Original Article

Food Allergy–Related Risk-Taking and Management Behaviors Among Adolescents and Young Adults

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What is already known about this topic? Adolescents with food allergy (FA) are at particularly high risk of fatal anaphylaxis; however, they regularly participate in behaviors that may increase their risk of anaphylaxis. FA negatively impacts affected adolescents' quality of life.

What does this article add to our knowledge? Adolescents and young adults clustered into 2 latent classes reflecting different levels of risk-taking behavior. AYA with greater peer, parent, or teacher support or an established 504 plan were less risky. Multiple positive outcomes of FA were identified.

How does this study impact current management guidelines? This article identifies clinical, demographic, and social factors associated with greater FA-related risk-taking behavior among AYA—as well as positive outcomes associated with FA—which can be targeted by clinicians during patient education.

BACKGROUND: Food allergy (FA) affects 8% of children and adolescents in the United States. Nearly 40% of those affected have experienced severe reactions. Fatal food-induced anaphylaxis is most common among adolescents and young adults (AYA); however, FA-related risk behaviors persist in this population and factors associated with these behaviors remain unclear.
OBJECTIVE: To characterize FA-related risk-taking and self-management behaviors of AYA with FA.
METHODS: A cross-sectional survey was administered to 200 AYA with FA. Latent class analysis was used to identify distinct behavioral risk classes and predictors of risk class membership.
RESULTS: Two distinct FA behavioral risk classes were identified, representing less (N = 120) and more (N = 80) risky subpopulations. After adjusting for age, sex, and anaphylaxis history, odds of more risky class membership were significantly reduced for AYA with peanut allergy (odds ratio [OR], 0.27; 95% CI, 0.11-0.65), supportive female friends (OR, 0.27; 95% CI, 0.07-0.99), overprotective mothers (OR, 0.42; 95% CI, 0.18-0.97), teachers who are aware of their FA (OR, 0.39; 95% CI, 0.17-0.91), a history of being bullied (OR, 0.22; 95% CI, 0.09-0.51), and an established 504 education plan (OR, 0.35; 95% CI, 0.15-0.81). AYA also reported numerous positive outcomes of their FA, such as greater responsibility, empathy, and improved diet, which was significantly associated with reduced odds of risky class membership (OR, 0.38; 95% CI, 0.18-0.80).
CONCLUSIONS: Among AYA, increased FA-related risk-taking was associated with clinical, demographic, and social factors, including peanut allergy, greater age, as well as absence of social support and specific school FA policies. These associations may be used to inform future interventions designed to address FA-related risk and management behaviors. **(J Allergy Clin Immunol Pract 2017;5:381-90)**

Key words: *Food allergy; Risk-taking behaviors; Adolescents and young adults (AYA); Self-management; Social support; Latent class analysis (LCA)*

Food allergy (FA) affects an estimated 8% of children and adolescents in the United States.[1,2] Nearly 40% of children and adolescents with FA have experienced severe, potentially life-threatening reactions,[2] with growing numbers of children and adolescents presenting to emergency departments with food-induced anaphylaxis.[3] Moreover, nearly 70% of FA-related fatalities reported in an anaphylaxis registry occurred among adolescents and young adults (AYA) aged 13 to 24 years.[4] Adolescents in particular have been shown to be at increased risk of mortality due to food-induced anaphylaxis if they delay administration of epinephrine and/or have a diagnosis of asthma.[5-8] Multiple studies have shown that AYA regularly participate in behaviors that may increase their risk of anaphylaxis, such as eating foods that "may contain" allergens.[7,9,10] In addition, AYA

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Abbreviations used
$_{Adj}$OR- Adjusted odds ratio
AYA- Adolescents and young adults
EAI- Epinephrine autoinjector
FA- Food allergy
LCA- Latent class analysis

do not reliably inform their social networks of their allergies, train peers on the use of epinephrine in case of an emergency, or carry or store epinephrine where they live, learn, and participate in daily activities.[7,9]

AYA with chronic illnesses, including FA, are often expected to assume greater autonomy and responsibility with regard to the management of these illnesses as they transition toward adulthood. Physicians often play a key role in helping AYA navigate this transition; thus, it is critical that clinicians caring for AYA with FA provide appropriate patient education and counseling about the management of FA, including strategies to minimize the risk of accidental allergen exposure. However, no work to date has systematically examined factors associated with FA-related risk-taking and self-management behavior among AYA that may inform the development of effective interventions targeting these behaviors. We therefore sought to characterize FA-related risk-taking and self-management behaviors and examine factors associated with these behaviors via latent class analysis (LCA). LCA has been previously used by allergists to identify and describe multiple atopic phenotypes, which were not known in advance, but rather, were inferred from clinical data.[11] In the present study, we hypothesized that participants would fall into distinct patterns of FA-related risk-taking and management behaviors, which could then be predicted by multiple clinical, demographic, and social factors.

METHODS

This study used a cross-sectional survey administered between June 2014 and January 2015 to AYA with food allergy and was approved by appropriate institutional review boards.

Survey development and design

A 50-question survey was developed by pediatricians, pediatric allergists, health services researchers, and FA educators. Survey domains included demographic information, FA history, reaction history, FA-related risk taking (ie, food choices and epinephrine carriage), perceived social support, perceived positive aspects of living with FA, FA-related desires, and a general risk-taking assessment. Items were drawn from previous electronically administered population-level surveys where possible.[2] Expert panel review and cognitive interviews of adolescents (n = 5) assessed clarity and general understandability of each survey item. Cognitive interviews were performed by a member of the study team either in-person or over the phone. The survey was then programmed for electronic administration using the Research Electronic Data Capture platform,[12] and quality control testing was conducted. Figure E1 in this article's Online Repository at www.jaci-inpractice.org contains the items included in the final survey instrument.

Study participants

Eligible participants included English-speaking AYA aged 14 to 22 years with 1 or more current FA. Participants older than 18 years

TABLE I. Demographic characteristics of adolescents with FA

Variable	Frequency, % (n) All adolescents (N = 200)
Age (y)	
14	24 (44)
15	16 (28)
16	14 (15)
17	10 (18)
18	12 (22)
19	8 (15)
20	8 (15)
21	3 (6)
22	4 (7)
Missing	10 (20)
Sex	
Female	58 (116)
Male	33 (65)
Missing	10 (19)
Race/ethnicity	
Caucasian/white	79 (152)
Asian	9 (18)
Hispanic/Latino	3 (5)
African American/black	1 (2)
Native American	2 (3)
Other	3 (6)
Additional medical conditions	
Environmental allergies	67 (134)
Asthma	55 (110)
Eczema	35 (69)
ADD/ADHD	10 (21)
Celiac	3 (5)
Diabetes	2 (3)
Other	12 (24)
Allergy	
Peanut	76 (151)
Tree nut (almonds, pecans, cashews, etc)	76 (151)
Milk/dairy	30 (59)
Shellfish (shrimp, lobster, crab, etc)	27 (53)
Egg	20 (39)
Sesame	19 (38)
Soy	15 (30)
Fin fish (salmon, tuna, trout, etc)	13 (26)
Wheat	12 (24)
Other	34 (68)
Number of allergies	
1	21 (41)
≥2	79 (159)
History of anaphylaxis	
Yes	54 (108)
No	32 (63)
I don't know	19 (10)
Missing	10 (5)
Number of severe FA reactions during past year	
0	63 (126)
1-5	29 (57)

(continued)

TABLE I. *(Continued)*

Variable	Frequency, % (n) All adolescents (N = 200)
6-10	3 (5)
11-15	1 (2)
>15	1 (1)
Missing	5 (9)
History of EAI use to treat an FA reaction	
Yes	38 (76)
No	56 (112)
Missing	6 (12)

ADD, Attention deficit disorder; *ADHD*, attention deficit/hyperactivity disorder.

were recruited via email and social media messages posted by the following organizations: Food Allergy Research and Education, Food Allergy & Anaphylaxis Connection Team, Allergy and Asthma Network, and Mothers of Children Having Allergies. In-person recruitment also took place at teen FA conferences and summits organized by Food Allergy Research and Education and Food Allergy & Anaphylaxis Connection Team. Caregivers determined if survey participation was appropriate for their children. If so, caregivers forwarded the email containing the secure survey link to their children, which constituted parental consent. An overview of the study was outlined at the beginning of the survey instrument. At the end of the overview, participants were asked to consent. Participants who were at least 18 years of age also provided active consent before beginning the survey, whereas participants younger than 18 years provided assent.

Statistical analysis

Frequencies of categorical responses are presented descriptively. LCA was conducted using 12 dichotomized indicators to identify homogeneous, mutually exclusive latent classes of FA risk behavior hypothesized to exist within our study population. Additional details are provided in this article's Online Repository at www.jaci-inpractice.org. To determine specific factors predictive of class membership, each factor was added to the model to test independent associations via multinomial logistic regression after adjusting for participant sex, age, and anaphylaxis history (yes vs no).

Although complete data were available for most study variables, some missingness was observed, most notably for participant sex ($N_{missing} = 19$) and age ($N_{missing} = 20$). This was addressed in 2 ways. First, all estimation was carried out using full-information maximum likelihood. Second, all analyses were re-run using a multiply imputed data set calculated using the complete set of observed study variables. The results of these analyses were nearly identical and did not differ meaningfully from those reported here.

RESULTS

Sample

Demographic characteristics of the sample (N = 200) are found in Table I. A slight majority of participants (58%) were female, and most (79%) reported being white. Frequencies of comorbid atopy and other chronic conditions are provided in Table I.

TABLE II. FA-related risk behaviors and attitudes used as latent class indicators

Variable	Frequency, % (n)
Carry EAI (eg, EpiPen, Auvi-Q, Adrenaclick)*	
Yes	87 (174)
No	5 (10)
Sometimes	8 (16)
→ If No or Sometimes, why not?†	
I forgot to take it with me	54 (14)
I don't think I will have a reaction	46 (12)
Carrying it is inconvenient or uncomfortable	42 (11)
I don't think my allergy is severe enough to require it	27 (7)
I don't have a prescription for it	19 (5)
Carrying it makes me self-conscious	8 (2)
Medication is in the main office at school	4 (1)
Eat packaged foods labaled as "manufactured in a facility" with most severe allergen*‡	
Yes	37 (74)
No	63 (126)
Sometimes	20 (40)
Eat packaged foods labeled as "processed on equipment" with most severe allergen‡	
Yes	20 (39)
No	80 (161)
Eat packaged foods labeled "may contain" most severe allergen‡	
Yes	20 (40)
No	80 (160)
Try to eat foods known to be severely allergenic	
Yes	2 (4)
No	96 (192)
Missing	2 (4)
Eat unpackaged or homemade food when unsure of whether it contains your allergen*	
Yes	3 (6)
No	85 (165)
Sometimes	12 (24)
Kiss people who have recently eaten the food(s) they're most allergic to*	
Yes	1 (1)
No	87 (168)
Sometimes	13 (25)
Feel they could die from their FA	
Yes	90 (174)
No	10 (19)
→ If No, why not?†	
I've never had a life-threatening reaction	58 (11)
I can treat myself if I have a serious reaction	53 (10)
My allergy is not that severe	53 (10)
Wear medical jewelry (eg, MedicAlert bracelet) to let people know about their FA	
Yes	42 (83)
No	58 (113)
→ If No, why not?†	
Wearing it is inconvenient or uncomfortable	42 (47)
Wearing it makes me self-conscious	29 (33)
I've never heard of it	16 (18)

(continued)

TABLE II. *(Continued)*

Variable	Frequency, % (n)
I forget to put it on	15 (17)
I've never heard of it	15 (16)
My allergy is not that severe	11 (12)
Other	27 (30)
Most severe allergen is present in home*	
Yes	44 (83)
No	38 (72)
Sometimes	18 (33)
Ask about allergenic ingredients in dish when eating at a restaurant	
Yes	82 (165)
No	18 (35)
Ask about cross-contact when eating at a restaurant	
Yes	65 (131)
No	35 (69)
Carry a chef card when eating at a restaurant	
Yes	12 (23)
No	88 (177)
Call ahead to restaurants to ensure they can accommodate their FA	
Yes	36 (72)
No	64 (128)

*This item was dichotomized Yes/Sometimes vs No when conducting LCA.
†Participants were allowed to select more than 1 reason why not.
‡Because of high collinearity between these 3 items, these were collapsed into a single dichotomous item reflecting any self-reported consumption of packaged foods with precautionary allergen labeling.

FA risk behaviors and management practices

Eighty-seven percent of respondents reported carrying an epinephrine autoinjector (EAI) with them at all times (Table II). Reasons for not always carrying are given in Table II. Approximately half (47%) of the respondents reported eating packaged foods with precautionary labeling for their most severe allergen. In addition, 15% reported eating unpackaged or homemade foods despite being unsure whether they contain their allergen, and 13% reported sometimes kissing people who have recently eaten their allergen.

More than 90% of respondents reported that they believe they could die from their FA, and 42% reported wearing medical jewelry for their FA. Most participants (82%) reported asking about allergenic ingredients and cross-contact at restaurants (65%), while fewer (36%) reported calling ahead to restaurants or carrying a chef card (12%).

Perceived support at home and school

Sixty-eight percent reported that their parents and/or caregivers remind them to carry an EAI (Table III). Most respondents reported that their parents and friends were each "supportive/great" about FA. However, a substantial minority of participants felt that their parents were "overly protective" (46% for mothers; 24% for fathers). Eighty-two percent of respondents reported that their female friends were "supportive/great" about their FA, whereas only 65% reported feeling this way about their male friends. In addition, 55% reported feeling that their female friends would know what to do in an FA-related emergency, 39% reported feeling that their male friends would know what to do in case of an emergency, and 11% reported feeling that their classmates would know what to do. Forty-three percent reported FA-related bullying. School-level FA policies and supports reported by participants are presented in Table IV. Table V presents AYA-reported ways in which FA presents a barrier to engagement in day-to-day social activities.

Reported positive aspects of living with FA

Eighty-nine percent of AYA surveyed reported that FA made them more responsible, and 72% indicated that their allergy made them a better advocate for themselves and others (Table VI). In addition, 64% reported that having an FA helped them appreciate and offer help to others with special needs. Sixty-one percent indicated that living with an FA made them more appreciative of the foods they can eat, and 55% indicated that their FA helped them eat healthier.

Latent classes

The final 2-class LCA solution classified 80 participants into class 1 and 120 participants into class 2 on the basis of participants' responses on the 12 survey items listed in Table II. See Figure E2 for relative model fit statistics comparing 1-, 2-, and 3-class models. Relative entropy (0.85) and average latent class probabilities (0.961-0.973) for the 2-class model were high, indicating that FA-related risk behavior is more homogeneous among participants assigned to the same class relative to participants assigned to different classes.

Significant differences (2-sided $P < .05$) in item probabilities were observed between classes for 10 of the 12 FA-related risk-taking behaviors used as latent class indicators (Figure 1). Relative to class 1, members of class 2 were significantly more likely to carry their EAI, wear medical jewelry, and believe they can die from their FA. When eating in restaurants, members of class 2 were more likely than members of class 1 to ask about allergenic ingredients, carry a chef card, call ahead to ask about FA accommodations, and ask about cross-contact. Members of class 2 were less likely than those of class 1 to have their allergen(s) present at home and to eat unpackaged foods with unknown ingredients.

Predictors of latent class membership

Adjusting for participant sex, age, and anaphylaxis history, respondents with peanut allergy were significantly less likely to be in class 1 than participants without peanut allergy (adjusted odds ratio [$_{Adj}$OR], 0.27; 95% CI, 0.11-0.65) (Table VII). Tree nut, shellfish, fin fish, milk, egg, soy, wheat, and sesame allergies were not significantly associated with latent class membership. Older participants were more likely than younger participants to be in class 1 ($_{Adj}$OR, 1.22; 95% CI, 1.04-1.42), but race and sex were not predictive of class membership. Age at first reaction, number of severe reactions, history of EAI use, number of FAs, the presence of comorbid chronic conditions, and history of anaphylaxis were not significantly associated with class membership.

Participants who reported that their teachers were aware of their FA were less likely to be in class 1 than participants whose teachers were unaware ($_{Adj}$OR, 0.39; 95% CI, 0.17-0.91); however, having a school nurse or friends who were aware of a participant's FA was not predictive of class membership. Participants reporting being bullied as a result of FA were less likely to be in class 1 than participants who did not report bullying ($_{Adj}$OR, 0.22; 95% CI, 0.09-0.51).

TABLE III. FA support among friends, classmates, and caregivers

Variable	Yes	No	Sometimes	NA	Missing
Primary male caregiver (dad/legal guardian)					
Is supportive/great about respondent's FA	80 (152)	6 (11)	11 (21)	3 (5)	6 (11)
Is overly protective about respondent's FA	24 (45)	48 (91)	25 (48)	3 (6)	5 (10)
Primary female caregiver (mom/legal guardian)					
Is supportive/great about respondent's FA	96 (183)	1 (1)	3 (6)	0 (0)	5 (10)
Is overly protective about respondent's FA	46 (86)	21 (40)	33 (63)	0 (0)	6 (11)
Parent/caregiver					
Reminds respondent to carry EAI	68 (129)	12 (22)	18 (35)	3 (5)	5 (9)
Male friends					
Are supportive/great about respondent's FA	65 (126)	4 (7)	23 (45)	8 (16)	3 (6)
Know what to do if respondent has an FA emergency	39 (75)	29 (55)	26 (50)	7 (14)	3 (6)
Female friends					
Are supportive/great about respondent's FA	82 (158)	2 (3)	10 (20)	6 (12)	4 (7)
Know what to do if respondent has an FA emergency	55 (107)	15 (29)	24 (46)	6 (12)	4 (7)
Most of classmates					
Are supportive/great about respondent's FA	48 (92)	11 (21)	29 (56)	12 (24)	4 (7)
Know what to do if respondent has an FA emergency	11 (21)	42 (81)	35 (68)	12 (22)	4 (7)

NA, Not applicable.

TABLE IV. School support for living with an FA

Variable	Frequency, % (n) (N = 200)
School contacts aware of respondent's FA*	
Friends	90 (180)
School nurse	69 (138)
Teacher	61 (122)
No one	2 (4)
I don't know	2 (3)
Other	20 (389)
Precautions for FA in place at school*	
Access to EAIs (eg, EpiPen, Auvi-Q, and Adrenaclick)	59 (117)
FA action plans	46 (92)
Full-time nurse	45 (90)
School staff trained on how to respond to a severe reaction	44 (87)
Individual plan for allergies (eg, 504 plan)	40 (80)
Labeled foods in cafeteria	27 (54)
FA restrictions in school	16 (31)
School-wide FA policy	13 (25)
Allergen-free tables	10 (21)
Ban on food sharing	7 (13)
Strict hand cleaning rules	7 (13)
None of the above	10 (19)
I don't know	9 (17)
Other	6 (11)
Have you ever felt bullied because of your FA?	
Yes	43 (83)
No	57 (110)

*Multiple response options were permitted.

Participants who reported that their female friends were supportive of their FA were less likely to be in class 1 than participants without supportive female friends ($_{Adj}$OR, 0.27; 95% CI, 0.07-0.99). Having supportive parents, male friends, and supportive classmates was not significantly associated with class membership. Participants who reported having overprotective mothers ($_{Adj}$OR, 0.42; 95% CI, 0.18-0.97) were less likely to be in class 1 than participants who did not.

Participants with individualized "504" plans for managing FA in school were significantly less likely to be in class 1 than participants without 504 plans ($_{Adj}$OR, 0.35; 95% CI, 0.15-0.81). Participants were also somewhat less likely to be in class 1 if their schools had undesignated/stock epinephrine available ($_{Adj}$OR, 0.48; 95% CI, 0.22-1.05), had staff trained in FA management ($_{Adj}$OR, 0.45; 95% CI, 0.19-1.06), or had established food restrictions ($_{Adj}$OR, 0.40; 95% CI, 0.14-1.15), though these associations were not statistically significant at a P value of less than .05.

Participants who reported limitations in their ability to hang out at friends' houses ($_{Adj}$OR, 0.35; 95% CI, 0.15-0.81) and eat out with friends ($_{Adj}$OR, 0.27; 95% CI, 0.12-0.61) were significantly less likely to be in class 1 than participants who did not report such limitations.

Finally, participants reporting that their FA helped them to eat healthier were significantly less likely to be in class 1 than participants who did not ($_{Adj}$OR, 0.38; 95% CI, 0.18-0.80). No other perceived benefit of FA was associated with FA risk-taking class membership ($P > .05$).

DISCUSSION

This study is the first to describe the existence of multiple discrete classes of FA-related risk-taking behavior among AYA. It appears that class 1 represents a subpopulation of AYA with FA who are more likely overall to engage in numerous FA risk-taking behaviors, and less likely to engage in recommended management practices than participants assigned to latent class 2 (ie, the less risky class). Overall, we found that AYA with greater support from peers, parents, and teachers and a 504 plan in place at school engage in fewer FA-related risk-taking behaviors than AYA who lack such supports. These findings that FA-related

TABLE V. Reported barriers to living with an FA (n = 190)

Barrier	Yes	No	Sometimes	NA	Missing
FA limits respondents' ability to					
Hang out at friends' houses	12 (23)	61 (121)	23 (45)	1 (1)	5 (10)
Go out to eat with friends	29 (58)	29 (57)	35 (70)	3 (5)	5 (10)
Go shopping with friends	4 (7)	77 (153)	10 (19)	5 (9)	5 (10)
Go to the movies with friends	6 (12)	77 (153)	10 (19)	3 (5)	5 (10)
Hang out with friends in general	8 (16)	72 (143)	15 (29)	1 (1)	5 (11)
Participate in extracurricular activities (eg, sports and clubs)	8 (15)	73 (145)	15 (29)	1 (1)	5 (10)
Attend school dances or other events	8 (15)	76 (151)	10 (19)	3 (5)	5 (10)
Attend sporting events	9 (18)	69 (138)	16 (31)	2 (3)	5 (10)
Get an after-school or part-time job	8 (16)	56 (111)	18 (36)	13 (26)	5 (11)

NA, Not applicable.

TABLE VI. Positive reported outcomes of living with an FA

Ways that FA has impacted respondents' lives*	Frequency, % (n)
Made them more responsible	89 (177)
Made them a better advocate of themselves and of others	72 (143)
Helped them appreciate and offer help to others with special needs	64 (128)
Made them more appreciative of the foods they can eat	61 (121)
Helped them to eat healthier	55 (110)
Brought them closer to their family	32 (64)
Brought them closer to their friends	27 (53)
Other	3 (5)

*Multiple response options were permitted.

risk-taking behaviors tend to cluster together and are associated with multiple clinical, demographic, and social factors provide guidance to clinicians and health educators who seek to reduce FA-related risk-taking and improve FA self-management among AYA.

Adolescence and young adulthood mark times of increasing peer affiliation as youth increasingly rely on friends for social support. In this study, as in previous work,[9] most respondents were not confident that their classmates or friends would know what to do in the event of an FA emergency. However, irrespective of participant sex, AYA with supportive female friends engaged in fewer risky behaviors than participants without supportive female friends. However, male friends were perceived as less supportive than female friends and less likely to know what to do in the event of an FA emergency. In our sample, older AYA engaged in more risky behaviors than younger AYA; this is in contrast to previous work within a population of 13- to 21-year-olds, where age was not associated with EAI carriage or consumption of foods with precautionary allergen labeling.[9] These findings highlight the need to educate friends and peers, particularly males, of food-allergic AYA.[9,13] Interestingly, in our sample, children who perceived their mothers as overprotective engaged in fewer risky behaviors, irrespective of participant age; however, the impact of perceived overprotection on AYA FA-related quality of life remains unclear and should be explored by future work.

It is noteworthy that within our sample, more than a quarter of AYA reported that their FA was a barrier to obtaining employment. Furthermore, AYA who engaged in fewer risky behaviors were more likely to report that their FA impeded their ability to spend time with friends at restaurants and at friends' homes. Avoidance of such social venues because of fear of allergen exposure is likely to adversely impact quality of life[14,15] for AYA with FA. Until effective FA self-management practices are more compatible with the developmental goals of adolescence and early adulthood (eg, peer affiliation and parental independence), it is likely that many AYA with FA will continue to engage in risk-taking behaviors, most of which are normative for their peers without FA.

Forty-three percent of AYA in this study reported experiencing bullying because of FA. This rate is higher than in previous studies.[16,17] In our study, AYA who reported bullying were less likely to engage in risky behaviors and more likely to be proactive about FA self-management in potentially risky environments, such as at restaurants or in the school cafeteria, than AYA who did not report experiencing bullying. It is possible that the high visibility of these public FA self-management behaviors may put AYA at increased risk of being targeted by bullying. Therefore, it is possible that the relatively high rates of FA self-management behaviors in our sample contributed to the elevated rates of bullying observed here relative to previous work.

Our findings extend previous work in a college undergraduate population, which found that although ingestion of self-identified food allergens was less frequent among individuals with a history of anaphylaxis relative to those who had not experienced anaphylaxis, it was still reported by 42% of these individuals.[7] Interestingly, in a previous sample of 13- to 21-year-olds, no associations between risk-taking behaviors and anaphylaxis history or number of previous reactions were identified.[9] In our sample, neither anaphylaxis history, number of previous reactions, nor other indicators of allergy severity (eg, previous use of an EAI, number of allergens, perceived allergy severity, and comorbid atopy) were associated with latent class membership.

Of the 9 most prevalent childhood food allergens, peanut was the only allergen associated with reduced risk-taking behavior. Peanut is one of the most common food allergens, allergy to it is unlikely to be outgrown,[2] and it is the most frequent cause of FA-related death. Peanut allergy is perhaps the most well-known and frequently accommodated allergy. Greater public awareness of peanut allergy relative to other FAs may increase the likelihood that AYA with peanut allergy are more likely to proactively manage and seek accommodations for their FA than AYA with other allergies.

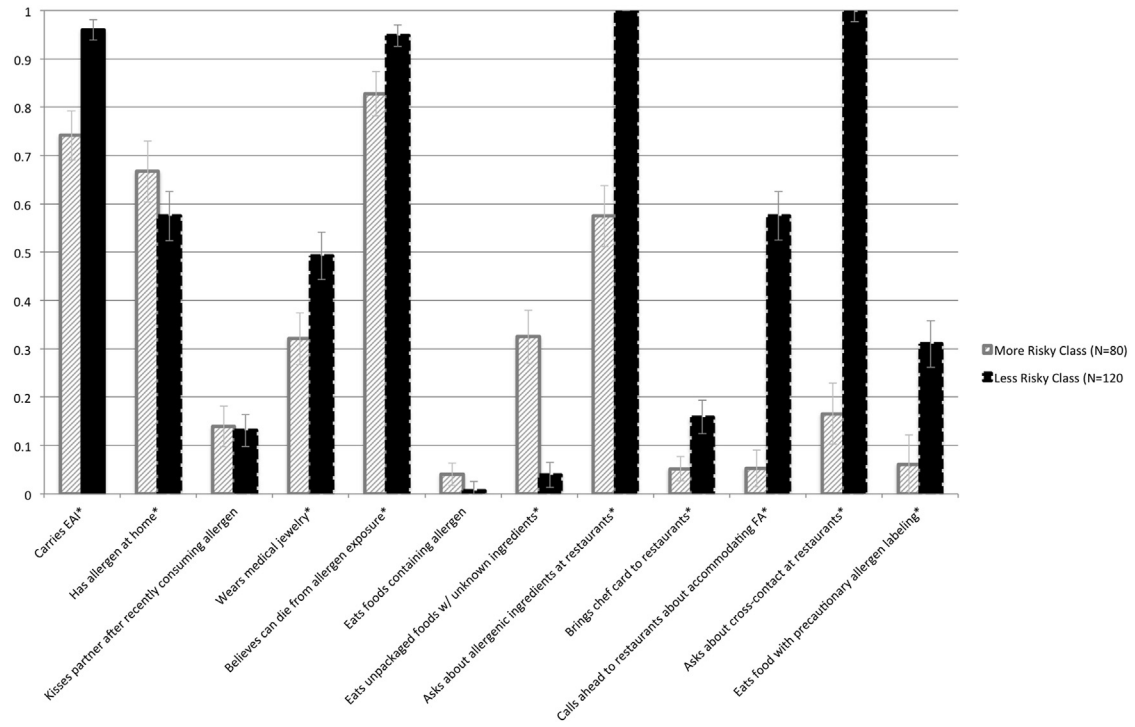

FIGURE 1. Proportion of respondents in each latent class endorsing each of the 12 FA risk-taking/management behaviors used as latent class indicators in the 2-class model. Asterisk (*) indicates that probabilities differ significantly between classes at *P* values of less than .05. Error bars reflect standard errors.

Improving FA management in schools and universities is crucial, and numerous policy-change efforts to ensure the health and safety of students with FA are currently underway. Examples of such policy interventions include teacher/staff education and the placement of undesignated/stock epinephrine in schools.[18-21] In our study, students who had individualized FA-related "504" plans were less likely than AYA without 504 plans to be in the risky group. Although 504 plans allow for the establishment of various individualized accommodations for children with FA to ensure access to a safe learning environment, many parents remain unaware of these federally mandated policies.[22] Given that the establishment of a 504 plan was associated with significantly reduced risk-taking behavior, these findings suggest that additional efforts to educate children with FA and their caregivers about the possible benefits of 504 plans may be warranted. Although not statistically significant, we also identified possible relationships between reduced FA risk-taking behavior and the presence of undesignated/stock epinephrine, food restrictions, and school staff trained on FA management. If replicated, these findings may lend support to ongoing efforts to increase the availability of stock epinephrine and train school personnel in the identification and treatment of anaphylaxis. Interestingly, teacher awareness of a student's FA was associated with less risky behavior, whereas school nurse and peer awareness was not. Although cross-sectional, these findings suggest that such school-level policies may promote reduced FA risk-taking behavior among AYA more broadly. Future, prospective studies may be able to confirm such hypotheses as well as explore possible mechanisms through which these effects may operate.

Importantly, this study is likely the first to report that AYA experience numerous positive aspects of living with FA. Many reported that FA made them more responsible and better advocates for both themselves and others. Respondents highlighted that their experiences also helped them appreciate and offer help to others with special needs. In addition, living with FA led many participants to develop greater appreciation for food and make healthier food choices. It is encouraging to discover that living with FA may improve interpersonal skills, such as responsibility, advocacy, and empathy, as well as self-care and that such positive outcomes may be more prevalent among AYA who follow recommended management practices and avoid unnecessary risk-taking behavior. These findings support the recent paradigm shift in research on adolescents with chronic medical conditions to explore positive outcomes, such as social and emotional resilience, in addition to risk behaviors.[23] Future work should continue to assess positive aspects of FA and consider including measures of resilience to best leverage AYAs' strengths. Furthermore, clinicians may consider querying patients about perceived positive aspects of living with FA to identify potential motivators for behaviors that minimize risk and maximize well-being.

There are limitations to this study. All data collected in this survey are self-reported and therefore subject to recall bias. Moreover, because data were de-identified and medical record data were not available, we were unable to confirm diagnoses of IgE-mediated FA. Selection bias is also likely, as online and in-person versions of the survey were administered by advocacy groups and at FA conferences, respectively. Recent work has demonstrated that such self-selecting respondents may differ in important ways from the general US patient population with

TABLE VII. Predictors of latent class membership

Predictor	Odds ratio	Lower 95% CI	Upper 95% CI
Clinical characteristics			
Peanut allergy (vs no)	0.27*	0.11*	0.65*
Tree nut allergy (vs no)	1.88	0.78	4.49
Fin fish allergy (vs no)	0.54	0.15	1.93
Shellfish allergy (vs no)	1.84	0.82	4.15
Milk allergy (vs no)	1.43	0.64	3.20
Egg allergy (vs no)	1.40	0.57	3.42
Soy allergy (vs no)	1.59	0.57	4.44
Wheat allergy (vs no)	0.96	0.27	3.41
Sesame allergy (vs no)	2.21	0.87	5.65
Number of food allergies (continuous)	1.03	0.88	1.21
History of anaphylaxis (vs no)	0.52	0.24	1.13
Number of severe reactions (continuous)	1.42	0.79	2.55
History of EAI use (vs no history of EAI use)	0.77	0.31	1.94
Comorbid asthma (vs no)	1.81	0.81	4.04
Comorbid environmental allergies (vs no)	0.87	0.39	1.94
Comorbid eczema (vs no)	1.49	0.70	3.15
Demographic characteristics			
Age (continuous)	1.22*	1.04*	1.42*
Male sex (vs female)	1.52	0.69	3.34
Black race/ethnicity (vs nonblack)	2.12	0.10	45.13
Asian race/ethnicity (vs non-Asian)	1.55	0.46	5.18
White race/ethnicity (vs nonwhite)	0.39	0.12	1.27
Hispanic race/ethnicity (vs non-Hispanic)	0.86	0.04	17.89
Native American (vs non-Native American)	0.54	0.02	11.91
Other race/ethnicity (vs above races/ethnicities)	1.10	0.12	10.25
Social support			
School nurse aware of participant's FA (vs no)*	1.06	0.43	2.61
Teachers aware of participant's FA (vs no)	0.39*	0.17*	0.91*
Friends aware of participant's FA (vs no)	0.81	0.25	2.58
History of being bullied as a result of FA	0.22*	0.09*	0.51*
Dad is supportive about FA	0.66	0.23	1.84
Mom is supportive about FA	0.30	0.04	2.19
Classmates are supportive about FA	0.85	0.38	1.93
Female friends are supportive about FA	0.27*	0.07*	0.99*
Male friends are supportive about FA	0.69	0.28	1.74
Mom perceived as overprotective (vs no)	0.42*	0.18*	0.97*
Dad perceived as overprotective (vs no)	0.48	0.22	1.05
Parent reminds participant to bring EAI	0.70	0.31	1.55
Female friends would know how to respond to FA emergency	0.60	0.27	1.31
Male friends would know how to respond in FA emergency	0.71	0.32	1.56
Classmates would know how to respond in FA emergency	1.02	0.30	3.43
School policies			
FA action plans posted in school (vs not)	0.84	0.39	1.82
Allergenic food restrictions established in school (vs not)	0.40	0.14	1.15
School-wide ban on food sharing (vs not)	0.81	0.18	3.71
Strict hand cleaning rules established in school (vs not)	0.85	0.19	3.77
Allergenic foods labeled in cafeteria (vs not)	0.66	0.29	1.52
Allergen-free tables in school cafeteria (vs not)	0.66	0.17	2.53
Full-time nurse present at school (vs not)	1.13	0.51	2.54
Stock/undesignated epinephrine available at school (vs not)	0.48	0.22	1.05
School staff trained on FA management (vs not)	0.45	0.19	1.06
School-wide FA policy established (vs not)	0.30	0.06	1.47
School 504 plan (vs not)	0.35*	0.15*	0.81*

(continued)

TABLE VII. *(Continued)*

Predictor	Odds ratio	Lower 95% CI	Upper 95% CI
No FA school policies (vs any policy)	1.06	0.21	5.46
Barriers to living with FA			
FA limits ability to hang out at friends' houses (vs no)	0.35*	0.15*	0.81*
FA limits ability to eat out with friends (vs no)	0.27*	0.12*	0.61*
FA limits ability to go shopping with friends (vs no)	0.92	0.30	2.80
FA limits ability to go to movies with friends (vs no)	1.07	0.39	2.94
FA limits ability to hang out with friends in general (vs no)	0.74	0.30	1.82
FA limits ability to participate in extracurriculars (vs no)	1.08	0.43	2.73
FA limits ability to go to school dances or events (vs no)	1.12	0.40	3.09
FA limits ability to attend sporting events (vs no)	0.79	0.34	1.83
FA limits ability to get a job (vs no)	0.42	0.17	1.03
Positive outcomes of FA			
FA made participant more responsible	0.43	0.11	1.67
FA brought participant closer to family	0.53	0.23	1.21
FA brought participant closer to friends	0.51	0.21	1.24
FA made participant appreciate/help others with special needs	0.55	0.25	1.21
FA made participant more appreciative of foods he or she can eat	0.74	0.35	1.58
FA helped participant to eat healthier	0.38*	0.18*	0.80*
FA made participant a better advocate for self and others	0.50	0.22	1.12

*$P < .05$.

FA.[24] For example, such individuals may be more knowledgeable and empowered to proactively manage their FA, while at the same time more aware of the potentially fatal consequences of allergen exposure. This may at least partially explain the relatively high level of adherence to key FA management behaviors (eg, EAI carriage) observed within our sample relative to previous work.[7] Expanding this survey to include a more racially and socioeconomically diverse sample more representative of the US FA population will be an important next step to better understand the full scope of FA-related behaviors and attitudes among AYA.

CONCLUSIONS

This study is the first to comprehensively assess FA-related risk-taking behavior among AYA and identify patterns of risk-taking behaviors that can be predicted by multiple clinical, demographic, and social risk factors. Overall, AYA with greater support from peers, parents, and teachers and a 504 plan in place at school engaged in less risk-taking behavior. To the extent that these factors are amenable to intervention (eg, teacher awareness of FA, implementation of 504 plans), further investigation and modification of these factors may provide a useful framework through which FA self-management and outcomes can be improved among AYA. Even identification of less malleable factors (eg, allergen type) may assist clinicians in targeting patient counseling and other educational efforts to patients most at risk.

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ADDITIONAL METHODOLOGICAL DETAIL ABOUT THE LCA

LCA is a statistical method for classifying individuals into distinct groups that were themselves not directly measured (and thus considered "latent"), using multiple categorical variables (ie, "latent class indicators"). For example, LCA can be used to categorize patients with asthma into different phenotypes on the basis of clinical data such as participant sex, allergic sensitization, or the presence of certain comorbidities or symptoms. Once you have identified these latent phenotypes and assigned each patient to a particular phenotype, you can then create models to test whether specific variables of interest can predict a patient's latent asthma phenotype.

In our study, LCA was carried out via MPlus 7.4 using the 3-step procedure, which accounts for classification uncertainty (ie, measurement error) while ensuring that latent class formation is not influenced by observed predictors of class membership.[E1] A robust maximum likelihood estimator was used.

Each LCA model was run at least 10 times with more than 10,000 iterations to obtain and replicate the best loglikelihood value (ie, the global maximum). To determine the most appropriate number of FA behavioral risk classes, we used an iterative process where the model was fit with an increasing number of classes, beginning with a single class. Bayesian information criteria (BIC) were compared to determine the best-fitting solution: a 2-class model ($BIC_{1class} = 4274$; $BIC_{2class} = 1971$; $BIC_{3class} = 1979$; $BIC_{4class} = 2020$).[E2] Akaike information criteria for the 3-class solution demonstrated very limited improvement relative to the 2-class solution, suggesting that a 2-class solution is most parsimonious. Posterior probabilities of latent class membership for each participant were then calculated using the 2-class model. Each participant was assigned to the class for which he or she had the maximum posterior probability.

Eligibility

1. Are you **currently** 14-22 years old?
   - □ Yes
   - □ No
     → *If not, we thank you for your interest, but you are not eligible for this survey.*

2. Do you **currently** have a food allergy?
   - □ Yes
   - □ No
     → *If not, we thank you for your interest, but you are not eligible for this survey.*

Food Allergy History

3. To which foods are you **currently** allergic? **Please mark all that apply.**
   - □ Peanut
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen
   - □ Tree nut (almonds, pecans, cashews, etc.)
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen
   - □ Fin fish (salmon, tuna, trout, etc.)
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen
   - □ Shellfish (shrimp, lobster, crab, etc.)
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen
   - □ Milk/Dairy
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen
   - □ Egg
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen
   - □ Soy
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen
   - □ Wheat
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen
   - □ Sesame
     → *If you selected this food, how would you rate the severity of this food allergy?*
     - □ Mild/moderate
     - □ Severe/life-threatening
     - □ Not applicable – I have never had a reaction to this allergen

FIGURE E1. Questionnaire items and response options included in final electronic survey administered to study participants.

□ Other_1 Please specify: _____
→ *If you selected this food, how would you rate the severity of this food allergy?*
□ Mild/moderate
□ Severe/life-threatening
□ Not applicable – I have never had a reaction to this allergen

□ Other_2 Please specify: _____
→ *If you selected this food, how would you rate the severity of this food allergy?*
□ Mild/moderate
□ Severe/life-threatening
□ Not applicable – I have never had a reaction to this allergen

□ Other_3 Please specify: _____
→ *If you selected this food, how would you rate the severity of this food allergy?*
□ Mild/moderate
□ Severe/life-threatening
□ Not applicable – I have never had a reaction to this allergen

4. If you have additional food allergies, please list them here. There is no need to designate severity.

_____

_____

_____

_____

5. Do you carry an epinephrine auto-injector (e.g. EpiPen, Auvi-Q, Adrenaclick, etc.) with you?
□ Yes
□ No
□ Sometimes
→ *If No or Sometimes, why not always?* ***Please mark all that apply.***
□ I don't think I will have a reaction
□ I don't think my allergy is severe enough to require it
□ I don't have a prescription for it
□ My insurance doesn't pay for it/it costs too much money
□ I forget to take it with me
□ Carrying it is inconvenient or uncomfortable
□ Carrying it makes me self-conscious
□ Other Please specify: _____

6. Do you carry other medications to treat food allergy with you?
□ Yes
→ *If Yes, please select the medicines you carry.* ***Please mark all that apply.***
□ Antihistamines (e.g. Benadryl, Claritin, Allegra, etc.)
□ Inhaler
□ Other Please specify: _____
□ No

FIGURE E1. (*Continued*).

7. Do you **currently** see a doctor or other healthcare provider for your food allergies? **Please mark all that apply.**
   - □ A pediatrician/general doctor
   - □ An allergist
   - □ A nutritionist
   - □ An alternative therapist Please specify: _____
   - □ Other Please specify: _____
   - □ I do not see a doctor or health care provider for my food allergies

8. Have you **ever** had any of the following? **Please mark all that apply.**
   - □ Had a positive skin test for food allergy
   - □ Had a positive blood test for food allergy
   - □ Had a food challenge (eaten the food(s) you are allergic to under medical supervision)
   - □ Had an alternative test for food allergy (e.g. NAET)
   - □ Told to avoid certain foods because of my food allergy
   - □ Don't remember

9. Have you **ever** had a food allergy reaction? A food allergy reaction can include the following symptoms: hives, eczema, wheezing, shortness of breath, low blood pressure, swelling of the eyes, lips, or face, trouble breathing, vomiting, diarrhea, coughing, impending doom, or itching of the lips, mouth, or throat.
   - □ Yes
   - □ No
   - □ Don't remember

→ If you selected "Yes," please continue to "Food Allergy Reactions" section on Page 7
→ If not, please skip to the "Food Allergy Risks" section on Page 9

FIGURE E1. (*Continued*).

Food Allergy Reactions

Please use the below definitions for reference when completing this section of the survey.

Mild/moderate allergic reaction – mild symptoms may include one or more of the following: hives, eczema, redness of the skin, itchy mouth, stomach pain, runny nose/sneezing, slight cough, & odd taste in mouth.

Severe/life-threatening allergic reaction – severe symptoms may include one or more of the following: obstructive swelling of the lips, tongue, and/or throat, trouble swallowing, shortness of breath, turning blue, drop in blood pressure, loss of consciousness, chest pain, weak pulse, or impending doom.

Anaphylaxis – a severe allergic reaction that can lead to death; during anaphylaxis, allergic symptoms can affect several areas of the body and may threaten breathing and circulation. Common symptoms of anaphylaxis include difficulty breathing and reduced blood pressure.

10. How old were you when you first had a food allergy reaction?
    - □ 1-11 months old
    - □ 1-5 years old
    - □ 6-10 years old
    - □ 11-22 years old
    - □ Don't remember

11. How many **severe** food allergy reactions have you had during the past 12 months?
    - □ No severe reactions
    - □ 1-5 severe reactions
    - □ 6-10 severe reactions
    - □ 11-15 severe reactions
    - □ More than 15 severe reactions

12. Tell us about the **worst reaction of your life.** What were your symptoms? **Please mark all that apply.**
    - □ Hives (welts) or red patches on skin
    - □ Eczema (dry, itchy skin rash that keeps coming back)
    - □ Wheezing (whistling sound in chest)
    - □ Low blood pressure (or passing out/fainting)
    - □ Trouble breathing
    - □ Swelling of lips, eyes, or face
    - □ Itching/tingling of lips, mouth, or throat
    - □ Vomiting
    - □ Diarrhea
    - □ Coughing
    - □ Impending doom/feeling that something bad is about to happen
    - □ Other Please specify: _____

13. Have you ever experienced **anaphylaxis** (a severe allergic reaction that can lead to death)?
    - □ Yes
    - □ No
    - □ Don't know

FIGURE E1. (*Continued*).

14. Have you ever used an epinephrine auto-injector (e.g. EpiPen, Auvi-Q, Adrenclick, etc.) to **treat** a food allergy reaction?
    - □ Yes
      - → *If Yes, how often have you used it during the past 12 months?*
        - □ Zero times
        - □ 1-5 times
        - □ 6-10 times
        - □ 11-15 times
        - □ More than 15 times
    - □ No

15. Have you ever used medications other than an epinephrine auto-injector (e.g. Benadryl, an inhaler) to **treat** a food allergy reaction?
    - □ Yes
      - → *If Yes, how often have you used these medications during the past 12 months?*
        - □ Zero times
        - □ 1-5 times
        - □ 6-10 times
        - □ 11-15 times
        - □ More than 15 times
    - □ No

Food Allergy Risks

16. Do you eat out at restaurants?
    - □ Yes
      - → *If Yes, do you do any of the following?* ***Please mark all that apply.***
        - □ Ask about allergenic ingredients
        - □ Ask about cross-contact
        - □ Carry a chef card
        - □ Call ahead to make sure restaurant can accommodate you
        - □ Other Please specify: _____
        - □ None of the above
          - → *If None of the Above, why not?* ***Please mark all that apply.***
            - □ I don't think I will have a reaction
            - □ I can treat a reaction if I have one
            - □ Asking makes me feel self-conscious
            - □ I forget sometimes
            - □ Other Please specify: _____
    - □ No
      - → *If No, why not?* ***Please mark all that apply.***
        - □ I'm afraid of having a reaction
        - □ I don't trust other people to cook for me
        - □ I think restaurant staff will ignore my allergy
        - □ I feel self-conscious making special orders
        - □ I feel embarrassed around my friends/family
        - □ Other Please specify: _____

17. Are the food(s) to which you are **most allergic** present in your home (e.g. can these foods be found in your refrigerator or pantry)?
    - □ Yes
    - □ No
    - □ Sometimes

18. Do you eat packaged foods that "may contain," that may be "processed on equipment," or that may be "manufactured in a facility" (with) the ingredient(s) to which you are **most allergic**? **Please mark all that apply.**
    - □ Yes – "may contain"
    - □ Yes – "processed on equipment"
    - □ Yes – "manufactured in a facility"
    - □ No
    - □ Sometimes

19. Do you eat unpackaged or homemade foods if you don't know what they contain?
    - □ Yes
    - □ No
    - □ Sometimes

FIGURE E1. (*Continued*).

20. If you know that you are **severely allergic to** a particular food, do you try to eat it?
    - □ Yes
    - □ No
    - □ Sometimes

21. Do you kiss people who have recently eaten the food(s) you are **most allergic to**?
    - □ Yes
    - □ No
    - □ Sometimes

22. Do you feel you could die from your food allergy?
    - □ Yes
    - □ No

    → *If No, why not?* ***Please mark all that apply.***
        - □ I've never had a life-threatening reaction
        - □ I can treat myself if I have a serious reaction
        - □ My allergy is not that severe
        - □ Other Please specify: _____

23. Do you wear medical jewelry (e.g. a MedicAlert bracelet) to let people know about your food allergy?
    - □ Yes
    - □ No

    → *If No, why not?* ***Please mark all that apply.***
        - □ My allergy is not that severe
        - □ I forget to put it on
        - □ Wearing it is inconvenient or uncomfortable
        - □ Wearing it makes me self-conscious
        - □ I've never heard of it
        - □ Other Please specify: _____

FIGURE E1. (*Continued*).

Food Allergy Support

24. Who at school is aware that you have a food allergy? **Please mark all that apply.**
    - □ School nurse
    - □ Teacher
    - □ Friends
    - □ Other Please specify: _____
    - □ No one
    - □ I don't know

25. Please tell us about your school. Which of the following precautions are in place for food allergy? **Please mark all that apply.**
    - □ Food allergy action plans
    - □ Food restrictions in school
    - □ Ban on food sharing
    - □ Strict hand cleaning rules
    - □ Labeled foods in the cafeteria
    - □ Allergen free tables
    - □ Full time nurse
    - □ Access to epinephrine auto-injectors (e.g. EpiPen, Auvi-Q, Adrenclick, etc.), if needed
    - □ School staff trained on how to respond to a severe reaction
    - □ School-wide food allergy policy
    - □ Individual plan for your allergies (e.g. 504 plan)
    - □ Other Please specify: _____
    - □ None of the above
    - □ I don't know

26. Have you ever felt bullied because of your food allergy?
    - □ Yes
      → *If Yes, when?* ***Please mark all that apply.***
        - □ Elementary School
        - □ Middle School
        - □ High School
        - □ College
    - □ No

27. Please tell us about your friends and classmates. **Please check only one answer for each statement.**

	Yes	No	Sometimes	N/A
Most of my **male** friends				
Are supportive/great about my food allergy.	□	□	□	□
Know what to do if I have a food allergy emergency.	□	□	□	□
Most of my **female** friends				
Are supportive/great about my food allergy.	□	□	□	□
Know what to do if I have a food allergy emergency.	□	□	□	□
Most of my **classmates**				
Are supportive/great about my food allergy.	□	□	□	□
Know what to do if I have a food allergy emergency.	□	□	□	□

FIGURE E1. (*Continued*).

28. Please tell us about your family. **Please check only one answer for each statement.**

	Yes	No	Sometimes	N/A
My **primary female caregiver** (mom/legal guardian) ...				
Is supportive/great about my food allergy.	□	□	□	□
Is overly protective about my food allergy.	□	□	□	□
My **primary male caregiver** (dad/legal guardian) ...				
Is supportive/great about my food allergy.	□	□	□	□
Is overly protective about my food allergy.	□	□	□	□

29. Does a parent/caregiver remind you to carry an epinephrine auto-injector (e.g. EpiPen, Auvi-Q, Adrenclick, etc.) with you?
    - □ Yes
    - □ No
    - □ Sometimes
    - □ Not applicable – I don't have a prescription for an epinephrine auto-injector

30. Does having a food allergy limit your ability to **Please check only one answer for each statement.**

	Yes	No	Sometimes	N/A
Hang out at friends' houses?	□	□	□	□
Go out to eat with friends?	□	□	□	□
Go shopping with friends?	□	□	□	□
Go to the movies with friends?	□	□	□	□
Hang out with friends in general?	□	□	□	□
Participate in extracurricular activities (sports, clubs, etc.)?	□	□	□	□
Attend school dances or other events?	□	□	□	□
Attend sporting events?	□	□	□	□
Get an after-school or part-time job?	□	□	□	□

31. Has your food allergy impacted your life in any of the following positive ways? **Please mark all that apply.**
    - □ Made me more responsible
    - □ Brought me closer to my family
    - □ Brought me closer to my friends
    - □ Helped me appreciate and help others with special needs
    - □ Made me more appreciative of the foods I can eat
    - □ Helped me to eat healthier
    - □ Made me a better advocate for myself and others
    - □ Other Please specify: _____

32. What do you think would help you with your food allergy? **Please mark all that apply.**
    - □ Better support at home
    - □ Better support from friends
    - □ Better support from school
    - □ More personal knowledge about food allergy
    - □ More information from my doctor
    - □ More public awareness
    - □ More/better treatments for anaphylaxis
    - □ Other Please specify: _____

FIGURE E1. (*Continued*).

General Risk Assessment

Please note that the below questions are from the 2011 Youth Risk Behavior Survey. These questions are being asked to assess the general risk taking behaviors of adolescents; they are not specific to food allergy. **Please remember that this survey is entirely anonymous and confidential**. No one will know how you responded to these questions, and you cannot get in trouble for any of your answers. Please answer truthfully to the best of your ability.

33. **When you rode a bicycle** during the past 12 months, how often did you wear a helmet?
    - □ I did not ride a bicycle during the past 12 months
    - □ Never wore a helmet
    - □ Rarely wore a helmet
    - □ Sometimes wore a helmet
    - □ Most of the time wore a helmet
    - □ Always wore a helmet

34. How often do you wear a seat belt when **riding** in a car driven by someone else?
    - □ Never
    - □ Rarely
    - □ Sometimes
    - □ Most of the time
    - □ Always

35. During the past 30 days, how many times did you **ride** in a car or other vehicle **driven by someone who had been drinking alcohol**?
    - □ 0 times
    - □ 1 time
    - □ 2 or 3 times
    - □ 4 or 5 times
    - □ 6 or more times

36. During the past 30 days, on how many days did you carry **a weapon** such as a gun, knife, or club?
    - □ 0 days
    - □ 1 day
    - □ 2 or 3 days
    - □ 4 or 5 days
    - □ 6 or more days

37. During the past 12 months, how many times were you in a physical fight?
    - □ 0 times
    - □ 1 time
    - □ 2 or 3 times
    - □ 4 or 5 times
    - □ 6 or 7 times
    - □ 8 or 9 times
    - □ 10 or 11 times
    - □ 12 or more times

38. During the past 12 months, did you ever **seriously** consider attempting suicide?
    - □ Yes
    - □ No

FIGURE E1. (*Continued*).

39. During the past 12 months, how many times did you actually attempt suicide?
    - □ 0 times
    - □ 1 time
    - □ 2 or 3 times
    - □ 4 or 5 times
    - □ 6 or more times

40. During the past 30 days, on how many days did you smoke cigarettes?
    - □ 0 days
    - □ 1 or 2 days
    - □ 3 to 5 days
    - □ 6 to 9 days
    - □ 10 to 19 days
    - □ 20 to 29 days
    - □ All 30 days

41. During the past 30 days, on how many days did you have at least one drink of alcohol?
    - □ 0 days
    - □ 1 or 2 days
    - □ 3 to 5 days
    - □ 6 to 9 days
    - □ 10 to 19 days
    - □ 20 to 29 days
    - □ All 30 days

42. During the past 30 days, on how many days did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?
    - □ 0 days
    - □ 1 day
    - □ 2 days
    - □ 3 to 5 days
    - □ 6 to 9 days
    - □ 10 to 19 days
    - □ 20 or more days

43. During the past 30 days, how many times did you use marijuana?
    - □ 0 days
    - □ 1 or 2 times
    - □ 3 to 9 times
    - □ 10 to 19 times
    - □ 20 to 39 times
    - □ 40 or more times

44. The **last time** you had sexual intercourse, did you or your partner use a condom?
    - □ I have never had sexual intercourse
    - □ Yes
    - □ No

FIGURE E1. (*Continued*).

Demographics

45. How old are you?
- □ 14
- □ 15
- □ 16
- □ 17
- □ 18
- □ 19
- □ 20
- □ 21
- □ 22

46. What is your gender?
- □ Female
- □ Male
- □ Other Please specify: _____

47. What is your race/ethnicity? **Please mark all that apply.**
- □ African American/Black
- □ Asian
- □ Caucasian/White
- □ Hispanic/Latino
- □ Native American
- □ Other Please specify: _____

48. Do you have any of the following other medical conditions? **Please mark all that apply.**
- □ Asthma
- □ Environmental allergies
- □ Eczema
- □ Diabetes
- □ ADD/ADHD
- □ Celiac disease
- □ Other Please specify: _____

49. Is there anything else you would like to tell us about your food allergy?

_____

_____

_____

_____

Thank you very much for your time! You have completed this survey.

FIGURE E1. (*Continued*).

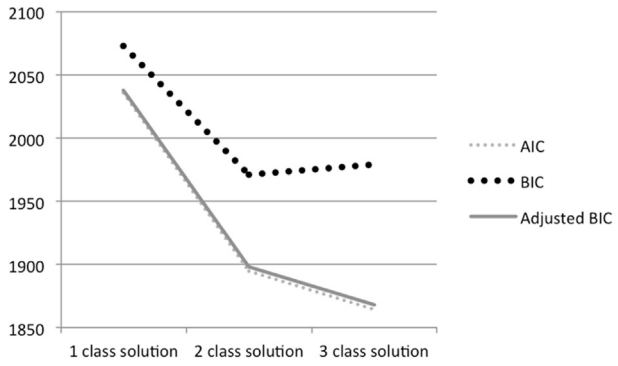

FIGURE E2. Comparison of relative latent class model fit between 1-, 2-, and 3-class models using Akaike information criteria (AIC), Bayesian information criteria (BIC), and sample size–adjusted BIC (adjusted BIC). Lower values indicate better fit.

REFERENCES

E1. Vermunt J. Latent class modeling with covariates: two improved three-step approaches. Pol Anal 2010;18:450-69.

E2. Nylund KL, Asparouhov T, Muthen BO. Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte-Carlo simulation study. Struct Equation Modeling 2007;14:535-69.