

Hospital Admission Trends for Pediatric Asthma: Results of a 10 Year Survey in Israel

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Key words: asthma, asthma morbidity, asthma mortality, asthma treatment, hospital admissions, re-admissions

Abstract

Background: In the last decade there has been an increase in asthma morbidity. Hospital admission rates for childhood asthma are influenced by the prevalence of asthma and the quality of asthma care.

Objectives: To assess trends in hospital admission and re-admission rates for childhood asthma in the Jezreel Valley in Israel in the last decade, and to evaluate the possible effect of changes in asthma treatment on hospitalization for acute asthma during this period.

Methods: All records of pediatric patients from the central hospital in the Jezreel Valley in northeastern Israel over a 10 year period from 1990 through 1999 who were diagnosed as having asthma were thoroughly reviewed and analyzed for admissions, re-admissions, and treatment before and during admissions

Results: There were 1584 admissions, 1208 were first-time admissions and 376 were re-admissions. The number of first-time admissions increased significantly over time ($P < 0.0001$), with a significant decrease in re-admissions ($P < 0.005$); this finding was more significant in children under the age of 8 years ($P < 0.005$). The length of hospital stay decreased significantly from 3.3 days to 2.7 days ($P < 0.002$). Significant changes in the use of medications included an increase in inhaled glucocorticoids and a decrease in the use of sodium cromoglycate and theophylline. Controller medication use was concomitant with a significant decrease in the re-admission rates.

Conclusions: The increase in the admission rate and the decrease in the rate of re-admissions and the length of hospital stay probably reflect the increase in the prevalence of asthma and changes in its treatment, respectively. It is essential that asthma be recognized as a significant cause of morbidity and that controller medications be administered to decrease its severity, morbidity, and resultant hospital admissions.

IMAJ 2005;7:785-789

Asthma is a common disease in childhood and appears in about 10% of the population. When inappropriately treated, the complications associated with asthma result in increased hospital admissions [1]. Similarly, an increase in prevalence and severity tends to increase hospital admissions, whereas better treatment results in fewer admissions and, particularly, a decrease in the re-admission rate.

In the last few decades hospital admission rates for asthma patients have increased in many countries [1-10], suggesting a worldwide trend. This reflects an increase in both the asthma rate [8] and its severity [2,11]. While some investigators suggest that this trend could reflect changes in healthcare ser-

vices [5,12], a change in how diseases are classified [13] and recurrent admissions [14], other reports do not support these arguments [15,16]. Interestingly, the admission rate for pediatric asthma has declined in the last decade [17-19], possibly due to the use of inhaled steroids [18]. Although the asthma rate increased [20], with a parallel increase in hospital admissions in children younger than 4 years, there was a decline in the re-admission rates and a decrease in the length of hospitalization [21].

The main objective of this study was to investigate possible changes in hospital admission and re-admission rates for childhood asthma in northeastern Israel from 1990 to 1999, and to assess its relation to asthma management during this period.

Patients and Methods

HaEmek Medical Center is the main hospital in the Jezreel Valley and receives all acute admissions of children from this area in the northeastern region of Israel. No major changes in population size or type occurred in the area throughout the study period. We obtained the hospital discharge data for asthma in children up to 18 years old admitted from 1990 to 1999, and used the international classification of diseases (ICD-9). The patients' charts were reviewed in detail. More specifically, the medical records were examined according to age, gender, ethnic group, home address, admission date, days of hospitalization, and treatment prior to admission and while in the hospital, as well as the number of re-admissions. Re-admission was defined as two or more admissions for a patient within a year after a previous admission, and the annual re-admission rate was calculated by dividing the number of re-admissions by all admissions in the same calendar year, and is given as a percentage. Data were registered for each calendar year. The decision to admit or discharge a patient with acute asthma was based on the child's clinical evaluation.

Admission data were expressed in number and percentage. Years were compared individually to analyze possible trends, and in 2 and 5 year periods, i.e., 1990-1994, 1995-1999. Chi-square and Student's *t*-test were used when appropriate. Results with *P* values below 0.05 were considered significant.

Results

Altogether, 1208 children with 1584 admissions over the 10 year period were included in the study.

Table 1. Patient demographics

| | No. | Percent |
|------------------|-----|---------|
| Age (yrs) | | |
| 0–3 | 637 | 52.7 |
| 4–7 | 298 | 24.7 |
| 8–17 | 273 | 26.6 |
| Origin | | |
| Jews | 707 | 58.6 |
| Arabs | 500 | 41.1 |
| Residence | | |
| City/town | 546 | 44.7 |
| Village/farm | 527 | 43.6 |
| Kibbutz | 70 | 5.8 |
| Other | 71 | 5.9 |
| Gender | | |
| Male | 778 | 64.4 |
| Female | 430 | 35.6 |

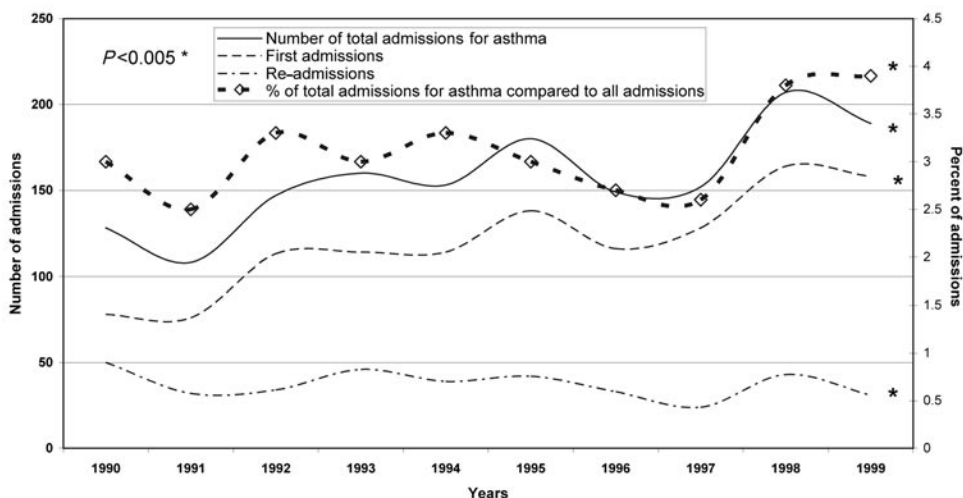


Figure 1. Number of first admissions for asthma, re-admissions for asthma, and total number of admissions for asthma, and percent of admissions for asthma compared to total number of admissions for all reasons.

Patient demographics

We first determined whether there was any relation between age, gender, ethnic origin, and place of residence regarding the number and rate of admissions. The asthmatic children were subdivided into three age groups: 0–3, 4–7, and 8–17 years. About half of the patients admitted for asthma were less than 3 years old [Table 1]. Fifty-eight percent of the patients were Jews and 41.4% were Arabs. About 45% lived in the city, 49% in agricultural communities (i.e., moshav, which comprises privately owned homes, and kibbutz, where all property is shared by all members), and 6% in other non-agricultural communities located outside the cities. More males than females were admitted for asthma treatment. There was no statistical correlation between ethnic origin, place of residence, and gender with regard to the number and rate of either first-time admissions or re-admissions, both for the whole period and between each of the periods.

Changes in the rate of admissions and re-admissions with time

During the last decade there has been an increase in the percentage of asthma admissions compared to the total number of childhood hospital admissions [Figure 1]. This increase occurred in parallel with an increase in the total number and rate of first admissions for asthma, along with a significant decrease in the number and rate of re-admissions. The number of asthma re-admissions decreased significantly between 1990 and 1999 (16.4% compared to 39.1%, $P < 0.005$). There was a 10.8% decrease in re-admissions between the first half of the decade compared to the second half (1990–1994 and 1995–1999, respectively, 19.7% vs. 28.9%, $P = 0.0001$).

Disease severity

The mean time in hospital for re-admissions was significantly longer than for first-time admissions (3.3 and 2.7 days, respectively, $P = 0.002$), reflecting increased disease severity. Eight children, 0.7% of all admissions, were admitted to the pediatric

intensive care unit, of whom five were first-time asthma hospital admissions and three were re-admissions. The number of re-admissions, compared to the total number of asthma admissions in the unit, was higher than for first-time admissions, 37.5% vs. 20.7%, respectively. Taken together, these data show that re-admissions reflect a risk factor and indicate more severe cases.

Seasonal effects

Forty percent (n=529) of the admissions were in the fall, of which 69.8% were first admissions and 30.2% re-admissions; 26.3% of the admissions were during winter, 24.0% in spring and 16.0% in summer. The seasonal difference between total, new, and recurrent admissions was highly significant ($P < 0.0001$).

Effect of age

The admission rate significantly increased with time in the younger children, who were 7 years old and less, compared to children aged 8–17, but there was a decrease in the re-admission rate in the younger group and a relative increase in the admission rate among older children [Figure 2]. In the children aged 0–3 years there were 52% new admissions and 48% re-admissions in 1990, and 82% and only 18%, respectively in 1999 ($P < 0.005$). In children aged 4–7 years there were 56% new admissions and 44% re-admissions in 1990, and 97% and 2/9%, respectively, in 1999 ($P < 0.005$). In the 8–17 year olds there were 86% new admissions and 14% re-admissions in 1990, and 77% and 23%, respectively in 1999 ($P = NS$). When comparing the first and second half of the decade there was a marked increase in first admissions and a significant decrease in re-admissions in the 0–7 year old children, which is even more pronounced in the 0–3 year old group, and there was an opposite, although not statistically significant, trend in the 8–17 year olds.

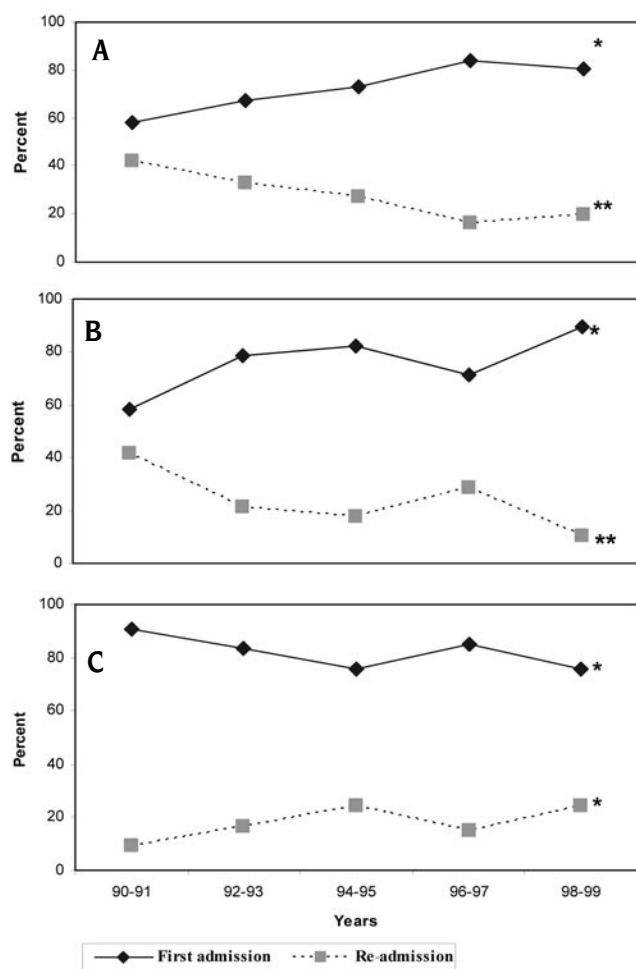


Figure 2. Admission trends in different age groups with time. [A] 0-3 years, [B] 4-7 years, [C] 8-17 years.

Effect of pre-hospital medical treatment on admission rate

Of 1208 children, 829 (69%) did not receive any preventive treatment before admission and 379 (31%) were prescribed medications and were admitted. Of the admitted patients, 26.6% were treated with one drug and only 5.2% received two drugs. The majority (68.6%) of the admitted patients constituted children who were not treated at all before admission ($P < 0.01$) [Figure 3]. As shown, there was no significant change in the ratio of new admissions compared to re-admissions between children who did not receive any treatment and those who were treated before admission. The admission rate was significantly lower in children treated with one drug, and much lower in those treated with two or more drugs, both for new admissions and re-admissions. The results show unequivocally that medical treatment markedly lowered the number of hospital admissions.

With time there have been changes in the medications for asthma. A comparison of the use of medications between the first and second half of the decade in the treated patients before admission showed a significant increase in the use of inhalant bronchodilators (38.5% vs. 65.5%, respectively, $P < 0.03$) and inhalant glucocorticoids (23.3% vs. 76.7%, respectively, $P < 0.0001$), and a significant decrease in the use of theophylline

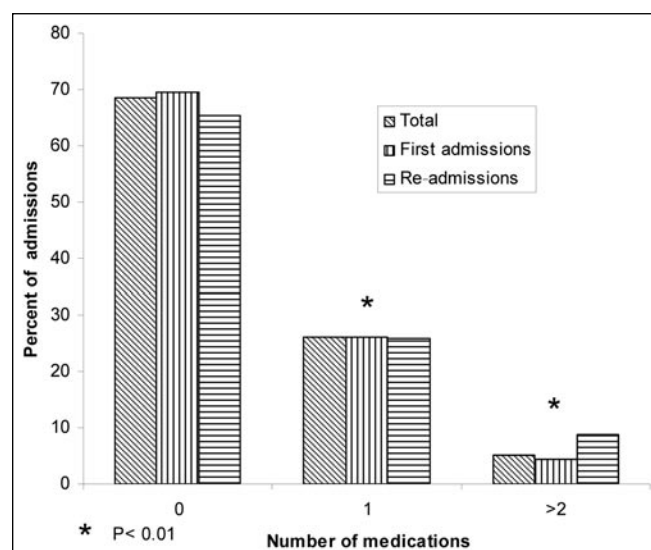


Figure 3. Percent of admissions in relation to medication use before admission.

(92.5% vs. 5.0%, respectively, $P < 0.0001$), sodium cromoglycate (74.4% vs. 7.6%, respectively, $P < 0.0001$), and ketotifen (94.7% vs. 5.3%, respectively, $P < 0.0001$).

Effect of treatment on re-admission rate

Administering appropriate medical treatment is important not only for controlling persistent symptoms of asthma exacerbation, but also for controlling and preventing future outbreaks of the disease. Anti-inflammatory and preventive medical treatment, which was initiated during the first admission, significantly reduced the rate of re-admissions. This was confirmed indirectly by examination of the extent of controlling medical treatment that was given during the previous admission period of the re-admitted patients (75% vs. 25%, respectively, $P < 0.0001$).

Discussion

This study examined trends and changes in admissions for childhood asthma in the Jezreel Valley in northeastern Israel, as reflected by admissions to HaEmek Medical Center, which is the major hospital for admission in the area. The results show a definite increase in the number of admissions for asthma during the last decade, with a relative increase in asthma admissions compared to other conditions [Figure 1]. This increase was mainly the result of admissions of children aged 0-3 years [Figure 2A]. The major finding was a continuous increase with time in the number of first admissions accompanied by a decrease in the number of re-admissions. Use of medications before and during admissions [Figure 3] lowered the number of first and recurrent admissions.

The increased rate of asthma, especially in infancy, is in agreement with previous reports [21,22]. Note that in this study we used strict and very specific criteria for correctly diagnosing asthma. More specifically, we not only reexamined the diagnosis upon discharge (ICD-9), we also systematically and thoroughly

examined each patient's chart. It is possible that some cases diagnosed as bronchiolitis or pneumonia in infancy (age 0–3 years), which actually may reflect asthma, were not included, thereby strengthening our finding of an increased trend for childhood asthma. The thorough and careful examination of the charts by physicians who were not involved in the patients' treatment further confirms the results of this study compared to other studies.

Demographically, there were no significant differences with regard to ethnic origin or place of residence [Table 1]. This finding suggests that the exposure to allergens and respiratory pathogens is similar. On the other hand, this could indicate that the quality of medical treatment received is similar in the different subpopulations. The fact that more males were hospitalized than females reflects the greater frequency of asthma in males compared to females and is in full agreement with previous reports [6,16].

Our findings did not reveal any deaths from childhood asthma in our area in the last decade. Although it is not possible to completely rule out the deaths of patients who were not admitted, this scenario is highly unlikely and we are not aware of such cases. Asthma mortality decreased during the last decade probably because of early and better treatment modalities [3,10]. Compared to the total number of first and recurrent admissions, the number of children with recurrent admissions to the pediatric intensive care unit is higher than those admitted for the first time, thus strengthening the assumption that recurrent admissions and admissions to the unit are risk factors for more severe asthma.

Asthma exacerbations are often season-dependent. Seasonal variations in this study showed more admissions during winter and significantly less in summer, in agreement with other reports [9]. These variations most likely reflect an increased rate of exacerbations, together with exposure to allergens and respiratory tract infections, which are less prevalent in the summer. The fact that the variation was less significant for recurrent admissions reflects the more persistent severe and uncontrolled asthma in these patients.

The main purpose of this study was to examine changes in the admission rate with time and especially the ratio between first-time and recurrent admissions. The increase in the admission rate in the last decade [Figures 1 and 2], especially during the second half of the decade compared to the first, concurs with other studies [2,14,19]. The increase was found in children younger than 7 but not in the older group (8–17 years). The significant increase in admission rate of infants and young children 0–3 years old is also in agreement with previous results [14,21]. Since only those with severe and life-threatening asthma were admitted, it is reasonable to assume that the increase in the admission rate in young children reflects a significant and parallel increase in the prevalence of asthma [20,23]. Regarding the lack of an increase and even a decrease in the admissions of older children, there can be at least three explanations: First, the airway narrowing is anatomically more significant when the airway caliber is smaller, a phenomenon that decreases with

age. Second, the course of treating asthma is such, that in some children there is a significant recovery and even complete clinical recovery with age. Third, the use of controller medications can prevent admission, as seen in this study.

The re-admission rate decreased throughout the years, especially in infants [Figure 2]. This decrease can be explained at least partially by two main factors: First, the use of controller medications, which was also reported by others [18]. During the last decade there was increased use of inhalant glucocorticoids to the lungs. Second, awareness of asthma has increased, with much more stress on patient education. Among the important developments of the last decade was the introduction of clinical guidelines for the treatment of asthma. These were initially introduced in 1992 by the U.S. National Heart, Lung and Blood Institute, National Institutes of Health, and later in collaboration with the World Health Organization [17,24]. These guidelines were adopted by the Israel Medical Association in 2000. The re-admission rate in the older group of children, 8–17 years, did not decrease and even increased slightly but not in a statistically significant manner. This reflects the group of more severe asthmatics, which is also supported by our finding that the much longer re-admission time was significantly longer, either due to disease severity or to treatment failure. The re-admissions in this age group account for 5% of all admissions for asthma.

There were no differences in the admission rates between males and females, Jews and Arabs, and between inner city and rural inhabitants. The lack of such differences strengthens the notion that the course of asthma is similar among different populations [16]. The decrease in the length of admission with time could be the result of improved treatment and/or because the admitted patients were referred earlier due to increased awareness of asthma.

In this study we also examined the connection between the use of medication before and during admission with regard to the rate of first and recurrent admissions. The percentage of admissions was significantly lower in children treated with a single controller medication compared to those not treated at all, and even lower in those treated with two or more medications, regarding both primary and recurrent admissions [Figure 3]. These results show at least indirectly that preventive medical treatment significantly decreased the number of admissions. The low percentage of children who were treated with multiple drugs and admitted represents the more difficult and severe asthmatics or those who did not take their medications correctly. The low percentage of these patients among the admitted patients reveals that most admitted asthmatics were not severe asthmatics who did not respond to treatment, but rather, patients who did not take any medications and were incorrectly considered by themselves, their families, or their physicians as patients with a mild disease. Taken together, these results clearly and unequivocally show that preventive medical treatment decreased the number of admissions.

The connection between specific drugs and admissions is of particular interest. The most striking result is the threefold in-

crease in the use of inhalant steroids and a significant decrease in the use of theophylline, ketotifen, and sodium cromoglycate. The decrease in re-admissions parallels the increase in the use of inhalant steroids and agrees with other reports [18]. The results support the notion that the use of inhalant steroids decreased the rate of admissions. Therefore, the use of inhalant steroids is of major importance as a preventive measure and in preventing re-admissions.

In conclusion, there was a significant increase in admissions for childhood asthma, especially in infancy, with a decrease in the re-admissions rate. These results reflect an increase in the prevalence of asthma, and a decrease in re-admissions with the use of preventive controller medications. The results should support the acknowledgment of asthma as a significant cause of morbidity in our region, and should enhance the use of controller medications to reduce the disease's severity and the number of admissions.

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