Prevalence of clinic-defined food allergy in early adolescence: The SchoolNuts study

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Background: Rising rates of food-induced anaphylaxis have recently been shown in the adolescent age group, following earlier descriptions of a rise in children younger than 5 years. However, few population-based studies have examined the prevalence of food allergy in adolescence using objective measures such as oral food challenge (OFC).

Objective: We sought to determine the prevalence of food allergy among a population-based sample of 10- to 14-year-old adolescents using clinical evaluation including OFC to confirm the diagnosis.

Methods: Schools were randomly selected from greater metropolitan Melbourne, Australia. Students aged 10 to 14 years, and their parents, were asked to complete a questionnaire regarding the adolescent's food allergy or food-related reactions. Clinic evaluation, which consisted of skin prick tests and OFC where eligible, was undertaken if students were suspected to have current food allergy from parent response. Among 9816 students assessed, 5016 had complete parent response and clinic evaluation when eligible. An additional 4800 students had student questionnaires only.

Results: The prevalence of clinic-defined current food allergy based on history, sensitization data, and OFC results was 4.5% (95% CI, 3.9-5.1), with the most common food triggers being peanut, 2.7% (95% CI, 2.3-3.2), and tree nut, 2.3% (95% CI, 1.9-2.8). Among the additional group of 4800 adolescents who had only self-reported food allergy status available, the prevalence of self-reported current food allergy was 5.5% (95% CI, 4.9-6.2), with peanut, 2.8% (95% CI, 2.3-3.3), and tree nut, 2.3% (95% CI, 1.9-2.8), the most common.

Conclusions: Approximately 1 in 20 10- to 14-year-old school students in Melbourne has current food allergy. This high prevalence suggests that the previously reported rise in food-induced anaphylaxis in this age group may reflect an increasing prevalence of food allergy rather than simply increased reporting of anaphylaxis. (J Allergy Clin Immunol 2017;■■■:■■■-■■■.)

Key words: *Food allergy, adolescence, anaphylaxis, peanut allergy, tree nut allergy, prevalence, population*

Although previous data on hospital anaphylaxis admission rates showed that anaphylaxis related to food allergy was most common among preschool-aged children,[1,2] more recent Australian data suggest that the increase in food anaphylaxis admission rates for older children is accelerating at a greater rate than for preschool-aged children.[3] However, despite the accelerating increase in rates of anaphylaxis, the prevalence of food allergy in this age group at the population level has not been studied to the same extent as in early childhood.[4-6] In particular, few studies have used objective tests for sensitization (skin prick test [SPT] or specific IgE [sIgE] levels) and oral food challenge (OFCs) tests as the diagnostic criteria when measuring the prevalence of food allergy in older children.[7-9]

We aimed to assess the population prevalence of clinic-confirmed food allergy and to investigate disease characteristics in the early adolescent age group within the SchoolNuts study.

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Abbreviations used
ICSEA: Index of Community Socio-educational Advantage
OFC: Oral food challenge
sIgE: Specific IgE
SPT: Skin prick test

METHODS

Study design

A school-based, cross-sectional stratified cluster sampling of primary and secondary school students in greater metropolitan Melbourne (population 3.6 million) was used to recruit a sample of 10- to 14-year-old children (from 2011 to 2014). Schools were randomly selected to reflect the variation in socioeconomic status throughout school districts, and included each of the government, Catholic, and independent school sectors. Schools were eligible for inclusion if they were less than 80 km from the central business district and had more than 20 students per year level. A list of schools was obtained from the 2010 Melbourne Street Directory, stratified by primary versus secondary schools and subdivided into government, Catholic, and independent schools. Each school within those groups was then assigned a number, and a random number generator was used by an independent statistician to select schools to approach.

At each participating school, we invited all students in years 5 and 6 (primary schools) and 7 and 8 (secondary schools) to take part. Researchers visited the schools to distribute a self-administered questionnaire to parent-consented students (student questionnaire). Their parents were also asked to complete a questionnaire (parent questionnaire). To improve the parent participation rate, modified versions of the parent questionnaires with survey questions shortened were subsequently sent by mail, email, or SMS to those who had not completed the full parent questionnaire.

Questionnaire identification of possible food allergy cases (phase 1). The student questionnaire included questions regarding the student's history of food allergy and asthma, and knowledge and attitudes toward food allergy. The parent questionnaire collected additional information on the student's history of food allergy along with family's demographic characteristics, and the allergy history of the other family members.

We selected students eligible for clinic evaluation by a 2-step process. On the basis of the assumption that parents have a better understanding about the history of the student's food allergy, we identified the students with possible current food allergy through the response to the parent questionnaire. Broad criteria were used to capture all cases of possible current food allergy, which was a positive response to either of the following questions:

1. "Does your child currently have food allergy?"
2. "Has your child ever had food allergy, a food reaction, or food-related anaphylaxis?"

Or a negative response to the following question:

3. "Has your child ever eaten the following common allergens (egg, cow's milk, sesame, fish, shellfish, soy, peanut, tree nuts)?" to capture students who may have unrecognized food allergy.

Trained allergy research nurses then collected further information of the reaction/allergy by phone to evaluate whether current food allergy was likely, and if so, whether it was possibly IgE-mediated or not. Students were invited for clinic evaluation when the history suggested current IgE-mediated food allergy (ie, evidence of an acute allergic reaction following ingestion of a food).

Clinic evaluation (phase 2). Students with parent-reported possible food allergy from phase 1 underwent an SPT to a panel of 15 food allergens (egg white, cow's milk, soy, peanut, cashew, almond, hazelnut, walnut, pistachio, macadamia, pecan, brazil nut, pine nut, sesame, shellfish) along with a positive and a negative saline control (ALK-Abelló SA, Madrid, Spain) as well as any other reported allergens using a single tine lancet (Stallergenes, Antony, France) on the student's volar forearm. Blood samples were also collected for serum IgE level measurement.

OFC test. Students were eligible for OFC if they had a positive SPT result to a food they had a history of reaction to and currently avoiding, or they had never eaten. We considered participants with the following criteria to be highly likely to be clinically allergic to that food and did not perform the OFC.[10,11]

1. SPT wheal size of 3 mm or more AND 1 or more of the following:
   a. a history of severe reaction requiring multiple doses of adrenaline;
   b. an episode of anaphylaxis when older than 10 years; and
   c. a convincing history of recent reaction (in the past 12 months) consistent with IgE-mediated food allergy.

Or

2. A history of reaction and highly sensitized (SPT wheal size of ≥8 mm).

A small number of OFCs were conducted despite a negative SPT result due to equivocal history. OFC dosage protocols were consistent with those of the Australian Society of Clinical Immunology and Allergy using graded, incremental doses administered at 15- to 20-minute intervals. Criteria to define a positive OFC result were based on the standardized criteria used in the HealthNuts study with 1 modification, namely, the inclusion of strictly defined subjective persistent symptoms in the upper airways or the gastrointestinal tract[12,13] (for details, see this article's Online Repository at www.jacionline.org).

OFCs were deemed positive if they showed 1 or more of the following reactions within 2 hours of ingestion: 3 or more concurrent noncontact urticaria persisting for at least 5 minutes, perioral or periorbital angioedema, vomiting/diarrhea, or evidence of circulatory or respiratory compromise. When the student did not show objective signs, but had the subjective symptoms of itchy mouth or throat, abdominal pain or nausea, tightness in throat, difficulty talking or difficulty breathing, continuing up to the timing of the next dose, the previous dose was repeated. If the above symptoms persisted for a total of more than 40 minutes or reoccurred on 3 doses, it was recorded as a positive reaction as per previous guidelines.[14]

OFCs were deemed negative when the student had a negative result on the day of the OFC and did not report any positive reactions during home-based food introduction in the week after the OFC.

Definitions

We classified students into 2 groups depending on the availability of the parent questionnaire and completion of research nurse history. Students who had a parent questionnaire, with successful phone contact and completion of clinic evaluation when eligible, had a clinic-defined food allergy status available and were classified as the clinic group. *Current clinic-defined food allergy* was defined as a positive OFC or convincing recent or severe history in the context of IgE sensitization (SPT wheal size of ≥3 mm or sIgE ≥ 0.35), or highly sensitized (SPT wheal size of ≥8 mm) (see Table I for details). Students eligible for an OFC but declined were also treated as inconclusive current food allergy cases.

We classified the remaining students, who had a student questionnaire only or parent questionnaire but without nurse contact or completion of clinic evaluation when eligible, as the questionnaire group. An affirmative response to "Do you have current food allergy?" to core foods was defined as self-reported current food allergy among the questionnaire group (Table II).

We defined the core foods to which we evaluated the prevalence of allergy as cow's milk, egg, soy, wheat, peanut, tree nuts, pine nut, sesame, fish, shellfish, kiwi, banana, avocado, meats, and legumes, on the basis of the most commonly reported allergens in clinics.[15]

Ethics

Ethical approval was obtained from the Royal Children's Hospital Human Research Ethics Committee (Human Research Ethics Committee no. 31079), the Department of Education and Early Childhood, and the Catholic Education Office.