

Letter to the Editor

Prevalence of self-reported food allergy in the National Health and Nutrition Examination Survey (NHANES) 2007-2010

To the Editor:

Food allergy is a common condition, with widely varying estimates of prevalence worldwide and within the United States. The National Health and Nutrition Examination Survey (NHANES) is a periodic survey conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention that examines a nationally representative sample of approximately 5000 subjects each year. Further description of NHANES methodologies can be found in this article's Online Repository at www.jacionline.org. In the 2 most recently published NHANES, 2007-2008 and 2009-2010, information on specific food allergies was collected by questionnaire. To our knowledge, this is the first report of the overall prevalence of food allergy, the prevalence of specific food allergies, and information on demographic characteristics and comorbidities in both children and adults from this survey.

For this analysis, the prevalence of self-reported food allergy was assessed by a positive response to the question, "Do you have any food allergies?" If the subjects answered yes, they were asked, "What foods are you allergic to?" with options including allergies to wheat, cow's milk, eggs, fish, shellfish, corn, peanuts, other nuts, soy products, and other foods. Self-reported food allergy was then compared with the subject's reported consumption of milk, shellfish, and fish over the previous 30 days. Self-reported peanut allergy was compared with the reported consumption of peanut in the 24-hour dietary recall. These methods are detailed in this article's Online Repository at www.jacionline.org. Predictors of food allergy, including demographic features and other medical conditions, were then examined, as are also detailed in this article's Online Repository at www.jacionline.org.

To account for oversampling, complex sampling methods, and nonresponse, weights and survey strata provided with the surveys were used for all analyses. Because the prevalence of food allergy in the 2007-2008 and 2009-2010 surveys was found to be similar, these data were combined (see [Tables E1 and E2](#) in this article's Online Repository at www.jacionline.org). All analyses were done in STATA SE/11 (College Station, Texas).

A total of 20,686 individuals were surveyed between 2007 and 2010. Overall, the prevalence of self-reported food allergy was 8.96% (95% CI, 8.32% to 9.60%), corresponding to 6.53% in children (95% CI, 5.69% to 7.37%) and 9.72% in adults (95% CI, 8.94% to 10.5%). When limiting the analysis to adults who reported allergy to peanuts, tree nuts, fish, and shellfish, which are more likely to persist into adulthood,¹ this prevalence decreased to 3.51% (95% CI, 3.01% to 4.02%). "Other," milk, peanut, and shellfish were the most common self-reported allergies in both children and adults ([Table I](#)). "Other" allergy likely includes symptoms with fruits and vegetables, such as found in pollen-food allergy syndrome, and this value is consistent with prevalence estimates reported in a systematic review on plant food allergy.²

Of the subjects with self-reported milk allergy, 34.4% (34.2% of children and 34.5% of adults) reported drinking cow's milk in the month before the interview. We similarly found that 24.6%

(11.0% of children and 26.5% of adults) of those with shellfish allergy and 34% (21.7% of children and 37.8% of adults) of those with fish allergy reported consumption of the respective food over the previous month. Only 4.8% of subjects with peanut allergy (5.4% of children and 4.6% of adults) reported recent peanut consumption, but by necessity, this question was more limited (24-hour recall). Estimated prevalence excluding those with reported consumption of these foods is included in [Table I](#).

Among adults, self-reported food allergy was more common in women, in those with a higher household education level, and in those of non-Hispanic black race/ethnicity ([Table II](#) and [Table E3](#) in this article's Online Repository at www.jacionline.org). Among children, there were no significant differences in prevalence by gender or household education level, but food allergy was more prevalent in non-Hispanic black children than in other race/ethnicities. In both adults and children, food allergy was more common among subjects with asthma or allergic rhinitis and increased in prevalence with increasing severity of asthma ([Table II](#) and [Table E4](#) in this article's Online Repository at www.jacionline.org).

Our analysis is limited in that it is based on self-report, which has been shown to overestimate the true prevalence of oral food challenge-confirmed food allergy.³ Furthermore, the question asked here, "Do you have any food allergies?" is broad and may be answered affirmatively by subjects who have had other adverse reactions to foods, such as lactose intolerance or gluten sensitivity, rather than true IgE-mediated disease. We expected this to be a more significant problem for milk and wheat allergy than for peanut, tree nut, fish, or shellfish allergy. However, we found that a similarly high percentage of subjects (25% to 35%) with self-reported milk, fish, and shellfish allergies reported recent consumption of these foods. It is possible that individuals with a true IgE-mediated allergy to one particular fish or shellfish may have admitted to eating a fish or shellfish to which they were not allergic, but we would expect this to be a small number of participants. The percentage of subjects with self-reported peanut allergy who admitted to recent consumption was considerably less, although peanut consumption was assessed by a 24-hour rather than 30-day dietary recall.

Recently, a Canadian study compared prevalence estimates based on self-report of peanut, tree nut, shellfish, fish, or sesame allergy to either a convincing history of an IgE-mediated reaction or self-reported physician diagnosis and found little difference.⁴ Following this example, we also estimated the prevalence of peanut, true nut, fish, or shellfish allergy only among adults and found that the estimated prevalence decreased from 9.72% to 3.49%, which is more consistent with previously reported estimates of overall food allergy when confirmed by oral food challenges.⁵ This is still likely an overestimate of true food allergy to these foods, especially given that many with self-reported food allergy admitted to recently eating that food.

Despite these limitations, our estimated prevalences of 8.96% overall and 6.53% among children are similar to previously reported values.^{6,7} Our estimate for children is also consistent with the recent estimated prevalence of 5.1% from the National Health Interview Survey 1997-2011.⁸ Our estimated prevalence of 9.72% among adults is higher than the 6.56% recently reported by Soller et al⁶ but, as above, this value decreased to 3.49% when

TABLE I. Self-reported prevalence of food allergy in the United States

Self-reported specific food allergies	Children	Adults	Total study population	New study population*
All foods	6.53 (5.69-7.37)	9.72 (8.94-10.5)	8.96 (8.32-9.60)	7.64 (7.03-8.24)
Milk	1.94 (1.43-2.44)	2.64 (2.15-3.13)	2.47 (2.10-2.85)	1.62 (1.32-1.92)
SF	0.87 (0.56-1.17)	2.04 (1.70-2.38)	1.76 (1.49-2.03)	1.33 (1.12-1.53)
PN	1.16 (0.83-1.49)	0.89 (0.61-1.17)	0.95 (0.72-1.19)	0.86 (0.65-1.07)
TN	0.52 (0.26-0.79)	0.87 (0.61-1.13)	0.79 (0.59-0.98)	NA
Egg	0.64 (0.41-0.86)	0.51 (0.37-0.65)	0.54 (0.42-0.66)	NA
Wheat	0.29 (0.11-0.47)	0.63 (0.42-0.84)	0.54 (0.38-0.71)	NA
F	0.43 (0.13-0.73)	0.46 (0.33-0.59)	0.45 (0.34-0.57)	0.29 (0.20-0.37)
Soy	0.25 (0.14-0.37)	0.35 (0.17-0.53)	0.33 (0.18-0.47)	NA
Corn	0.28 (0.09-0.47)	0.22 (0.09-0.35)	0.24 (0.12-0.35)	NA
PN/TN	1.42 (1.03-1.81)	1.47 (1.08-1.86)	1.46 (1.13-1.79)	1.38 (1.06-1.70)
PN/TN/SF	2.06 (1.61-2.51)	3.26 (2.79-3.73)	2.97 (2.58-3.36)	2.50 (2.15-2.86)
PN/TN/F/SF	2.29 (1.79-2.80)	3.49 (3.00-3.99)	3.21 (2.80-3.61)	2.62 (2.26-2.99)
Other	2.83 (2.30-3.35)	4.49 (4.02-4.96)	4.09 (3.72-4.47)	NA

Values reported as % (95% CI).

F, Fish; NA, not applicable; PN, peanut; SF, shellfish; TN, tree nuts.

*Study population after excluding those reporting allergy to peanut, shellfish, fish, and milk with recent consumption of the culprit food.

TABLE II. Self-reported prevalence of food allergy by demographic characteristic*

Demographic characteristics	Children	P value	Adults	P value	Total study population	P value
Overall	6.53 (5.69-7.37)		9.72 (8.94-10.5)		8.96 (8.32-9.60)	
Gender						
Male	6.08 (5.23-7.06)	.19	8.21 (7.40-9.11)	.0001	7.68 (7.03-8.39)	.0001
Female	7.00 (5.83-8.39)		11.1 (9.99-12.4)		10.2 (9.22-11.2)	
Education						
<College	5.89 (4.76-7.27)	.30	7.75 (6.81-8.81)	<.001	7.31 (6.55-8.15)	<.001
≥College	6.83 (5.76-8.08)		11.2 (10.0-12.4)		10.1 (9.16-11.2)	
Income						
<1.75 × PL	6.21 (5.40-7.13)	.42	9.06 (8.18-10.0)	.13	8.21 (7.48-9.01)	.02
≥1.75 × PL	6.77 (5.62-8.13)		9.99 (9.06-11.0)		9.30 (8.55-10.1)	
Race						
White	6.34 (5.21-7.69)	.03	9.64 (8.56-10.8)	.24	8.96 (8.03-9.97)	.04
Black	8.13 (6.54-10.1)		11.1 (9.76-12.7)		10.3 (9.16-11.9)	
Hispanic	5.16 (4.26-6.22)		8.48 (7.28-9.87)		7.38 (6.42-8.49)	
Asthma						
No	5.19 (4.54-5.92)	<.0001	8.55 (7.80-9.36)	<.0001	7.76 (7.15-8.42)	<.0001
Yes	13.9 (10.7-17.7)		17.0 (14.9-19.4)		16.2 (14.5-18.0)	
AR						
No	5.88 (5.16-6.69)	<.0001	8.14 (7.39-8.97)	<.0001	7.57 (6.97-8.23)	<.0001
Yes	11.9 (9.27-15.2)		17.5 (15.3-20.0)		16.5 (14.5-18.8)	

Values expressed as % (95% CI).

AR, Allergic rhinitis; PL, poverty level.

*P value determined by Pearson χ^2 test.

including only peanut, tree nut, fish, and shellfish allergy, which is more likely to represent true IgE-mediated disease. Our estimated prevalences for self-reported peanut, tree nut, fish, and shellfish allergy in adults are furthermore consistent with recently reported Canadian values.⁶ Our estimate of peanut allergy prevalence is similar to, though slightly lower than, that reported by Sicherer et al⁹ from a nationwide telephone survey, which may be explained by the higher response rate in the NHANES.

Our findings further support previous observations that food allergy appears to be more prevalent in black children than in other races/ethnicities. Through national telephone surveys, self-reported shellfish allergy was found to be more prevalent in African Americans,¹⁰ and a study examining food allergen-specific IgE demonstrated that non-Hispanic blacks were more

likely to be sensitized to food allergens than other races/ethnicities,¹¹ though the reasons for these disparities remain unclear.

Overall, our results highlight the need for more sophisticated methods, such as validated questionnaires, to perform wide-scale epidemiologic evaluations of food allergy.

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C.A.K. was funded by the National Institutes of Health/National Institute of Allergy and Infectious Diseases (NIAID) (grant no. 1K23AI103187).

Disclosure of potential conflict of interest: The authors declare that they have no relevant conflicts of interest.

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<http://dx.doi.org/10.1016/j.jaci.2013.07.018>

NHANES

The NHANES is designed to assess the health and nutrition of children and adults in the United States. Since 1999, the NHANES has been conducted continuously in 2-year blocks. The survey examines a nationally representative sample of approximately 5000 individuals from 15 counties across the United States each year. Interviews are initially conducted in subjects' homes, followed by physical examinations in mobile centers. In the 2007-2010 surveys, non-Mexican Hispanics were oversampled to provide sufficient power for subgroup analyses. There was an 80% response rate among those interviewed, and sample weights were applied to produce an unbiased national estimate. The NHANES was approved by the institutional review board of the National Center for Health Statistics, and all subjects provided informed consent.

METHODS

Self-reported food allergy was compared with recent ingestion of milk, fish, shellfish, and peanut. Thirty-day consumption of foods was asked for milk, shellfish, and fish, but not for the other allergens queried in the food allergy questionnaire. Twenty-four-hour consumption of peanut was extracted from the detailed food diary as outlined below. For milk, subjects were initially asked the question, "In the past 30 days, how often did you have milk to drink or on your cereal?" If they answered affirmatively ("rarely," "sometimes," "often," "varied"), they were then asked, "What type of milk was it?" Subjects were classified as "drinking milk" if they answered yes to whole milk, 2% milk, 1% milk, or fat-free milk. Consumption was then compared with whether the subject reported a milk allergy to determine what percentage of those with self-reported milk allergy were still consuming the food. Shellfish ingestion was similarly ascertained by asking the question, "During the past 30 days, did you eat any types of shellfish listed on this card?" Subjects were included in the analysis of the percentage of individuals with a self-reported shellfish allergy who were still consuming the food if they answered yes to eating crabs, crayfish, lobster, or shrimp. For fish, subjects

were asked, "During the past 30 days, did you eat any types of fish listed on this card?" and were included if they endorsed eating breaded fish, tuna, bass, catfish, cod, flatfish, haddock, mackerel, perch, pike, pollock, porgy, salmon, sardines, sea bass, shark, swordfish, trout, or walleye. Finally, subjects were interviewed in person to report the type and amount of food and beverages they consumed 24 hours before the interview (midnight to midnight). Peanut-containing foods were identified in the NHANES list of possible participant responses. Subjects who recorded eating these peanut-containing foods were identified and included in the analysis of those with self-reported peanut allergy who were still consuming the food. Further analyses excluded subjects who reported allergy to a food but also reported consuming it either in the past 30 days (milk, fish, shellfish) or 24 hours (peanut).

Education level was assessed by asking the following question to the household representative, "What is the highest grade or level of school you have received?" and was dichotomized as less than or greater than the median value, which was attending college. Income level was assessed as a ratio of family income to poverty threshold and was dichotomized as less than or greater than/equal to the median value of 1.75. The categories of self-reported race/ethnicity were Mexican American, other Hispanic, non-Hispanic white, non-Hispanic black, and other race, including multiracial. For analyses, Mexican American and other Hispanic were combined.

The presence of asthma was assessed by a positive response to the question, "Has a doctor or other health professional ever told you that you have asthma?" and allergic rhinitis was a positive response to the question, "During the past 12 months, have you had an episode of hay fever?" Asthma severity was further characterized by participant responses to the following questions: (1) "Do you still have asthma?" (2) "During the past 12 months, have you had an episode of asthma or an asthma attack?" and (3) "During the past 12 months, have you had to visit an emergency room or urgent care center because of asthma?"

Multivariable logistic regression, stratified by age, was performed to assess the relationship between food allergy and demographic and clinical characteristics. Multivariable models were adjusted for gender, race/ethnicity, education, income, allergic rhinitis, and asthma. A 2-tailed *P* value of less than .05 was considered statistically significant.

TABLE E1. NHANES 2007-2008 prevalence of self-reported specific food allergies

Self-reported specific food allergies	Children	Adults	Total study population
Milk	2.39 (1.48-3.30)	2.70 (1.88-3.53)	2.63 (2.03-3.23)
SF	0.77 (0.21-1.33)	2.09 (1.68-2.50)	1.77 (1.47-2.08)
PN	1.42 (0.90-1.94)	1.06 (0.59-1.53)	1.15 (0.77-1.52)
TN	0.56 (0.17-0.96)	0.96 (0.48-1.43)	0.86 (0.51-1.21)
Egg	0.41 (0.07-0.75)	0.54 (0.34-0.75)	0.51 (0.34-0.68)
Wheat	0.32 (−0.01 to 0.66)	0.74 (0.42-1.05)	0.64 (0.39-0.89)
F	0.53 (−0.05 to 1.10)	0.43 (0.27-0.60)	0.46 (0.27-0.65)
Soy	0.37 (0.14-0.59)	0.34 (0.10-0.58)	0.34 (0.14-0.55)
Corn	0.51 (0.13-0.88)	0.27 (0.05-0.48)	0.33 (0.13-0.52)
PN/TN	1.65 (1.13-2.17)	1.67 (0.96-2.38)	1.66 (1.11-2.22)
PN/TN/SF	2.18 (1.50-2.86)	3.37 (2.61-4.13)	3.09 (2.48-3.70)
PN/TN/SF/F	2.35 (1.61-3.10)	3.55 (2.73-4.37)	3.27 (2.61-3.92)
Other	3.22 (2.44-4.01)	4.81 (4.06-5.56)	4.43 (3.85-5.01)
All foods	7.02 (5.73-8.31)	10.0 (8.72-11.4)	9.32 (8.24-10.4)

Values reported as % (95% CI).

F, Fish; PN, peanut; SF, shellfish; TN, tree nuts.

TABLE E2. NHANES 2009-2010 prevalence of self-reported specific food allergies

Self-reported specific food allergies	Children	Adults	Total study population
Milk	1.49 (0.98-2.01)	2.58 (1.97-3.19)	2.32 (1.81-2.83)
SF	0.96 (0.63-1.29)	1.99 (1.42-2.56)	1.75 (1.27-2.22)
PN	0.90 (0.43-1.37)	0.72 (0.38-1.06)	0.76 (0.45-1.08)
TN	0.48 (0.09-0.87)	0.78 (0.51-1.05)	0.71 (0.48-0.93)
Egg	0.86 (0.55-1.17)	0.48 (0.26-0.69)	0.57 (0.39-0.75)
Wheat	0.25 (0.07-0.43)	0.51 (0.21-0.82)	0.45 (0.23-0.67)
F	0.33 (0.08-0.57)	0.49 (0.27-0.71)	0.45 (0.31-0.59)
Soy	0.14 (0.04-0.24)	0.36 (0.06-0.66)	0.31 (0.08-0.54)
Corn	0.06 (−0.04 to 0.17)	0.18 (0.00-0.35)	0.15 (0.01-0.28)
PN/TN	1.20 (0.57-1.84)	1.27 (0.86-1.68)	1.26 (0.84-1.67)
PN/TN/SF	1.95 (1.30-2.60)	3.15 (2.54-3.76)	2.86 (2.32-3.40)
PN/TN/SF/F	2.23 (1.50-2.97)	3.44 (2.81-4.07)	3.15 (2.61-3.69)
Other	2.44 (1.66-3.22)	4.18 (3.56-4.80)	3.76 (3.24-4.29)
All foods	6.05 (4.83-7.27)	9.40 (8.43-10.4)	8.60 (7.80-9.39)

Values reported as % (95% CI).

F, Fish; PN, peanut; SF, shellfish; TN, tree nuts.

TABLE E3. Relationship between demographic and clinical characteristics and self-reported food allergy*

Characteristic	Children		Adults	
	OR (95% CI)	P value	OR (95% CI)	P value
Female	1.25 (0.73-1.59)	.08	1.35 (1.14-1.59)	.001
Race/ethnicity				
Caucasian	1 (REF)		1 (REF)	
Hispanic	0.94 (0.69-1.28)	.67	1.12 (0.89-1.39)	.32
Black	1.31 (0.93-1.83)	.12	1.28 (1.06-1.53)	<.01
Other	1.54 (0.97-2.46)	.07	1.01 (0.63-1.48)	.94
College education	1.12 (0.79-1.60)	.52	1.46 (1.18-1.82)	.001
Income > 1.75 × PL	1.04 (0.84-1.29)	.70	1.03 (0.91-1.17)	.65
Asthma	2.76 (2.02-3.75)	<.001	1.87 (1.56-2.24)	<.001
Allergic rhinitis	1.85 (1.42-2.40)	<.001	2.11 (1.71-2.61)	<.001

Values reported as adjusted ORs (95% CI).

OR, Odds ratio; PL, poverty level; REF, reference.

*Adjusted for gender, race/ethnicity, education, income, asthma, and allergic rhinitis.

TABLE E4. Prevalence of self-reported food allergy by asthma indicator*

Asthma indicator	Children	<i>P</i> value	Adults	<i>P</i> value	Total study population	<i>P</i> value
No asthma	5.19 (4.54-5.92)	<.0001	8.55 (7.80-9.36)	<.0001	7.76 (7.15-8.42)	<.0001
“Ever been told you have asthma?”	7.40 (4.60-11.6)		13.6 (10.7-17.1)		12.2 (9.94-14.8)	
“Still have asthma?”	15.2 (10.7-21.2)		16.7 (12.8-21.6)		16.3 (13.0-20.3)	
“Had asthma attack in the past year?”	19.9 (13.0-29.3)		24.8 (19.0-31.6)		23.1 (19.1-28.3)	
“Emergency care visit for asthma in the past year?”	21.6 (13.9-32.0)		19.3 (12.5-28.7)		20.1 (14.7-26.9)	

Values reported as % (95% CI).

**P* value obtained by test for trend.