

Food allergy prevalence, knowledge, and behavioral trends among college students — A 6-year comparison



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Clinical Implications

- Food allergy awareness among students identifying as food-allergic has modestly improved compared with 6 years earlier. However, notable risk-taking behavior is still problematic. Non—food-allergic peers have good food allergy awareness regarding the need for strict allergen avoidance.

TO THE EDITOR:

Food allergy is a public health concern affecting nearly 8% of children, and may have doubled in prevalence between 1997 and 2011.^{1–4} We published the index study pertaining to food allergy in college students at the University of Michigan in 2009, highlighting poor rates of self-injectable epinephrine (SIE) carriage, student-reported allergen avoidance, and on-campus food allergy awareness.⁵ Since that publication, this university created a program for comprehensive food allergy dietary/nutritional support and dining hall labeling.⁶ We therefore sought to reassess trends in reported student food allergen awareness and preparation, to compare 6-year outcomes within the same university, as well as assess awareness among non—food-allergic students and compare trends at 2 other large Midwestern universities without a food allergy diet/labeling program.

In the spring of 2014, a 39-question electronic survey was randomly distributed using Survey Monkey (Portland, Ore) to approximately 26,500 undergraduate e-mail accounts of students older than 18 years at the University of Michigan, 24,000 accounts at the Ohio State University, and 18,000 accounts at the University of Pittsburgh. No data were available on the final number of accounts that received the message or messages that were actually opened to verify the response rate. Electronic informed consent was obtained, and the University of Michigan Medical School Institutional Review Board approved this study. The full methods are detailed in the Appendix of this article's Online Repository at www.jaci-inpractice.org.

A total of 1772 students responded to the survey, with 748 (42.2%) reporting that they had a food allergy, 52.6% (n = 394) of which reported past reaction symptoms consistent with the National Institutes of Allergy and Infectious Diseases/Food Allergy and Anaphylaxis Network anaphylaxis criteria.⁷ Details of the sample are described in Table I.

In 2014, less than 50% of the 414 Michigan food-allergic students reported maintaining any emergency medication (n = 173 [41.7%]), including 36.7% (n = 152) indicating they maintain SIE. Approximately 82.6% (n = 342) reported that at least 1 close campus contact was aware of their food allergy. Only

50.5% (n = 209) reported always practicing strict allergen avoidance, 28.5% (n = 118) reported that campus dining hall foods were always labeled for allergen content, and 33% (n = 138) reported that allergen-free alternative foods were available in the dining halls. Figure 1 details the comparison of trends in food allergy awareness and self-management preparation between Michigan students in 2009 and 2014. Although multiple key trends were significant, the total numbers within these trends did not eclipse more than 50% of students reporting adherence for these measures in 2014. A similar significant trend was noted for reported reasons why a food-allergic student would not always practice strict allergen avoidance (see Figure E1 in this article's Online Repository at www.jaci-inpractice.org).

In exploring 2014 trends across the 3 universities surveyed, there were relatively few significant proportional differences between the populations, further detailed in this article's Online Repository at www.jaci-inpractice.org and in Figures E2 and E3 in this article's Online Repository at www.jaci-inpractice.org. A logistic regression model predictive of factors associated with reported student compliance with both strict avoidance and epinephrine carriage (at all 3 universities) was created, noting significant positive associations with health behavior adherence based on food allergen type, a reported history of being bullied, and a reported history of prior anaphylaxis (see Table E1 in this article's Online Repository at www.jaci-inpractice.org).

A total of 1024 non—food-allergic students at the 3 universities also responded to this survey. Reported awareness of food allergy and associated health behaviors among the non—food-allergic students was high—81.8% (n = 838) reported knowing someone with a food allergy, 44.6% (n = 457) reported knowledge of how to use an SIE device, and 59.7% (n = 611) reported that allergen content was clearly labeled for dining hall food. A higher proportion of the nonallergic students than food-allergic students reported that practicing strict avoidance is always necessary (70.2% vs 50.4%; $P < .001$), and significantly fewer non—food-allergic students reported strict avoidance would not be necessary than food-allergic students (see Table E2 in this article's Online Repository at www.jaci-inpractice.org).

Despite significant interval improvement from 2009 on the Michigan campus across multiple trends, awareness and adherence with commonly recognized food allergy self-management among students remain disconcerting. Rates of maintaining any emergency medication, always carrying epinephrine, practicing strict allergen avoidance, and food preparer awareness were well under 50%. The proportion of risk-taking behavior among Michigan students worsened over time, though present-day risk-taking trends were similar across all 3 universities surveyed. Moreover, the non—food-allergic students demonstrated more awareness of practicing strict avoidance than the allergic students across all campuses. These trends suggest a potential lack of progress in adherence to and awareness of optimal food allergy self-management behavior, which hopefully is not representative of a “plus ça change, plus c'est la même chose” situation in an era of progressively intensive food allergy education.

The impact that Michigan's awareness and labeling program has had is difficult to assess, though the study was not specifically designed to assess this. It is disconcerting that just slightly more

TABLE I. Population characteristics

Trend (n = 1772 unless stated)	% (n)
Male	24.7 (439)
Class (n = 1772)	
Freshman	22.4 (398)
Sophomore	23.1 (409)
Junior	23.3 (412)
Senior/graduate	28.9 (503)
Report having a food allergy	42.2 (748)
Tree nut	216 (28.9)
Peanut	175 (23.4)
Milk	138 (18.5)
Wheat	114 (15.2)
Shellfish	85 (11.4)
Soy	36 (5.8)
Seed	43 (5.7)
Egg	39 (5.2)
Fish	30 (4)
Campus	
University of Michigan	414 (55.3)
The Ohio State University	129 (17.2)
University of Pittsburgh	205
History of symptoms of anaphylaxis (n = 748)	52.7 (394)
Age of initial reaction (y) (n = 666)	
0-6	41 (273)
6-12	21 (140)
>12	38 (254)
Age of most recent reaction (y) (n = 656)	
0-6	7.3 (48)
6-12	5.9 (39)
>12	86.7 (569)
Maintains emergency medication (n = 748)	44.2 (330)
Epinephrine autoinjector	35.6 (266)
Always carry epinephrine autoinjector (n = 266)	51.2 (138)
Reported past bullying (n = 748)	
Any school level	40.5 (303)
College	27 (202)
Non-food-allergic student awareness (n = 922)	
Can use SIE	48.7 (457)
Allergen content labeled for dining hall food	66.3 (611)
Knows someone with food allergy (n = 1024)	81.2 (838)

than 25% of food-allergic students clearly identify and report that foods are always labeled for allergen content in the dining hall, and that fewer than one-third of students reported availability of an allergen-free alternative meal, but particularly interesting that a higher number of the non-food-allergic students did report foods were labeled. It is unclear whether this labeling and awareness program fails to reach the at-risk students, or has difficulty influencing behavioral change. High level of reported awareness of labeling of meals by the nonallergic students may suggest the latter explanation. In fact, we observed encouraging levels of awareness among non-food-allergic students in terms of knowledge in how to use an SIE device, awareness of allergen content labeling in the dining hall, as well as reporting better understanding of the need for comprehensive allergen avoidance compared with their allergic counterparts. These trends suggest that a somewhat strong

baseline level of food allergy awareness may exist among non-food-allergic students.

This study is limited by a low response rate of approximately 1% to 4%. Emails were sent out to the student body with no way to monitor how many were unread or ignored, though the response rate was similar to that in 2009, using consistent methodology. Approximately less than 5% of students aged 18 to 22 years have food allergy, and the study would appeal mostly to the food-allergic population, so the response rate may be appropriate. Other limitations include the use of self-reported data, which are subject to both recall bias and possible challenges to the validity of any student's reported diagnosis. It is possible that some students misperceived the fact that they have a food allergy (eg, oral allergy syndrome or food intolerances) or are simply misdiagnosed or misclassified (eg, positive sensitization only, baked milk/egg tolerant, or have oral allergy syndrome), which could influence poor reported adherence with anticipated health behaviors. To counter some of these pitfalls, questions were used to enrich the sample for respondents most likely to have a "valid" diagnosis, similar to other self-reported food allergy surveys.^{4,8}

Although reported awareness among food-allergic students, SIE maintenance/carriage, and perpetual avoidance of one's food allergen have somewhat improved relative to 6 years ago, risk-taking behaviors and poor adherence with health behavior recommendations remain problematic among food-allergic undergraduates. Despite statistically significant improvement in multiple parameters reflecting allergic students' adherence with positive health behaviors regarding food allergy self-management, the clinical significance of these changes remains questionable when fewer than 50% of students responded in a way that would reasonably reflect understanding of appropriate self-management. These data indicate a continuing need for increased support of food-allergic students on campus, and ongoing need to study the impact of programs to help guide food-allergic students on campus for gaps and areas of suboptimal implementation given the difficulties of chronic disease management in young adults.

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Conflicts of interest: T. D. Green is director of the Food Allergy Research & Education Clinical Network Web site. M. Greenhawt has received research support from Agency for Healthcare Research and Quality (1K08HS024599-01, Career Development Award); has received travel support from National Institute of Allergy and Infectious Diseases, Joint Taskforce on Allergy Practice Parameters; is an unpaid member of the National Peanut Board scientific advisory council; has received consultancy fees from the Canadian Transportation Agency, Nutricia, Nestle, Aimmune, Kaleo Pharmaceutical, Monsanto, Intromune Pharmaceutical; is associate editor for the *Annals of Allergy, Asthma, and Immunology*; and has received lecture fees from American College of Allergy, Asthma, and Immunology, Reach MD, Thermo Fisher Scientific, New York Allergy and Asthma

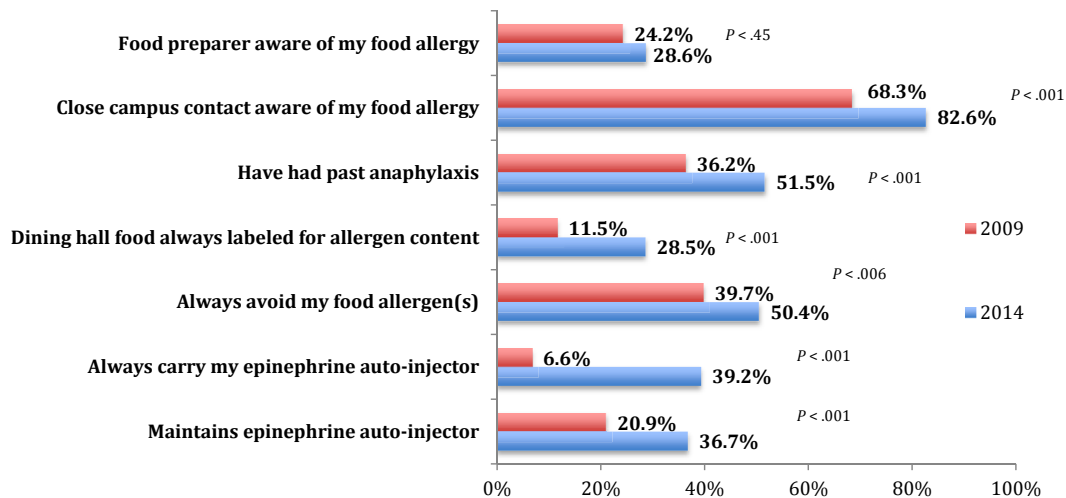


FIGURE 1. 5-year comparisons in student food allergy preparation among University of Michigan students.

Society, University of California Los Angeles/Harbor Heiner Lectureship, Medscape, Aspen Allergy Society, European Academy of Allergy and Clinical Immunology, Canadian Society of Allergy and Clinical Immunology, and Pennsylvania Society for Allergy and Immunology. The rest of the authors declare that they have no relevant conflicts of interest.

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APPENDIX

METHODS

A 39-question survey was designed for electronic distribution and data collection, using Survey Monkey (Portland, Ore), an Internet-based survey company. This survey was randomly distributed to approximately 26,500 undergraduate e-mail accounts of students older than 18 years at the University of Michigan, Ann Arbor, in the spring of 2014, as well as to 26,000 accounts at the Ohio State University and 18,000 at the University of Pittsburgh. The e-mail contained an introductory recruiting statement seeking volunteer participants to take a survey pertaining to food allergies among undergraduate students at the university, as well as a link to the question set. No data were available on the final number of accounts that received the message or messages that were actually opened to verify the response rate and we were aware of only the total potential distribution. Electronic informed consent was obtained, and this study was approved by the University of Michigan Medical School Institutional Review Board. This survey methodology was identical to that of the 2009 study.^{E1} Students did not have to have a known food allergy to be sent the survey. Non-food-allergic students were deliberately included in the distribution, and sought for recruitment. Survey questions were based on our previous study.^{E1} We inquired about history of a food allergy, including symptoms and triggering foods, emergency medications maintained, method of diagnosis, and initial and most recent reactions. As well, students were asked about campus notification patterns, reactions occurring in specific venues, dining habits, involvement of campus health services, and satisfaction with campus accommodation. Additional questions also assessed food allergen dietary avoidance, specific avoidance of food service locations, risk-taking behaviors, and potentially bullying because of one's food allergy. Students identifying themselves as non-food-allergic were queried regarding the presence of close contacts with food allergy, familiarity with use of an epinephrine autoinjector, food allergy bullying, perception of the need for and ease of allergen avoidance in someone with a food allergy, and the adequacy of campus accommodations for food allergy.

Collected data were downloaded to an MS Excel spreadsheet (Microsoft Corporation, Redmond, Wash) for data cleaning, and then uploaded into a statistical program for analysis. Data were analyzed using Stata 13 SE (Stata Corp, College Station, Texas) for descriptive statistics including frequency analysis, as well as bivariate/proportional inferential analysis using chi-square/Fisher exact test and logistic regression for modeling mutually adjusted associations with particular outcome variables. Trends were compared between present allergic and nonallergic students, and between the 2009 study and present study populations.

RESULTS

Comparison of trends across the 3 university campuses

Among responding students on each respective campus, there were relatively few significant proportional differences between the populations. University of Pittsburgh had a significantly higher proportion of students reporting food allergy compared with Ohio State or Michigan ($P < .001$, respectively), and a higher proportion of those always carrying SIE compared with Michigan ($P = .02$; NS for Ohio State). However, there were no proportional differences in rates of general medication maintenance, food preparer awareness, students reporting past anaphylaxis, students practicing strict allergen avoidance, rates of having had an on-campus reaction, or reported concern for an on-campus reaction occurring. Michigan had significantly higher proportional reported awareness of close campus contacts than Ohio State ($P = .03$, NS with Pittsburgh), but had significantly better food labeling in the dining hall than either of the other campuses ($P < .001$ vs Pittsburgh, $P = .04$ vs Ohio State). There were no significant differences noted among the universities pertaining to reasons why a student would not always practice strict avoidance (eg, lack of a past severe reaction, inconsistent symptom occurrence, belief in a threshold dose, and belief that a reaction could be easily treated).

Comparison of trends at Ohio State and Pittsburgh to historical Michigan trends

Given the significant differences noted between 2009 and 2014 on Michigan campus, and the similarities (and limited significant differences) in responses noted among the 3 universities in 2014, we compared data from Ohio State and Pittsburgh to the historical data from Michigan 2009 to investigate similarities between universities without on-campus food allergy programs at the time the data were obtained (Figure E1). There were no significant differences noted between Ohio State, Pittsburgh, and the 2009 Michigan sample of those reporting they practice strict allergen avoidance, and only Pittsburgh had a higher proportion of students reporting that a close campus contact was aware of the food allergy ($P = .001$). Both Ohio State and Pittsburgh had significantly proportionally higher numbers of students reporting a past history of anaphylaxis ($P < .001$ respectively); having a reaction on-campus (Pittsburgh $P < .001$, Ohio State $P = .02$); that they maintain an epinephrine device ($P < .001$, respectively) and always carry their device ($P < .001$, respectively); and that foods were clearly labeled for allergy content in the dining hall ($P < .001$, respectively) compared with Michigan in 2009 (Figure E1). Similar to the 6-year comparisons with Michigan, the overall proportion of students reporting adherence with these measures was generally less than 50%. Both universities had a significantly higher proportion of students reporting reasons why a student would not always practice strict avoidance (eg, lack of a past severe reaction, inconsistent symptom occurrence, threshold dosing, and belief that a reaction could be easily treated; all $P < .001$, respectively).

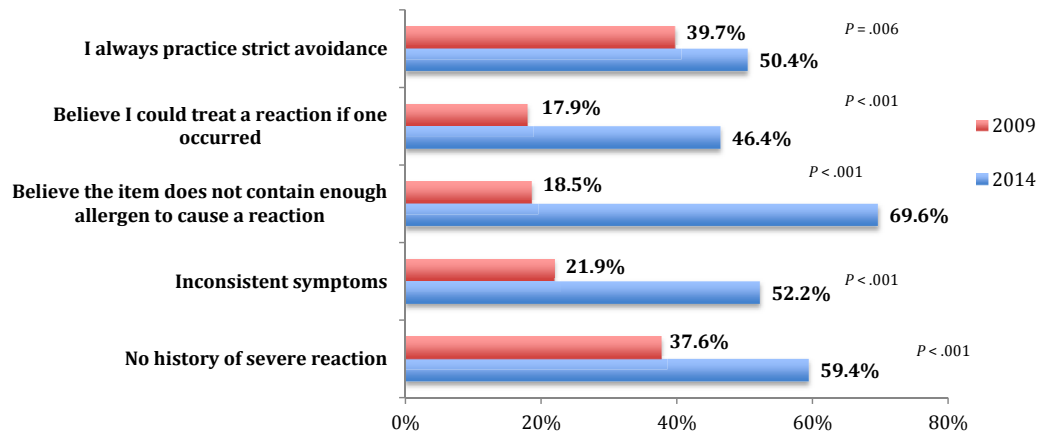


FIGURE E1. The 6-year comparisons in reasons why strict avoidance was not always practiced. The 2014 reported trends at the University of Michigan were compared to 2009 reported trends at the University of Michigan regarding student responses as to why strict allergen avoidance was not always practiced.

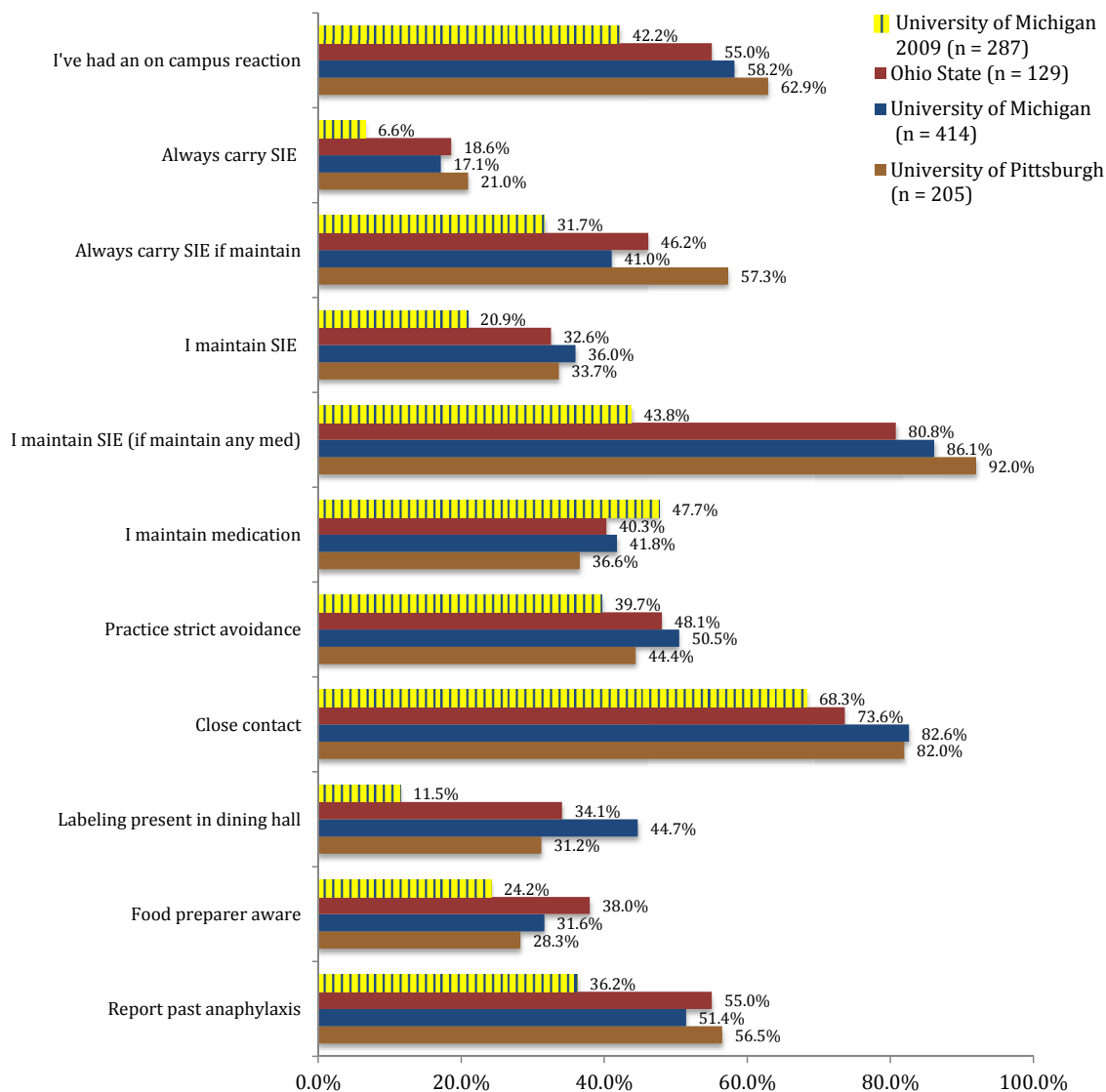


FIGURE E2. Comparison of food allergy awareness and health behaviors among all universities compared with 2009 University of Michigan trends. The 2014 reported trends at the Ohio State University, the University of Pittsburgh, and the University of Michigan were compared with 2009 reported trends at the University of Michigan.

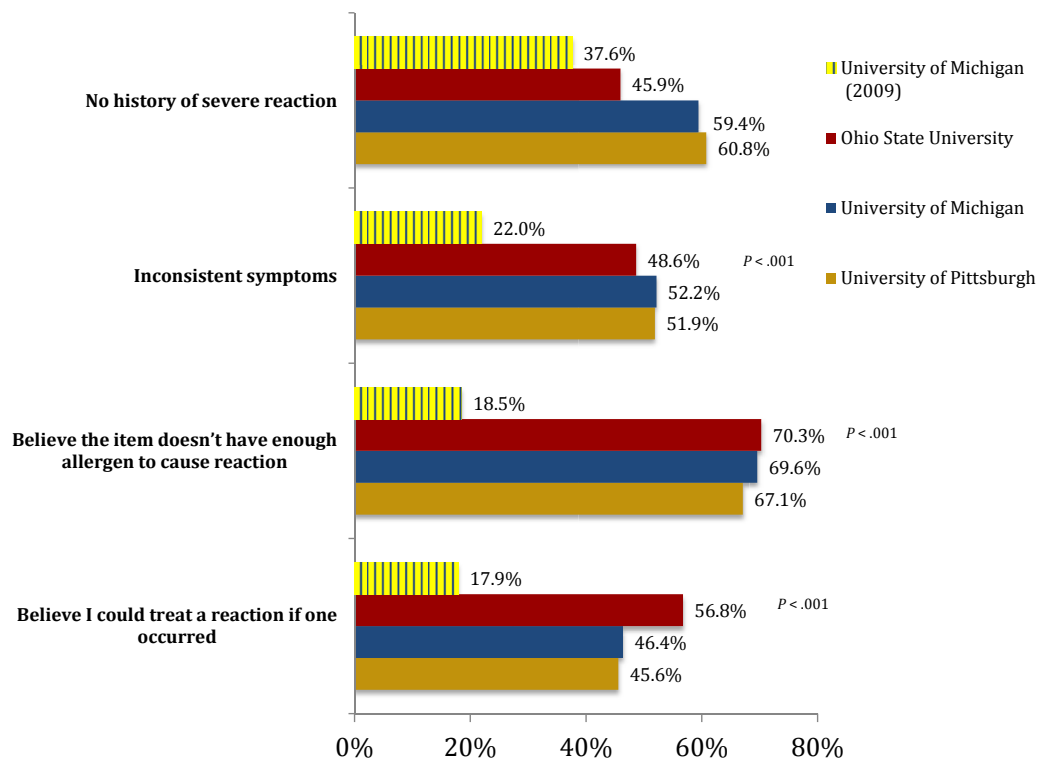


FIGURE E3. Comparison of reasons why strict avoidance is not always practiced among all universities compared with 2009 University of Michigan trends. The 2014 reported trends at the Ohio State University, the University of Pittsburgh, and the University of Michigan were compared with 2009 reported trends at the University of Michigan regarding student responses as to why strict allergen avoidance is not always practiced.

TABLE E1. Factors associated with compliance with epinephrine carriage and allergen avoidance among food-allergic students

Predictive factor	Odds ratio	P	95% CI
Peanut allergy	2.75	.03	1.05-2.89
Tree nut allergy	2.9	<.001	1.78-4.6
Wheat allergy	0.31	.02	0.12-0.85
History of reported bullying	2.42	<.001	1.5-3.9
History of anaphylaxis to a food	2.2	.003	1.30-3.73

Model adjusted for allergy to milk, egg, soy, shellfish, fish, and seed; having had a reaction on campus, grade level, campus contact being aware of the food allergy, and sex.

TABLE E2. Comparison of food-allergic vs non–food-allergic student beliefs

Circumstances where strict avoidance is not necessary	Allergic %	Nonallergic %	P
No history of severe reaction	57.9 (147 of 254)	34.9 (307 of 880)	<.001
Inconsistent symptoms	51.6 (131 of 254)	28.9 (255 of 880)	<.001
Believe the item does not have enough allergen to cause reaction	68.9 (175 of 254)	31.5 (277 of 880)	<.001
Believe I could treat a reaction if one occurred	47.6 (121 of 254)	17.7 (156 of 880)	<.001
Must always practice strict avoidance	48.4 (362 of 748)	63.2 (647 of 1024)	<.001

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