

The Canadian Childhood Asthma Primary Prevention Study: Outcomes at 7 years of age

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Background: Avoidance of any one of the individual risk factors associated with childhood asthma has not been successful in preventing its development.

Objective: The purpose of this study is to determine the effectiveness of a multifaceted intervention program for the primary prevention of asthma in high-risk infants at 7 years of age.

Methods: Five hundred forty-five high-risk infants with an immediate family history of asthma and allergies were prospectively randomized into intervention or control groups prenatally. Intervention measures introduced before birth and during the first year of life included avoidance of house dust, pets, and environmental tobacco smoke and encouragement of breast-feeding with delayed introduction of solid foods. Assessment of outcomes at 7 years consisted of examination by pediatric allergists, methacholine inhalation tests, and allergy skin tests.

Results: At 7 years, 469 of the 545 children were contacted, and 380 returned for further assessment. The prevalence of pediatric allergist-diagnosed asthma was significantly lower in the intervention group than in the control group (14.9% vs 23.0%; adjusted risk ratio, 0.44; 95% CI, 0.25-0.79). The prevalence of allergic rhinitis, atopic dermatitis, atopy (defined as positive skin test reactions to any common allergen), and bronchial hyperresponsiveness (defined as the provocative concentration of methacholine that induced a 20% decrease in FEV₁ from a postsaline value of less than 7.8 mg/mL) were not significantly different between the 2 groups. The prevalence of asthma (defined as wheeze without colds and the presence of bronchial hyperresponsiveness) was also significantly lower in the intervention group compared with the control group (12.9% vs 25.0%; adjusted risk ratio, 0.39; 95% CI, 0.22-0.71).

Conclusion: The multifaceted intervention program was

effective in reducing the prevalence of asthma in high-risk children at 7 years of age. (*J Allergy Clin Immunol* 2005;116:49-55.)

Key words: Asthma, primary prevention

Asthma and other atopic disorders are complex diseases because of interaction between environmental influences and genetic predisposition. The rapid increase in the prevalence of asthma observed in many countries is unlikely to be related to genetic changes. A number of intervention studies have focused on reducing one or more environmental exposures in early life that might be modified in families with a strong history of asthma.¹⁻⁵ These environmental interventions have involved indoor aeroallergens, environmental tobacco smoke, and breast-feeding. Avoidance of individual risk factors has not been successful in preventing the development of asthma.

We conducted a prospective, randomized controlled study to determine the effectiveness of a multifaceted intervention program in the primary prevention of asthma in high-risk infants in 2 Canadian centers, Vancouver and Winnipeg, in 1995.⁶ The intervention program included reduction of exposure to common indoor allergens, avoidance of environmental tobacco smoke, encouragement of breast-feeding, and delayed introduction of other foods during the first 12 months of life. We hypothesized that intervention during this window of opportunity has the potential for long-term modification of the infant's risk for asthma development. We have previously reported that the prevalence of possible asthma was significantly reduced by 34% and 40% in the intervention group compared with the control group at 12 and 24 months of age, respectively.^{6,7} This is a report of the outcomes of this cohort at 7 years of age.

METHODS

Study population

The cohort has been described in previous reports.^{6,7} Briefly, infants at high risk for asthma development, defined as those with at least one first-degree relative with asthma or 2 first-degree relatives with other IgE-mediated allergic diseases (atopic dermatitis, seasonal or perennial allergic rhinitis, or food allergy), were identified during the mother's third trimester of pregnancy. Families were randomly allocated to our multifaceted intervention (n = 279) or to the control group (n = 266). There were 4 pairs of twins at birth. At 7 years of

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Abbreviations used

BHR: Bronchial hyperresponsiveness

OR: Odds ratio

PC₂₀: Provocative concentration of methacholine that induced a 20% decrease in FEV₁ from postsaline value

RR: Relative risk

age, 80 (14% of the cohort) families were lost to follow-up. The number of families that dropped out was not significantly different between the 2 groups. Of the 466 families (3 pairs of twins) that could be contacted, 250 in the intervention and 219 in the control group completed a questionnaire by interview or telephone. In addition, 202 in the intervention group and 178 in the control group were assessed by a pediatric allergist in each center; of these, 186 in the intervention group and 164 in the control group also underwent a methacholine inhalation test (Fig 1).

Study protocol

Home visits were carried out during the third trimester of pregnancy and at 2 weeks and 4, 8, 12, 18, and 24 months after the birth of the child. During the initial visit, a standardized questionnaire was completed by trained interviewers to obtain information relating to the demographic and health characteristics of the families, and the children were randomly assigned to the intervention or control group after the initial assessment. The control group followed the usual care recommended by their primary care physicians.

Intervention measures during the first year of life

The multifaceted intervention program implemented before birth and during the first year of life has been described previously.^{4,5} Briefly, it consisted of the following: (1) house dust mite control measures that included encasing parents' and infants' mattresses and box springs with vapor-impermeable covers, hot water wash of all bedding weekly, and application of benzyl benzoate powder (Acarosan powder; Bencard Laboratories-SmithKline Beecham Inc, Mississauga, Ontario) to carpets in bedrooms and benzyl benzoate foam to the upholstered furniture in the most commonly used room before and at 4 and 8 months after birth; (2) pet avoidance measures consisting of removal of cats, dogs, or both from the home and, where this was not possible, instructions to keep pets outside the home or at least outside the infant's bedroom; (3) avoidance of environmental tobacco smoke, including counseling parents on smoking cessation and instructing families to keep their homes smoke free; and (4) encouragement of mothers to breast-feed for at least 4 months and for the first year if possible and to delay introduction of other foods until 6 months of age. Partially hydrolyzed whey formula (Good Start; Nestle Canada, Inc, North York, Ontario, Canada) was supplied for supplementation if necessary and after weaning until 12 months of age. Families were also encouraged to avoid use of daycare facilities until after the first year of life. At each visit, the research nurse reinforced the various avoidance measures.

The compliance and efficacy of the intervention measures have been reported previously.^{6,8} The average house dust mite allergen (Der p 1 plus Der f 1) levels had been significantly reduced in the intervention group compared with the control group at 12 and 24 months after birth.^{6,8} Although the prevalence of pets did not change, there was less, but not statistically significantly less, cat allergen exposure in the intervention homes compared with the control homes (average Fel d 1, 1.68 vs 2.09 $\mu\text{g/g}$ dust and 2.24 vs 2.5 $\mu\text{g/g}$ dust

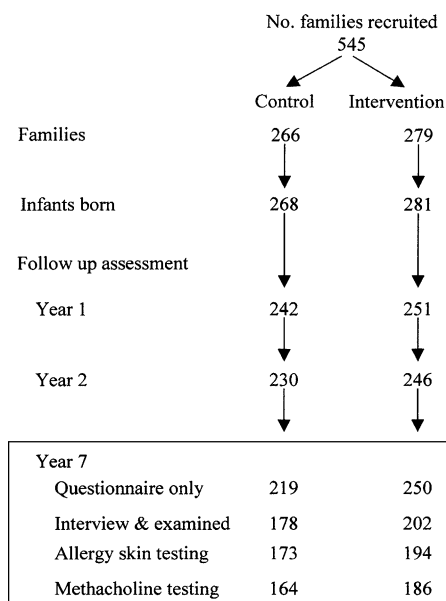


FIG 1. Profile of clinical trial and follow-up assessment.

during 12 and 24 months, respectively).⁷ Only 6% of the mothers in the intervention group and 8.7% in the control group smoked at the time of recruitment. The prevalence of mother smoking at 12 and 24 months after delivery were not different from baseline and also not different between the 2 groups.^{6,8} A high proportion of mothers in both groups breast-fed their infants from birth (93% and 92% in the intervention and control groups, respectively). At 8 months after birth, differences in the prevalence of breast-feeding between the intervention and control groups were significant (61% vs 50%, $P = .02$). Only 19.5% of infants in the intervention group received solids by the age of 4 months compared with 49.8% of the control infants ($P < .001$). Significantly fewer children in the intervention group were in daycare by 1 year compared with control infants (3.6% vs 10.3%, $P = .004$).

Follow-up assessment

At 7 years, the research nurse completed a questionnaire on all children contacted ($n = 469$), either when they returned for their interview with the pediatric allergist or by telephone for those who were unable to return or refused. The questionnaire used was modified from that used in the International Study of Asthma and Allergy in Childhood.⁹ Respiratory symptoms asked about included wheeze, attacks of wheeze and shortness of breath, nocturnal awakening caused by wheeze, and the frequency and severity and medication for treatment of wheeze attacks in the last 12 months.

On those who returned for further assessment, a pediatric allergist in each center without knowledge of the group allocation status of the children and who did not provide health care services to the families conducted a structured interview with parents by using a standardized form to record symptoms and physical findings ($n = 380$). Spirometry and methacholine challenge testing were performed after obtaining parental consent. The diagnoses of asthma and other atopic disorders were clinical decisions made by the pediatric allergists without knowledge of the results of the questionnaire, allergy skin tests, spirometry, or methacholine challenge tests.

Allergy skin tests were performed with the epicutaneous method by using a prick lanceter (Hollister-Stier, Omega Laboratories LTD, Montreal, Quebec, Canada) with the following allergens (Hollister-Stier, Omega Laboratories LTD): house dust mite (*Dermatophagoides*

pteronysinus and *Dermatophagoides farinae*), cat, dog, cockroach, *Alternaria* species, *Cladosporium* species, tree, grass and weed (ragweed) pollens, cow's milk, egg white, wheat, soy, and peanut. Histamine (1 mg/mL) was used as the positive control, and saline was used as the negative control. The largest wheal diameter and its perpendicular were measured at 15 minutes after testing. A mean wheal diameter of 3 mm or greater than that elicited by the negative control was considered a positive reaction. Atopy was defined as a positive skin test reaction to one or more of these common allergens.

Methacholine (Methapharm Inc, Brantford, Ontario, Canada) challenge testing was carried out according to the protocol of Cockcroft et al.¹⁰ Two children who had FEV₁ values of less than 70% of predicted value were excluded from methacholine testing, but both of them had a postbronchodilator change in FEV₁ of 12% or more, and they were considered to have bronchial hyperresponsiveness (BHR). The provocative concentration of methacholine that induced a 20% decrease in FEV₁ from postsaline value (PC₂₀) was determined. BHR was defined as a PC₂₀ of less than 7.8 mg/mL methacholine.¹¹ The percentages of children whose FEV₁ values decreased by 20% at 2, 4, 6, and 7.8 mg/mL methacholine were also determined.

Follow-up assessment of all children was completed in 1 year.

Ethics

Ethics Committees of the University of British Columbia and the University of Manitoba approved the study. Parents provided written informed consent.

Data analysis

Our aim was to identify the size of the effect of our intervention program on the point prevalence of asthma symptoms, pediatric allergist-diagnosed asthma, allergic rhinitis and atopic dermatitis, BHR, and atopy at 7 years of age. Distribution of outcome profiles was compared between the control and intervention groups by using χ^2 analysis and *t* tests, where appropriate. Relative risks (RRs) with 95% CIs were estimated, and risk estimate-adjusted potential confounding variables included sex (male and female), first-born status (yes and no), race (white, oriental, and others), socioeconomic status (mother with and without postsecondary education), maternal and paternal history of asthma, and history of asthma in older siblings (yes and no for each) by using multiple regression analysis.

Statistical analysis was carried out with SPSS/PC Version 10 (SPSS, Chicago, Ill) and Stata statistical software, version 6.0 for Windows 8 (Stata Corp, Tex).

RESULTS

The characteristics at baseline of the 380 children who returned for an interview and physical examination at 7 years of age are shown in Table I. Except for a greater percentage of mothers in the control group having postsecondary education, personal and family characteristics at baseline of those who came in for interview and examination at 7 years of age were not different from the characteristics of those who only completed a questionnaire over the telephone and also were not different from those of the 80 children who were lost to follow-up (data not shown).

Table II shows the frequencies and adjusted RRs and 95% CIs of allergic rhinitis, atopic dermatitis, pediatric allergist-diagnosed asthma, and asthma symptoms, nasal

TABLE I. Demographic characteristics of those who were interviewed and examined by pediatric allergists at age 7 years (n = 380)

Characteristics	Control group (n = 178)	Intervention group (n = 202)	P value*
Male, N (%)	84 (47.2)	93 (46.0)	.837
First born, N (%)	102 (57.3)	96 (47.5)	.064
Ethnic, N (%)			
Whites	142 (79.8)	159 (78.7)	.899
Nonwhites	36 (20.2)	43 (21.3)	
Mother received postsecondary education, N (%)	151 (84.8)	144 (71.3)	.002
Family history of asthma, N (%)			
Mother	69 (38.8)	93 (46.0)	.177
Father	69 (40.1)	61 (31.1)	.081
Older sibs	24 (13.5)	39 (19.3)	.132
Family history of other allergic disorders, n (%)			
Mother	140 (78.7)	152 (75.2)	.466
Father	121 (69.9)	122 (61.9)	.124
Older sibs	61 (34.3)	80 (39.6)	.290
Smokers in the family at birth, N (%)			
Mother	17 (9.8)	13 (6.4)	.341
Father	30 (16.9)	34 (16.8)	1.00
Others	5 (2.8)	9 (4.5)	.429
Pets at home at birth, N (%)			
Any	64 (36.0)	82 (40.6)	.398
Cats	38 (21.3)	40 (19.8)	.799
Dogs	26 (14.6)	32 (15.8)	.776
City where the trial was conducted, N (%)			
Vancouver	86 (48.3)	100 (49.5)	.838
Winnipeg	92 (51.7)	102 (50.5)	

*Comparison of the 2 groups by using χ^2 tests.

symptoms, and skin rash in the last 12 months in the control and intervention groups. The proportion of children with pediatric allergist-diagnosed asthma was significantly lower in the intervention group (14.9%) compared with the control group (23.0%; adjusted RR, 0.44; 95% CI 0.25-0.79). The prevalence of allergic rhinitis and atopic dermatitis was not different between the 2 groups.

The prevalence and relative risks for most of the asthma symptoms in the last 12 months were lower in the intervention group compared with the control group, and this is significant for wheeze and wheeze apart from colds. The prevalence of emergency department visits for wheeze or asthma was higher in the intervention group, but the numbers were small.

Comparisons of asthma symptoms, nasal symptoms, and skin rash in the control and intervention groups were also carried out to include children who only had questionnaire data. The prevalence of asthma symptoms were also significantly lower in the intervention group compared with the control group for wheeze (16.8% vs 26.0%; adjusted odds ratio [OR], 0.55; 95% CI, 0.34-0.86),

TABLE II. Symptoms in the last 12 months (questionnaire), diagnosis by pediatric allergists, and laboratory findings in the control and intervention groups

	Control group	Intervention group	Adjusted RR (95% CI)*	P value
Symptoms in the last 12 mo	N = 178	N = 202		
Wheeze	52 (29.2)	35 (17.3)	0.42 (0.25-0.71)	.001
Wheeze apart from colds	24 (13.5)	15 (7.4)	0.39 (0.18-0.83)	.015
≥3 attacks of wheeze and SOB	25 (14.0)	22 (10.9)	0.61 (0.31-1.20)	.152
Nocturnal awakening caused by wheeze	5 (2.6)	3 (1.5)	0.51 (0.12-2.29)	.359
Wheeze after exercise	25 (14.0)	17 (8.4)	0.48 (0.22-1.01)	.054
Cough at night, apart from colds	37 (20.8)	40 (19.8)	0.84 (0.49-1.43)	.520
Used bronchodilator for wheeze	43 (24.2)	39 (19.3)	0.63 (0.37-1.07)	.085
Used anti-inflammatory for wheeze	37 (20.9)	31 (15.3)	0.63 (0.36-1.10)	.107
Emergency department visit for wheeze	4 (2.2)	10 (5.0)	1.68 (0.42-6.78)	.464
Nasal symptoms apart from colds	60 (33.7)	80 (39.6)	1.23 (0.80-1.89)	.344
Skin rash lasting for ≥6 mo	45 (25.3)	45 (22.4)	0.83 (0.51-1.34)	.445
Diagnosis by pediatric allergists				
Asthma	41 (23.0)	30 (14.9)	0.44 (0.25-0.79)	.006
Allergic rhinitis	49 (27.5)	64 (31.7)	1.13 (0.71-1.81)	.611
Atopic dermatitis	24 (13.5)	25 (12.4)	0.92 (0.49-1.73)	.791
Laboratory investigations	N = 164	N = 186		
BHR (PC ₂₀ ≤7.8)	117 (71.3)	141 (75.8)	1.27 (0.77-2.10)	.347
Atopy (positive skin test to ≥1 allergens)	72 (41.6)	95 (49.0)	1.23 (0.80-1.90)	.349
Asthma (wheeze plus BHR)	41 (25.0)	24 (12.9)	0.39 (0.22-0.71)	.002

*Adjusted for differences in maternal education, maternal and paternal and older siblings with history of asthma, and male sex.

wheeze apart from colds (8.0% vs 13.2%; adjusted OR, 0.54; 95% CI, 0.29-0.99), attacks of wheeze associated with shortness of breath (16.5% vs 26.0%; adjusted OR, 0.53; 95% CI, 0.34-0.84), nocturnal awakening caused by wheeze (9.2% vs 11.9%; adjusted OR, 0.70; 95% CI, 0.38-1.28), and wheeze after exercise (7.6% vs 13.2%; adjusted OR, 0.48; 95% CI, 0.26-0.90).

The mean FEV₁ values (92.7% ± 11.3% of predicted value in the control group and 93.3% ± 12.5% of predicted value in the intervention group) were not different between children in the intervention and control groups. The findings were similar for forced vital capacity and FEV₁/forced vital capacity (data not shown).

Fig 2 shows that there were no significant differences in the proportions of children who had a decrease in FEV₁ by 20% at varying concentrations of methacholine between the control and intervention groups. The prevalence of BHR, defined as a PC₂₀ of less than 7.8 mg/mL, was similar in the 2 groups. The prevalence of a PC₂₀ of less than 2 mg/mL was higher in the intervention group than in the control group but not statistically significant.

The prevalence of asthma, defined as wheeze in the last 12 months and the presence of BHR, was 12.9% in the intervention group and 25.0% in the control group (adjusted RR, 0.39; 95% CI, 0.22-0.71; Table II).

Almost all (96.6%) of the children who came for an interview and physical examination had allergy skin tests. Although there were no significant differences between groups, the intervention group had a higher proportion of children with a positive skin reaction to one or more common allergens than the control group (49.0% vs 41.6%, $P = .349$), especially to peanut (12.4% vs 6.9%, $P = .113$; Fig 3).

DISCUSSION

This is a study of the outcomes at 7 years of a prospective, randomized controlled trial with a multifaceted intervention program to decrease exposure to allergens (both inhaled and ingested) and environmental tobacco smoke in the first year of life of infants at high risk for the development of asthma because of their family history. We have previously reported a significant reduction in possible asthma (defined as having, over the past 12 months, at least 2 distinct episodes of cough, each lasting for 2 or more weeks; at least 2 distinct episodes of wheeze, each lasting 1 or more weeks; or, in the absence of a cold, at least one of the following: nocturnal cough at least once a week and hyperpnea-induced cough or wheeze) in the intervention group at 12 and 24 months of age.^{6,7}

We now report a significant reduction of 56% in the prevalence of pediatric allergist-diagnosed asthma associated with a significant reduction of asthma symptoms, including wheeze, attacks of wheeze with shortness of breath, and wheeze associated with nocturnal awakening, at 7 years of age in children in the intervention group compared with children in the control group. There was also a tendency toward the prevalence of bronchodilators and anti-inflammatory drugs for the treatment of asthma symptoms to be lower in the intervention group compared with the control group. This multifaceted program, however, did not reduce the prevalence of BHR or sensitization to common allergens in the intervention group. The dissociation between the successful reduction of asthma diagnosis by pediatric allergists and the more objective tests of BHR and atopy is unlikely the result of incorrect diagnoses made by the pediatric allergists because BHR

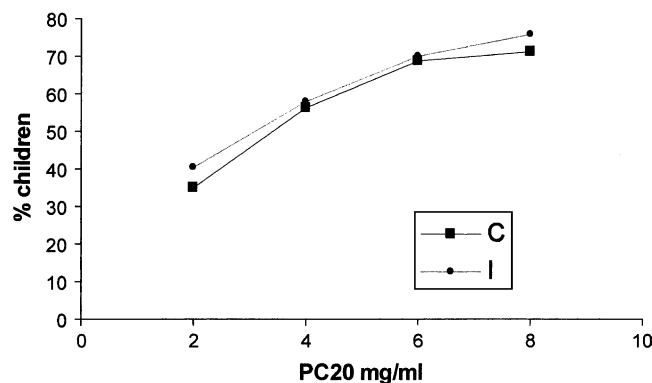


FIG 2. Proportion of children with BHR according to different cutoff points of PC₂₀ in the intervention group (I) and the control group (C).

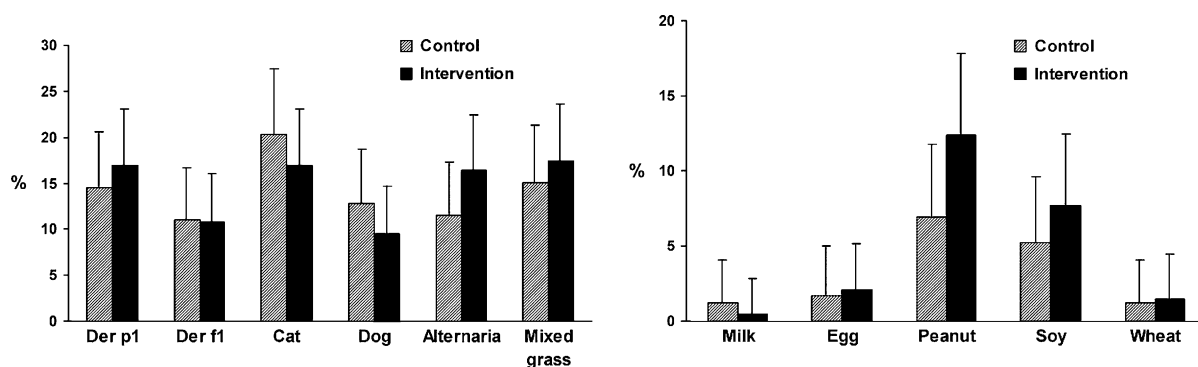


FIG 3. Percentage of children with positive skin test reactions to various specific allergens in the intervention and control groups.

and atopy are often present in individuals without asthma. It was also not due to bias on the part of the pediatric allergists because they were not aware of the group allocation of the children or the results of methacholine challenge tests and allergy skin tests when they were conducting their assessment of the children. The prevalence of asthma, defined as BHR plus wheeze in the last 12 months and derived from a questionnaire interview conducted independently by research nurses, was also significantly reduced by 61% in the intervention group compared with the control group, providing additional evidence for less asthma in the intervention group.

The prevalence of BHR (defined as a PC₂₀ of less than 7.8 mg/mL) in this cohort at age 7 years was 73.7%. This is very high compared with the 16% to 30% prevalence reported in other studies of schoolchildren.¹¹⁻¹³ The high prevalence of BHR in the cohort is likely due to our selection of a high-risk group on the basis of a history of asthma and other atopic diseases among the first-degree relatives for this study. Self-reported asthma was present in 42.6% of mothers, 35.3% of fathers, and 13.4% of older siblings. Another explanation for the high prevalence of

BHR could be related to the quality of the first methacholine challenge test attempted in this group of 7-year-olds.

Arshad and colleagues^{1,14-16} carried out a primary prevention of asthma study in 120 high-risk infants on the basis of an atopic background. Using an intervention focused on house dust mite control and food avoidance in early life, the authors reported a dramatic reduction in recurrent wheezing at 12 months. By 2 years of age, although the prevalence of asthma was lower in the intervention group compared with that in the control group, the difference was not statistically significant.¹⁴ At the age of 8 years, a significantly reduced risk of asthma symptoms, such as current wheeze, nocturnal cough, and exercise-induced wheeze, was found in the intervention group compared with the control group.¹⁶ The prevalence of BHR defined as a PC₂₀ of less than 8 mg/mL at the age of 8 years was lower (not statistically significant) in the intervention group compared with the control group (32.7% and 43.1%, respectively), considerably lower than the prevalence of BHR in our cohort. However, a history of familial asthma was present in a significantly smaller proportion of their cohort (24.2% of mothers, 23.3% fathers, and 26.7% siblings) compared with our cohort. In

contrast to our study, Arshad et al¹⁶ observed that atopy was significantly reduced in the intervention compared with the control group at 8 years (OR, 0.21; 95% CI, 0.07-0.62). The prevalence of positive skin test responses to any allergen in their control group was 46.8%, about the same as our cohort. The history of allergy among first-degree relatives was similar for the 2 cohorts.

There are 3 other prospective, randomized controlled trials conducted in high-risk children recruited prenatally for primary prevention of asthma using house dust mite avoidance and other measures.²⁻⁵ The intervention measures of the Australian Childhood Asthma Prevention Study consisted of house dust mite avoidance measures and dietary supplementation with omega-3 fatty acids.^{3,4} At 3 years, there was a significant reduction of 10% in the prevalence of cough in atopic children but not in the nonatopic children in the active diet group and a significant reduction in sensitization to house dust mite in the active allergen avoidance group.⁴ The Manchester Childhood Asthma and Allergy Prevention Study, using environmental control measures, reported a significant reduction in the prevalence of severe wheeze with shortness of breath, prescription of medication for the treatment of wheezy attacks, and wheeze after vigorous playing, crying, or exertion during the first year of life.² However, the multinational study of prevention of allergy in children in Europe, consisting of not only house dust mite avoidance but also an educational package on the development of allergies, did not find any difference in the prevalence of sensitization to house dust mite or the prevalence of various asthma symptoms at 2 years.⁵ A longer period of follow-up will be required to determine the effectiveness of these intervention trials.

It is possible that both BHR and atopy, which are genetically predetermined, cannot be easily modified by decreasing exposure to allergens. We have shown that our intervention measures applied during the first year of life resulted in a lower level of exposure to indoor allergens, reduced exposure to environmental tobacco smoke, and a higher proportion of breast-feeding in the intervention group.⁶ These interventions reduced the prevalence of possible asthma at 1 and 2 years of age and clinical manifestations of asthma at 7 years. We speculate that it might be possible that our multifaceted intervention during an early-life window of opportunity had an effect on the developing airways in these children. The genetic determination of BHR and asthma might well be parallel events that, when they intersect, have the potential to induce clinical disease. Inflammatory airway changes, airway subbasement membrane collagen deposition, mucus gland hyperplasia and hypertrophy, and smooth muscle hyperplasia and hypertrophy might relate to atopy and could worsen constitutive airway responsiveness. Early-life modification of one or more of these inducible factors might affect the clinical presentation (symptomatic BHR) and decreased clinical asthma in our cohort.¹⁷ We hypothesize that the intervention measures might have reduced the degree of airway inflammation, which we did not measure as an outcome at 7 years. Asthma at age 7

years, especially in the presence of atopy, is likely to represent persistent disease.

It should be noted that our cohort consisted of highly educated families, with the majority of mothers having postsecondary education. This might have contributed to the effectiveness of the intervention program. Moreover, the prevalence of smoking among parents was low. Differences in the effectiveness of primary prevention of asthma and allergies could well be related to differential efficacy of decreasing allergen exposure, given the presence of absence of prenatal or postnatal environmental tobacco smoke exposure.

In conclusion, the multifaceted intervention program applied during the first year of life for the primary prevention of asthma in a group of high-risk children significantly reduced the prevalence of pediatric allergist-diagnosed asthma and asthma symptoms but not allergic rhinitis, atopic dermatitis, atopy, or BHR at 7 years of age. It will be important to reassess these children at age 11 to 12 years to determine whether the multifaceted intervention program carried out during the first year of life has been effective in decreasing the lifelong risk for asthma or has merely postponed the onset of asthma.

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Correction

With regard to the May 2005 editorial entitled "Does obesity weigh heavily on the health of the human airway?" (2005;115:921-4): In the second sentence of the section entitled "EXPERIMENTAL EVIDENCE FOR ASSOCIATION," a quotation was incorrectly attributed to an article in the May issue by S.A. Shore and J.J. Fredberg. In fact, the quotation is from the article in the May issue by G. Fantuzzi (pages 911-9). The sentence should have appeared as follows:

Fantuzzi,⁸ in an article in this issue, has quite rightly commented that "[t]he majority of studies published on this topic are epidemiologic investigations; the paucity of basic research on the possible role of adipose tissue in modulating asthma susceptibility and symptoms is quite striking."