

Comprehensive use of environmental control practices among adults with asthma

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ABSTRACT

Asthma is a common chronic illness among adults. National guidelines recommend comprehensive implementation of environmental control practices (ECP) for asthma management. The purpose of this study was to examine the association between preventive asthma care and comprehensive ECP use among adults with asthma. We used data from the Four-State National Asthma Survey, including 3727 adults with asthma. Comprehensive management was defined as implementing at least five of eight ECP: (1) air filter, (2) dehumidifier, (3) mattress cover, (4) pillow cover, (5) no pets, (6) no smoking, (7) no carpets, and (8) washing sheets in hot water. We examined the association between comprehensive implementation of ECP and receipt of preventive asthma care, as measured by number of routine asthma visits in the prior year and physician advice to modify the environment. Overall, 13.3% (95% confidence interval [CI], 11.8–14.8%) of participants reported comprehensive ECP use. The most frequently implemented ECP were no smoking (80%), no pets (54%), and washing sheets in hot water (43%). Comprehensive ECP use was associated with having received physician advice (odds ratio [OR], 2.3; 95% CI, 1.6–3.4) and increased number of routine asthma visits (1–2 visits: OR, 2.4, and 95% CI, 1.5–4.0; 3–4 visits: OR, 2.4, and 95% CI, 1.3–4.5; 5 or more visits: OR, 3.4, and 95% CI, 1.9–6.4). Receipt of preventive asthma care is associated with comprehensive implementation of ECP. Further research is needed to determine the factors mediating these associations to develop more effective asthma counseling.

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Asthma is a common chronic condition in the United States.¹ According to the 2003 Centers for Disease Control and Prevention's National Health Interview Survey, ~6.7% of adults in this country currently have asthma. This disease causes a great deal of morbidity in the United States and worldwide. There have been major public health initiatives in the past 10 years that curtailed the increase in asthma morbidity. The national asthma guidelines put forth by the National Heart, Lung, and Blood Institute (NHLBI) played an important role in setting the standard of care, and considerable efforts have been put toward ensuring that health care providers are adhering to these guidelines, particularly to recommendations for appropriate use of inhaled corticosteroids.^{2,3} It is thought that some of the improvements in asthma morbidity in recent years are attributable to increased adherence to these guidelines.⁴

An area of asthma management that has not received as much attention is the use of environmental

control strategies, especially the control of indoor triggers, which can greatly improve asthma morbidity.^{5–8} The Institute of Medicine has concluded that exposure to cockroaches, cats, house dust mites, and environmental tobacco smoke can cause asthma exacerbations, particularly in individuals who are sensitized.⁹ Although there is stronger data linking indoor allergen sensitization to outcomes in children,^{10,11} many studies suggest that these associations may be important among adults. Based on these data, the recently updated NHLBI guidelines recommend a comprehensive approach to control indoor allergens and not just individual steps to achieve an adequate control of asthma, especially among patients with persistent asthma.² A few studies have evaluated factors associated with use of certain specific environmental control practices (ECP) in children, but there is a paucity of data regarding predictors of use of ECP among adults.

The importance of physician counseling has been well documented in other areas of asthma self-management, including receipt of the seasonal flu vaccine.¹² The objective of this study was to use population-based data to examine whether physician advice to modify the home environment and increased routine office visits are associated with comprehensive use of ECP among adult asthmatic patients.

METHODS

This study used data from the four-state population sample (California, Alabama, Texas, and Illinois) col-

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lected as part of the National Asthma Survey (NAS). The survey was conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics between March 1, 2003 and March 10, 2004. NAS used a State and Local Area Integrated Telephone Survey design, using the same sampling frame as the Center for Disease Control's National Immunization Survey. Approximately 95% of the four-state surveys were conducted in English; the remainder was conducted in Spanish.

Participating households were screened for the presence of any members with a physician diagnosis of asthma; overall, 5741 asthmatic patients were drawn from the four states. In each household, up to one adult and one child with asthma were randomly selected for interview. Our analyses were restricted to participants ≥ 18 years of age. Participants who reported neither asthma symptoms nor asthma medication use in the past 5 years were excluded from this analysis.

Our outcome of interest was the comprehensive use of ECP. From 16 available ECP that were evaluated in the survey, we selected 8 that have either been evaluated previously as part of multifaceted environmental interventions¹³⁻¹⁶ or are recommended by the NHLBI guidelines.² These included (1) use of an air filter, (2) use of a dehumidifier, (3) use of mattress covers, (4) use of pillow covers, (5) no pets in the home, (6) no smoke exposure, (7) no carpets in the home, and (8) washing sheets in hot water. Prior randomized controlled studies showing the benefit of multifaceted environmental modifications included at least five ECP as part of the intervention.¹³⁻¹⁷ Thus, we considered patients using five or more ECP as implementing a comprehensive environmental control of allergens. Secondary analyses were conducted using different definitions for the cut-off of comprehensive management.

As part of the survey, information was collected on age, gender, and residence in a metropolitan statistical area (MSA), which is designated as an area with a population $\geq 500,000$, based on each participant's home zip code. Age was categorized in the following groups: 18-24 years, 25-44 years, 45-64 years, and ≥ 65 years. The respondent's race/ethnicity was categorized as white, black, Hispanic, multiracial, or other race. Participants reported health insurance status at the time of the interview and if there was any time in the previous year when he/she did not have insurance. Annual household income was categorized based on approximate quartiles of the sample as follows: $< \$25,000$; $\$25,000-44,999$; $\$45,000-74,999$; and $\geq \$75,000$. Participants were also asked whether there were others living in the home with a diagnosis of asthma.

Asthma symptoms were reported as frequency per month. Asthma control was categorized based on the frequency of symptoms and degree of activity limitation, using the NHLBI guidelines as an outline.² Categories

included well-controlled (symptoms 0-8 and/or 0-2 nights/month and/or no activity limitation), not well-controlled (symptoms ≥ 9 and/or 3-7 nights/month and/or mild to moderate activity limitation), and poorly controlled (daily symptoms and/or ≥ 8 nights/month and/or severe activity limitation).

Our main predictors of interest were whether participants had ever received physician advice to change their environment to improve their asthma and the number of physician visits during the prior year for the routine care of asthma (not urgent visits). Based on the distribution of data, routine asthma visits were categorized as follows: 0, 1-2, 3-4, and ≥ 5 visits in the prior year.

Statistical Analysis

We used the chi-square test to evaluate differences in the characteristics of respondents practicing or not practicing comprehensive environmental control. The univariate association between comprehensive management and physician advice as well as number of routine visits was also tested using the chi-square test.

We used multiple logistic regression to assess whether comprehensive ECP implementation was associated with receiving physician advice and number of routine visits after adjusting for age, gender, race/ethnicity, MSA, income level, insurance status, presence of others in the home with asthma, and asthma control category. We conducted secondary analyses using different cut-offs to define comprehensive management to assess the robustness of our findings: four or more ECP as well as six or more ECP. Odds ratios (ORs) are presented with 95% confidence intervals (CIs).

We adjusted variance estimates for the complex survey design by using statistical techniques allowing for complex design specifications, incorporating weights available with the NAS data. These are person-level weights including a base sampling weight, an adjustment for multiple telephone lines within a household, and various adjustments for nonresponse.¹⁸ All results are reported as weighted percentages, used two-tailed significance levels of $p < 0.05$, and were conducted with SAS statistical software (SAS Institute, Cary, NC). The study was approved by the Institutional Review Board of Mount Sinai School of Medicine.

RESULTS

Of the 5741 participants in the four-state sample, 3727 (65%) were ≥ 18 years of age. We excluded 367 participants (10%) because of lack of asthma symptoms or asthma medication use in the prior 5 years, leaving a cohort of 3360 adults with asthma. Of these, 69% were women. In terms of the age distribution, 11% were 18-24 years, 38% were 25-44 years, 38% were 45-64 years, and 13% were ≥ 65 years. The racial and ethnic composition of the cohort was primarily white

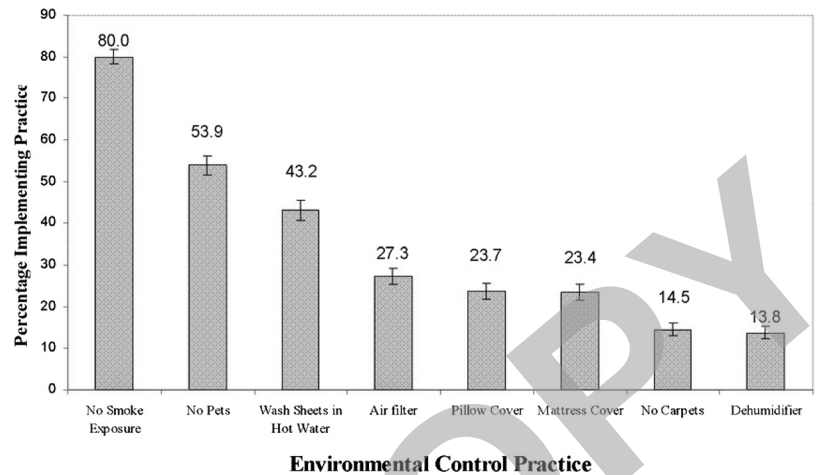


Figure 1. Rates of implementation of environmental control practices among adults with asthma in the four-state sample of the National Asthma Survey.

(59%) but with a significant percentage of blacks (11%) and Hispanics (19%). The overwhelming majority lived in an MSA (90%). In regard to income, the participants were roughly equally divided into the four income groups. Although the majority of respondents were insured, almost 16% reported no insurance and an additional 8% were uninsured in the prior year. Asthma was well controlled in ~34% and poorly controlled in almost 28%.

Overall, only 13.3% (95% CI, 11.8–14.8%) of the study participants reported using five or more ECP. As shown in Fig. 1, the most frequently implemented ECP were no smoking (80%), no pets (54%), and washing sheets in hot water (43%). Conversely, use of a dehumidifier (14%) and no carpets in the home (14%) were less common among participants. The sociodemographic characteristics of respondents who did and did not practice comprehensive management are seen in Table 1. Women ($p < 0.0001$) and those who were older in age ($p < 0.0001$) were more likely to use five or more ECP. Similarly, those who had stable insurance were more likely to practice comprehensive management ($p = 0.0008$), and those participants whose asthma was poorly controlled were more likely to use at least five ECP ($p = 0.02$). There were no significant differences in terms of race/ethnicity, living in an MSA, income, and presence of others in the home with asthma ($p > 0.10$ for all comparisons).

Unadjusted analyses showed that comprehensive implementation of ECP was significantly associated with receiving physician advice as well as number of routine care asthma visits in the prior year (Table 1). Almost 52% of patients who did not use comprehensive ECP had no routine visits for asthma during the prior year compared with 32% of those who used five or more ECP ($p < 0.0001$). Similarly, 59% of patients using five or more ECP received physician advice compared with only 40% of those who did not use comprehensive ECP. Multivariable analyses also showed

that physician advice and the number of routine visits remained significantly associated with comprehensive implementation of ECP after adjusting for potential confounders (Table 2). Those who had received physician advice had more than twice the odds of comprehensive management compared with those who had not received advice (OR, 2.3; 95% CI, 1.6–3.4). Similarly, an increasing number of routine care visits for asthma was associated with higher odds of comprehensive management compared with those respondents with no routine visits in the prior year (1–2 visits: OR, 2.4, and 95% CI, 1.5–4.0; 3–4 visits: OR, 2.4, and 95% CI, 1.3–4.5; 5 or more visits: OR, 3.4, and 95% CI, 1.9–6.4). Similar results were found in secondary adjusted analyses using four or more ECP and six or more ECP as the outcome.

DISCUSSION

Asthma is a common chronic illness causing significant morbidity among adults in the United States.^{1,15} There is good evidence that environmental modifications, especially used in a comprehensive manner, can help improve asthma outcomes.^{13–16} Thus, ECP are recommended by current national asthma treatment guidelines. This study examined factors associated with comprehensive ECP use in a large, population-based sample of adults with asthma in four states. We found that few households (13%) were practicing comprehensive environmental management. Two factors associated with comprehensive use of ECP were receipt of physician advice to modify the environment and number of routine asthma visits in the prior year, suggesting potential targets for efforts to increase ECP use among adults with asthma.

There are limited data in the literature assessing barriers and/or facilitators for ECP use in adults with asthma.^{19–20} Cabana *et al.* evaluated predictors of use of at least one ECP in children.¹⁹ This study showed

Table 1 Participant characteristics according to comprehensive environmental management among adults in the four-state sample* of the National Asthma Survey

	Uses Less Than Five ECP ¹ (n = 2913; weighted %)	Uses Five or More ECP (n = 447; weighted %)	p Value
Age (yr)			<0.0001
18–24	18.1	7.0	
25–44	38.3	39.7	
45–64	30.6	36.0	
≥65	13.0	17.3	
Sex			<0.0001
Male	42.4	27.3	
Female	57.6	72.7	
Race/ethnicity			0.13
White	59.2	58.5	
Black	10.5	12.9	
Hispanic	19.7	1.2	
Multiple	4.8	3.4	
Other	4.0	3.3	
Unknown	1.8	4.2	
Metropolitan Statistical Area			0.59
Yes	89.7	90.5	
No	10.3	9.4	
Income			0.10
<\$25,000	28.7	23.8	
\$25–44,999	21.1	19.1	
\$45–74,999	22.2	21.2	
>\$75,000	28.0	36.0	
Insurance Status			0.0008
Insured	75.0	85.0	
Unstable insurance [#]	8.3	4.7	
Uninsured	16.7	10.2	
Others in House with Asthma			0.21
No	68.4	64.2	
Yes	31.6	35.8	
Asthma control			0.02
Well controlled	34.7	28.8	
Not well controlled	38.5	36.3	
Poorly controlled	26.8	34.8	
Routine asthma visits in past year			<0.0001
0	51.6	32.0	
1–2	26.0	35.8	
3–4	11.9	15.9	
≥5	9.9	14.9	
Physician advice to change environment			<0.0001
Yes	40.2	59.2	
No	59.8	40.8	

*California, Alabama, Texas, and Illinois.

[#]Currently has insurance, but did not have insurance at some point during prior year.

ECP = Environmental control practices.

that parents of children who received asthma education had 80% higher odds of pursuing any action to address an environmental trigger, and those with more

primary care office visits had 5% higher odds of addressing a trigger. Similarly, Hansel *et al.* showed that parents of children who received physician advice re-

Table 2 Adjusted odds of comprehensive environmental management among adults in the four-state sample* of the National Asthma Survey

Variable	Odds Ratio	95% Confidence Interval
Physician advice to change environment	2.3	1.6–3.4
Routine asthma visits in past year		
0	Reference	
1–2	2.4	1.5–4.0
3–4	2.4	1.3–4.5
≥5	3.4	1.9–6.4
Age (yr)		
18–24	Reference	
25–44	2.5	1.1–5.7
45–64	1.9	0.8–4.5
≥65	2.6	1.0–6.5
Male gender	0.4	0.3–0.7
Race/ethnicity		
White	Reference	
Black	1.7	1.0–3.2
Hispanic	1.1	0.7–2.0
Multiple	0.8	0.3–2.4
Other	0.6	0.2–2.2
Unknown	2.7	0.8–8.9
Living in metropolitan statistical area	0.9	0.5–1.7
Income		
<\$25,000	Reference	
\$25–44,999	1.6	0.9–2.9
\$45–74,999	1.0	0.6–1.9
>\$75,000	2.0	1.1–3.5
Insurance		
Insured	Reference	
Unstable Insurance#	0.7	0.3–1.6
Uninsured	0.9	0.5–1.7
Others in home with asthma	1.1	0.7–1.7
Asthma control		
Well controlled	Reference	
Not well controlled	0.8	0.5–1.3
Poorly controlled	1.2	0.7–2.1

*California, Alabama, Texas, and Illinois.

#Currently has insurance, but did not have insurance at some point during prior year.

garding a specific ECP were more likely to implement that ECP to improve their asthma control.²⁰ However, similar studies have not been conducted among adult patients. Moreover, patients with asthma are frequently sensitized to multiple allergens and most evidence suggests that comprehensive rather than the specific interventions evaluated in prior studies are

necessary to improve asthma outcomes.² Our findings extend the results of previous studies by showing that asthma education and interaction with health care providers are associated with increased comprehensive ECP use among adults with asthma.

These findings have important implications for asthma counseling and management. Over the past number of years, there has been an important effort to improve pharmacologic management of asthma, in particular, use of inhaled corticosteroids for persistent asthmatic patients in the United States.^{2,3} These efforts have translated into increased rates of inhaled corticosteroid prescriptions for patients with persistent asthma.³ However, less emphasis has been placed on the role of other self-management behaviors such as environmental modifications for improving asthma control. To address this issue, the updated national guidelines underscore the importance of comprehensive environmental management and encourage physicians to discuss these issues with their patients. Our data suggest that these efforts may translate into increased patient adherence to ECP.

Appropriate asthma management is complex and requires health care providers to build an ongoing partnership with patients. Physicians must treat acute symptoms, choose the appropriate long-term medications, and educate about the disease process, as well as counsel on multiple aspects of disease management (e.g., peak flow use, asthma action plans, and environmental control). All of these tasks can be difficult to accomplish during one visit, particularly if there is a need to discuss other preventive care issues or if the patient is presenting for an acute episode of illness. However, these tasks are critical given that physician recommendation is a strong predictor of use of several self-management behaviors such as inhaled corticosteroid use, influenza vaccination, and, in this study, ECP use.¹² Developing a partnership over the course of repeated office visits allows the opportunity to adequately discuss and reinforce the many issues involved in asthma management, such as environmental modifications.

Some strengths and limitations to this study should be acknowledged. First, this is a cross-sectional study, and therefore we can not prove that routine asthma visits and physician recommendations increase comprehensive ECP use. However, an important strength is that these associations were found using a large, population-based data set, which should improve the generalizability of our findings. Another limitation is that the participants' allergen sensitization status is unknown. Although ECP are more likely to be effective when targeted toward sensitized individuals, prior randomized controlled trials showing the effectiveness of these practices used a universal ECP approach for

most important allergens.^{14,15,21} There is also a lack of details in the NAS about the quantity and quality of physician–patient interactions; there was no information about the quality of the advice provided by physicians. More detailed information would be helpful to better understand this to identify which counseling strategies are most effective. There is also no information about whether or not the patient receives specialty care, and all data were collected by self-report. Although we found a high rate of no smoking (80%), this was not corroborated with objective evidence and could be an example of reporter bias. An additional limitation is that there is no established definition of what constitutes comprehensive use of ECP. However, our classification was based on the type of environmental interventions used in randomized controlled trials that show a beneficial effect of ECP on asthma outcomes. Additionally, secondary analyses using different cutoffs for comprehensive ECP use yielded similar results, further validating our findings.

CONCLUSION

In summary, we found significant associations between comprehensive ECP use in adults and physician advice as well as increasing number of routine asthma visits. Further research is needed to elucidate the specific mediators of these associations to guide more effective and efficient asthma monitoring and education.

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