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Oded Scheuerman ^{ab}; Joseph Meyerovitch ^{bc}; Nufar Marcus ^{ab}; Vered Hoffer ^{ab}; Erez Batt ^c; Ben-Zion Garty ^{ab}

^a Department of Pediatrics B and Kipper Institute of Allergy and Immunology, Schneider Children's Medical Center of Israel, Petah Tiqwa, Israel ^b Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel ^c

Research and Health Planning Department, General Health Services (Clalit), Tel Aviv, Israel

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ORIGINAL ARTICLE

The September Epidemic of Asthma in Israel

ODED SCHEUERMAN,^{1,3,*} JOSEPH MEYEROVITCH,^{2,3} NUFAR MARCUS,^{1,3} VERED HOFFER,^{1,3} EREZ BATT,²
AND BEN-ZION GARTY^{1,3}

¹Department of Pediatrics B and Kipper Institute of Allergy and Immunology, Schneider Children's Medical Center of Israel, Petah Tiqwa, Israel

²Research and Health Planning Department, General Health Services (Clalit), Tel Aviv, Israel

³Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

Background. The seasonality of asthma morbidity is well recognized. A peak in asthma exacerbations in September has been noted for years at our center. **Objective.** To examine the hypothesis that the increment in asthma exacerbations in September is influenced by the beginning of the kindergarten and school year. **Methods.** The monthly admission rate for asthma in patients of different ages was retrospectively evaluated in seven hospitals from various areas in Israel from January 2003 to December 2005. **Results.** Of the 408,242 hospital admissions during the study period, 8,011 were for asthma exacerbations: 4,091 in adults (1.3% of adult admissions) and 3,920 in children (3.8% of pediatric admissions). The asthma admission rates varied considerably throughout the year, with a peak of 4% of total admissions in the winter months and a nadir of 2% in the summer months. September was unique for its particularly high rate of admissions for asthma attacks in children (6% of total admissions), especially toddlers and the school-age group. In adults there was a progressive increase in asthma admissions from September through December without a unique peak in September. **Conclusions.** There is a characteristic increase in asthma exacerbations and admissions in September in the pediatric age group. This phenomenon might be explained by the increased exposure to respiratory viruses, to new allergen exposure in school or kindergarten, increased emotional stress due to start of the new school year, or poor compliance and withdrawal of treatment during the summer. Clinicians should consider administering prophylactic treatment for asthma in children before onset of the school year.

Keywords asthma, September, school, children, epidemics

INTRODUCTION

Asthma is a chronic inflammatory condition of the lung that results in episodic airflow obstruction. It is one of the most common chronic diseases worldwide (1, 2). The prevalence of asthma among children in the United States increased from 3.6% in 1980 to 5.8% in 2003, and it continues to rise in industrialized nations. Two-thirds of all asthma cases are diagnosed before the age of 18 years, and asthma is currently one of the leading causes of hospitalization of children and adolescents in the United States (2–5). Despite intensive research on epidemiology, pathophysiology, and treatment of asthma, asthma morbidity increases. Asthma continues to have a significant economic impact worldwide (4, 5), and its exacerbations place a heavy toll on health care systems (4).

Many factors, such as environmental allergens, viral respiratory infections, exercise, environmental pollutants, tobacco smoke, and emotional stress may contribute to asthma exacerbations (6–8). Several studies of asthmatic children reported the lowest frequency of hospital admissions in summer and the highest in autumn, especially in September, which was attributed to increased viral respiratory infections (3, 9). This seasonality in smaller proportions was documented in adults as well (3, 7, 9, 10). In a previous study by our group, conducted in 1993, regarding possible corre-

lation between emergency room visits of asthmatic children and air pollution, weather changes, and airborne allergens, we observed an exceptionally high incidence of emergency room visits and hospital admissions during September that could not be explained by these factors (7). We speculate that it was related to the beginning of the school year and caused by viral infections or emotional stress. The same pattern occurred in our hospital every year during 15 years (unpublished data) (except for one year). Since the study was conducted in a children's hospital in central Israel, we decided to expand the study also to general hospitals from different parts of the country. The aim of the present retrospective population-based study is to evaluate the seasonal variation in asthma exacerbations in children and adults in Israel.

METHODS

Data were obtained from seven hospitals in Israel serving about 1.5 million people, approximately one fourth of the national population. The hospitals are located throughout the country and belong to the General Health Services (Clalit), the largest of the country's four health maintenance organizations.

Admissions to the seven hospitals are recorded in the central database of the General Health Services. For the present study, we searched the database for all admissions of children and adults with a main diagnosis of asthma from January 2003 to December 2005. Children younger than 1 year were excluded because of the difficulty in differentiating wheezing bronchitis from asthma in this age group. The patients were

*Corresponding author: Oded Scheuerman, Schneider Children Medical Center, Pediatrics B, and Kipper Institute of Immunology, 14 Kaplan, Petah Tiqwa, 49202 Israel; E-mail: odedshv@clalit.org.il.

divided by age as follows: 1 to 2 years; 3 to 5 years; 6 to 14 years; 15 to 20 years, and adults. The prevalence of asthma in each group was determined and analyzed against the weekly and monthly hospital admission rate.

The study was approved by the Helsinki Committee of the Rabin and Schneider Medical Centers.

Statistical Analysis

Weekly and monthly admissions for asthma were calculated as the absolute number and the percentage of total admissions. All data were charted and calculated using Excel. The statistical significance of differences between groups was analyzed with Pearson chi-square tests.

RESULTS

Hospitalization Data

During the 3-year period of the study, there were 408,242 admissions to the seven hospitals. These included 104,046 (25%) pediatric admissions (0–18 years) and 304,196 adult admissions. A total of 8,011 admissions (2%) were for asthma attacks: 4,091 in adults (1.3% of adult admissions) and 3,920 in children (3.8% of pediatric admissions).

Seasonal Variation

The rate of admissions for asthma in children was higher than for adults throughout the year. The monthly asthma admission rate for children changed markedly throughout the year. Rates ranged around 4% in the winter months and 2.0% to 2.5% in the summer months (July through August). September had an exceptionally high rate of 6% for asthma admissions (Figure 1).

For the adult group, the mean monthly admission rate for asthma (as a percentage of total admissions) was 1.44% (range 0.94%–1.97%). There was a gradual increase in the winter months (November through January) and only mild increment during September (Figure 1).

The variations in the rates of admissions for asthma for the individual months against the mean monthly admissions are shown in Figure 2. From November through Jan-

uary, admissions for asthma increased significantly in both children and adults ($p < 0.001$). Thereafter, there was a progressive decrease in admissions every month until June–August ($p < 0.001$). In September, there was a sharp increase in admissions for asthma in children compared to average ($p < 0.001$), but in adults the admission rate in September, although mildly increased compared to previous months, was still below the annual average.

Analysis of the pediatric subgroups (Figure 3) showed that seasonal variation was pronounced, with a peak in autumn (September through November) and a trough in the summer months (July through August). Children 3 to 5 and 6 to 14 years of age showed a marked increase in asthma admissions in September, whereas in infants (1–2 years) and adolescents (15–20 years), this increase was more moderate.

DISCUSSION

Seasonal variations in asthma exacerbations have been recognized since the time of Hippocrates (400 B.C.) (11,12), who noted a higher frequency of occurrence in autumn (12). Maimonides, in the *Magala Fi Al-Rabu* (Treatise on Asthma), claimed that asthma was caused by a liquid flowing down from the brain, mainly in autumn (12). We published in 1998 that asthmatic children in our hospital have exceptional high rates of emergency room visits and admissions during September and that this could not be explained by air pollution, weather conditions, or allergies; we proposed that this is caused by viral infection and/or stress (7). Recent studies reported seasonal asthma exacerbations with a peak in September in many countries of the northern hemisphere, including Canada (13), the USA (14), the UK (15), Mexico (16), Finland (17), Malta (18), and Trinidad (19). Opposite seasonal cycles, with a peak during February, have been reported in the Southern Hemisphere, in Australia (20) and New Zealand (21).

The present study confirms the reported seasonal variability in asthma exacerbations in all age groups, with peaks in winter and troughs in summer. In September, however, there was an exceptional increase in hospital admissions for asthma

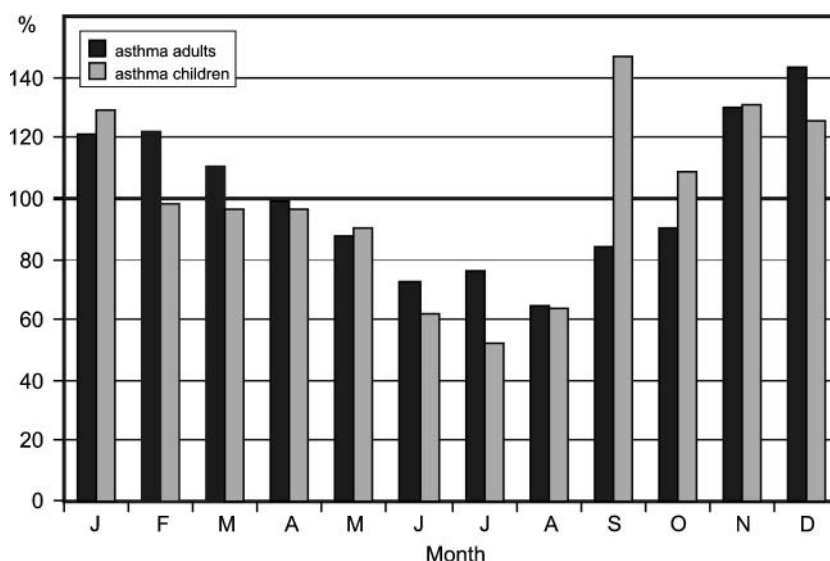


FIGURE 1.—Monthly asthma admission compared to average (100%).

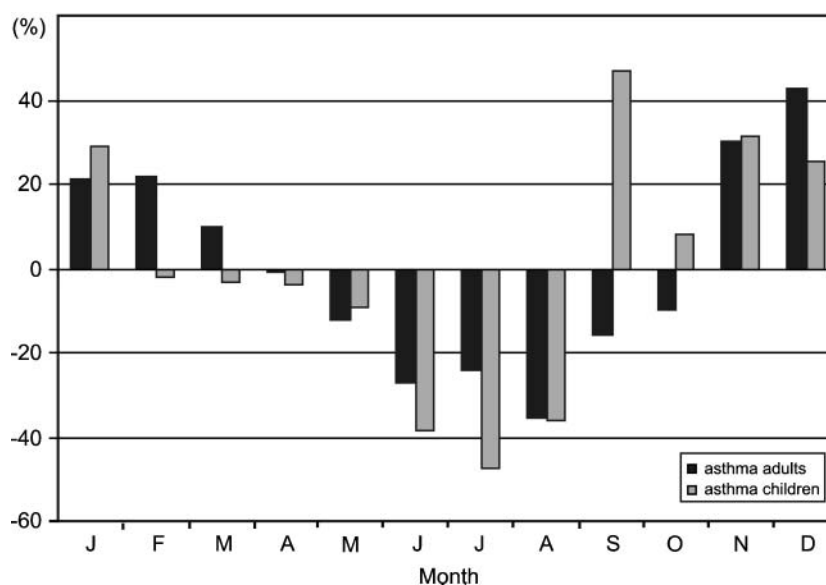


FIGURE 2.—Monthly changes in asthma admission compared to average (0%).

among children of kindergarten and school age (age 3–14 years). Similar results regarding the differences of asthma admissions of different age groups were reported in Canada, with highest rate of admissions at 6 to 7 years of age (22). Children 1 to 2 years of age, adolescents, and young adults (15–20 years) had a milder increase of asthma morbidity. Adults had also a mild increase in asthma admissions during September, but it was part of a continuous increment in admission rates from September through December, without a unique pattern in September, which may be due to transmission of viral infections from the school children to other family members.

Although previous studies have suggested that pollen allergy or aeroallergens may account for the seasonality of asthma exacerbations, the finding that the September peak is prominent in school-age children suggests that this phe-

nomenon is related to the start of the school year. Support for this may be found in studies from other countries. In Malta, where school begins in mid-October, studies have shown a sharp increase in asthma hospitalizations in October (18). In New Zealand, where school begins in mid-January, the peak in asthma attacks in children occurs in February (21).

The increased asthma morbidity associated with the onset of the school year may be linked to reports of infections with respiratory viruses, especially from the Picornaviridae family (>80% rhinovirus), in 60% to 80% of patients with asthma exacerbation in the UK and Canada (22–24). In a study from Canada, 62% of the asthmatic children who came to the emergency department with exacerbation had an identifiable respiratory virus infection, mostly rhinovirus (25). The peak periods of rhinovirus infection are distinct from those of influenza virus infection and occur in early autumn and, to

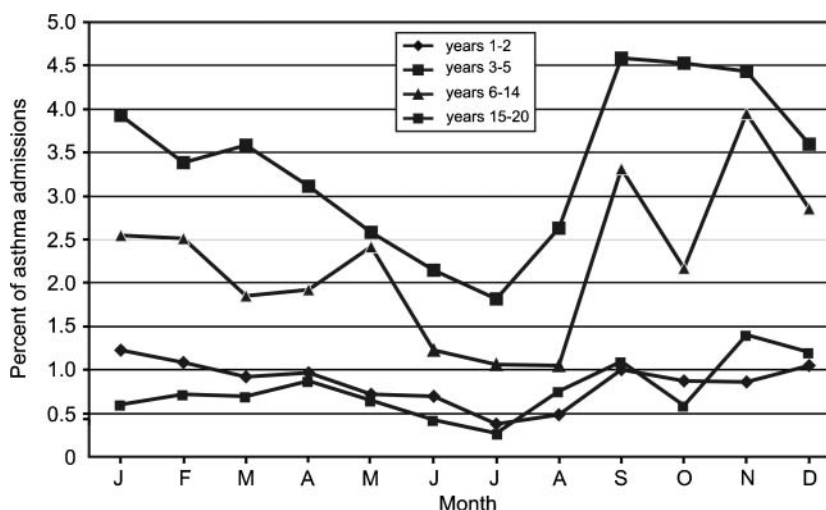


FIGURE 3.—Percent of asthma admissions out of total admissions.

a lesser extent, in spring. Rhinovirus infections have been reported to increase in September, a few days after beginning of the school year (26).

It was reported that the admission due to asthma exacerbation during September started at the third week of September (27). This was observed also in our study (data not shown), and might be due to a gradual spread of viral infections at school. Thus, the high rate of hospital admission for asthma after the summer vacation may be due to re-exposure to viruses, particularly rhinoviruses, on return to school.

Other potential contributors to asthma exacerbations at the start of school and kindergarten are emotional stress, exposure to allergens at school, and poor compliance to prophylactic asthma treatment during summer. Although stress is known to exacerbate asthma, there is no quantitative information on the specific influence of stress-associated asthma exacerbation with onset of the school year.

Prescription of asthma medications in children increases substantially during September. To calculate the prescription rate for asthma medications by primary care physicians we reviewed the central database of the "General Health Services" which serves approximately 60% of the population of Israel (data not shown). In adults (>18 years old), there was an increase of 9.7% in asthma medications prescriptions between August and September. During the same period, in children of ages 1–4 years and 5–14 years, the prescription of asthma medications increased by 63% and 60%, respectively. In October, there was further increment in adults, but in children the number of prescriptions in October declined. This increment of prescriptions for asthma in September, especially in children, further emphasizes the impact of September on asthma morbidity.

In summary, hospital admissions for asthma exacerbations in children in Israel peak in September. This was especially prominent at ages 3 to 14 years and less at the second year of life and in adolescents or adults. This might be due to the fact that many children in the second year of life do not go to kindergarten and the same is true for some adolescents and young adults regarding school attendance.

Prophylactic treatment for asthma starting at the end of August should be considered to avoid the September peak. Montelukast, a leukotriene receptor antagonist, has been shown to attenuate the September epidemic of asthma in children 2 to 14 years of age (27). This modest attenuation might be related to restarting prophylactic treatment, in general, and not to Montelukast specifically. Further prospective controlled studies are needed to determine prophylactic treatment efficacy. Other modalities of treatment, such as inhaled corticosteroids, might also be tried.

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