

Characterization of tree allergy prevalence in children younger than 4 years

The prevalence and severity of atopic diseases in children are increasing.^{1,2} The effects of aeroallergen sensitivity on these diseases are manifold. In young children, the presence of aeroallergen sensitivity may serve as a risk factor for the development of persistent asthma.³ Concomitant aeroallergen sensitivity is frequently present in both chronic upper⁴ and lower airway diseases⁵ and is additionally associated with severity of rhinitis and asthma in children.^{5,6} Therefore, understanding of an atopic child's aeroallergen sensitivity profile through testing is important not only for instituting therapeutic avoidance measures but also as a prognostic indicator.⁷

Because sensitization requires exposure over time, some clinicians suggest withholding formal testing for aeroallergen sensitivity, in particular to outdoor allergens, in infants or young children. We previously described the aeroallergen sensitivity profiles of atopic children of all ages⁸ and noted that, although indoor aeroallergen sensitivity was more common, sensitization to outdoor aeroallergens (tree, grass, or weed pollens) was present in 9.5% of children aged 0 to 2 years and 18.2% of children aged 2 to 4 years being sensitized to pollens. In particular, tree pollen was the primary sensitizer in these younger children, with prevalence rates approaching that of dust mite sensitization.⁸

In this context, we sought to further characterize tree pollen sensitization with a focus on which tree species may be more commonly sensitizing. We retrospectively analyzed the subset of a previously described atopic pediatric cohort⁸ who received tree pollen allergy testing with skin prick tests (SPTs) to commercially available extracts (Greer Laboratories, Lenoir, North Carolina; and Hollister-Stier, Spokane, Washington) (including birch, oak, elm, maple, ash, hickory, and/or tree extract mixtures [mix 1: birch, oak, elm, and maple; mix 2: pecan, maple, oak, American sycamore, and black willow]) as part of an allergy evaluation. Descriptive statistics and univariate and multivariate associations (through logistic regression with the `lrm[]` function of the `rms` library or Poisson regression with the `glm[]` function, where appropriate) were performed with R statistical software (www.r-project.org). Only results of multivariate regressions, which were performed on variables statistically significant ($P < .05$) on univariate association, are reported.

This cohort of 1,208 children, with mean age of 7.0 years (age range, 0.53–18.9 years), included 57.8% boys ($P < .001$). In these children, the prevalence of tree allergy, reflected by the presence of at least one positive tree allergen test result, was 36.7% (95% confidence interval [CI], 34.0%–39.4%). The prevalence of tree pollen sensitization increased with age (Fig 1A), with the highest prevalence noted in children aged 10 to 12 years (57.9%; 95% CI, 49.9%–65.5%). Both male sex (odds ratio, 1.54; 95% CI, 1.19–1.98; $P = .001$) and increasing age (odds ratio, 1.15; 95% CI, 1.12–1.18; $P < .001$) were associated with an increased risk of any tree pollen sensitization. In 688 children, tree-specific allergy testing to birch, oak, elm, maple, ash, and/or hickory trees was performed (Fig 1A). Associations were performed to understand why only a fraction of the cohort received tree-specific testing. Tree-specific testing was not associated with positive test results on mixed tree allergen testing ($P = .08$) or sex ($P = .73$) but instead only associated with increasing age ($P < .001$), reflecting the simple convenience of performing a greater number of SPTs in older children.

Of children in this cohort who underwent SPTs for tree pollens, 361 were younger than 4 years. In these children, who

were predominantly male (62.6%; 95% CI, 57.5%–67.4%), the prevalence of any tree pollen sensitization was 13.0% (95% CI, 9.9%–16.9%). In those children with positive test results for tree sensitization, 86.3% (95% CI, 74.3%–93.2%) had comorbid asthma or allergic rhinitis and 21.6% (95% CI, 12.5%–34.6%) had comorbid eczema/atopic dermatitis. Moreover, 64.7% (95% CI, 51.0%–76.4%) experienced outdoor asthma or rhinitis exacerbations (reported by parents as increased frequency of symptoms, such as sneezing or wheezing) during tree pollen season. Compared with children 4 years or older, the prevalences of tree-specific sensitizations in children younger than 4 years were significantly different (Figure 1B). In children younger than 4 years, the most common tree-specific sensitivities were for maple (11.3%) and ash (9.4%) compared with birch (5.6%), oak (5.6%), elm (7.4%), and hickory (5.7%). In children 4 years and older, the prevalences of birch ($P = .003$), oak ($P = .004$), and hickory ($P = .007$) pollen sensitizations were significantly lower in children younger than 4 years (P values adjusted for multiple comparisons with the Holm-Bonferroni method).

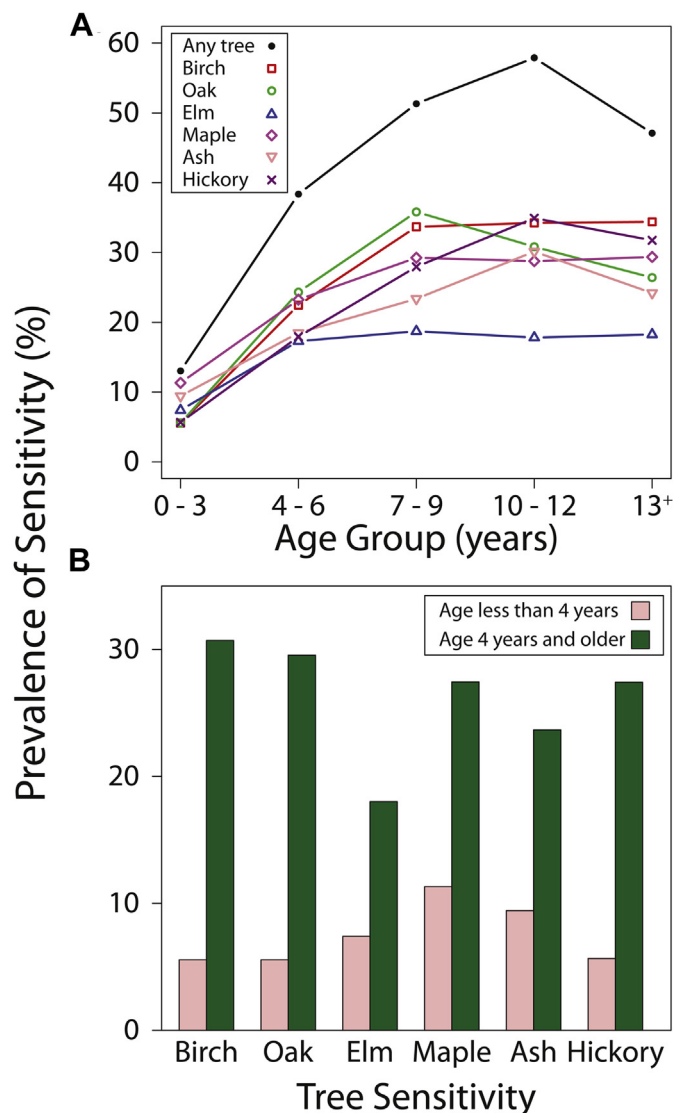


Figure 1. Prevalence of sensitivity to trees (A) across age groups and (B) in children younger than 4 years of age compared to those children 4 years and older.

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These results reflect the characterization of pediatric tree sensitization, the most prevalent pediatric outdoor allergy, in a large cohort of children. Although these results reflect characteristics of our patients and may not be applicable to other patients in other regions, these results nonetheless illustrate several considerations in the approach to pediatric aeroallergen sensitization. In addition, because tree pollen season may be even longer for patients in other areas of the country compared with our cohort in the Northeast, it is likely that the significance of tree sensitization in children demonstrated here is generalizable to other areas of the country. Our results indicate that although outdoor sensitization is traditionally not expected or sought in younger children, tree sensitization may be present in a clinically significant fraction of children of all ages. With a notable prevalence (13.0%) in children younger than 4 years, the prevalence of tree pollen sensitivity approaches that of the most common indoor aeroallergen sensitivity by the age of 4 years.⁸ In our cohort, the tree allergen sensitization profile of children younger than 4 years (in whom maple tree sensitivity was most prevalent) was significantly different than children 4 years and older (in whom birch tree sensitivity was most prevalent). Moreover, the clinical relevance of these tree sensitivities in these children younger than 4 years was confirmed by reports of seasonal outdoor exacerbations of rhinitis or asthma symptoms in a large fraction of the children. In light of the important role for aeroallergen sensitivity in the pathogenesis of pediatric rhinitis and asthma,^{2,7} our results support consideration of performing SPTs to trees in children, including those younger than 4 years.⁹ Particular consideration for tree SPTs should be given to those children younger than 4 years who have a diagnosis of asthma, recurrent wheezing, or suspicious symptoms outdoors during tree pollen season.¹⁰

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Effect of inhalation exposure to wheat flour on sputum levels of brain-derived neurotrophic factor

In the physiopathogenesis of occupational asthma (OA), neurogenic mechanisms may be involved, although they remain poorly understood. Currently, there is increasing interest in the potential role of neuroeffector mechanisms in asthma. The neurotrophins family, comprising nerve growth factor, brain-derived neurotrophic factor (BDNF), neurotrophin 3, and neurotrophin 4, appears to have a role in features of asthma, including airway hyperresponsiveness and inflammation, neuronal plasticity, and airway remodelling.¹ BDNF levels have been found to be enhanced in serum from asthmatic patients.² In addition, BDNF levels are increased in bronchoalveolar lavage fluid (BALF) from asthmatic patients after allergen challenge.³ This finding has been corroborated in mouse models of allergen challenge.⁴ BDNF also appears to play a role in the eosinophilic inflammation observed in asthma. This effect is exerted by direct interaction with the neurotrophin receptors on the surface of eosinophils.⁵ In addition, human peripheral eosinophils are capable of producing BDNF.⁶ There are

no data on changes in BDNF levels in induced sputum (IS) after challenge with occupational allergens. We assessed the effect of specific inhalation challenge (SIC) with flour on sputum levels of BDNF.

Eight men (27–49 years old) with a known diagnosis of OA due to wheat flour were studied (eTable 1). The diagnosis of OA was made in all cases by SIC in a specialized hospital laboratory. The men had a positive skin prick test result to one or more common aeroallergens and to wheat flour. Forced expiratory volume in 1 second (FEV₁) was 70% or greater in all study participants. Most participants were nonsmokers or ex-smokers (n = 7 of 8), with a mean duration of exposure to causal agent of 12.7 years. After the diagnosis of OA, all participants were no longer exposed to causal agent and asthma symptoms were stable. Informed consent was obtained from all participants.

The study participants underwent standardized SIC as previously described,⁷ with monitoring of bronchial responses on consecutive control and active challenge days. FEV₁ was measured before and serially (every 10 minutes for 1 hour, every 30 minutes for 2 hours, and then hourly) for 6 hours after exposure. IS examination and measurement of bronchial responsiveness to

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