Published in final edited form as:

J Allergy Clin Immunol. 2014 December ; 134(6): 1466–1468.e6. doi:10.1016/j.jaci.2014.08.037.

Milk allergy is associated with decreased growth in U.S. children

Karen A. Robbins, MD [Fellow],

Pediatric Allergy and Immunology, Johns Hopkins University School of Medicine, Division of Pediatric Allergy and Immunology, Baltimore, MD

Robert A. Wood, MD [Professor], and

Johns Hopkins University School of Medicine, Division of Pediatric Allergy and Immunology, Baltimore, MD

Corinne A. Keet, MD, PhD [Assistant Professor]

Johns Hopkins University School of Medicine, Division of Pediatric Allergy and Immunology, and Graduate Student, Johns Hopkins Bloomberg School of Public Health, Department of Epidemiology, Baltimore, MD

Karen A. Robbins: krobbin6@jhmi.edu; Robert A. Wood: rwood@jhmi.edu

Keywords

food allergy; food hypersensitivity; milk allergy; growth; nutrition

To the editor

Food allergy has the potential to impact nutrition and growth, yet population-wide studies investigating these issues are limited.¹ Food allergy is often the first manifestation of allergic disease, arising early in life at a time when adequate nutrition is most important for overall growth, brain development, and bone mineralization. Allergen avoidance is the mainstay of treatment for food allergy, however, many of the most common food allergens are integral parts of the typical Western diet and contain macro- and micronutrients that are essential for normal growth and development. Even with close supervision, growth in food-allergic children may lag.² While several studies have assessed the relationship of food allergy, nutrition, and growth in smaller groups of children,²⁻⁸ investigation on a population-wide scale is lacking.

Our objective was to compare anthropomorphic measures and dietary intake of calcium, vitamin D, total calories, protein and fat between children with and without reported food allergy using The National Health and Nutrition Examination Survey (NHANES). NHANES is a continuously obtained, nationally representative cross-sectional survey of the civilian,

© 2014 American Academy of Allergy, Asthma and Immunology. All rights reserved.

Correspondence to: Corinne A. Keet, MD, PhD, Johns Hopkins Hospital, CMSC 1102, 600 N. Wolfe St. Baltimore, MD 21287, Ph: (410) 955-5883, Fax: (410) 955-0229, ckeet1@jhmi.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

non-institutionalized population, designed with the purpose of assessing the health and nutritional status of the American population. In 2007-2008 and 2009-2010 NHANES, respondents were questioned regarding the presence of food allergy. Full description of these methods are described in this article's Online Repository.

Age-adjusted percentiles for height, weight, and BMI were calculated using CDC's Epi Info software package (Epi Info™ v. 3.5.4, 7/23/2008), with comparison to CDC reference growth curves (2000)⁹. Differences in nutrient intakes and anthropomorphic measurements between subjects with and without food allergy were calculated using linear and logistic regression as appropriate for continuous and dichotomous variables, respectively, in models adjusted for age, gender, ethnicity, and income. Survey weights and strata provided with the data were used to account for NHANES complex sampling design and oversampling. All of the statistical analyses were conducted with STATA 12.1 software (StataCorp, College Station, Tex).

6189 children aged 2-17 were included in this sample, representing a diverse selection of the US population (Table E1, Online Repository). Overall, 6.3% (95% CI: 5.5 – 7.3) of children reported a food allergy, with the most common trigger identified as milk (1.8%, 95% CI: 1.3 – 2.3), followed by peanut (1.2%, 95% CI: 0.9 – 1.6), and egg (0.6%, 95% CI: 0.4 – 0.8). After excluding those who reported milk intake in the past 30 days, 1.1% (95% CI: 0.8-1.6) of children (N=58) were classified as “cow's milk allergic”. Characteristics of all children with reported food allergy are shown in the Online Repository Table E1.

Mean weight, height, and BMI percentiles were significantly lower in those with milk allergy in multivariate analyses (Figure 1), but not in other groups of food-allergic children (see Figure E1 in the Online Repository; other data not shown). Milk-allergic children also had decreased skin triceps folds, a measurement of adiposity (mean difference: 1.8 mm, 95% CI: 0.55 – 3.05, p=0.006). Milk-allergic children had lower calcium intake on 24-hour recall, and trended towards lower vitamin D and total caloric intake compared with non-milk-allergic children (Table 1). However, adjustment for dietary intake of total calories, protein, fat, calcium, and vitamin D did not change our findings of decreased growth measurements in milk-allergic children (see Table E2 in the Online Repository) or adiposity measurements (data not shown). The other groups of food-allergic children had no significant differences in calcium or vitamin D intake, although there were modest differences in fat, protein and calorie intake with certain other food allergies, including significantly lower protein intake in peanut allergic children (see Table E3 in the Online Repository).

Milk avoidance itself was associated with a trend towards lower mean weight, height, and BMI percentiles for age. However, milk-allergic children had significantly lower weight and BMI percentiles than non-allergic children who were not drinking milk (see Table E4 in the Online Repository). Further, milk-allergic children had significantly smaller triceps skin fold measurements than non-milk-allergic children who avoided milk (mean difference: 1.85, 95% CI 0.18 – 3.52, p=0.03).

In this nationally representative sample, milk-allergic children appeared to be at risk for nutritional compromise in several domains. Our findings are consistent with prior studies involving smaller groups of children suggesting that food allergy in general,^{2,6,10} and cow's milk allergy in particular, are potential risk factors for decreased weight-for-age and/or height-for age percentiles^{3,6,7}. These studies have also noted decreased growth in the context of low vitamin D and calcium intake.⁶ We found that milk allergy, rather than other reported food allergies, was associated with decreased growth measures across many domains.

Although growth differences in milk-allergic children are likely related to the dietary importance of milk, these differences were not entirely explained by milk avoidance or energy intake alone. Other mechanisms besides inadequate intake could potentially be involved in poor growth, including chronic allergic inflammation, increased metabolic demands, corticosteroid exposure, and comorbid asthma or atopic dermatitis.¹ Although our data suggest that some other mechanism besides poor intake may contribute to poor growth in milk allergic subjects, we were not able to distinguish between these possibilities in our analyses. Future research is needed in order to better understand the factors contributing to poor growth.

There were several limitations to our analysis, including the use of only one 24-hour dietary recall. Although it is known that the use of the 24-hour recall may not accurately estimate usual intake, we used only the first day of dietary intake because we found that there was substantial missing data for the second day in our population. This likely introduced some measurement error into our dietary estimates, leading to loss of precision. Other limitations include the fact that, although our overall sample size is quite large, the number of subjects reporting each food allergy is relatively small, and we relied on self-report of food allergy which typically overestimates true food allergy. Although we did restrict our definition of milk allergy to those avoiding milk, we did not have this data for other foods, nor did we include analyses of consumption of milk in less concentrated forms. However, perception of allergy and the avoidance that follows may have substantial nutritional risks itself, and so these results are informative even in the absence of confirmatory data regarding true allergy. Finally, because of the cross-sectional design of this study, we cannot characterize long term outcomes in growth restriction or 'catch up' growth, and cannot easily determine other contributing or exacerbating factors, such as corticosteroid use. Despite these limitations, our study is noteworthy for description of growth and nutrition patterns of food-allergic children for the first time in a large population-based study of U.S. children.

These findings support the need for nutritional supervision, calcium and vitamin D supplementation (where appropriate), and close monitoring of growth for milk-allergic children.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Sources of support: This research was funded in part by NIAID/NIH grant number 1K23AI103187 (to C.A.K) and 5T32AI007007-34 (K.A.R)

References

1. Mehta H, Groetch M, Wang J. Growth and nutritional concerns in children with food allergy. *Curr Opin Allergy Clin Immunol*. 2013; 13(3):275–279. [PubMed: 23510952]
2. Flammarion S, Santos C, Guimber D, Jouannic L, Thumerelle C, Gottrand F, et al. Diet and nutritional status of children with food allergies. *Pediatr Allergy Immunol*. 2011; 22(2):161–165. [PubMed: 20561235]
3. Isolauri E, Sutas Y, Salo MK, Isosomppi R, Kaila M. Elimination diet in cow's milk allergy: Risk for impaired growth in young children. *J Pediatr*. 1998; 132(6):1004–1009. [PubMed: 9627594]
4. Tiainen JM, Nuutinen OM, Kalavainen MP. Diet and nutritional status in children with cow's milk allergy. *Eur J Clin Nutr*. 1995; 49(8):605–612. [PubMed: 7588511]
5. Paganus A, Juntunen-Backman K, Savilahti E. Follow-up of nutritional status and dietary survey in children with cow's milk allergy. *Acta Paediatr*. 1992; 81(6-7):518–521. [PubMed: 1392365]
6. Christie L, Hine RJ, Parker JG, Burks W. Food allergies in children affect nutrient intake and growth. *J Am Diet Assoc*. 2002; 102(11):1648–1651. [PubMed: 12449289]
7. Jensen VB, Jorgensen IM, Rasmussen KB, Molgaard C, Prahl P. Bone mineral status in children with cow milk allergy. *Pediatr Allergy Immunol*. 2004; 15(6):562–565. [PubMed: 15610372]
8. Sova C, Feuling MB, Baumler M, Gleason L, Tam JS, Zafra H, et al. Systematic review of nutrient intake and growth in children with multiple IgE-mediated food allergies. *Nutr Clin Pract*. 2013; 28(6):669–675. [PubMed: 24166727]
9. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, et al. CDC growth charts: United states. *Adv Data*. 2000; (314):1–27. 314. [PubMed: 11183293]
10. Meyer R, De Koker C, Dziubak R, Venter C, Dominguez-Ortega G, Cutts R, et al. Malnutrition in children with food allergies in the UK. *J Hum Nutr Diet*. 2013

Abbreviations

NHANES	National Health and Nutrition Examination Survey
BMI	body mass index
PIR	poverty income ratio

Figure 1. Weighted boxplots of anthropometric features for children age 2-17 comparing milk allergic versus non-allergic children. P values from multivariate linear regression, adjusting for age, gender, race/ethnicity, and income.

Table I
Mean nutrient intake by milk-allergic status

Mean differences as determined by multivariate linear regression, adjusting for age, gender, ethnicity, and income, and presented with 95% confidence intervals. Mean values presented with 95% confidence intervals and standard errors (SE).

	Milk Allergy		Adjusted Difference	p
	Yes	No		
Mean total daily caloric intake, kcal	1757.6 (1626.5–1888.7) SE: 64.4	1887.3 (1851.8–1922.8) SE: 17.4	-136.5 (-275.3–2.4) SE: 68.1	0.054
Mean total daily protein intake, gm	63.1 (55.0–71.2) SE: 3.9	67.1 (65.6–68.7) SE: 0.8	-4.2 (-12.1–3.8) SE: 3.9	0.30
Mean total daily fat intake, gm	62.6 (55.0–71.2) SE: 4.2	69.2 (67.3–71.0) SE: 0.9	-7.0 (-15.5–1.6) SE: 4.2	0.11
Mean total daily vitamin D intake (D2+D3), IU	212.2 (107.5–316.9) SE: 51.4	308.4 (284.3–332.4) SE: 11.8	-84.0 (-169.1– 1.1) SE: 41.8	0.053
Mean total daily calcium intake, mg	802.2 (702.0–902.3) SE: 49.2	1047.0 (1018.5–1075.5) SE: 13.9	-251.5 (-359.6– -143.5) SE: 53.0	<0.001