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Anxiety associated with food allergy in adults and adolescents: An analysis of data from the National Health and Nutrition Examination Survey (NHANES) 2007-2010

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23 Clinical Implications: Self-reported food allergies are associated with more anxiety and poorer self-
24 reported mental health in the general U.S. population, particularly among adolescents.

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27 To the Editor:

28 Food allergies affect up to 10% of the population.(1) Anxiety is often reported as a consequence
29 of food allergy; the recent Institute for Clinical and Economic Review Final Evidence Report on food
30 allergy treatments found that “Patients and their caregivers often lead a lifestyle heavily impacted by
31 fear and anxiety”, and cited caregiver and patient anxiety as a major motivation for pursuing food
32 allergy treatments.(2) Several studies have suggested increased psychological distress, including anxiety
33 and impaired quality of life, in those with food allergy, although others have shown no increase in
34 general anxiety or a diagnosable anxiety disorder. (3-6) Most previous studies have focused on
35 caregivers and children and the experiences of adults with food allergy have been largely ignored.
36 Moreover, most prior studies have been small and have included predominately white non-Hispanic
37 families seeking care in specialty centers, and thus may represent a biased population. It is important to
38 have data from representative populations on the relationship between food allergy and anxiety in
39 order to inform our understanding of the burden of anxiety associated with this disease. Here we use
40 the National Health and Nutrition Examination Survey (NHANES) to understand the relationship
41 between self-reported food allergy and anxiety and general mental health in the overall U.S. population.
42 To our knowledge, this is the first report of the association of anxiety in adult and adolescents in the
43 general U.S. population with self-reported food allergy.

44 NHANES is a survey of the non-institutionalized U.S. population by the Centers for Disease
45 Control and Prevention to assess the health and nutritional status of adults and children in the United
46 States. In NHANES 2007-2008 and 2009-2010, information on food allergies, anxiety, and mental health
47 was collected by questionnaires. Methods are detailed in the online repository text and Figure E1.

48 14,706 individuals 12 years and older were included. 9.5% of the population reported at least
49 one food allergy and 1.5% reported peanut or tree nut allergies. 25% of the population reported 7 or

more anxious days in the past 30 days and 19% reported 7 or more days of “not good” mental health. Those with 7 or more days of anxiety or poor mental health were more likely to be female, more likely to have asthma, and had a lower income than those with less than 7 anxious or poor mental health days (Table I).

Of those with self-reported food allergies, 30% reported 7 or more anxious days and 24% reported 7 or more days of poor mental health day in the past month, compared to 24% and 18% of those without food allergies ($p=0.02$ and 0.03), respectively (Figure E2). Although in unadjusted analyses, self-reported food allergy was associated with higher average days of anxiety and poor mental health, with adjustment for age, race/ethnicity, gender, income, and current asthma these differences were only significant for adolescents, where food allergy was associated with 1.5 more days of anxiety (95% CI: 0.2-2.8) and 1.6 more days of “poor mental health” (95% CI: 0.1-3.2) per month (Table II). Further, adolescents with food allergy had 1.7 times increased odds (95% CI: 1.1-2.6) of having at least 7 days of anxiety in the previous 30 days and 1.8 times increased odds (95% CI: 1.0-3.0) of having at least 7 days of poor mental health. Depression, for which data was only available for those 18 and over, was not statistically significantly associated with food allergy.

We then evaluated the associations between peanut/tree nut allergy and anxiety and poor mental health and found that overall the effect sizes were similar or larger than for any food allergy; however, these relationships were not statistically significant. For adolescents, these relationships did not generally hold. This group actually had significantly fewer days of poor mental health in the previous 30 days (1.6, 95%CI: -2.9 to - 0.2) than their counterparts without these allergies (Table E1). There was no significant association between having at least 7 poor mental health days and peanut/tree nut allergy in either adolescents or adults.

Current asthma was significantly associated with anxiety, poor mental health, and depression (Table E2), but did not substantially confound the relationship between food allergies and these measures (Table E3).

Our analysis of a representative sample of the U.S. population showed that self-reported food allergy was associated with a higher burden of anxiety and poorer self-reported mental health in adolescents. This supports previous work in children that found that while rates of diagnosable mental health conditions may not be elevated among those with food allergies, anxious feelings are more common.(6) Our finding of no association between food allergy and depression contrasts with a population based Canadian survey conducted in 2002, where self-reported food allergy was associated with a 1.8 times increased odds of major depression.(7) Little is known about the effects of food allergies on mental health across the lifespan, and these findings show that this relationship varies between adolescents and adults, with food allergy overall associated with anxiety in adolescents, but not adults. Surprisingly, peanut or tree nut allergy was not associated with anxiety or poorer health in adolescents, for reasons we do not understand, but may be related to the small number of adolescents with peanut or tree nut allergy in our sample. The finding that food allergy was not associated with anxiety or poor mental health in adults provides some reassurance that the relationship between food allergy and anxiety may weaken with age, perhaps as patients develop more coping strategies for dealing with their food allergies.

Food allergy may be particularly anxiogenic both because of the threat of unpredictable severe reactions and because food is central to social interactions. (3) Conversely, anxiety may heighten the perception of food reactions, potentially resulting in over diagnosis of food allergies. (5) Furthermore, child anxiety can be influenced by parental anxiety and behaviors and perhaps the youth food allergy-anxiety relationship weakens as one moves away from home. (8) Regardless of whether all of the food allergy reported in this survey would be confirmed if food challenges were done, these results suggest

that self-reported food allergy is associated with increased likelihood of high levels of anxiety, which should be addressed by healthcare practitioners. However, these findings also suggest that many individuals with food allergy have minimal anxiety, with 35% of those with food allergy and 32% of those with peanut/tree nut allergy reporting no days of anxiety in the past month (compared to 43% of those without food allergy). Moreover, on average, adolescents with food allergy only had 1.5 more days of anxiety per 30 days than those without food allergy, a small difference that may not be clinically meaningful.

The relationship between food allergy and anxiety is confounded by several factors; anxiety and food allergy are both more common in adult women, and race/ethnicity and income may also confound these relationships. Prior literature has shown an association between asthma and anxiety.⁽⁹⁾ However, the relationship between food allergy and anxiety remained significant in adolescents even after adjusting for these confounders.

In addition to the limitations of relying on self-report of food allergy and anxiety/mental health, this analysis is also limited by lack of information on mental health diagnoses or treatments. Questions about anxiety and mental health were not asked of younger children, and were not asked of caregivers, who may themselves have poorer mental health related to food allergies. These limitations were balanced by the opportunity to study a representative population that was not clinic based.

Overall, our results emphasize the need to consider the psychological implications of food allergy and other allergic diseases, but provide reassurance that many people with food allergies experience little anxiety. Healthcare providers should address these concerns, and more work is needed to find effective ways to reduce emotional distress associated with food allergy.

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Variable	Food Allergies (n=1376)	No Food Allergies (n=13,330)	P value	Peanut or Tree Nut Allergy (n=178)	No Peanut or Tree Nut Allergies (n=14,528)	P value	Seven or More Anxious Days per 30 days (n=3166)	Six or Fewer Anxious Days per 30 days (n=9703)	P value	Seven or More Poor mental health days per 30 days	Six or Fewer Poor Mental Health Days per 30 days	p value
Mean age, SE	43.5 (0.65)	42.6 (0.33)	0.17	41.8% (1.5)	42.7% (0.33)	0.53	42 (0.44)	43 (0.37)	0.66	40 (0.55)	43 (0.39)	<0.001
Gender, % female	59.7% (56.4-62.9%)	50.5% (49.8-51.3%)	<0.001	54.2% (45.1-63.0%)	51.4% (50.7-52.1%)	0.53	58.3% (56.1-60.5%)	48.2% (47.3-49.2%)	<0.001	62.2% (59.8-64.5%)	48% (47.1-49%)	<0.001
Race/ethnicity			0.002			0.005			0.056			0.01
Mexican	6.0% (4.6-7.9%)	9.3% (6.8-12.7%)		2.1% (0.9-4.9%)	9.1% (6.7-12.3%)		8% (5.4-11.6%)	9.5% (7.0-12.6%)		7.4% (5.2-10.6%)	9.5% (7-12.8%)	
Other Hispanic	6.5% (4.3-9.7%)	5.0% (3.5-7.1%)		4.0% (1.9-8.2%)	5.1% (3.6-7.3%)		5.7% (4-8%)	4.9% (3.4-7.1%)		5.9% (4.1-8.2%)	5% (3.4-7.2%)	
White/Caucasian	66.5% (60.7-71.8%)	67.6% (62.3-72.5%)		68.6% (57.8-77.7%)	67.5% (62.3-72.3%)		70% (64.6-74.9%)	67.7% (62.4-72.5%)		67.8% (62-73.1%)	68.2% (63.1-73%)	
Black/African American	13.5% (11.0-16.5%)	11.6% (9.6-13.9%)		16.9% (11.3-24.5%)	11.7% (9.8-14.0%)		11% (9.2-13.1%)	11.7% (9.6-14.2%)		13% (10.5-16%)	11.2% (9.3-13.5%)	
Other	7.5% (5.0-10.9%)	6.5% (5.2-8.2%)		8.4% (4.3-15.7%)	6.6% (5.2-8.2%)		5.4% (4.0-7.3%)	6.3% (5.1-7.7%)		6% (4.2-8.4%)	6.1% (5-7.5%)	
Mean household income to poverty level ratio, SE	3.0 (0.07)	2.9 (0.05)	0.09	3.4 (0.20)	2.9 (0.05)	0.002	2.8 (0.06)	3.1 (0.5)	<0.001	2.6 (0.06)	3.1 (0.05)	<0.001
Current asthma	16.9% (14.8-19.3%)	6.9% (6.2-7.7%)	<0.001	20.6% (14.8-28%)	7.7% (6.9-8.6%)	<0.001	11.3% (9.7, 13%)	7% (6.3-7.8%)	<0.001	12.8% (7.3-8.8%)	6.9% (6.3-7.5%)	<0.001

- 1 **Table I.** Demographic features by food allergy, peanut or tree nut allergy and anxiety status.
- 2 **Table II.** Relationship between food allergy and anxiety/mental health.

	Unadjusted analyses, overall	Unadjusted, adolescents (12-21)	Unadjusted, adults	Adjusted⁺ analyses	Adjusted⁺, adolescents	Adjusted⁺, adults
n	13,295	2,732	10,756	12,182	2,506	9,859
Days of anxiety in the past 30 days (effect size, 95% CI)	1.3 (0.3, 2.3), p=0.01	1.8 (0.2, 3.4), p=0.03	1.2 (0.1, 2.2), p=0.03	0.9 (-0.1, 1.9), p=0.08	1.5 (0.2, 2.8), p=0.03	0.8 (-0.3, 1.9), p=0.14
Odds of higher anxiety* (OR, 95% CI)	1.3 (1.0, 1.7), p=0.02	1.7 (1.1, 2.7), p=0.02	1.3 (1.1, 1.7) p=0.06	1.2 (1.1, 1.6), p=0.1	1.7 (1.1, 2.6), p=0.02	1.2 (0.9, 1.6), p=0.18
n=	13,303	2,734	10,762	12,190	2,508	9,865
Days of poor mental health in the past 30 days (Effect size, 95% CI)	0.9 (0.1, 1.6), p=0.02	1.9 (0.2, 3.6), p=0.03	0.7 (-0.1, 1.5), p=0.07	0.6 (-0.1, 1.3), p=0.08	1.7 (0.1, 3.2), p=0.04	0.5 (-0.3, 1.2), p=0.19
Odds of poor mental health* (OR, 95% CI)	1.3 (1.0, 1.7), p=0.03	1.9 (1.2, 3.1), p=0.01	1.2 (0.97, 1.6), p=0.09	1.2 (0.95, 1.5), p=0.11	1.8 (1.0, 3.0), p=0.04	1.1 (0.9, 1.5), p=0.29
n=	5,731			5,248		
Odds of depression (OR, 95% CI)	1.4 (0.9, 2.2), p=0.13			1.2 (0.8, 1.8), p=0.33		

- 3 *Higher anxiety defined as >6 anxious days in the past 30 days
- 4 *Poor mental health defined as >6 days of poor mental health in the past 30 days
- 5 ⁺Adjusted for age, gender, income, ethnicity, age squared, income, and current asthma