

Food allergy and anaphylaxis in a university campus dining program



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Background: The estimated prevalence of food allergy (FA) among college students is 15%. However, the risk of FA, anaphylaxis, and related outcomes in college dining halls remains unclear.

Objective: We aimed to assess the landscape of food allergens and allergic reactions within a university dining system that offers FA support measures, including stock epinephrine.

Methods: This observational study collected data from the incoming 2023 University of Michigan freshman cohort via a survey examining self-reported food-related adverse reactions.

We could determine whether these were true IgE-mediated reactions. Additional self-reported reaction data from 2019 to 2023 were also gathered. To identify common allergens, reactions were categorized by food. Adherence to recipes, label compliance, and use of stock epinephrine were evaluated.

Results: Of 1325 first-year respondents, 492 reported adverse reactions to 847 potential allergens (248 reported reactions to multiple foods). The most common allergens were tree nut (n = 259 [30.5%]), peanut (n = 206 [24.3%]), and wheat (n = 91 [10.7%]). In all, 53 dining hall reactions with symptoms such as emesis, hives, difficulty breathing, and itchy throat were reported. Frequent triggers included tree nut (n = 12 [23.1%]), peanut (n = 7 [11.5%]), and milk (n = 8 [15.4%]). Epinephrine was used by 14 respondents (26%); of those, 10 used personal autoinjectors and 4 used university stock. Recipes linked to tree nut and peanut reactions showed high rates of label (78%) and recipe compliance (89%).

Conclusion: College students with FAs remain at risk for anaphylaxis. While dining halls have enhanced FA support measures, tree nut and peanut continue to be high-risk foods. Stock epinephrine proved to be a crucial, potentially life-saving intervention. (*J Allergy Clin Immunol Global* 2026;5:100594.)

Key words: Food allergies, college dining halls, recipe and label compliance, stock epinephrine programs

Food allergy (FA) presents a growing issue globally, affecting up to 10% of the world population.¹ Approximately 33 million people in the United States have FAs, and 5% of the population

Abbreviations used

FA: Food allergy
FARE: Food Allergy Research and Education
U-M: University of Michigan

has experienced at least 1 lifetime anaphylaxis event.² Although fatal anaphylaxis is rare, the data show increases in the rate of fatal reactions in the second and third decades of life.² According to self-reported data, FA prevalence among college students (aged 18-22 years) may reach as high as 15%.³ Young adults are disproportionately affected by FA owing to high rates of food-induced anaphylaxis.^{2,4} College students are particularly vulnerable to allergic reactions on account of being in a new environment and eating in common areas such as dining halls.⁵ Many college students are assuming responsibility for their health for the first time, and navigating FAs in dining halls can thus be a challenge.⁶

College students will be less vigilant in avoiding food allergens and are thus at greater risk of an allergic reaction. Only 40% of college students consistently avoid foods containing their allergen, and only 7 to 21% consistently carry their epinephrine injector.⁷ Additionally, 54% of adolescents and young adults have purposefully ingested a food that was potentially unsafe.⁸ Nevertheless, a recent study reports that 80% of all college students, both with and without FAs, wish they knew how to help someone in the event of anaphylaxis; 69% of such students have indicated that increased awareness about FAs might improve quality of life on campus.⁹ The campus environment can also create a new social static with students wanting to blend in with their cohort.¹⁰ They may not want to be perceived as “difficult” or “different” when going out to eat with peers, and they may experience fatigue from constantly having to navigate their FA.^{10,11} These social factors can lead to students not disclosing their FAs to their peers and dining food services potentially, thus putting them at greater risk for allergic reactions. Additionally, these individuals may also miss out on additional education opportunities provided by dining food services to students with FAs.¹¹


Universities and dining services together bear responsibility to ensure that the proper measures are in place for students with FAs.¹² The Food Allergy Research and Education (FARE) college program started in 2014 to help improve the quality of life of college students. It has been helpful in providing colleges with training and guidance on how to manage FA. The FARE college search can also be helpful for incoming students to identify tools offered by dining services for students with FA.¹³ Appropriate management of FAs with proper labeling, adherence to recipes, and quick access to medical care is crucial for the health and safety of these students.^{5,14} According to student reports, only 12% to 45% of college students reported consistent food labeling and readily available information on allergens.⁵ This study sought to evaluate the landscape of food allergens

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Box 1. Incoming freshmen special dietary needs questionnaire

1. Do you have any FAs or dietary restrictions?
2. What food(s) are you allergic to?
3. Do you have any dietary restrictions or religious dietary observances (eg, halal, kosher, gluten free, lactose intolerant, vegetarian, vegan, other) apply to you?
4. Would you like to be contacted for more information on how to navigate your dietary restrictions on campus by one of our registered dietitians?
5. Do you want access to our gluten-free pantries?
6. Do you have any other dietary information that dining services should be aware of?

and allergic reactions within a single university dining hall system in the context of active support measures for individuals with FA.

METHODS

This observational study was designed to gather data on the prevalence of self-reported FAs among college students, the frequency and causes of allergic reactions in dining halls, and the effectiveness of current dining hall practices in managing FAs. This study includes data collected via e-mail by dining food services at the University of Michigan (U-M).

An annual survey is distributed by campus dining services to all incoming first-year college students with their housing applications to assess self-reported allergies (Box 1). This survey asks first-year college students to report whether they have any dietary restrictions, report any FAs, and list the specific allergens. Responses from the 2023 incoming freshmen class were deidentified and used for data analysis. Individuals that reported only having a dietary restriction such as lactose intolerance, kosher diet, halal diet without having FAs were excluded from this study. Additionally, individuals who specified certain health conditions such as celiac disease were also excluded. We were unable to differentiate between IgE-mediated FAs and perceived food adverse events caused by specific allergens.

In addition, self-reported surveys examining any allergic reactions in the time span from 2019 to 2023 that occurred on the U-M campus were gathered; the surveys included details regarding the individuals' allergies and the foods that they ate, whether medical care was needed, and whether any epinephrine was utilized. These incidents were investigated by campus dining services. Further data assessing adherence to the recipe and proper food allergen labeling were then obtained. A total of 11 reaction surveys that did not pertain to allergic reactions (eg, finding objects in one's food, accidentally receiving sugar-free items, or receiving the incorrect item but not experiencing an allergic reaction) were removed from this study.

Lastly, information regarding stock epinephrine use on the U-M campus from 2018-2023 was gathered. These data were obtained via dining services forms that were submitted to the Licensing and Regulatory Affairs Office of Michigan as part of the stock epinephrine program. These forms indicated the food that was consumed, details of the reaction that occurred, and the quantity of epinephrine administered.

Descriptive statistical analysis was performed. The most common food allergens in the incoming first-year class were identified. Additionally, reactions were compared based on need for medical care and further stratified based on epinephrine use per allergen. Dining hall practices were evaluated for recipe

compliance by cross-checking the recipe that is on file with the food staff member who had prepared the food and noting whether anything was changed owing either to ingredient availability or to personal preference. Lastly, reactions were evaluated for food labeling compliance by assessing the presence of clear and proximate labeling indicating the inclusion of any of the top 9 major food allergens, as well as the availability of an easily accessible ingredient list to identify less common allergenic components.

RESULTS**Self-reported allergies**

Incoming first-year college students were surveyed by dining services regarding dietary restrictions. Because the survey did not collect demographic information from individual respondents, demographic data for the entire incoming freshman class in fall 2023 are provided for context. The cohort included 7466 students, of whom 7426 (99%) were enrolled full-time and 40 (1%) were enrolled part-time. There was a nearly even distribution by sex, with 4049 women (54%) and 3417 men (46%). According to race/ethnicity, the largest group was White ($n = 3346$ [44.8%]), followed by Asian American ($n = 1511$ [20.2%]) and Hispanic American ($n = 1099$ [14.7%]). African American students comprised 5.8% of the respondents ($n = 432$), with 208 (2.8%) identifying as being of 2 or more underrepresented minority races and 226 (3.0%) identifying as being of 2 or more non-underrepresented minority races. Smaller groups included Native American ($n = 18$ [0.24%]), Native Hawaiian or Pacific Islander ($n = 12$ [0.16%]), and international ($n = 271$ [3.6%]) students. An additional 343 students (4.6%) did not report their race or ethnicity.¹⁵

A total of 1325 of the 7466 enrolled first-year students (18%) completed this survey. Of these students, 898 reported having dietary restrictions whereas 427 reported not having any restriction. Of those 898 individuals, 406 reported dietary restrictions that were not food allergies, such as being kosher, halal, gluten-free, etc. This left 492 individuals who reported a dietary restriction due to self-reported FA (37% of all survey respondents [6.6% of the total incoming first-year class]). The self-reported FA survey is unable to differentiate between IgE-mediated food allergies, food intolerances, or other reactions. Of the 492 individuals with self-reported FA, 244 reported having allergy to 1 food allergen, 152 reported having allergy to 2 food allergens, 52 reported having allergy to 3 food allergens, and 44 reported having allergy to 4 or more food allergens (Fig 1). Among the 492 individuals with food allergies, a total of 847 allergens were reported, as many students had multiple FAs, as already noted. Of the 847 reported allergens, the most common were tree nuts ($n = 259$ [30.5%]), peanut ($n = 206$ [24.3%]), and wheat ($n = 91$ [10.7%]) (Fig 2). However, rarer food allergens, such as sunflower seed, coconut, chickpea, and eggplant, were also present on campus.

Allergic reactions on campus

Incident reports for self-reported allergic reactions that occurred on the U-M campus were gathered from August 2019 to September 2023. During that time, there were a total of 64 documented reports of food concerns, with the majority ($n = 53$ [88%]) being allergic reactions with symptoms consisting of vomiting, hives, throat or lip swelling, or shortness of breath. We evaluated whether medical care was provided and epinephrine was utilized. Additionally, each



FIG 1. Flowchart to demonstrate the responses to survey data for FAs from freshmen class of 2023.

Summary of food allergens self-reported to dining services

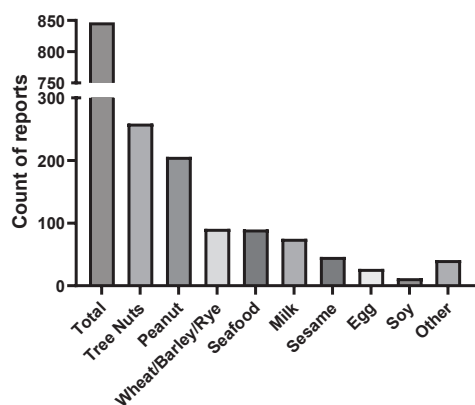


FIG 2. FAs of incoming first-year students for the class of 2023, stratified by food allergen.

reported food involved in the reaction was analyzed by dining services after the reaction had occurred to determine whether appropriate labeling was in place and whether there were any discrepancies between the ingredients used and those listed in the original recipe. Among the 53 reported dining hall allergic reactions, the most frequently implicated allergens were tree nuts ($n = 12$ [23%]), milk ($n = 8$ [15%]), and peanut ($n = 7$ [13%]) (Table 1). Medical care was most often required for the 53 reactions involving peanut ($n = 7$ [13%]) and tree nuts ($n = 7$ [13%]). Epinephrine was required in 14 cases (26%), with peanut ($n = 5$ [38%]) being the allergen most associated with epinephrine use (Fig 3). Of these 14 cases, 4 (29%) required the use of stock epinephrine. The cases requiring stock epinephrine use involved peanut ($n = 2$ [50%]), tree nuts ($n = 1$ [25%]), and milk ($n = 1$ [25%]). Food was inappropriately labeled in 14 of the cases (26%). The highest number of allergic reactions secondary to improper labeling involved tree nuts ($n = 4$ [33%]). Furthermore, when dining services reviewed the recipes for the suspected foods responsible for each reaction, they found that in 12 cases (23%), the recipe was not followed properly. This was due to various factors, including ingredient unavailability, quality control issues, and modifications made by the chef. The greatest number of cases of allergic reactions due to nonadherence to the recipe involved milk ($n = 4$ [50%]) (Fig 3). Additionally, 3 of the cases that showed labeling inconsistencies were secondary to recipe noncompliance.

DISCUSSION

This study found a 6.6% prevalence of self-reported FA among first-year college students at a single institution, which is a figure lower than the national estimates—likely reflecting self-reporting and sampling biases—but consistent with the ASSESS FA study, which reported a 6.6% prevalence of physician-verified FA among US adults across multiple countries.¹ In these cases of self-reported FA, it was not possible to differentiate between IgE-mediated reactions and perceived adverse food events due to specific allergens. However, although individuals may not readily recognize a difference between allergies and adverse food reactions, all food-related problems may cause distress and make it difficult to navigate dining halls.

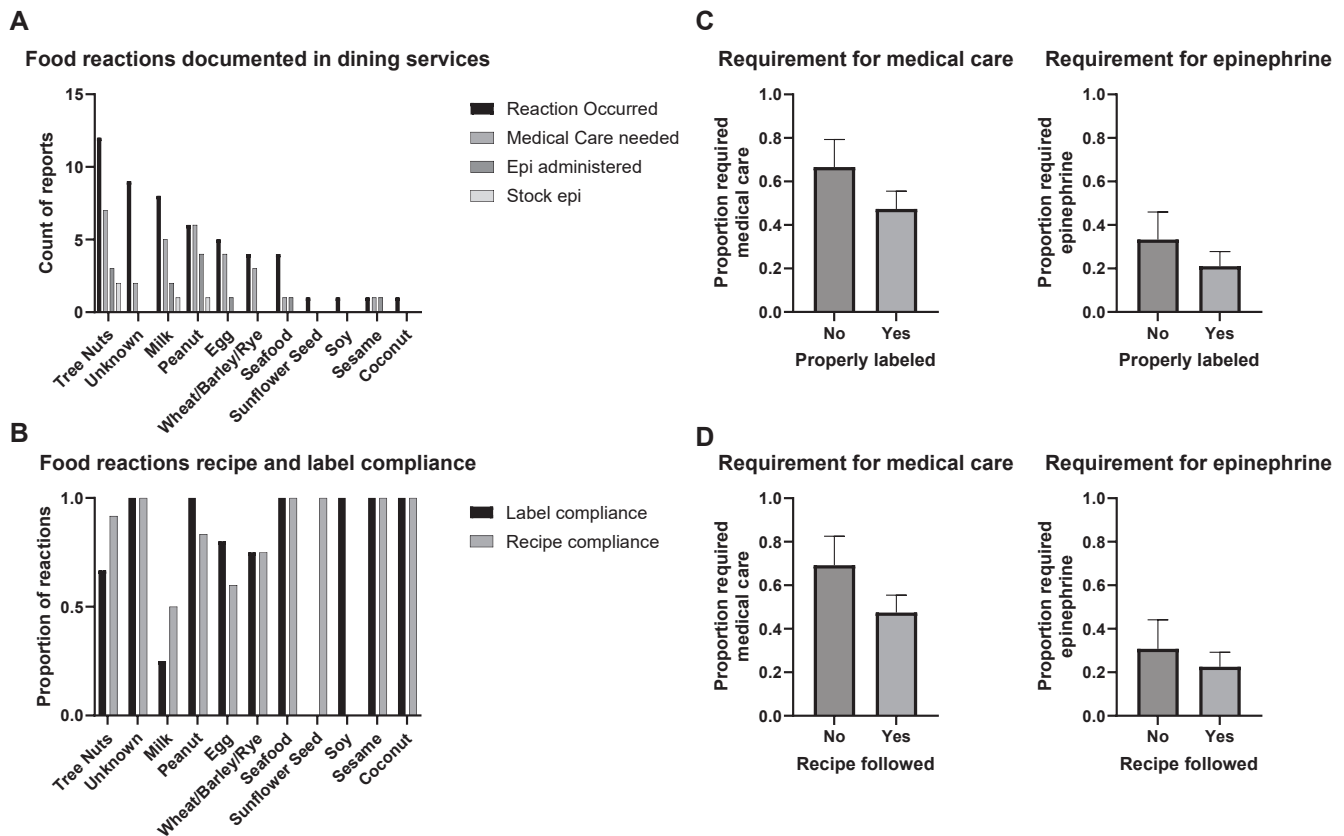
Given the high number of individuals reporting FA at the study institution, along with the increasing prevalence of FA among young adults noted in other studies, it is imperative to implement robust preventive practices—especially for students eating in communal settings such as dining halls.⁷ Since 2017, tree nuts and peanuts have consistently been the most common allergens at U-M.¹⁶ In 2023, the third most reported allergen was wheat, barley, and/or rye, as opposed to milk in 2017.¹⁶ However, because the survey did not distinguish between celiac disease and FA, the number of reported wheat, barley, and/or rye allergies may be artificially elevated. The less-reported allergens—such as soy, sunflower seed, chickpea, and eggplant—highlight the diversity of food allergies. Notably, nearly 50% of respondents reported having multiple FAs.

U-M has implemented significant FA prevention strategies in its dining halls, including allergen labeling, detailed ingredient lists, mobile apps with food information, and education for students with FA. Additionally, all dining staff complete a comprehensive training program focused on safe food preparation, handling, and cleaning to minimize cross-contamination. Despite these efforts, 53 allergic reactions were reported on campus over the past 4 years.

Importantly, the top 3 allergens responsible for these reactions were tree nuts, milk, and peanuts—consistent with their known roles as leading causes of food-induced anaphylaxis.¹⁷ All reactions involving peanuts and more than half involving tree nuts required medical attention, thus underscoring their severity. Peanut reactions were associated with the highest rate of epinephrine use in the study. These findings align with broader data indicating that peanut and tree nuts remain among the top causes of fatal anaphylaxis worldwide.^{17,18} Thus, when serving these allergens in campus dining settings, it is essential to enforce rigorous safety measures.

TABLE I. Documented self-reported allergic reactions from 2019–2023 stratified by allergen suspected to cause the reaction

Allergen	Reaction occurred, no. (%) (n = 53)	Medical care needed, no. (%) (n = 30)	Epinephrine administered, no. (%) (n = 14)	Stock epinephrine, no. (%) (n = 4)	Labeled improperly, no. (%) (n = 14)	Recipe not followed, no. (%) (n = 12)
Tree nuts	12 (23%)	7 (23%)	3 (21%)	2 (50%)	4 (28.6%)	2 (16.6%)
Milk	8 (15%)	5 (17%)	3 (21%)	1 (25%)	6 (42.9%)	4 (33.3%)
Peanut	7 (13%)	7 (23%)	5 (36%)	1 (25%)	1 (7.1%)	2 (16.6%)
Egg	5 (9%)	4 (13%)	1 (7%)	0 (0%)	1 (7.1%)	2 (16.6%)
Wheat, barley, rye (gluten-free)	4 (8%)	3 (10%)	0 (0%)	0 (0%)	1 (7.1%)	1 (8.3%)
Seafood	4 (8%)	1 (3%)	1 (7%)	0 (0%)	0 (0%)	0 (0%)
Sunflower seed	1 (2%)	0 (0%)	0 (0%)	0 (0%)	1 (7.1%)	0 (0%)
Soy	1 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (8.3%)
Sesame	1 (2%)	1 (3%)	1 (7%)	0 (0%)	0 (0%)	0 (0%)
Coconut	1 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Unknown	9 (17%)	2 (7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

**FIG 3.** Food reactions occurring in dining halls, stratified by allergen (A) and labeling and recipe compliance (B). Additionally, severity of the reaction based on medical care and epinephrine use is illustrated, as stratified by labeling (C) and recipe (D) compliance.

Interestingly, both peanut- and tree nut-containing foods in this study had high rates of proper labeling and recipe compliance. In contrast, foods containing allergens not included among the top 9 (peanut, tree nuts, milk, egg, fish, shellfish, wheat, soy, and sesame) may carry a higher risk for accidental exposure, as labeling regulations often focus on these primary allergens. At U-M, allergen labeling extends beyond the top 9 allergens to include beef, pork, oats, and alcohol to accommodate various dietary

restrictions. Fried items are also labeled owing to the potential for cross-contamination in shared fryers.

Nevertheless, our findings show that most allergic reactions still occur as a result of the top 9 allergens, emphasizing the need for continued patient education. Counseling individuals with FA on allergen avoidance and risk reduction strategies remains a critical component of care. Furthermore, educating students, faculty, and staff about FAs and developing individualized FA

management plans may help reduce risk-taking behaviors that contribute to allergic reactions.⁸

Although peanut and tree nuts were associated with good recipe compliance, milk was associated with lower recipe and label compliance. Similarly, other allergens such as shellfish, egg, and wheat, barley, and/or rye showed variability in labeling and recipe adherence, highlighting potential food-related gaps in current food safety practices. Accommodations available for students with FA vary widely across college campuses.⁵ Physicians can help proactively prepare young adults entering college by encouraging early discussions with dining services, coming up with a plan to obtain safe food, and preparing for some of the social pressures of college.¹¹

Stock epinephrine is an additional safety measure in place for students with FA. The stock epinephrine program was implemented in Michigan in 2018 after state legislation enacted a stocking law that allowed entities outside K-12 schools to carry and administer epinephrine in emergent cases.¹⁹ This study indicated that stock epinephrine has been used on 4 occasions since this program was implemented at U-M. Currently, only 7% of the universities participating in FARE provide stock epinephrine.^{5,13} Stock epinephrine is a potentially lifesaving measure that can be provided by dining food services at universities.

This study is limited by reliance on self-reporting by students. How many of the self-reported FAs are true IgE-mediated allergies and whether they have been confirmed by a medical professional are unclear. Additionally, there is a possibility that the students could have provided inaccurate information on their survey or chosen to not disclose a FA, thus skewing prevalence reporting. Specifically, the high number of wheat allergies could be confounding with gluten intolerance or celiac disease. The incident reports analyzed are limited by the self-reported nature of reactions. Therefore, there could be allergic reactions that are missing from this study if the individual never reported them. Recall bias is also an additional limitation because most of these reports were completed after the reaction had occurred. Third-party bias may also be prevalent because some reports were filled out by bystanders or parents of the student involved in the event.

Conclusion

Improving FA management in universities is crucial. This study demonstrates the high prevalence of FA in a college population and high rates of allergic reactions. By identifying the most common allergens causing allergic reactions, we can place a higher emphasis on ensuring that recipe and label adherence is followed and educate students and staff appropriately. Ultimately, the goal is to create a safe and inclusive environment for all students eating in dining halls, ensuring that students with FAs do not have a challenging time navigating their allergies. Continued research and proactive measures on college campuses are vital to improving the quality of life for students with FAs.

Statement on use of artificial intelligence tools: During the preparation of this work, the authors used ChatGPT to improve sentence readability and make the language used more concise. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Clinical implications: This study highlights the need to improve FA management on college campuses by enhancing cross-contamination safety, staff training, stock epinephrine availability, recipe consistency, and accurate allergen labeling.

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