The effect of asthma specialist intervention on asthma control among adults

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ABSTRACT

Background: Various ways to improve asthma control have been studied, with only a modest effect.

Purpose: To evaluate the effect of asthma specialist visit on asthma control among adult asthma patients.

Patients and methods: This matched cohort study included patients ages 21–50 with asthma and at least 1 visit to an asthma specialist. Patients were compared to adult asthma patients treated only by primary care physicians. The study outcomes, included use of asthma medication, healthcare visits, and mortality. All outcomes were compared one year before and after specialist visit.

Results: 4166 pairs were included in the study. In the study group, a statistically significant decrease in the average number of relievers (1.5 ± 3.2 vs. 1.17 ± 2.9, \(p < 0.001\)) and systemic steroids purchased (0.53 ± 1.2 vs. 0.4 ± 1.2, \(p < 0.001\)), with an increase in average number of inhaled steroid purchased (1.6 ± 2.5 vs. 2.3 ± 3.3, \(p < 0.001\)) was seen over time. A significant decrease in the average number of PCP visits (9.5 ± 7.2 vs. 8.9 ± 7.3, \(p < 0.001\)), emergency department (ED) visits (0.46 ± 1 vs. 0.4 ± 0.9, \(p = 0.05\)) and all-cause hospitalization (0.03 ± 0.22 vs. 0.01 ± 1.9, \(p < 0.001\)) was seen in the study group but not in controls. Generalized linear modeling demonstrated an overall significant effect of specialist intervention for all parameters (\(p < 0.01\)), except ED visits (\(p = 0.06\)). During follow-up, eight (0.2\%) study group patients vs. 19 (0.5\%) controls died (\(p = 0.03\)).

Conclusion: We found that asthma specialist intervention significantly improved asthma outcomes in adults. Referring adult asthma patients to an asthma specialist should be a goal of asthma management plans.

Trial registration: Not relevant.

Keywords: Asthma, Specialist, Treatment, Outcome, Allergist
INTRODUCTION

Asthma is a chronic respiratory disease estimated to affect 0.2–21% of adults worldwide. It is mostly incurable, and the aim of treatment is to minimize exacerbations, improve quality of life and prevent lung function deterioration. The main treatment includes inhaled corticosteroids (CS) and bronchodilators. Severe asthma patients may require systemic CS and biological treatments to control their disease. Although most asthma patients have mild disease, as many as 50% have uncontrolled disease. This is usually accompanied by need for systemic CS, frequent visits to primary care physicians (PCP), emergency department (ED) visits, hospitalization and even death. Substantially reduced quality of life and high direct and indirect healthcare costs are also part of the spectrum of uncontrolled asthma.

The goal of good asthma management is to achieve disease control with minimal impact on quality of life and minor side-effects from medication. Various ways to improve asthma control have been studied, including inhaler use instruction, home peak flow measurements, telephone healthcare supervision, and improved access to healthcare providers. All interventions, so far, have had only modest effects on asthma control parameters.

Asthma guidelines include evaluation by an asthma specialist as one of the measures to achieve asthma control. This intervention is essential in order to define all comorbidities prone to make asthma control difficult. Amongst them esophageal reflux, chronic sinusitis, and allergic rhinitis. Laboratory findings including eosinophilia and specific IgE are also best evaluated in the proper context by specialists. Although recommended by all professional associations, data demonstrate that most asthma patients are not referred to an asthma specialist, even when indicated according to national guidelines. Information regarding the effect of asthma specialist evaluation on asthma outcomes is scarce, with conflicting results and mostly focus on children.

The current study evaluated the effect of an asthma specialist’s intervention on asthma control in a large cohort of adult asthmatic patients.

METHODS

Study design and data source

This matched cohort study was conducted using the electronic medical records (EMR) of Clalit Health Services (CHS). CHS is the largest of the 4 Health Maintenance Organizations in Israel, serving nearly 5 million people. It is both an insurer and provider. CHS created a centralized electronic warehouse where primary care, specialist, hospital, pharmacy, and laboratory records, in addition to demographic and socioeconomic information are stored. For this study, data of CHS members living in the Sharon district of Israel were accessed. The data are comprehensive, as members receive most of their care within CHS. Data were extracted using the Clalit Research Data sharing platform powered by MDClone (https://www.mdclone.com).

Use of EMR data in this study was approved by the local Institutional Review Board. Informed consent was waived due to the retrospective nature of data collection.

Study population

CHS members ages 21 to 50, first diagnosed with asthma as adults, during the study period (2004–2019), who had at least 1 visit to an asthma specialist (allergist or pulmonologist), were included in the study. Patients were compared to newly diagnosed adult asthma patients treated only by PCP. We limited both samples to patients younger than 50 years of age to minimize the possibility of disease misclassification, confusing chronic respiratory pulmonary disease (COPD) with asthma. Excluded were patients with comorbidities that may cause shortness of breath (heart or lung conditions) or require treatment with systemic steroids (chronic kidney or autoimmune diseases). Matching was done by age, gender, and year of asthma diagnosis. Because our outcomes were medications and healthcare visits, we could not match by asthma severity. To overcome this potential bias, and to overcome the possibility of natural improvement in asthma outcomes over time, we did not compare the study and controls directly. Rather, we compared the average changes in all outcomes over the study period. Demographic data, including age, sex, body mass index (BMI), and ethnicity were included in the analysis.
The study outcomes included the following elements of asthma control:

1. Asthma medication usage, including systemic CS, inhaled CS (as single or combined inhalers) and short-acting beta agonists
2. Healthcare visits to PCP and emergency departments (ED)
3. Hospital admissions and all-cause mortality.

All outcomes were compared over time: 1 year before the index visit to the asthma specialist or index visit to the PCP and 1 year afterwards.

**Statistical analysis**

Descriptive statistics were used to characterize the study participants. Chi-square tests were employed to examine differences in demographic characteristics, between the study and control groups. Generalized linear modeling (GLM) repeated measures ANOVA (F-test) were used to test the hypotheses about the effects of the index visit to the asthma specialist on the outcome variables. Covariates included in the model were age, gender, ethnicity, and BMI. P-values less than 0.05 were considered statistically significant. All analyses were performed using IBM SPSS, version 26.0 (IBM Corp., Armonk, NY).

**RESULTS**

**Demographics**

A total of 12,480 patients were diagnosed with asthma for the first time, during the study period. Among them, 4,575 visited an asthma specialist. After matching, a total of 4,166 well-matched pairs were included in the study. Of them, 3,140 (75.7%) visited a pulmonologist and the rest an allergy specialist. On average, patients visited the asthma specialist 1.5 ± 1.8 times during study period. Most patients (2,601, 62.7%) had a single specialist visit (median-1, range 1–6). Epidemiologic and demographic data are summarized in Table 1. Sex distribution had a slight male predominance (51.6%). Ethnic distribution followed Israeli demographic patterns. There were significantly more Arab patients in the study group than in the control group (19.4% vs. 13.4%, respectively; p < 0.01). Morbid obesity (BMI > 35) was significantly more common in the study group (8.6% vs. 6.5%, p < 0.01).

**Inhalers and systemic corticosteroids**

Over time, a statistically significant decrease in the average number of purchases of relievers (1.5 ± 3.2 vs. 1.17 ± 2.9, p < 0.001) and systemic CS (0.53 ± 1.2 vs. 0.4 ± 1.2, p < 0.001) was demonstrated in the study group. The average number of inhaled CS purchased increased significantly in the study group (1.6 ± 2.5 vs. 2.3 ± 3.3, p < 0.001) over the study period (Table 2). A decrease in purchases of relievers and systemic steroids over time was noted in the controls, as well, with no change in the average number of inhaled steroid purchases (Table 2). Although purchase of relievers and systemic steroids decreased significantly in both groups over time, the mean decrease was greater in the

| Variable               | Study N = 4166 | Control N = 4166 | P-value |
|------------------------|----------------|------------------|---------|
| Male sex, N (%)        | 2148 (51.6)   | 2148 (51.6)      | NS      |
| Age, years, mean ± SD  | 33.7 ± 8.8     | 33.8 ± 8.8       | NS      |
| Ethnicity, N (%)       |                |                  |         |
| Jewish                 | 3357 (80.6)    | 3606 (86.6)      | <0.01   |
| Arab                   | 809 (19.4)     | 560 (13.4)       |         |
| Body mass index, N (%) |                |                  |         |
| <18                    | 151 (3.7)      | 161 (4)          | <0.01   |
| 18-24.9                | 1956 (47.6)    | 1909 (47.1)      |         |
| 25-29.9                | 1167 (28.4)    | 1210 (29.8)      |         |
| 30-34.9                | 484 (11.8)     | 512 (12.6)       |         |
| >35                    | 353 (8.6)      | 264 (6.5)        |         |

Table 1. Demographics of the study population
study group (0.33 vs. 0.15 for relievers and 0.11 vs. 0.04 for systemic CS). When these relations were tested using GLM, we detected an overall independent significant effect of specialist intervention (p < 0.01, for all parameters) (Table 2, Fig. 1).

Healthcare visits and mortality

A significant decrease in the average number of visits to PCP (9.5 ± 7.2 vs. 8.9 ± 7.3, p < 0.001), average number of ED visits (0.46 ± 1 vs 0.4 ± 0.9, p = 0.05) and average all-cause hospitalization (0.03 ± 0.22 vs. 0.01 ± 1.9, p < 0.001) was demonstrated in the study group over time (Table 2). In the study group 2.2%, were hospitalized at least once in the year before specialist intervention vs. 1.2% in the year after intervention (p < 0.001). This improvement in healthcare visits was not evident in the controls (Table 2, Fig. 2). When these relations were tested using GLM, we detected an overall independent significant effect of specialist intervention on PCP visits and on all-cause hospitalizations (p < 0.01), but not for ED visits (p = 0.06; Table 2, Fig. 2).

During follow-up, 27 patients died; 8 (0.2%) patients in the study group and 19 (0.5%) in the control group (p = 0.03).

### DISCUSSION

The results of this study demonstrated significant benefits from specialist intervention in adult patients with asthma. We found that these patients benefitted significantly from at least 1 visit with a specialist, as noted in all elements of disease control. Improvement in medical treatment including use of inhaled steroids, along with less frequent use of inhaled short-acting beta agonists and systemic steroids. Moreover, consumption of healthcare services decreased, including fewer PCP, ED visits and all cause hospitalization. Overall, the data presented here suggest that adult asthma patients have fewer asthma exacerbations and better controlled disease, up to one year after an encounter with an asthma specialist.

As opposed to COPD, asthma has a remitting-relapsing course and is characterized by spontaneous improvements and exacerbations. To overcome the potential natural improvement in disease parameters over time, we compared the study group to a matched control group of patients with asthma who did not consult an asthma specialist. By using GLM ANOVA, we found that specialist intervention had an independent significant, positive effect on nearly all parameters tested. This was exceptionally notable in consumption of healthcare services,
which significantly improved in the study group, but did not change among the controls over time.

In pediatric patients with asthma, our group and others have demonstrated the positive effect of asthma specialist intervention on asthma control parameters.\textsuperscript{15-17,22} However, information regarding the effect of specialist intervention on asthma control in adult patients is scarce and the results are conflicting. Although recommended by all asthma guidelines, specialist intervention is often neglected in adults for various reasons, including lack of availability and low sense of need.\textsuperscript{10,11,13} In Israel, specialist intervention is available to all, but only 36.6% of the patients in our cohort were referred to an asthma specialist.
One reason for this low adherence to guidelines might be the scant and inconsistent data regarding the effect of asthma specialist intervention for adults. Erickson et al found that specialist intervention reduced hospitalizations but not ED visits in a cohort of asthma patients, who were observed prospectively after being hospitalized due to asthma exacerbation. They concluded that specialist intervention had only a modest effect on asthma control.14 As opposed to our study, their cohort was older (mean 59 years) and most patients were smokers (66%), raising the possibility, that it included patients with COPD overlap. Schatz et al. have demonstrated a positive effect of specialist intervention in a large group of children and

* PCP – Primary care physician. E.R – Emergency room

** p<0.01 for PCP and hospital admissions. P=0.06 for E.R visits (ANOVA). Adjusted for gender, age, ethnicity and BMI

Fig. 2 Average healthcare visits over treatment over time, study vs control
adult asthma patients. Allergy specialist care and use of inhaled CS were found to be independent predictors for reduced ED visits in their cohort.\textsuperscript{20}

A survey performed on a large cohort of persistent asthma adult patients clearly showed that patients followed by allergists reported better disease control as was demonstrated by use of inhaled CS, less unscheduled healthcare visits and fewer hospitalizations. Compared to patients followed by PCP they reported better quality of life and satisfaction of care.\textsuperscript{19} In line with this, Wu et al conducted a mail survey including almost 3000 adult patients with asthma and found that those who visited an asthma specialist reported better quality of life, and fewer hospitalizations and ED visits compared to asthma patients treated by PCP only.\textsuperscript{18}

The data presented in the current study reinforce these findings. Our results are more robust as they rely on objective data including medication purchases, visits and hospitalizations.

The improvement after specialist intervention can be attributed to accurate diagnosis and disease staging, along with prescription of correct controller medications and education regarding when and how to use rescue medications, which are very important steps in asthma management. A recent study demonstrated that specialists agree and adhere to asthma guidelines significantly more than PCP.\textsuperscript{23} Not surprisingly, patients who had been treated by asthma specialists adhere to asthma guidelines more than patients treated by PCP according to a recent survey done among pediatric patients.\textsuperscript{16}

All-cause mortality was significantly lower in the study group as compared to controls. This finding is intriguing because we assume that patients in the control group probably had milder disease to begin with. This information must be considered with caution because of the small numbers and because we do not know the cause of death. Still, this might be an important clue regarding the impact of an asthma intervention on mortality.

This study had several limitations inherent to its retrospective nature. First, we were unable to diagnose asthma according to guidelines, but relied on diagnoses in the EMR. However, given that every patient in the study population had visited an asthma specialist and most patients in both groups received asthma-directed treatments indicates that the study population had asthma. Second, we could only compare use of all-cause healthcare services and mortality and not those specific for asthma. Moreover, we did not collect data regarding other comorbidities or smoking, factors that are important in asthma control.\textsuperscript{24,25} Still, we restricted our population to patients younger than 50 years, which decreases the possibly of other unrelated comorbidities. This implies that the major disease responsible for most healthcare visits was indeed asthma. Third, we could not divide the population or match the study and control groups according to asthma severity. This resulted in the control group having better clinical parameters initially, suggesting that as a group, they had milder disease. The finding that the study group improved significantly after a specialist visit, even though they probably had more severe disease, strengthens our findings. Forth, in order to avoid misclassification with COPD, we limited our cohort to patients under than 50 although asthma is also frequent in the elderly.\textsuperscript{26,27} More studies are needed to evaluate specialist intervention in elder asthma patients.

A major strength of our study is that in Israel all patients have health insurance. As such, there is easy access to medical treatment, emergency departments and specialists, independent of socioeconomic status or geographic location. This is probably the reason why our study group included significantly more Israeli minorities, populations that traditionally have poorer access to specialists. This enabled accurate exploration of asthma control in a large, heterogeneous population, with minimal demographic or socioeconomic bias.

In conclusion, we found that asthma specialist intervention significantly improves asthma outcome in adults. Referring adult asthma patients to an asthma specialist should be one of the goals of asthma management plans.

\textbf{Abbreviations}

BMI: body mass index, CHS: clalit health services, COPD: chronic respiratory pulmonary disease, CS: corticosteroids, ED: emergency department, EMR: electronic medical records, GLM: generalized linear modeling, PCP: primary care physicians
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Availability of data and materials

All data and materials are available upon request.

Statement of ethics

This study was approved by the local IRB of the Meir Medical center. Case Num. 0304-20-MMC.

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Declared competing interest

The authors have no conflicts of interest to declare.

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Consent for publication

We consent that the manuscript will be published in the "world allergy organization journal".

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