
Identification of preschool children with asthma from low-income families in Los Angeles, CA

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Background: Few studies have addressed asthma screening in the preschool age group. Early asthma recognition and intervention in preschool children may reduce costs related to unscheduled medical care and missed school and work.

Objective: To facilitate an early recognition and referral process for asthma in a preschool education program in Los Angeles, CA.

Methods: We administered a 7-question survey to parents and guardians of children aged 12 months to 6 years in the prekindergarten program of a large school district in Southern California. English and Spanish survey questions addressed health care use, school absenteeism, and asthma symptoms. Postsurvey reports to parents recommended clinical evaluation of children who had probable asthma.

Results: Of the 609 surveys returned from 8 centers ($\geq 80\%$ survey return rate), 12% were positive for probable asthma and only 5.4% of these cases had been previously diagnosed. Of the 12% found to have a high probability of asthma, 3 independent factors were associated with a lower likelihood of prior asthma diagnosis: Hispanic descent; Spanish speaking; and medicine use 2 or more times per week for symptoms such as cough, chest tightness, trouble breathing, or wheezing. Symptoms at play, during the day, and at night were noted in 35% to 44% of the preschoolers. Cough was the most frequently reported symptom (71.9%, $n = 424$).

Conclusions: A school-based screening process in an early education program can help identify preschool children with a high probability of asthma and offer a basis for early recognition and intervention.

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INTRODUCTION

Current asthma prevalence in the United States includes 6.3 million children from birth to 17 years of age.^{1,2} However, this statistic might underestimate asthma prevalence in children as evidenced by Gerald et al,³ who found a high percentage of elementary school children with undiagnosed asthma. Of all children with asthma, an estimated 50% to 80% have asthma symptoms before the age of 5 years.⁴ For persons with early adulthood asthma symptoms, evidence

suggests that pulmonary function changes in the first 10 years of life, especially before the age of 3 years.⁵ Preschoolers demonstrate a clear need for asthma screening and care. Children younger than 4 to 5 years are estimated to have the highest annual rate of emergency visits for individuals with asthma of all age groups.^{1,2} Among all children with asthma, the highest rates of hospital admissions occur in those younger than 5 years.⁶ For the year 2000, in the United States, there were 4,487 deaths due to asthma; 223 deaths accounted for persons from birth through the age of 17 years.¹ Although asthma deaths are rare in children, the death rate increased from 1980 to 1999 by 1.4% annually.⁷

In the school setting, asthma is the most common cause of absences for chronic illness.² Missed school days have an impact on a child's ability to learn and on working parents, who must stay home with their sick child. The cost for asthma for the age group 18 years and younger is estimated at \$3.2 billion per year²; an estimated \$1 billion of this amount accounts for the indirect costs of caring for children with asthma.⁴ Recently, asthma screenings have taken place in school settings to identify children who have asthma symptoms but no diagnosis.^{3,8–10} Newer models of care on school campuses are providing children with asthma evaluation and treatment after screening.¹¹

Few studies have addressed asthma screening in the preschool age group. Asthma is difficult to diagnose in the preschool population.^{12,13} Asthma diagnosis relies in part on verbalization of symptoms and on following instructions for

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spirometry.¹⁴ Such measures are particularly challenging in very young children.

It may be that early identification of asthma will inhibit the possibility of permanent airway changes.¹⁵ Better detection might improve children's health and reduce costs of medical care.¹⁶ The purpose of this study was to facilitate an early recognition and referral process for asthma in the early childhood education program at the Los Angeles Unified School District (LAUSD). The following questions were addressed: (1) What percentage of children had a prior diagnosis of asthma (known asthma); (2) What percentage of children had symptoms suggestive of probable asthma; and (3) Do children with known asthma differ in sociodemographics and symptoms from children with symptoms consistent with asthma but not diagnosed as such?

METHODS

Setting and Sample

The study took place at all early childhood education centers of the LAUSD. Screening included parents and guardians of children aged 12 months to 6 years enrolled in the LAUSD early childhood education program. At the time of the screening, there were 99 LAUSD early childhood education centers located throughout greater Los Angeles. Each center had an administrator, an office manager, and preschool teachers who were responsible for 60 to 240 children aged 12 months to 6 years. Families were required to demonstrate that they were low income before their child was accepted into the program and every 6 months thereafter.

Parents of children who attended the LAUSD early childhood education centers participated in the study. They were asked to complete a 7-question asthma survey on the health of their child. Because we anticipated that many of the parents would not be native English speakers, we provided the screening survey in English and Spanish. There were no exclusion criteria.

Instrument

The Asthma Health Screening Survey is a 7-question, 11-item survey designed to evaluate whether a child has a cluster of symptoms that might signal asthma and indicate a need for further evaluation by a health care provider¹⁷ (Table 1). The first question, which contains 5 items, plus 6 questions of 1 item each comprise the total of 7 questions and 11 items.

Jones et al¹⁷ developed the instrument for the Breathmobile Program and evaluated the survey in a study of school-aged children with asthma. Both the English and Spanish versions of the survey were validated by comparing results with comprehensive clinical assessments. The algorithm was valid in assessing the likelihood of disease in 147 children younger than 6 years (88.9% sensitivity, 85.3% specificity). Responses to the 7-question (11-item) survey fell into 3 result categories: (1) negative, (2) possible, and (3) positive for asthma. A description of the validation procedure and copy of the survey were recently published.

Table 1. Outline of Asthma Health Screening Survey Questions*

1. Episodes of
 - a. Asthma
 - b. Cough
 - c. Trouble breathing
 - d. Chest tightness
 - e. Bronchitis
2. Emergency department or hospital treatment
3. Missed school
4. Exercise-related episodes
5. Medicine use
6. Day symptoms
7. Night symptoms

* Question 1 consists of 5 items; therefore, the 7-question survey includes a total of 11 items.

Procedure

The University of California, Los Angeles, Institutional Review Board and LAUSD granted approval for the involvement of human subjects. Research and LAUSD staff informed all early education administrators about the study at an annual LAUSD early childhood education program meeting. Staff distributed 12,403 surveys and explained confidentiality measures, including numerical participant identification. Administrators distributed the surveys to office managers at their respective centers. Office managers handed packets to parents and guardians who picked up or dropped off their preschoolers and invited them to complete the questionnaire and return it to the center. A cover letter and the informed consent accompanying the survey assured parents that choosing not to participate would not affect their child's preschool program eligibility. The written materials also encouraged parents with questions to call the principle investigator (J.B.) or the Los Angeles County (LAC) and University of Southern California (USC) Department of Allergy and Immunology. Center staff sent completed surveys to the school district office to be picked up by research staff.

Initially, we screened 99 centers without incentives. Twenty-five of these centers returned no surveys. We questioned whether surveys had been distributed to parents from the 25 centers due to administrative changes at LAUSD. Based on the procedure by Jones et al, we redistributed surveys to the 25 centers using incentives.

Incentives were based on a sliding scale whereby the study would award a dollar amount per completed survey in the form of educational gift certificates for each center. For 75% to 100% of completed surveys returned, the incentive awarded was \$5.00 per survey; for 50% to 74% returned, \$3.00 per survey; for 25% to 49% returned, \$2.00 per survey; and for 24% or less, a flat \$25.00 was awarded.

Research staff scanned completed surveys into the database for analysis. For parents, the study generated reports on their child that described the parents' responses to the 7 questions. Each report contained a recommendation about whether the child might benefit from further evaluation for asthma. The reports suggested that parents discuss symptom

clusters that needed further evaluation with their child's physician. Cover letters also explained that there may be further opportunities for evaluation and treatment through a mobile van asthma program in the school district. In addition, cover letters invited participants to call the principal investigator or the LAC and USC Department of Allergy and Immunology for any questions. In addition, research staff contacted school principals and school nurses to monitor follow-up treatment and evaluation.

Data Analysis

Data management involved entry and verification. The SPSS statistical software version 11.0¹⁸ was used for statistical analysis. The SPSS analysis strategies included descriptive statistics and discriminant analysis. Frequency distributions of demographic questions were used to describe the sample. They were reported as aggregate data, illustrating ethnicity, insurance information, health care provider information, and other socioeconomic status variables. A *t* test was used to evaluate the average difference in age among survey return rate groups. The χ^2 test was used to evaluate categorical variables. For children with a high probability of asthma, logistic regression analysis investigated the impact of demographic characteristics, morbidity, and medicine use on the probability of prior asthma diagnosis. The Asthma Health Screening Survey responses were analyzed as group data to describe the children. Analysis of individual survey forms based on the algorithm developed by Jones et al.¹⁷ determined asthma probability and formed the basis of reports and recommendations to parents.

RESULTS

Asthma Probability

From the total sample of 99 preschool centers, 3,789 surveys (30.5%) were returned. We focused on a subsample of preschool centers with an 80% or higher return rate. From the subsample of 8 preschool centers, 609 surveys were returned. Of these, 73 surveys (12%) identified a child as positive with either previously known or previously unknown asthma (Fig 1).

Description of the Sample

The 609 surveys from the subsample of 8 centers with return rates of 80% or greater did not differ from the larger sample when examined using χ^2 statistics ($\chi^2 = 4.1$, $P = .25$). The only variable that was significantly different between the total sample and the subsample was ethnicity. There was a higher percentage of Latinos than other ethnic groups in the 80% or greater return rate group compared with the larger sample ($\chi^2 = 13.295$, $P = .001$). There were no differences for insurance status, sex, and known asthma between the 2 return rate groups. In light of the fact that no significant differences were found between the larger sample and the subsample, we will confine the remainder of the findings to the 609 surveys returned from the subsample in a similar manner to Jones et al.¹⁷ To minimize potential sample bias, the analysis was

restricted to children from classrooms with 80% or greater return rates. Parents who completed forms from centers with less than 80% return rates represented children with similar demographic composition but a slightly greater percentage of children with prior asthma diagnosis. They may characterize children whose parents have experience with asthma and exclude children whose parents were anxious about participating in the survey. However, when the analysis was applied to this group of children, the results were consistent with study findings for children from centers with return rates of 80% or greater (data not shown).

In the subsample of 609 participants, 281 parents (46.1%) completed the survey in Spanish. Latino was the predominant ethnicity (84.2%). Among probable asthmatic patients of Hispanic descent, the potential influence of survey version (English or Spanish) on prior diagnosis was evaluated. Probable asthmatic children of Hispanic descent whose parents responded to the English version of the survey were 4.5 times more likely to have had their asthma previously diagnosed ($P = .01$). The percentage of Hispanic children with probable asthma with a prior diagnosis whose parents responded in Spanish compared with English was 21% and 54%, respectively.

Other major ethnic categories included African American (8.3%), Asian and Pacific Islander (1.6%), white (0.5%), and a multiethnic category (3.0%). More than half of the parents (54.7%) reported having health insurance through Medi-Cal, the Medicaid program of California, and 15% reported having no health insurance. Children ranged in age from 12 months to 6 years (mean age, 3.72 years); most were female (Table 2).

Description of Survey Responses

The survey asked parents and guardians to report repeated episodes of asthma, cough, chest tightness, trouble breathing, and bronchitis during the past 2 years. Thirty-three (5.4%) of the subsample of 609 parents reported a prior history of repeated asthma in their children. Of symptoms, parents reported repeated episodes of cough most frequently (71.9% of 590 valid responses, $n = 424$).

Eighteen percent of the preschoolers ($n = 110$) missed school more than 5 days per year due to cough, chest tightness, trouble breathing, and wheezing. Episodic symptoms of cough, chest tightness, trouble breathing, and wheezing were noted at play (35.7%), during the day (42%), and at night (44.7%). During the previous 2 years, parents reported that 20.7% (of 599 valid responses, $n=124$) of the preschoolers had been to the emergency department or hospital at least once for cough, chest tightness, trouble breathing, and wheezing. Approximately 8% of them had been to the emergency department or hospital 2 or more times.

Most children (58%) were not taking medication for respiratory symptoms. Some (23.7%) were taking medications for respiratory symptoms fewer than 2 days a week, and others were taking medications for respiratory symptoms 2 or more

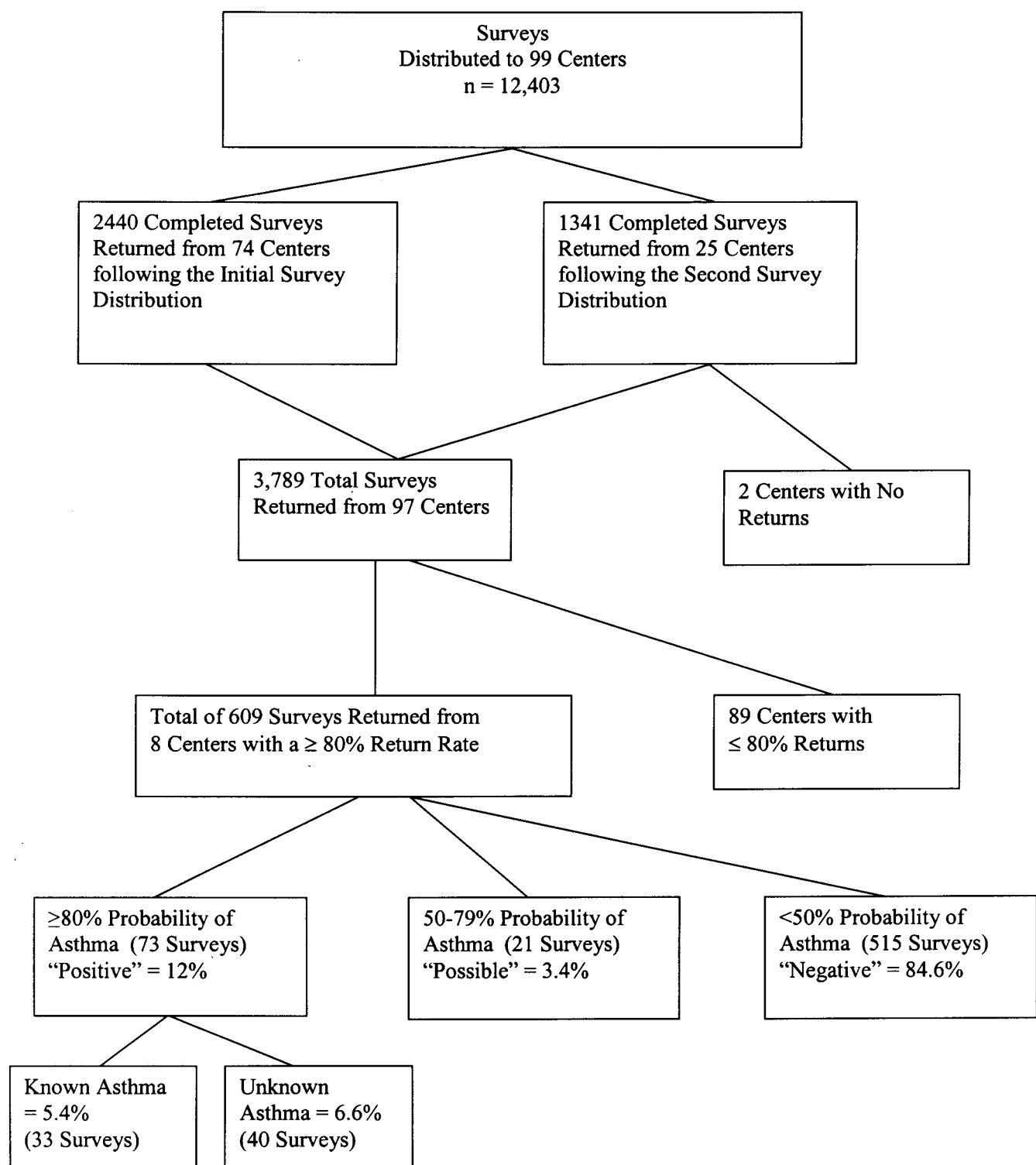


Figure 1. Survey distribution and rate of return for 99 early childhood education centers. Asthma probability is expressed for centers with a return rate of 80% or greater. In the high probability of asthma group, data show the percentage of previously known and previously unknown asthma.

Table 2. Description of Survey by Return Rate Group

Characteristic	No. (% valid)		χ^2 and <i>P</i> value
	Survey response <80% (n = 3,180) for whole sample	Survey response ≥80% (n = 609) for subsample	
Sex			
Male	1,369 (47.5)	265 (46.7)	$\chi^2 = 0.1, P = .73$
Female	1,511 (52.5)	302 (53.3)	
Language			
English	1,702 (53.6)	328 (53.9)	$\chi^2 = 0.0, P = .90$
Spanish	1,475 (46.4)	281 (46.1)	
Ethnicity			
Multiethnic	86 (2.9)	17 (3.0)	$\chi^2 = 32.2, P < .01$
African American	365 (12.4)	47 (8.3)	
Arab	5 (0.2)	5 (0.9)	
Asian	110 (3.7)	7 (1.2)	
White	54 (1.8)	3 (0.5)	
Latino	2,270 (77.3)	474 (84.2)	
Pacific Islander	7 (0.2)	2 (0.4)	
Other	39 (1.3)	8 (1.4)	
Insurance			
Medi-Cal	1,559 (54.3)	306 (54.7)	$\chi^2 = 2.3, P = .32$
Private	807 (28.1)	168 (30.1)	
None	507 (17.6)	85 (15.2)	

days per week (18.2%). The survey requested no further specifics concerning medications.

Identification of Children with Asthma Symptoms

Four categories emerged from responses to the survey. Probability statistics indicated the likelihood of the child having asthma. Jones et al¹⁷ reported previously on the probability calculation of the Asthma Health Screening Survey. Category 1 (negative) included all children who were identified as having less than a 50% probability of having asthma (84.6%). Category 2 (possible) included all children who had a 50% to 79% probability of having asthma (3.4%). Category 3a (positive, previously unknown) included those children with a 80% or greater probability and a parent response of “no” to previous asthma episodes (6.6%). Category 3b (positive, previously known) refers to children who had a parent response of “yes” to previous asthma (5.4%). Table 3 presents the

frequencies of responses for these categories. Approximately 12% of our subsample was designated as positive for asthma; the remaining 88% were designated with a negative or possible probability of asthma. Of the 12% who were positive for asthma, 5.4% had been previously diagnosed as having asthma and 6.6% were previously unknown to have asthma (Table 3). Among children positive for asthma, 3 factors were associated with a lower likelihood of previously diagnosed asthma: Hispanic descent, Spanish speaking, and using medicine 2 or more times per week for symptoms (cough, chest tightness, trouble breathing, and wheezing; Table 4). Of those children covered by Medi-Cal, 41.9% had a previous diagnosis of asthma; of those without Medi-Cal, 50.0% had a previous diagnosis of asthma. The difference in rate of asthma diagnosis with and without Medi-Cal was not significant.

Table 3. Categories of Asthma Probability Based on Survey Responses

Category	Asthma probability, %	No. (% valid)		χ^2 and <i>P</i> value
		Survey response <80% (n = 3,180) in whole sample	Survey response ≥80% (n = 609) in subsample	
Negative	<50	2,643 (83.1)	515 (84.6)	$\chi^2 = 0.7, P = .39$
Possible	50–79	92 (2.9)	21 (3.4)	$\chi^2 = 0.5, P = .46$
Positive (previously unknown)	≥80	202 (6.4)	40 (6.6)	$\chi^2 = 0.0, P = .84$
Positive (previously known)	≥80	242 (7.6)	33 (5.4)	$\chi^2 = 3.6, P = .06$

Table 4. Association of Demographic Characteristics and Medicine Use for Cough, Chest Tightness, Trouble Breathing, and/or Wheezing with Likelihood of a Previous Diagnosis among Children with Probable Asthma

Characteristic	Children with a high probability of asthma (n = 609), No. (%)	OR (95% CI) of previous diagnosis	P value
Sex			
Male	40 (47.5)	1.3 (0.5–3.4)	.56
Female	32 (40.6)		
Language			
English	41 (63.4)	6.2 (2.2–17.7)	.001
Spanish	32 (21.9)		
Ethnicity			
Hispanic	53 (35.8)	14.3 (1.7–122.7)	.02
Black	9 (88.9)	1.8 (0.2–13.8)	.57
Other	4 (50.0)		
Insurance			
Medi-Cal	31 (41.9)	1.4 (0.5–3.9)	.54
Private	26 (50.0)	1.4 (0.3–5.8)	.66
None	10 (50.0)		
Medicine use, d/wk			
None	27 (63.0)	7.4 (1.7–32.3)	.008
<2	29 (41.4)	3.1 (0.7–13.1)	.13
≥2	16 (18.8)		

Abbreviations: CI, confidence interval; OR, odds ratio.

DISCUSSION

School-based screenings have been implemented for a variety of childhood disorders.³ Recent attempts have been made to screen and facilitate asthma treatment for school-aged children with asthma. Expansion of screening to preschool programs will permit earlier recognition and may alter the course of childhood and adult asthma. In the future, it may be possible to make health screening part of the preschool admission process, especially in low-income populations.

The identification process needs to be fine-tuned to elicit a high response rate. Our experience has taught us to attend to every step and to modify our approach as needed. We redistributed surveys and provided incentives to 25 centers that initially returned no completed surveys. As a result, all but 2 centers responded with survey returns.

Our preliminary results indicated that 12% of our sample had a high likelihood of asthma and needed further evaluation. Only 5.4% had a prior asthma diagnosis. These findings are similar to those of other school screenings.^{9–11,16} Slezak et al¹⁹ examined asthma prevalence in Head Start sites in Chicago, IL, and found that approximately 20% of children aged 3 to 5 years wheezed in the last 12 months. In our study, symptoms suggestive of asthma at play, during the day, and at night were noted in 35% to 44% of the preschoolers with known and unknown asthma, respectively.

Childhood asthma is a significant health problem throughout the world. It has been proposed that most children with asthma develop airway changes before 5 years of age.^{5,15} Asthma symptoms contribute to missed school days and reduced quality of life for both parent and child.²⁰ Our preliminary findings suggest that in our sample of low-income,

predominantly Latino preschoolers, at least half of those with asthma symptoms remain undiagnosed and untreated. These findings emphasize the need to address school-based case identification of asthma in the preschool population. School-based screening can help identify preschool children with a high probability of asthma and offer a basis for early treatment.

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