

Original article

Food allergy and food allergy attitudes among college students

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Background: Little information is known about food allergy among college students.

Objective: We sought to assess food allergy trends and behavioral attitudes on a large university campus.

Methods: An online survey was distributed by e-mail to local university undergraduate students. Symptom severity was determined based on previously published criteria for anaphylaxis.

Results: A total of 513 individuals responded, with 57% reporting an allergic reaction to food. Of this group, 36.2% reported symptoms consistent with anaphylaxis, and these reactions frequently occurred while enrolled. Allergy to milk ($P = .032$), tree nut ($P < .0001$), shellfish ($P < .0001$), and peanut ($P < .0001$) was significantly associated with having symptoms of anaphylaxis. Some form of emergency medication was reportedly maintained in 47.7%, including self-injectable epinephrine (SIE; 21%), although only 6.6% reported always carrying this device. Medication maintenance was significantly lower among students who had not had a reaction while enrolled ($P < .0001$). Only 39.7% reported always avoiding foods to which they were allergic. Within the group that reported intentionally consuming known allergens, there were significantly lower numbers of individuals who reported carrying SIE ($P < .0001$) and significantly higher numbers of individuals with a history of a reaction that had not resulted in symptoms of anaphylaxis ($P = .026$).

Conclusion: Potentially life-threatening anaphylactic reactions to foods are occurring on college campuses. Only 39.7% of students with food allergy avoided a self-identified food allergen, and more than three fourths did not maintain SIE. Such behaviors might place these students at increased risk for adverse events. (J Allergy Clin Immunol ■■■■;■■■;■■■-■■■.)

Key words: Food allergy, college students, anaphylaxis, self-injectable epinephrine, food allergy attitudes

Abbreviation used

SIE: Self-injectable epinephrine

Food allergy is a growing concern in the United States and worldwide. Recent evidence indicates the incidence has been increasing over the past 2 decades.^{1,2} Food allergy is estimated to account for approximately 30,000 emergency department visits and 150 to 200 fatalities annually, although these numbers likely underestimate the true extent of the problem based on new data suggesting that the overall incidence of anaphylaxis has doubled from previous estimates.³⁻⁵ The natural history of peanut and tree nut allergy suggests that less than 20% of subjects with peanut allergy and 10% of subjects with tree nut allergy will outgrow their allergy, which is in stark contrast to other common childhood allergies, such as milk, egg, wheat, and soy, that are generally perceived to be outgrown.^{1,6-9} However, recent evidence suggests that milk and egg allergy might not be outgrown as rapidly or to the extent previously thought.^{10,11}

College-aged individuals might be at risk for fatal food allergy–induced anaphylaxis. A 2-part recent food allergy fatality series spanning 1994 to 2006 demonstrated that a total of 16 of 63 food allergy–related fatalities occurred in college-aged subjects (18–22 years). Fifty percent of these fatalities occurred on a college campus.^{3,12} Another study has shown that adolescents and teenagers are more likely to take risks pertaining to their food allergy, including not carrying self-injectable epinephrine (SIE), eating foods known or likely to contain an allergen, and failing to inform their friends of the presence of a food allergy or how to treat it in an emergency.¹³ Given the recently reported increase in food allergy prevalence in late teens and young adults,¹⁴ as well as the anticipated increase in food allergy prevalence, these behavioral trends could indicate a potentially grave situation for certain individuals that is potentially avoidable. Therefore the objective of this study was to assess current trends in food allergies, attitudes toward personal health choices surrounding food allergy, and potential risk-taking behaviors pertaining to food allergy in a college population.

METHODS

Study design

A 32-question survey was designed for electronic distribution and data collection by using Survey Monkey (Portland, Ore), an Internet-based survey company. This was randomly distributed to 14,990 undergraduate e-mail accounts of students older than 18 years at the University of Michigan, Ann Arbor. The e-mail contained an introductory recruiting statement seeking

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TABLE I. Symptoms reported

Symptom*	Percentage (n = 287)
Itching of the throat	35.9 (n = 103)
Itching of the mouth	33.8 (n = 97)
Hives	30.3 (n = 87)
Lip or tongue swelling	30.3 (n = 87)
Dyspnea	25.8 (n = 74)
Diarrhea	22.3 (n = 64)
Swelling of the throat	20.9 (n = 60)
Difficulty swallowing	20.6 (n = 59)
Vomiting	18.1 (n = 52)
Wheezing	16 (n = 46)

*Students were allowed to select multiple symptoms.

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. Electronic informed consent was obtained, and this study was approved by the University of Michigan Medical School Institutional Review Board. Individuals were eligible for inclusion based on affirming they were 18 years of age or older and having an active university e-mail account to receive the survey. Students did not have to have a known food allergy to be sent the survey. Individuals who responded but did not specifically affirm that they have had or likely had an allergic reaction to a food item were subsequently excluded from the survey through skip logic that redirected these participants to a debriefing statement. Furthermore, because skip logic was used in other places within the survey and respondents were not required to record an answer for every question, this accounted for some attrition of respondents for certain questions. Survey questions asked about the occurrence of a specific allergic reaction, the symptoms and food attributable to the reaction, and emergency medications maintained. Other questions pertained to notification patterns, specific reaction venues, campus dining habits, and the involvement of campus health services. Additional questions designed to assess risk taking inquired about food allergen dietary avoidance, specific avoidance of food service locations, and self-perception of risk, including specific disclosure of why an individual might intentionally consume a known food allergen. A written pilot version of this study had been previously assessed for content validity in a similar population.

Food allergy severity and anaphylaxis grading

Reaction severity was graded according to published criteria to determine which respondents had anaphylaxis as a result of the exposure.¹⁵ This set of criteria for the diagnosis of anaphylaxis had been established in a joint National Institutes of Allergy and Infectious Diseases/Food Allergy & Anaphylaxis Network symposium. We therefore applied the following:

1. Acute onset of an illness with involvement of the skin/mucosal tissue (eg, urticaria, generalized itching/flushing, or swollen lips/tongue/uvula) AND EITHER airway compromise (eg, dyspnea, wheezing/bronchospasm, stridor, or reduced peak expiratory flow) OR reduced blood pressure or associated symptoms (eg, hypotonia or syncope).
2. Two or more of the following after exposure to an allergen: involvement of the skin/mucosal tissue (eg, urticaria, generalized itching/flushing, or swollen lips/tongue/uvula), airway compromise (eg, dyspnea, wheezing/bronchospasm, stridor, or reduced peak expiratory flow), reduced blood pressure or associated symptoms (eg, hypotonia or syncope), or gastrointestinal symptoms (eg, crampy abdominal pain or vomiting).
3. Hypotension after exposure to a known allergen.

Statistical analysis

Data were analyzed with SPSS (version 16; SPSS, Inc, Chicago, Ill). Differences in proportions between groups were tested by means of χ^2 analysis and the 2-sided Fisher exact test, where appropriate. Among those reporting they had or likely had a food allergy, subgroups were stratified for statistical comparison based on symptom severity as measured based on the reported presence or absence of symptoms of anaphylaxis in the setting of an allergic reaction to a food.

TABLE II. Food allergies reported among university students

Food allergy*	Percentage (n = 287)
Multiple food allergies	23.7 (n = 68)
Milk	18.8 (n = 54)
Tree nut	16.4 (n = 47)
Shellfish	16 (n = 46)
Peanut	15 (n = 43)
Fish	4.9 (n = 14)
Wheat	4.2 (n = 12)
Soy	3.1 (n = 9)
Egg	2.8 (n = 8)
Other foods	36.2 (n = 104)

*Students were allowed to select multiple foods.

RESULTS

Reaction severity

A total of 513 individuals responded to the survey, for a response rate of 3.5%. Two hundred ninety-three (57%) of 513 respondents reported they had a known food allergy or likely had an allergic reaction attributable to a food. Of these 293 respondents, 287 answered further questions about their reaction characteristics and were included for further analysis. One hundred four (36.2%) of 287 respondents reported symptoms that satisfied the criteria for anaphylaxis. The most common symptoms reported are detailed in Table I. There was a significant relationship between having a prior reaction result in symptoms consistent with anaphylaxis and having had a reaction occur while enrolled at college ($P = .008$). Thirty-three (11.5%) of 287 respondents reported that their allergy had been outgrown, although only 19 (6.6%) of 287 reported that a physician informed them of this.

Foods reported

Food allergens reported are detailed in Table II. Milk ($P = .032$), fish ($P = .001$), tree nut ($P < .0001$), peanut ($P < .0001$), and shellfish ($P < .0001$) were significantly more commonly reported among those with symptoms consistent with anaphylaxis versus those without reported symptoms of anaphylaxis.

Medications maintained

Fig 1 summarizes trends in maintenance of emergency medication, including SIE. Within the overall population who reported a reaction (n = 287), only 47.7% (137/287) reported maintaining any type of emergency medication, and 21% (60/287) reported maintaining SIE. Only 19 (6.6%) of 287 reported always carrying their SIE device with them. There were 78 (27.1%) of 287 students who reported that they were never prescribed an SIE device despite having a food allergy. Among those within the anaphylaxis subset, 42 (40.4%) of 104 reported maintaining SIE, and 10 (9.6%) of 104 reported always carrying this device with them. Moreover, 25 (24%) of 104 within the anaphylaxis subset reported they were never prescribed SIE. However, both the overall rate of maintaining emergency medication and the rate of maintaining SIE specifically were significantly higher among those reporting symptoms consistent with anaphylaxis ($P < .0001$). The number of respondents who reported carriage of epinephrine varied by allergen, although significantly more persons with peanut and tree nut allergy reported that they always

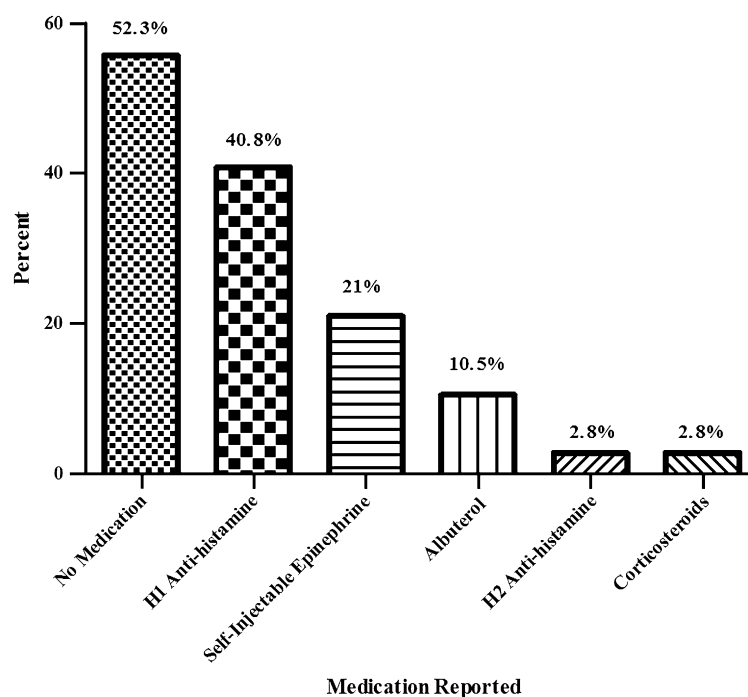


FIG 1. Emergency medication use among university students reporting a food allergy (n = 287). Students were allowed to select multiple medications.

TABLE III. Selected characteristics of a student's food allergy

Characteristic*	Percentage (n = 287)
Is anyone aware of the food allergy	77 (n = 221)
Close campus contact aware of the food allergy	68.3 (n = 196)
Has had an allergic reaction to food while enrolled in college	42.2 (n = 121)
Always avoid the food to which an allergy is reported	39.7 (n = 114)
Live on campus	34.1 (n = 98)
Reported symptoms consistent with anaphylaxis (n = 104) and always avoid the food to which an allergy is reported	37.5 (n = 39)
Has had allergic reaction to food on campus	26.1 (n = 75)
Has concern for exposure to food allergen in the dining hall	24 (n = 69)
Avoid a particular location because of food allergy	19.9 (n = 57)

*Students were allowed to select multiple characteristics.

carried SIE ($P = .008$ for peanut and $P < .0001$ for tree nut). Individuals who reported that they had not experienced a reaction while enrolled in college were significantly less likely to report carrying any emergency medications (38% vs 59%, $P < .0001$), including SIE (16.4% vs 26.2%, $P = .028$).

Reaction locations and patterns of notification

Table III summarizes reported patterns of notification about the food allergy, as well as reaction location and avoidance strategy.

Persons who were aware of the individual's food allergy included parents (218/287 [76%]), a close friend (188/287 [65.5%]), a housemate or roommate (140/287 [48.8%]), health services (37/287 [12.9%]), and dining services (10/287 [3.5%]). The students reported significantly higher levels of notification about their food allergy to their parents ($P < .0001$), close friends ($P < .0001$), roommates ($P < .0001$), and health services ($P = .001$) within the group reporting symptoms consistent with anaphylaxis. A significantly higher number of students who had a reaction while enrolled reported having a close campus contact that was aware of their food allergy versus those who did not have a reaction occur at college ($P < .0001$). One hundred twenty-four (43.2%) of 287 persons reported they did not prepare their own food. Within this subset, only 24.2% (30/124) reported that their food preparer was aware of their allergy.

Fig 2 details the locations where these reactions were reported to occur while enrolled. One hundred seventy-one (59.6%) of 287 reported that no reaction had yet occurred while enrolled. Seven individuals reported using SIE within the past year, and 16 reported using SIE within the past 5 years. Among those reporting a reaction while enrolled (n = 122), 62.3% (76/122) of the reported reactions occurred on campus, and 37.7% (46/122) occurred off campus. Of the 39 individuals who reported reactions that occurred in the dining hall, 22 (56%) of 39 had symptoms consistent with anaphylaxis.

Risk-taking behavior

Thirty-three (11.5%) of 287 reported that dining hall foods were always labeled to identify allergen content, and only one hundred five (36.6%) of 287 reported that a main course alternative was available in the event a main course contained their

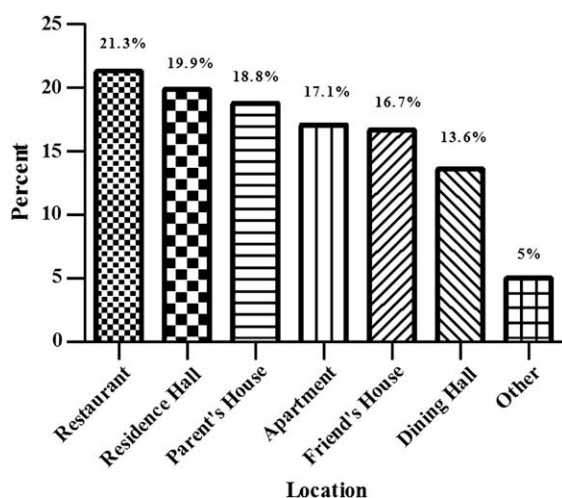


FIG 2. Reaction locations of a food allergy while enrolled at a university ($n = 287$). Students were allowed to select multiple venues.

particular allergen. Thirty-four (32.7%) of 104 of those within the group with symptoms consistent with anaphylaxis reported concern about potential exposure in the dining halls.

As shown in Table III, only 39.7% (114/287) of the students reported they always avoided ingesting the food item to which they reported an allergy. Among the 60.3% (173/287) who reported they did not always avoid the food item to which they reported an allergy, a significantly higher number of students who had not reported symptoms consistent with anaphylaxis reported they willingly continued to eat a food to which they identified themselves as allergic versus those reporting symptoms consistent with anaphylaxis (56.6% vs 41.5%, $P = .026$). The results of a specific follow-up question asking these 173 students to detail why they would take such a risk are summarized in Table IV. Among those individuals who continued to eat self-identified allergens, there were significantly more individuals reporting they did not always carry SIE ($P < .0001$).

DISCUSSION

College represents a unique time in a young adult's life. For most individuals, this is the first experience living without direct parental supervision, and responsibility is shifted to these individuals in all aspects of life. Such responsibilities include making sure SIE prescriptions are filled and up-to-date, carrying the device at all times, familiarizing persons preparing their food with their specific needs, and remembering what is safe to eat. Given an emerging epidemic of food allergy over the past 10 years, more individuals who attend college will likely have a food allergy. Thus the ability to handle the aforementioned responsibility will be critical in keeping this subset of students safe while away from home.

Recent work has estimated the prevalence of food allergy in teenagers to be approximately 2.3%.¹⁶ Although it is unknown whether this is also the same rate of food allergy among students entering college, this number likely represents a close estimate. According to the most recent US census data, there were approximately 10.9 million full-time college students in the United States, but this figure increases to 17.5 million if part-time students and non-four year institutions are included.¹⁷ If a more widely quoted number for the prevalence of food allergy in children and

TABLE IV. Reasons justifying food allergy risk-taking behavior among university students

Reasons given*	Percentage (n = 173)
No history of severe reaction	37.6 (n = 65)
Do not have consistent symptoms	21.9 (n = 38)
Do not perceive this to be a risky action	20.8 (n = 36)
Belief that item does not contain enough allergen to trigger a reaction	18.5 (n = 32)
Belief that I could treat any reaction that occurred	17.9 (n = 31)
Belief that I can eat around the allergen	14.5 (n = 25)
Indifference	12.1 (n = 21)
Last reaction was in the distant past	10.4 (n = 18)

*Students were allowed to select multiple reasons.

adolescents is used (4% to 8%), when extrapolated, this would estimate approximately 436,000-700,000 college-aged students who might have food allergies.^{1,9,10,11} To date, no previous research has examined food allergy on college campuses. However, data from the American College Health Assessment Fall 2007 survey of more than 20,000 students indicated that 51% of college students reported having an allergic disease within the preceding 12 months.¹⁸ This provides some baseline evidence that there might be considerable on-campus atopic disease, including food allergy.

Within our population, we highlight several issues. The low rate of reported maintenance of any emergency medication, including SIE, is concerning. Notification patterns indicate that close campus contacts, campus health services, and dining services are often not made aware of these students' food allergies. Also alarming, we identified that 60.3% of those individuals reporting a reaction continue to willingly ingest a self-identified food allergen. We did observe that within the group reporting symptoms consistent with anaphylaxis, this specific risk-taking behavior was significantly lower. However, this might suggest that such risk-taking behavior in these students is reinforced within the group who did not report symptoms of anaphylaxis. In our opinion this is unnecessarily predisposing these individuals for potentially severe reactions and possibly future fatality.

Risk taking in adolescent and young adult populations is well documented, including self-reported data.^{13,19-21} In a case series of fatal food-induced anaphylaxis by Bock et al,^{3,12} lack of availability of epinephrine was a significant risk factor predisposing fatality. We document a 21% self-reported carriage rate of SIE, which is lower than in other age groups and populations.^{15,20,21}

Presently, colleges might not be equipped to handle the needs of students with food allergy. The Food Allergy & Anaphylaxis Network has recognized that colleges and universities are in potential need of education, advocacy, and protection and has made educational materials available on their Web site.²² Given our findings, we see evidence that campus dining services would benefit from ensuring that foods are clearly labeled for ingredient content, modifying preparation areas to avoid cross-contamination, and providing allergen-free foods on request. Similarly, it might be advisable for university health services to screen individuals for food allergies through intake forms before the student's arrival on campus. This will better identify such individuals for further education and provide periodic follow-up to verify that SIE prescriptions are being carried at all times

and are up-to-date. Likewise, it might also be beneficial if residence hall staff are trained to use SIE, and institutions will have to decide whether first aid kits should be stocked with SIE devices.

There are limitations to this study. Self-reported data are subject to recall bias, as well as potential problems with the validity of the responses, although it has been an accepted form of investigation within the food allergy literature despite such limitations. A higher-than-expected rate of food allergy was reported, which might have arisen from respondent selection bias. Individuals reporting symptoms perceived to be allergy might have actually had a non-IgE-mediated food intolerance. Because only deidentified data were collected, we did not have the means to further verify individual reactions. Despite these limitations, a sample size of 513 was adequate to provide initial data into the scope of food allergy and food allergy-related behavioral choices in college students. We made a deliberate choice to focus on behavioral choices pertaining to the self-diagnosis of a food allergy, and this study was not intended, by design, to assess prevalence. A multiple-campus study will be an important step to better define the true scope and prevalence of food allergy in the college student population.

In summary, we present the first study examining food allergy in college students. Food allergy might be a growing problem on college campuses. Our data indicate that awareness and management of food allergy on a large university campus at present is less than optimal. We demonstrate that unnecessary risks are taken in those self-identifying as having food allergy and that lack of a previous anaphylactic reaction might reinforce such actions. Maintenance of emergency medication, including SIE, is appallingly low, as is strict avoidance of the particular food allergen. This highlights both a poor perception of one's health care needs at this age, a general sense of invulnerability in this age group, and a failure of patient educational efforts. University health services and university dining services should strongly consider a more proactive approach in assisting behavioral choices of students who identify themselves as having food allergy. Allergists caring for college-aged individuals must reinforce avoiding risk taking and carrying of SIE to help protect these individuals in settings where parents can no longer be the advocate.

Clinical implications: College students might be taking unnecessary risks in terms of food allergy-related behaviors because notification, medication use, and avoidance of self-identified allergens were suboptimal within this population.

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