Analysis of IgE sensitization patterns to tree pollens based on Ecoregion II may allow for geographically informed design of laboratory allergen panels

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Introduction

- Sensitization towards environmental allergens plays a central role in the pathogenesis of allergic diseases (asthma, rhinitis, atopic dermatitis).
- National testing laboratories offer regional respiratory allergy profiles that include "most likely" sensitizers in each region.
- The selection of tree species for allergy panels is typically based on knowledge of local flora, pollen counts and pollen potency, with regional boundaries often based on state lines.
- In this study, we examined sensitization patterns (sIgE positivity rates) to a wide range of tree species in various geographic regions across the United States.

Methods

- Results of sIgE testing for sensitization to pollen from 31 tree species were analyzed from 3,067,173 patients with test orders originating from January 2014 - December 2023 at a single U.S. clinical laboratory (Labcorp; Burlington, NC).
- Positive results were defined as concentration of sIgE antibody ≥0.10 kUa/L.
- Positivity rates were analyzed in various geographic regions using patients' 5-digit zip codes.

Results

- Analysis by Ecoregion II, as defined by the U.S. Environmental Protection Agency, showed different sensitization patterns based on regions with similar ecological profiles **(Figure, Table)**.

  Example: Marine West Coast Forest and Western Cordillera share a common boundary, but have different sensitization patterns, with the former showing the highest positivity for Beech, Hackberry and Mesquite, and the latter showing the highest positivity for Cedar, Olive and Spruce.
- Overall, urban regions showed higher mean positivity compared to rural regions (21.4% vs. 17.8%, respectively). Patients were assigned to "urban" vs. "rural" zip codes based on degree of urbanization reported in the 2010 U.S. Census, as follows: <50% rural ("urban") and ≥50% rural ("rural").
- By U.S. region, the highest positivity rates were seen in the Northeast (23.9%), Mountain Plains (23.4%) and West (22.5%), followed by the Southeast (18.8%) and Midwest (18.1%).

Conclusions

- Analysis by Ecoregion II allowed for a fine-grained delineation of sensitization patterns in scientifically defined regions with homogeneous climate, vegetation and geological characteristics.
- Evaluation of sensitization patterns using large-scale, real-world data may help more appropriately inform geographic boundaries for laboratory allergy testing panels, and better determine the target species to include on such panels.

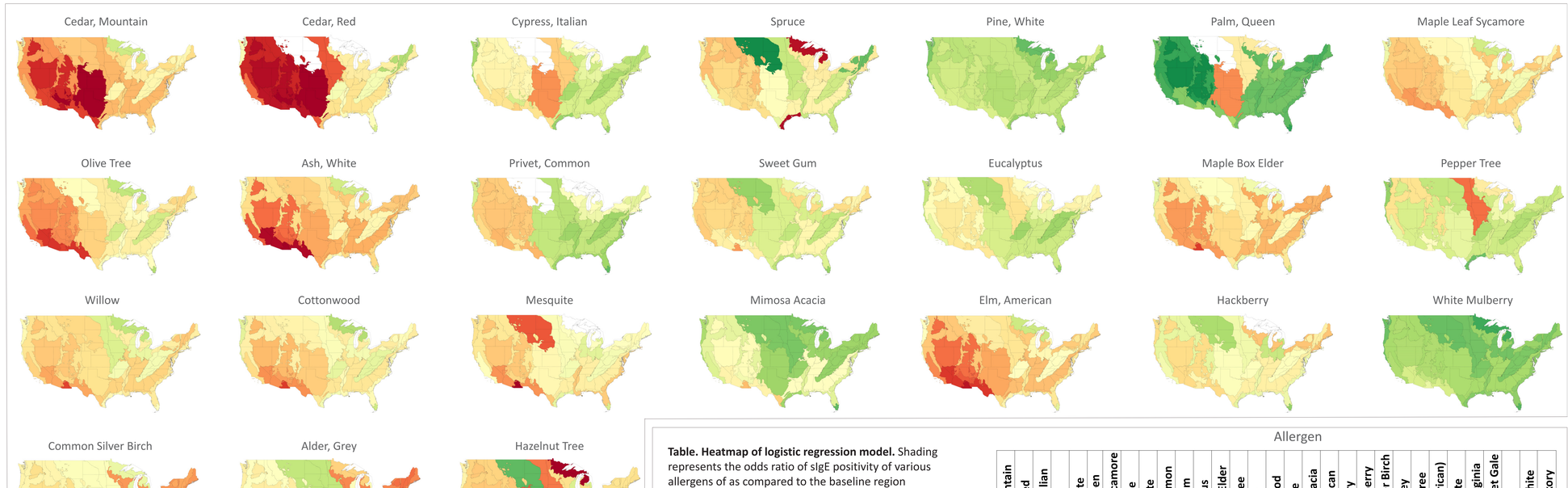

Figure. Heatmaps depicting sIgE positivity rates for 31 tree species by U.S. EPA Level II Ecoregion.

Table. Heatmap of logistic regression model. Shading represents the odds ratio of sIgE positivity of various allergens of as compared to the baseline region (Southeastern USA plains). Cells with no shading indicate regions with an insufficient number of tests for analysis of that allergen.

U.S. EPA Level II Ecoregions	Cedar, Mountain	Cedar, Red	Cypress, Italian	Spruce	Pine, White	Palm, Queen	Maple Leaf Sycamore	Olive Tree	Ash, White	Privet, Common	Sweet Gum	Eucalyptus	Maple Box Elder	Pepper Tree	Willow	Cottonwood	Mesquite	Mimosa Acacia	Elm, American	Hackberry	White Mulberry	Common Silver Birch	Alder, Grey	Hazelnut Tree	Beech (American)	Oak, White	Oak, Live Virginia	Bayberry Sweet Gale	Walnut	Hickory, White	Pecan, Hickory
Alaska tundra																														
Alaska boreal interior																														
Mixed wood shield																														
Atlantic highlands																														
Boreal cordillera																														
Western cordillera																														
Marine west coast forest																														
Mixed wood plains																														
Central USA plains																														
Southeastern USA plains																														
Mississippi alluvial and southeast USA coastal plains																														
Temperate prairies																														
West central semiarid prairies																														
South central semiarid prairies																														
Texas Louisiana coastal plain																														
Tamaulipas Texas semiarid plain																														
Cold deserts																														
Warm deserts																														
Mediterranean California																														
Western Sierra madre piedmont																														
Upper gila mountains																														
Everglades																														

Allergen

0.25 0.50 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00

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