correlated with emergency department visits for asthma (21), and this was more noticeable in children younger than 5 years (Table 2) and contradictory to what was reported by Mohr et al. (22), who observed a positive association in summer and a negative association during winter time.

Several studies have emphasized the relationship between low temperatures or cooling and asthmatic attacks. Cold temperature is a major environmental factor that exacerbates chronic inflammatory airway diseases (eg, chronic obstructive pulmonary and asthma) (23, 24).

Cold temperature has often been followed by an increase in bacterial and viral infections of the airways, infiltration of inflammatory factors, and mucus secretion (23, 25, 26). Reduced temperatures often precedes the onset of infections (26), a finding that may explain, at least in part, the effects of the mean temperature on asthma (23).

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Other weather variables, including rising dust and thunderstorm, did not show notable effects on childhood admissions for asthma, possibly because data was on monthly basis; and thus, the short effect of some weather variables might have been lost. Therefore, conducting further studies to support the findings of this study is highly recommended.

Conclusion

The findings of this study suggest that high humidity, rain, wind, and cold temperature may trigger asthma attacks and that effective strategies are needed to protect at risk children.

Conflict of Interests

The authors declare that they have no competing interests.

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