



Knowledge, attitudes, and behaviors about dining out with food allergies: A cross-sectional survey of restaurant customers in the United States



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ABSTRACT

For the increasing number of consumers with food allergies in the United States, dining out may pose serious health threats. Both restaurateurs and consumers need to be vigilant to prevent food allergy reactions in restaurants, but empirical studies that explored knowledge, attitudes, and behaviors of consumers with food allergies are limited. Therefore, this research aimed to examine food allergy knowledge, attitudes and behaviors of customers with food allergies or parents or guardians with children with food allergies by conducting focus groups and a cross-sectional survey. Customers with food allergies ($n = 63$) and parents or guardians of children with food allergies ($n = 257$), who were members of a food allergy social networking website, participated in the survey. Due to the nature of the website, in which members share their dining experience and recommendations, only 2.8% of participants indicated that they have never eaten at a restaurant. The average knowledge score of participants was 24.7 out of 30 (82.3%), and they well recognized typical causes of food allergy reactions in restaurants (i.e., hidden allergens, cross-contacts, and restaurant employees' lack of knowledge, care, and communication about food allergies). Customers with food allergies took a variety of actions to prevent food allergy reactions before or during their visits to restaurants. Depending on the types of food allergens and previous dining experiences, respondents voiced diverse concerns about different types of restaurants. Restaurateurs may benefit from recognizing and addressing these concerns to improve their service for customers with food allergies.

1. Introduction

In modern times, dining out is more often considered a necessity because of its convenience and workplace demographic changes (Fraikue, 2016). The National Restaurant Association (NRA) of the United States (U.S.) estimated that restaurants generated close to \$825 billion in sales in 2018 (NRA, 2018), and on average, 18.2 meals are eaten outside of the home each month (Hamm, 2017). Although dining out provides an opportunity for social bonding and relaxation as well as food and convenience, it may pose some health threats for individuals with food allergies (Begen et al., 2018; Pitchforth et al., 2011), which are immune reactions to a food protein that is touched, inhaled, or ingested (Mayo Clinic, 2019).

Statistics have shown that food allergies affect over 10% of adults (Gupta et al., 2019), or over 25 million individuals in the U.S., based on the latest census data (U.S. Census Bureau, 2019), and the number of individuals affected by food allergies (National Institute of Allergy and Infectious Diseases [NIAID], 2017). More specifically, there was an 18%

increase in food allergy cases among the pediatric population since 2008 (Branum & Lukacs, 2009). The number of hospitalizations of children suffering from food allergy reactions in the U.S. has also increased two-fold, from 0.6 to 1.3 per 1000 patients from 2000 to 2009 (Rudders, Arias, & Camargo, 2014). There is no cure for a food allergy, and the only way to prevent an allergic reaction is to avoid contact, ingestion, and inhalation of the triggering substance (Gupta et al., 2019; Sampson, Muñoz-Furlong, & Sicherer, 2006; Sicherer & Sampson, 2006).

Restaurants or commercial foodservice establishments are one of the venues where food allergy reactions have commonly occurred for a variety of reasons. The existence of hidden allergens, insufficient knowledge of employees about food allergies, improper food allergen handling practices, and miscommunication between and among employees and customers have been identified as common causes of food allergy reactions (Bailey, Albardiaz, Frew, & Smith, 2011; Eigenmann & Zamora, 2005; Lee & Sozen, 2018; Lee & Xu, 2015; Lefèvre et al., 2018; Mandabach, Ellsworth, Vanleeuwen, Blanch, & Waters, 2005; Versluis et al., 2014; Wen & Kwon, 2017; Wham & Sharma, 2014). Despite the

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fact that food allergies have become more prevalent (Gupta et al., 2019), restaurant managers and staff mostly perceive that customers with food allergies should be responsible for preventing allergic reactions by informing them about their special dietary needs (Lee & Sozen, 2018; Lee & Xu, 2015; Soon, 2018; Wen & Kwon, 2017). Customers have also become self-dependent and vigilant to ensure their own safety (Kwon & Lee, 2012).

Several studies have examined restaurant staff's knowledge and attitudes toward serving their customers with food allergies (Bailey et al., 2011; Lee & Sozen, 2018; Loerbroks, Tolksdorf, Wagenmann, & Smith, 2019; Mandabach et al., 2005; Sogut et al., 2015; Wen & Kwon, 2017). However, there is limited research assessing the knowledge, attitudes, and behaviors of customers with food allergies when it comes to dining out. Without knowing their allergic customers' attitudes toward and behaviors during dining out, it may be difficult for restaurateurs to develop strategies for preventing potential allergic reactions in their establishments. Therefore, the objectives of the current study were to (1) investigate food allergy knowledge, attitudes and the dining behaviors of customers with food allergies or with children with food allergies and (2) compare and contrast the findings between individuals with food allergies and the parents or guardians of children with food allergies and among respondents with different food allergies.

2. Literature review

2.1. Food allergies in the U.S

A food allergy is an adverse health condition caused by a food protein that triggers an immunological response in the body (Mayo Clinic, 2019). Even small amounts of skin contact, inhalation, or ingestion of food allergens could result in severe allergic reactions (Gupta et al., 2019). Anaphylaxis is one of the most severe life-threatening allergic responses affecting multiple body functions such as decreased blood pressure and difficulty in breathing, and it can lead to a coma or even death (Mayo Clinic, 2019). In the U.S., 150 to 200 fatalities are reported each year because of food allergy reactions (NIAID, 2017).

It is estimated that 25 million adults (18 years or older) in the U.S. are affected by food allergies, including 7.6% of children under the age of 18 years (Gupta et al., 2018; Gupta et al., 2019; NIAID, 2017). More specifically, 2.9% of American adults have shellfish allergies, followed by milk (1.9%), peanut (1.8%), and tree nut (1.2%) allergies (Gupta et al., 2019). Even though more than 170 foods have been found to cause food allergy reactions, eight major food allergens – termed the “Big 8” – account for more than 90% of food allergy reactions in the U.S. (FARE, 2019). These eight major food allergens include eggs, fish, milk, peanut, soy, shellfish, tree nuts, and wheat. Among these, milk, egg, and peanut caused the most food allergy reactions among young children, while peanut, tree nuts, and seafood commonly led to food allergy reactions among teenagers and adults (FARE, 2019).

There are several legislations in the U.S. that require accommodations for individuals with food allergies. Section 504 of the *Rehabilitation Act (1973)* mandates public schools to provide accommodations to students with disabilities, and life-threatening food allergies are considered as qualifying disability. In addition, the U.S. federal government provides a financial incentive for states to establish their own legislation to require schools to stock non-student specific epinephrine auto-injectors (e.g., EpiPen®) for unexpected food allergy reactions at schools (*School Access to Emergency Epinephrine Act, 2013*). At the state level, Illinois, Maryland, Massachusetts, Michigan, Rhode Island, and Virginia require restaurants to display food allergy awareness posters in employee areas or to mandate at least one certified food production manager who is trained on food allergy prevention and management be on duty (FARE, 2019). Furthermore, the Food Labeling and Consumer Protection Act (FALCPA) of 2006 requires food manufacturers to clearly state whether the eight major food allergens and their derivatives are included in packaged foods (U.S. Food and Drug Administration [FDA] 2006).

2.2. Food allergies in restaurant operations

Because the number of individuals affected by food allergies has been on the rise (Gupta et al., 2018; Gupta et al., 2019; NIAID, 2017), it remains a challenge for restaurants to provide allergen-free foods to customers with food allergies (Kwon & Lee, 2012; Wen & Kwon, 2016, 2017). Previous literature has been showed that food served in restaurants were accounted for most of the food allergy reactions (Eigenmann & Zamora, 2005). Researchers found that 41.5% of participants with seafood allergies and 13.7% of participants with peanut or tree nut allergies had experienced allergic reactions after dining out at commercial restaurants (Furlong, Maloney, & Sicherer, 2006; Sicherer, Furlong, DeSimone, & Sampson, 2001).

An analysis of food allergy-related fatalities reported in the United Kingdom further revealed that 11 of 48 cases happened in restaurants and there were additional four cases caused by take-out foods from restaurants (Pumphrey & Gowland, 2007), which shows that food made in restaurants contributed to over 30% of fatal food allergy reactions. Most of these cases occurred because customers with food allergies assumed that no allergens were present in the foods they ordered and did not ask for an allergen-free meal. Nevertheless, allergens were presented in foods through cross-contacts or as hidden ingredients in sauces or mixed dishes, when customers did not suspect the existence of allergens (Furlong et al., 2006; Sicherer et al., 2001). The presence of unexpected, hidden food allergens in food items, cross-contact, and miscommunication were recognized by customers with food allergies as the most critical causes for food allergy reactions in restaurants (Eigenmann & Zamora, 2005; Furlong, DeSimone, & Sicherer, 2001; Knoblaugh, McProud, Wagle, & Finkelstein, 2007; Kwon & Lee, 2012; Leftwich et al., 2011).

In addition, restaurant employees seemed to lack knowledge and awareness about food allergies (Abbot, Byrd-Bredbenner, & Grasso, 2007; Bailey et al., 2011; Lee & Sozen, 2016, 2018; Lefèvre et al., 2018; Mandabach et al., 2005; Soon, 2018; Wen & Kwon, 2017; Wham & Sharma, 2014). For instance, Abbot et al. (2007) found that employees were not aware of food allergens on menu items and ways to prevent cross-contacts. Another study of employees working at carry-out outlets revealed that there was confusion between lactose intolerance and milk allergy and a general misunderstanding about proper food allergen-handling practices (Soon, 2018). Moreover, Bailey et al. (2011) found gaps between restaurant employees' knowledge and perceived confidence levels for providing safe foods to customers with food allergies. These researchers found that 81% of the restaurant staff they studied felt confident in providing safe foods to customers with food allergies, but 25% thought that it would be safe to remove food allergens from a finished meal; and 35% of the respondents believed that fryer heat could destroy food allergens. These researchers recommended that foodservice employees should be trained on the storage and preparation of foods, as well as informed of ingredients of menu offerings (Abbot et al., 2007). Choi and Rajagopal (2013) also contended that foodservice employees should be better trained to recognize a wide variety of food allergens, in addition to the “Big 8” and ways to avoid cross-contacts, to ensure that food prepared for and served to customers with food allergies is safe for consumption.

There is no conclusive result on the types of restaurants that are more prepared for their customers with food allergies. Mandabach, Blanch, Van Leeuwen, and Waters (2006) found that managers from independently-owned restaurants had lower knowledge scores about food allergies than managers working for multiunit, company-owned or franchised restaurants. Chain restaurant managers' higher scores may indicate that their companies had specific food allergy training that enhanced the knowledge and awareness of restaurant managers toward customers with food allergies (Mandabach et al., 2006). In contrast, Lee and Sozen (2018) found no significant difference in food allergy knowledge scores between employees working at independently-owned restaurants and working at chain restaurants. These researchers,

however, found that restaurant employees working at casual dining and fine dining restaurants demonstrated higher food allergy knowledge than those from quick service restaurants (Lee & Sozen, 2018). In a focus group study, customers with food allergies perceived ethnic restaurants, especially Chinese, Italian, Mexican, and Thai restaurants, as being high-risk for food allergy reaction because their customers may not be familiar with multiple ingredients used in ethnic foods, as compared to food items served at non-ethnic restaurants (Kwon & Lee, 2012).

2.3. Dose-response in food allergy reactions

Many factors may affect the threshold doses for various food allergens, such as food preparation techniques (e.g., roasted, boiled, or fried), carbohydrate moiety of the glycoproteins, and route of exposure (Hourihane, 2001; Shreffler et al., 2006; Sicherer & Sampson, 2007, 2010). Because of these reasons, the attempt to achieve an agreement on the threshold doses for food allergy reactions caused by common allergens such as peanut, egg, milk, and fish may be premature (Baller-Weber, 2015; Taylor et al., 2002). Currently, the threshold dose of the allergenic food is best estimated based on controlled clinical challenge trials (Taylor et al., 2002). Using double-blind, placebo-controlled food challenges, Hourihane et al. (1997) concluded the threshold dose of peanut protein to provoke an allergic reaction varied. As little as 100 µ of peanut protein provoked symptoms in two of 14 individuals with peanut allergy with short-lived symptoms, whereas five individuals in the same experiment did not react to any dose up to 50 mg of peanut protein (Hourihane et al., 1997). Using the same technique, Baller-Weber et al. (2015) found that symptoms of allergic reactions occurred when the subjects were exposed to as little as 27.3 mg of protein in fish, 2.5 mg of protein in shrimp, and 2.8 mg protein in peanut. It was also found that severe allergic reactions were frequently caused by oral ingestion of food allergens as opposed to by skin contacts or inhalation (Hourihane, 2001).

The previous research in regards to the threshold dose for food allergy reactions is limited to non-fatal food allergy reactions during the clinical experiment setting. However, “deaths typically occurred in those whose previous reactions had been mild” (Pumphrey & Gowland, 2007, p. 1019), and therefore, the thresholds identified in previous research should be considered as relevant to all food allergy reactions including fatal reactions. In summary, it is difficult to establish generally acceptable levels of food allergens that triggers food allergy reactions due to several factors such as individual, substance, and route variations (Hourihane, 2001; Hourihane et al., 1997; Shreffler et al., 2006; Sicherer & Sampson, 2007, 2010).

2.4. Dining out with food allergies

Some individuals with food allergies avoid eating out totally (Wanich, Weiss, Furlong, & Sicherer, 2008), while others take preventive strategies and stay vigilant when dining out (Kwon & Lee, 2012). Wanich et al. (2008) found that a significant percentage of their research participants with food allergies had experienced food allergy reactions in restaurants because of the lack of communication between them and restaurant employees. Through qualitative research, Kwon and Lee (2012) documented that customers with food allergies chose restaurants that they were familiar with and avoided certain types of restaurants that were perceived as posing a higher risk, such as ethnic or buffet restaurants in order to avoid food allergy reactions. Checking menus and allergen information online prior to eating out was also common (Kwon & Lee, 2012; Leftwich et al., 2011). Customers with food allergies expressed the need to have more food allergy-related resources available to them at restaurants, preferably in a written format (Begen et al., 2016).

Traveling also poses additional challenges for individuals with food allergies. When it comes to traveling abroad, researchers revealed that

the language barrier, uncertainty whether people with food allergies have access to medical services, and travel through confined flights were major challenges (Barnett, Botting, Gowland, & Lucas, 2012; Leftwich et al., 2011). To avoid food allergy reactions, these individuals reported being selective when choosing their destinations, prepared extra medications, and packed their own foods and snacks (Barnett et al., 2012). With the increasing number of individuals with food allergies and the challenges and potential risks they face, it is important for the restaurant industry to understand needs and attitudes of customers with food allergies toward dining out. It is also imperative to know the customers' dining behaviors in order to prevent allergic reactions. The more the restaurateurs understand their customers, the better prepared they would be for special needs of customers with food allergies.

3. Methods

Prior to data collection, the research protocol was approved by Kansas State University institutional review board (IRB Approval Number: 5461). A mixed methods approach utilizing qualitative (focus groups) and quantitative (online survey) research protocols was employed. For both the focus groups and the survey, the target population was customers with food allergies (age > 18) or parents or guardians of children with food allergies.

3.1. Focus groups

Four sessions of focus groups were conducted in a large university located in the Midwest region at Kansas State University in the U.S. to elicit the participants' insights, perceptions, and attitudes toward dining out with food allergies. Focus group questions were developed based on previous food allergy-related studies (Gupta et al., 2008; Leftwich et al., 2011). The participants were recruited through flyers posted on campus and public bulletin boards around the city, and potential participants were asked to contact the researcher. Each participant received a \$20 cash payment for participating in the study. A total of 17 individuals with food allergies participated in one of the four focus groups, which lasted for an average of 60 minutes. All focus group sessions were audio-recorded, transcribed verbatim, and organized using NVivo (Version 8.0). Themes related to the participants' past dining experiences, factors that triggered food allergy reactions, preventive measures taken when dining out, and attitudes and expectations toward restaurants in serving allergen-free foods were identified by using the constant comparative method (Glaser, Strauss, & Strutzel, 1968). The constant comparative method allows the development of new concepts by coding and analyzing the data at the same time (Taylor & Bogdan, 1998). In this study, the raw data was collected and constant comparisons were performed until core themes emerged (Strauss & Corbin, 2008).

3.2. Survey and data collection

An online survey instrument was developed based on the focus group results and a previous study related to food allergies (Leftwich et al., 2011). Ten knowledge questions covered topics about common food allergens, proper food allergen-handling methods, and prevention strategies for food allergy reactions. Both multiple choices and true or false formats were used for knowledge questions, and all 30 questions and responses are listed in Table 2.

The attitude and behavior questions included perceived reasons for triggering food allergy reactions in restaurants (11 items; Table 3), customers' expectations towards the restaurants (15 items; Table 5), and preventive measures taken by customers for their food allergies (16 items; Table 6). Other questions included the likelihood of dining in various types of restaurants (Table 4). Customer attitudes were measured using either a 7-point (1 = very unlikely, 7 = very likely) or 5-point Likert scale with appropriate anchors (i.e., 1 = strongly disagree;

2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5 = strongly agree). Customer behaviors were also measured using a 7-point Likert scale (1 = very unlikely, 7 = very likely). In addition, participants were asked with an open-ended question about their experience at certain restaurants and reasons why they would avoid or prefer certain types of restaurants. Demographic characteristics such as gender, age, types of food allergies, and frequency of dining out were included at the end of the questionnaire to describe the research participants and to compare data based on different demographic characteristics (Table 1). Once developed, the questionnaire was reviewed by a panel of four food safety and food allergy researchers for content validity. The questionnaire was then revised based on their comments.

A pilot study was conducted with a convenience sample of 12 customers with food allergies. Cronbach's alpha was calculated to test the inter-item reliability, with the desired value of $\alpha \geq 0.70$ (Cronbach, 1951). The results of Cronbach's alpha test indicated that the items within each construct were reliable (i.e., perceived likelihood of each reason in triggering food allergy reactions in commercial restaurants [$\alpha = 0.78$], likelihood to take action to prevent food allergy reactions in the restaurants [$\alpha = 0.85$], expectations of customers with food allergies towards restaurants [$\alpha = 0.79$], and likelihood of visiting certain restaurants with a food allergy [$\alpha = 0.82$]). Only editorial revisions were made after the pilot study, and the instrument was finalized for data collection.

The study participants were recruited from a food allergy social networking website (AllergyEats.com), where its members share their dining experience at restaurants in various locations in the U.S. and seek recommendations, to reach the target population. The founder of AllergyEats.com confirmed that the members of the website met the criteria of the survey and gave permission to recruit their members for the study. The link for the final online survey using the Qualtrics online survey system (Qualtrics, Provo, UT) was distributed by the founder of AllergyEats.com to its members through an announcement on the website. Qualtrics is an online survey platform in which researchers can build surveys as well as distribute survey to their target participants.

3.3. Data analysis

Descriptive statistics such as frequencies, means, standard deviations, and cross-tabulations were calculated using SPSS (Version 21.0). Answers to knowledge questions were recoded as "1" for correct and "0" for incorrect answers. The total knowledge score was then computed by adding the score for each knowledge question. The differences in responses including likelihood of visiting certain types of restaurants (e.g., quick service, full service, buffet) between individual customers with food allergies and parents or guardians of children with food allergies were evaluated using independent sample t-tests. Paired-sample t-tests were performed to compare individual respondent's likelihood to visit different types of restaurants. To assess if there are differences in the prevention strategies taken by customers with food allergies and parents or guardians with children with food allergies, independent sample t-tests were conducted. Statistical significance was set at $p < 0.05$.

4. Results

A total of 320 complete and usable questionnaires were received from either individuals with food allergies ($n = 63$) or the parents or guardians ($n = 257$) of children with food allergies from 38 states in the U.S. Most participants were females ($n = 299$, 93.4%), Caucasian ($n = 287$, 89.7%), had a bachelor's degree or higher ($n = 246$, 76.9%), and reported an annual household income of \$60,001 or higher ($n = 292$, 81.8%). The participants reported that either themselves or their children were allergic to not only one of the eight major food allergens, but also less common food allergens, such as fruits (e.g., strawberries, bananas, citrus fruits, mangoes, and kiwi), corn, beef, barley, oats, and sesames. Most of the participants dined out often or more frequently

Table 1
Demographics of the research participants ($n = 320$).

Items	Frequency (n)	Percentage (%) ^a
Gender		
Female	299	93.4
Male	21	6.6
Race/Ethnic group		
Non-Hispanic/Black	4	1.3
Non-Hispanic/White	287	89.7
Asian & Pacific Island	12	3.8
Hispanic	11	3.4
American Indian	2	0.6
Other (Please specify)	9	2.8
Highest education completed		
Less than high school	1	0.3
High school graduate or GED	11	3.4
Some college	36	11.3
Associate degree	19	5.9
Bachelor's degree	127	39.7
Graduate or professional degree	119	37.2
Prefer not to answer	7	2.2
Annual household income (\$)		
≤ 20,000	11	3.4
20,001–40,000	14	4.4
40,001–60,000	33	10.3
60,001–80,000	40	12.5
80,001–100,000	43	13.4
100,001–120,000	99	30.9
≥ 120,001	80	25.0
Food allergen		
Shellfish	219	22.6
Wheat	186	19.2
Peanuts	135	13.9
Tree nuts (almonds, walnuts, pecans, etc.)	122	12.6
Fish	60	6.2
Eggs	47	4.9
Milk	40	4.1
Soy	28	2.9
Other ^b	86	8.9
Frequency of Eating out		
Never	9	2.8
Rarely	26	8.1
Infrequent	52	16.3
Sometimes	99	30.9
Often	93	29.1
Frequent	36	11.3
Very frequent	5	1.6

Note. ^a Some participants were allergic to more than one food allergen, and therefore the sum of the number of participants exceeds 320 responses, and 100%.

^b Other allergens include fruits (i.e., strawberries, bananas, and citrus fruits), corn, barley, sesames, and beef.

($n = 134$, 42.0%), and only nine participants (2.8%) indicated that they had never dined out because of their food allergies (Table 1).

4.1. Participants' knowledge about food allergies

The mean $\pm$ standard deviation (SD) of the overall food allergy knowledge score was 24.7 ± 3.8 of the maximum 30 points. All 30 questions and the number and percentage of participants answered each question correctly are listed in Table 2. The participants appeared to be fairly knowledgeable about the causes of food allergy reactions, prevention strategies, consequences of food allergy reactions, and recognition of the food allergens on food labels. However, more than 80% of the participants missed questions related to the diagnosis of food allergies and no relationship between breast-feeding and developing food allergies. Furthermore, more than half of the participants thought all food allergens are listed on food labels; however, the FALCPA of 2004 requires only the "Big 8" food allergens to be listed.

Over two-thirds ($n = 216$, 67.5%) of the participants failed to recognize "arachis oil" (peanut oil) as one of the ingredients that a person

Table 2
Participants' knowledge about food allergies (n = 320).

Knowledge Questions	Correct	Incorrect
	Frequency (%)	
General Information about Food Allergies		
Suppose that a person with milk allergy accidentally has consumed food that contains milk. Mark all symptoms of food allergy reactions that may be observed.		
a. Hyperactivity in 2 days	315 (98.4)	5 (1.6)
b. Stuffy and runny nose ^a	312 (97.5)	8 (2.5)
c. Abdominal cramps and diarrhea ^a	312 (97.5)	8 (2.5)
d. Hives immediately or within hours ^a	309 (96.6)	11 (3.4)
e. Asthma ^a	290 (90.6)	30 (9.4)
f. Swelling of throat ^a	282 (88.1)	38 (11.9)
g. Anaphylaxis ^a	266 (83.1)	54 (16.9)
h. Shortness of breath ^a	255 (79.7)	65 (20.3)
A person can die from having a food allergic reaction.(True)	313 (97.8)	7 (2.2)
An allergic reaction can happen when the body considers a protein as harmful. (True)	294 (91.9)	26 (8.1)
The only way to prevent food allergy is to stay away from food that cause the allergic reactions. (True)	285 (89.1)	35 (10.9)
Lactose intolerance (trouble digesting dairy products) is the same as having a milk allergy. (False)	283 (88.4)	37 (11.6)
Modern medicine can cure food allergy. (False)	226 (70.6)	94 (29.4)
The only way to know if a person has food allergy is by laboratory test. (True)	52 (16.3)	268 (83.8)
Foods eaten by a mother can be passes to her child through her breast milk. (False)	48 (15.0)	272 (85.0)
Food Allergen Recognition		
Acidic food like lemons, oranges, and tomatoes is one of the most common food allergens. (False)	238 (74.4)	82 (25.6)
A person can be allergic to beef. (True)	222 (69.4)	98 (30.6)
A person can be allergic to herbs like basil. (True)	217 (67.8)	103 (32.2)
Mark all ingredients and/or statements that a person with peanut allergy should avoid.		
a. “Whey” listed in the list of ingredients	317 (99.1)	3 (0.9)
b. “Contains peanut” ^a	313 (97.8)	7 (2.2)
c. “May contain peanut” ^{na}	312 (97.5)	8 (2.5)
d. “Processed in a factory which also processed food containing peanut” ^a	308 (96.3)	12 (3.7)
e. “Arachis Oil” listed in the list of ingredients ^a	104 (32.5)	216 (67.5)
Mark all ingredients and/or statements that a person with milk allergy should avoid:		
a. “Contains milk” ^a	314 (98.1)	6 (1.9)
b. “Milk solids” listed in the list of ingredients ^a	312 (97.5)	8 (2.5)
c. “Casein” listed in the list of ingredients ^a	265 (82.8)	55 (17.2)
d. “Whey” listed in the list of ingredients ^a	257 (80.3)	63 (19.7)
e. “Artificial butter flavor” listed in the list of ingredients ^a	124 (38.8)	196 (61.3)
Food Allergen Handling Practice		
If a person has peanut allergy, removing peanuts from salad dish before serving will prevent from an allergic reaction. (False)	311 (97.2)	9 (2.8)
Food Allergen Labeling Law		
All allergens are listed in the food labels. (False)	140 (43.8)	180 (56.3)

Note. ^a indicates correct Answer.

with a peanut allergy should avoid. While a larger proportion of customers with peanut allergies (83 of 204 participants, 40.7%) recognized arachis oil being the same as peanut oil than those without peanut allergies (21 of 116 participants, 18.1%), 59.3% of individuals with peanut allergies still did not recognize this was another name for peanut oil. Similarly, 196 participants (61.3%) did not know a person with a milk allergy should avoid food items that contain "artificial butter flavor." Among customers with milk allergies (n = 116), only 57 participants (49.1%) knew that they had to avoid artificial butter flavor, while only 32.8% of customers who were allergic to other food knew this fact.

4.2. Attitudes and behaviors of dining out with food allergies

4.2.1. Perceived causes of food allergy reactions in commercial restaurants

Perceived causes of food allergy reactions in restaurants were identified using a 7-point Likert scale, ranging from 1 being "very unlikely" to 7 being "very likely." The top five factors that participants perceived most likely to trigger food allergy reactions were cross-contact with allergens (6.3 ± 1.2), employees lacking knowledge about the consequences of food allergy reactions (6.3 ± 1.3), lack of communication between servers with other staff (6.3 ± 1.4), restaurant employees not taking special food requests seriously (6.3 ± 1.4), and ingredients not being fully reported on the menus (6.1 ± 1.4). The participants indicated that it was somewhat likely that a food allergy reaction may occur because certain allergenic ingredients could not be omitted to preserve the authenticity of the menu (4.9 ± 1.9 ; Table 3).

4.2.2. The likelihood of dining out at certain types of restaurants

The likelihood of dining out at certain types of restaurants was also measured using a 7-point Likert scale. Overall, participants preferred chain restaurants to independently-owned restaurants. Paired-sample t-tests of all participants between chain and independently-owned restaurants showed significant differences in mean scores when compared with restaurants that have similar concepts. For example, participants preferred full service non-ethnic chain restaurants to full service non-ethnic independently-owned restaurants (4.7 ± 2.0 vs. 4.4 ± 1.9 , respectively, $p = 0.006$), full service ethnic chain restaurants to full service ethnic independently-owned restaurants (4.2 ± 2.0 vs. 3.6 ± 2.1 , respectively, $p < 0.001$), and non-ethnic chain buffet restaurants to non-ethnic independently-owned buffet restaurants (2.4 ± 1.9 vs. 2.2 ± 1.9 , respectively, $p = 0.013$).

When compared between customers with food allergies and parents or guardians of children with food allergies, the pattern of likelihood of dining out at particular restaurants was different between the two groups. Independent sample t-tests showed that when compared with parents or guardians of children with food allergies, adult customers who have food allergies were more likely to visit buffet restaurants (3.1 ± 2.1 vs. 2.0 ± 1.6 , $p < 0.001$) and full-service restaurants (4.9 ± 1.4 vs. 4.0 ± 1.6 , $p < 0.001$). However, there was no significant difference in the likelihood to visit quick service restaurants between the two groups (4.1 ± 2.1 vs. 3.6 ± 1.9 , $p = 0.074$).

Furthermore, adult customers with food allergies were more likely to visit independently-owned restaurants than parents or guardians of children with food allergies (4.1 ± 1.5 vs. 2.8 ± 1.4 , $p < 0.001$). The

Table 3

Perceived factors that cause the food allergic reactions in the commercial kitchen (n = 320).

Items	Mean $\pm$ SD
Cross-contact with allergens.	6.3 $\pm$ 1.2
Restaurant employees' lack of knowledge about consequences of a food allergic reaction.	6.3 $\pm$ 1.3
Restaurant servers not taking special food requests seriously.	6.3 $\pm$ 1.4
Restaurant servers not communicating with other staff (such as cooks and other servers) about food allergy precautions informed by consumers.	6.3 $\pm$ 1.4
Ingredients not fully reported on menus.	6.1 $\pm$ 1.4
Lack of complete labeling on food products purchased by restaurants.	6.0 $\pm$ 1.5
Restaurants staff are too busy to receive specific requests.	5.8 $\pm$ 1.6
Customers not informing restaurant servers about their food allergies.	5.4 $\pm$ 2.2
Expense of providing a separate area and staff for allergen free food in restaurants.	5.3 $\pm$ 1.8
High employee turnover in the restaurants.	5.1 $\pm$ 1.8
To keep authenticity of menu, certain food allergens cannot be omitted.	4.9 $\pm$ 1.9

Note. The likelihood of dining out was indicated on a Likert scale, from 1 being “very unlikely” to 7 being “very likely”.

Table 4

The likelihood of dining out in certain types of restaurants indicated by the research participants (n = 320).

Types of Restaurants	Individuals (n = 63)	Parents/guardians (n = 257)	t	p
	Mean $\pm$ SD			
Full service, non-ethnic, independent	5.3 $\pm$ 1.5	4.1 $\pm$ 1.9	10.309	.001**
Full service, ethnic, independent	5.0 $\pm$ 1.7	3.3 $\pm$ 2.0	9.943	.002**
Full service, ethnic, chain	4.8 $\pm$ 1.9	4.0 $\pm$ 2.0	1.820	.178
Full service, non-ethnic, chain	4.5 $\pm$ 2.0	4.7 $\pm$ 2.0	.091	.763
Quick service restaurants, non-ethnic	4.2 $\pm$ 2.2	4.3 $\pm$ 2.2	.055	.815
Quick service restaurants, ethnic	4.1 $\pm$ 2.3	3.0 $\pm$ 2.2	.041	.840
Buffet, non-ethnic, chain	3.1 $\pm$ 2.3	2.2 $\pm$ 1.8	14.747	< .001***
Buffet, ethnic	3.1 $\pm$ 2.3	1.7 $\pm$ 1.5	38.409	< .001***
Buffet, non-ethnic, independent	3.0 $\pm$ 2.2	2.0 $\pm$ 1.7	14.052	< .001***

Note. The likelihood of dining out was indicated on a Likert scale, from 1 being “very unlikely” to 7 being “very likely”.

*** p < 0.001, ** p < 0.01 * p < 0.05.

likelihood of visiting chain restaurants for parents or guardians was significantly higher (3.6 ± 1.6) than independently-owned restaurants (2.8 ± 1.4 , p < 0.001), although the differences between the two groups narrowed (4.2 ± 1.6 for adult customers vs. 3.6 ± 1.6 for Parents or guardians, p = 0.018). The likelihoods of customers with food allergies to visit ethnic or non-ethnic restaurants were also higher than those of parents or guardians of children with food allergies. The mean scores for customers with food allergies to visit ethnic restaurants were 4.2 ± 1.6 vs. 3.0 ± 1.5 for parents/guardians of children with food allergies (p < 0.001). While there was a difference in mean scores for the likelihood of visiting non-ethnic restaurants between customers with food allergies and parents or guardians of children with food allergies (4.0 ± 1.6 vs. 3.5 ± 1.4 , p = 0.005, respectively), the difference between the two groups was smaller for non-ethnic restaurants than ethnic restaurants.

More specifically, customers with food allergies reported that they were more likely to dine out in full service, non-ethnic, independently-owned restaurants (5.3 ± 1.5) followed by full service, ethnic, independently-owned restaurants (5.0 ± 1.7), and full service ethnic chain restaurants (4.8 ± 1.9). Parents or guardians of children with food allergies tended to dine out in full service, non-ethnic chain restaurants (4.7 ± 2.0), quick service non-ethnic chain restaurants (4.3 ± 2.2), full service non-ethnic, independently-owned restaurants (4.1 ± 1.9), and full service, ethnic, chain restaurants (4.0 ± 2.0). Significant differences in preferences between the two groups are identified in Table 4.

In the follow-up open-ended questions, a total of 221 comments were obtained from participants about the reasons why they would avoid or dine out at certain types of restaurants. A variety of responses were shared based on the types of food allergens, previous dining experiences, and whether they are customers with food allergies or parents or guardians of children with food allergies. The participants expressed both positive and negative opinions toward dining out in ethnic and non-ethnic restaurants (n = 16). There was a group of participants (n = 7) who would selectively avoid a particular kind of ethnic restaurant based

on the types of food items to which they were allergic. For instance, participants with peanuts or tree nut allergies would opt to dine out at Italian restaurants rather than Chinese, Thai, Mexican, Vietnamese, or Indian restaurants because peanut or tree nuts are commonly used in these ethnic cuisines. Five respondents reported having low confidence in dining out at ethnic restaurants because of language barriers. On the other hand, one customer commented that she would only dine out at Asian restaurants because of her milk allergy.

The respondents revealed mixed feelings about independently-owned versus chain restaurants. The group of respondents (n = 74) who preferred dining out at chain restaurants mentioned that the ingredients in the foods were more consistent and that the allergen information was more clearly listed on the menus. The respondents also expressed that chain restaurants were more likely to have standardized recipes and allergy-friendly policies. Chain restaurants usually have official websites with ingredient and allergen information, which facilitate customers with food allergies in making informed decisions. However, the respondents who did not favor chain restaurants (n = 4) expressed their concerns about the variations of ingredients among franchised restaurants, lack of flexibility in food preparation and the “bad food quality”.

Regarding independently-owned restaurants, some respondents (n = 16) indicated that customers could communicate with managers or chefs more easily when placing their special orders. Employees at these independently-owned restaurants were perceived to be more willing to accommodate special requests compared with employees in other types of restaurants. However, some participants (n = 4) also voiced that both independently-owned and chain restaurants could be risky places to dine at if the restaurant staff did not possess positive attitudes toward serving customers with food allergies.

Comparing various types of restaurants (i.e., quick service, full service, and buffet restaurants), a few respondents stated that they did not favor quick service restaurants because there was a higher risk of food being contaminated (n = 2). Because of this fear, one participant

Table 5
Customer' Expectations towards the restaurants (n = 320).

Items	Mean $\pm$ SD
<i>Restaurant staff</i>	
All restaurant employees should take my food allergy concerns seriously.	4.9 $\pm$ 0.5
All restaurant employees should be aware of common food allergens.	4.9 $\pm$ 0.5
All restaurant employees should be trained about food allergies.	4.8 $\pm$ 0.6
The managers/owners should develop emergency procedures for dealing with customers who develop an allergic reaction.	4.6 $\pm$ 0.7
All restaurant employees should be able to answer all questions about food ingredients.	4.3 $\pm$ 1.0
Restaurant employees should refer to managers/owner of the restaurant if they are not sure about food ingredients or if they are asked to provide allergen free food.	4.2 $\pm$ 0.5
More attention and care should be given to allergy issue at more expensive restaurants.	3.8 $\pm$ 1.4
The restaurant managers/owners should be responsible for any food allergic reactions.	3.4 $\pm$ 1.2
It is the restaurant staffs responsibility to ask each customer if he/she has any food allergies before customers make menu selections.	2.1 $\pm$ 1.2
<i>Restaurant menus</i>	
The eight major food allergens should be clearly marked on the menus.	4.4 $\pm$ 1.0
All restaurants should provide allergen free menu options.	4.1 $\pm$ 1.1
The menu in the restaurant should list all ingredients.	3.8 $\pm$ 1.2
<i>Customers with food allergies</i>	
It is the customer's responsibility to tell restaurant employees about their food allergies.	4.9 $\pm$ 0.4
Customers with severe food allergy should always carry an epinephrine auto-injector when dining out.	4.8 $\pm$ 0.5
Customers should bring "back-up" food if the restaurants cannot provide allergen free food.	3.8 $\pm$ 1.4

Note. The likelihood of dining out was indicated on a Likert scale, from 1 being "strongly disagree" to 5 being "strongly agree".

*** p < 0.001, ** p < 0.01 * p < 0.05.

reported that he or she visits the quick service restaurants during nonpeak hours only. In addition, a few participants perceived that employees at quick service restaurants did not seem to be concerned about or express their willingness to accommodate customers with food allergies (n = 3). Four respondents liked dining at upscale (fine) restaurants because they perceived that the food was prepared when it was ordered and that the employees and chefs working at these restaurants were well trained and were more knowledgeable of food allergies. Conversely, two participants stated that fine dining restaurant chefs felt offended when customers requested certain ingredients to be excluded from the signature dishes. Some respondents (n = 9) shared a common reason for avoiding buffet restaurants, the risk of cross-contacts between food items and undeclared food allergens.

4.2.3. Customers' expectations toward the restaurants

Using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), the respondents indicated what different roles they expected the restaurants and customers with food allergies to play when

preventing food allergy reactions. The results showed that these expectations could be classified into three broad aspects: expectations from the restaurant staff, roles of restaurant menus, and self-prevention of customers with food allergies. The participants expected restaurant employees to take the food orders seriously (4.9 $\pm$ 0.5), be aware of the common allergens (4.9 $\pm$ 0.5), refer to managers/owners if they were not sure about the ingredients used (4.8 $\pm$ 0.5), and be trained on food allergies (4.8 $\pm$ 0.6). Additionally, the participants expected the "Big 8" to be identified on the menus (4.4 $\pm$ 1.0) and allergen-free menu options to be provided for them (4.1 $\pm$ 1.1). On the other hand, the respondents also felt that customers with food allergies should tell restaurant employees about their food allergies (4.9 $\pm$ 0.4) and always carry epinephrine auto-injectors when dining out (4.8 $\pm$ 0.5) (Table 5).

4.2.4. Preventive measures of dining out with food allergies

Using a 5-point Likert scale ranging from 1 (never) to 5 (always; Table 6), the participants rated the frequency of taking a series of strategies to prevent food allergy reactions when dining out. Several

Table 6
Prevention strategies taken by individuals with food allergies and parents or guardians of children with food allergies while eating out in this study (n = 320).

Items	Individuals (n = 63)	Parents/Guardians (n = 257)	p	
	Mean $\pm$ SD	t		
Prior to eating out				
Visit restaurant website.	4.0 $\pm$ 1.3	4.1 $\pm$ 1.2	-.60	.55
Visit the restaurants which you have established a good relationship with staff who recognize your special needs.	3.9 $\pm$ 1.3	4.0 $\pm$ 1.4	-.72	.47
Always carry an epinephrine auto-injector in case of an allergic reaction.	3.3 $\pm$ 1.8	4.6 $\pm$ 1.1	-7.82	< .001***
Call the restaurant ahead of time.	2.8 $\pm$ 1.4	3.0 $\pm$ 0.4	-1.25	.21
Visit the restaurant ahead of time.	2.6 $\pm$ 1.5	2.7 $\pm$ 0.3	-1.38	.17
Take Benedryl or other allergy medicine before and/or after dining out.	2.2 $\pm$ 1.5	1.8 $\pm$ 1.3	2.16	.03*
On premise				
Read the menu to see if there are food items without allergens.	4.7 $\pm$ 0.6	4.7 $\pm$ 0.9	.49	.63
Communicate with the server and/or host about your food allergy.	4.6 $\pm$ 0.8	4.7 $\pm$ 0.9	-1.25	.21
Order menu items based on past experience.	4.3 $\pm$ 0.9	4.1 $\pm$ 1.1	1.97	.05*
Ask for a new meal if there are any doubts of allergenic food being present.	3.9 $\pm$ 1.3	3.9 $\pm$ 1.5	.08	.93
Order a simple/plain menu items prepared without hidden ingredients.	3.7 $\pm$ 1.3	3.9 $\pm$ 1.2	-.98	.33
Confirm with server after receiving food if the meal was prepared as requested.	3.7 $\pm$ 1.4	3.8 $\pm$ 1.4	-.69	.49
Communicate with the chef about your food allergy.	3.2 $\pm$ 1.4	3.6 $\pm$ 1.4	-1.98	.05*
Make food choices based on printed ingredient lists on the menu only.	3.1 $\pm$ 1.4	2.3 $\pm$ 1.4	4.76	< .001***
Ask servers and food preparers to wash hands before handling your food.	2.5 $\pm$ 1.6	2.3 $\pm$ 0.5	.74	.46
Pick off the pieces you are allergic to.	2.2 $\pm$ 1.6	1.3 $\pm$ 0.8	6.88	< .001***

Note. The preventive measures while eating out were measured using 5-point Likert scale, ranging from 1 being "never" to 5 being "always".

*** p < 0.001, ** p < 0.01 * p < 0.05.

strategies taken prior to arriving at the restaurants included visiting restaurant websites (4.0 ± 1.2) and visiting only restaurants where staff recognizes special needs (4.0 ± 1.4). On premise, the participants would read the menus to identify allergens that might exist in food items (4.7 ± 0.9), communicate with restaurant employees about their food allergies (4.7 ± 0.8), and order menu items that they had eaten safely before (4.1 ± 1.0). The parents or guardians of children with food allergies were more likely to carry an epinephrine auto-injector (4.6 ± 1.1) than individuals with food allergies (3.3 ± 1.8 , $p < 0.001$). In addition, while on premise, the parents or guardians of children with food allergies were more likely to communicate with chef about their children's food allergies (3.6 ± 1.4) compared to individuals with food allergies (3.2 ± 1.4 , $p < 0.05$). On the other hand, individuals with food allergies were more likely to order menu items based on their past experience ($p < 0.05$), make food choices based on printed ingredient lists on the menu only ($p < 0.001$), and pick off the pieces of the food allergens ($p < 0.001$) compared to parents or guardians of children with food allergies.

5. Discussion

Food allergies have become a public health concern in the U.S. and have been increasing over the years (Gupta, 2019; Verrill, Bruns, & Luccioli, 2015). Previous studies about customers with food allergies have focused mainly on the effects of food allergies on quality of life and experience while traveling abroad, only a few studies have explored the knowledge, attitudes, and behaviors of customers with allergies when dining out. The restaurant operators may not be able to fulfill the demands and expectations of customers with food allergies if these areas remained under-researched. Therefore, the current study was conducted to close this gap and understand the needs of customers with food allergies or parents or guardians of children with food allergies.

Significant proportion of respondents from this study experienced food allergy reactions at commercial restaurants as 44 of 63 adult customers with food allergies (69.8%) and 122 of 257 parents or guardians of children with food allergies (47.5%) reported having experienced food allergy reactions. Here, the participants in this study were subscribers to *AllergyEats.com*, a social networking website that provides information and ratings about how restaurants accommodate customers with food allergies or food intolerances. Therefore, participants in this study may be more inclined to dine out at restaurants. Furthermore, there is a greater tendency to participate in this type of survey if one has experienced this type of events (i.e., participant bias). These two factors may explain why such a high percentage of participants in the current study experienced food allergy reactions. Furthermore, only 2.8% of participants never eat out, while a previous study reported that 19–25% of the participants had never eaten at any dining establishments (Wanich et al., 2008).

In addition to the eight major food allergens, 8.9% of the participants were also allergic to other less prevalent allergens; this number is significantly lower than the number identified in a previous study conducted in the United Kingdom, in which about 40% participants had anaphylactic shocks because of items such as citrus fruits, banana, kiwi, peas, and sesames (Uguz et al., 2005). The discrepancies here may be because of different countries or geographic locations, which tend to show differences in common allergens. For example, buckwheat is one major food allergen in Japan (Akiyama, Imai, & Ebisawa, 2011), and mustard is a major food allergen in Canada (Canadian Food Inspection Agency, 2019). The variety of food allergens found in the current and previous studies indicate that restaurateurs may face greater challenges when modifying their menus to meet the needs of customers with food allergies that may not be as well-known.

The average knowledge score of 24.7 out of 30 showed that the respondents had a fair amount of food allergy knowledge. Previous study suggested that food allergy was often confused with food

intolerance (Lee & Sozen, 2016, 2018; Mandabach et al., 2005; Soon, 2018), but most of the participants (82%) in the current study were able to differentiate lactose intolerance and milk allergy. However, the participants lacked knowledge concerning current food allergy legislations and thought that all food allergens were indicated on food labels, when the FALCPA mandates only the eight major food allergens to be listed on food labels. These results indicate that there is a need to educate customers about label reading and to look for the words “contains” and the sources of allergen in parentheses to better identify food allergens.

The results of the perceived factors that trigger food allergy reactions in the restaurants were similar to the findings of previous studies, including a lack of knowledge about the consequences of food allergy reactions, cross-contact, hidden ingredients, miscommunication, and the poor food-handling behaviors of restaurant staff (Eigenmann & Zamora, 2005; Furlong et al., 2001, 2006; Kwon & Lee, 2012; Sicherer et al., 2001). It has been shown that restaurant employees who do not believe in the deadly consequences of food allergy reactions often “downplay” the risks and would not take the special dietary requests seriously (Kwon & Lee, 2012). The management team in the restaurant should identify strategies that promote attitude changes and increase awareness about food allergies among their staff in an effort to prevent food allergy reactions.

Food allergy reactions could be a result of cross-contact (Eigenmann & Zamora, 2005; Furlong et al., 2001; Knoblauch et al., 2007; Kwon & Lee, 2012; Leftwich et al., 2011). Cross-contact happens when food items are prepared with the same utensils or on the same work surfaces that were used to prepare allergenic food or when food allergens are accidentally transferred via dining tables or food handlers' hands (Jackson et al., 2008).

A retrospective study also indicated that 119 of 530 reported cases of food allergy reactions were caused by hidden food allergens, such as eggs in pastries and nuts in confectionary products (Anibarro, Seoane, & Mugica, 2007). Researchers have suggested that suppliers should provide and frequently update the complete list of allergenic food ingredients used in the manufacturing process to help the restaurateurs to reduce the risk of food allergy reactions from hidden allergens (Deibel et al., 1997).

In terms of communication, customers perceived that the front-of-the-house food service staff did not consult the back-of-the-house kitchen staff for accurate food allergen information, which can lead to the presence of allergens in the dishes, even after customers have requested a special meal (Kwon & Lee, 2012; Leitch, Walker, & Davey, 2005). Therefore, the findings of the current study indicate that food allergy training for restaurant employees should include topics such as avoiding cross-contact and communicating between the front and back-of-the-house staff to enhance their ability to provide safe foods for customers with food allergies.

Regarding the likelihood of dining out in certain types of restaurants, customers with food allergies were significantly more likely to dine out at independent, ethnic ($p < 0.01$), and non-ethnic full service restaurants ($p < 0.01$), as well as buffet restaurants (i.e., non-ethnic, independent [$p < 0.001$], non-ethnic, chain [$p < 0.001$], and ethnic [$p < 0.001$]) when compared with the parents or guardians of children with food allergies. Previous studies have indicated that the likelihood of visiting certain types of restaurants varies based on participants' past experiences and the types of food items to which they are allergic (Kwon & Lee, 2012; Leftwich et al., 2011). In a qualitative study, participants with a nut allergy perceived Thai, Chinese, and Indian restaurants as high-risk dining places because nuts are widely used in these cuisines, such as in their curries and sauces (Leftwich et al., 2011). In addition, by investigating the incidents of peanut and tree nut allergy reactions in food establishments, Furlong, McMorris, and Greenhawt (2008) found that many food allergy reactions occurred at Asian restaurants (13%) and bakeries (14%). Meanwhile, seafood allergies occurred most frequently at seafood restaurants and Asian restaurants

(Furlong et al., 2006).

Overall, the participants in the current study seemed to prefer dining out at chain restaurants. This result may be explained by findings from a previous study that customers with food allergies preferred large, food allergy-friendly chain restaurants to independently-owned restaurants because of the availability of food ingredient and allergen information online, consistency of menu items, and well-trained food-service employees (Kwon, Sauer, Wen, Bisges, & Myers, 2013). In addition, previous research found that managers of chain restaurants were more likely to include food allergy topics in trainings when compared with managers from independently-owned restaurants (Mandabach et al., 2005; Wen & Kwon, 2016). With more exposure to food allergy information through trainings, employees in chain restaurants were more prepared to serve customers with food allergies with systematic instructions (Wen & Kwon, 2016). Results in this current study also demonstrated that participants were more likely to dine out in full service restaurants. This finding may be explained by the fact that full service restaurants usually provide menu options to accommodate customers' special dietary restrictions (NRA, 2013). However, only a few participants commented that the employees from a multiunit company-owned or franchised restaurant might have better food allergy knowledge than employees of independently-owned restaurants. Previous literature has also indicated a lack of consensus regarding employees in which types of restaurants had better knowledge or awareness of food allergies and could guarantee allergen-free foods (Lee & Sozen, 2018; Mandabach et al., 2005). As commented by one respondent, the key to serving allergen-free foods depended on the attitudes and vigilance of the restaurant owners and employees. The fact that individuals with food allergies and parents or guardians of children with food allergies prefer different types of restaurants indicates that the vigilance and capability of serving allergen-free food may depend on the attitude of the restaurant staff, restaurant policies, availability of additional resources, and other factors. Future studies may compare food allergy policies and the procedures of ethnic vs. non-ethnic restaurants and franchised or corporate-operated multiunit vs. independently-owned restaurants to identify possible causes of these discrepancies.

Participants of this research practiced various strategies for food allergy reaction prevention while in the restaurant or even prior to eating out. Overall, the findings of the current study support the results of previous literature, which has indicated that individuals with food allergies would read information posted on restaurants' websites, printed menus, or menus displayed on restaurant windows; here, the word "contain" on the menu was important to help identify the presence of the food allergens in a food item (Begen et al., 2016; Wanich et al., 2008). These strategies were adopted mainly because individuals with food allergies wanted to avoid potential social embarrassment and did not want to be considered as "fussy eaters" (Leftwich et al., 2011). In addition, a "chef card" that contains food allergy information and the lists of ingredients that an individual needs to avoid could be useful, especially when a language barrier exists (Bordelon, 2016; Weiss & Munoz-Furlong, 2008). Individuals with food allergies also seek out familiarity and return to restaurants that had successful records of providing safe food (Begen et al., 2016; Wanich et al., 2008; Leftwich et al., 2011).

Compared with individuals with food allergies, the parents or guardians of children with food allergies were more likely to carry an epinephrine auto-injector with them while dining out ($p < 0.001$). Bringing an epinephrine auto-injector could be lifesaving because most anaphylaxis-induced fatalities were due to a delay in epinephrine injection (Weiss & Munoz-Furlong, 2008). Therefore, customers with food allergies or family members should be encouraged to carry an epinephrine auto-injector at all times to prevent food allergy-related fatalities. The results of this study implied that individuals with food allergies might involve in some risk-taking behaviors, such as picking off the pieces of the food allergens from food items they ordered. Such

behavior has also been observed and reported in several previous studies, especially among young adults and adolescents (Rivkina et al., 2015; Warren et al., 2017). Future education and interventions may be needed to address this kind of risk-taking behaviors, due to its detrimental consequences.

6. Conclusions

The current study investigated the food allergy knowledge, attitudes, and behaviors of customers with food allergies or parents with children with food allergies when they dine out. Overall, the participants were fairly knowledgeable about food allergies. Many of the factors that participants perceived responsible for triggering food allergy reactions involved restaurant employees, such as employees' lack of knowledge and awareness about food allergies, poor food allergen-handling practices (e.g., cross-contact), a lack of communication between restaurant staff, and a lack of time to take special requests. It also appears that the participants were more likely to dine out at full service, non-ethnic, and independently-owned restaurants, whereas buffet restaurants remained the least favored restaurant type. The findings of this study further showed that the participants took various preventive measures prior to and during dining out to ensure their own safety.

There are several limitations in the current study. First, the participants were subscribers of [AllergyEats.com](https://www.allergy-eats.com), a social networking website offering restaurant information for customers with food allergies; these individuals may be more informed about allergy prevention strategies. Thus, the results from the survey may not be generalized to other customers with food allergies who may not be as actively involved in food allergy networks or social media websites. Second, the researchers classified ethnic (e.g., Asian, Italian, Mexican, etc.) cuisines under a single umbrella term of "ethnic" restaurant. Therefore, the results of the present study may not reflect the true perceptions of each specific type of ethnic restaurant. Future studies may investigate each type of ethnic restaurant separately to provide more meaningful recommendations for restaurant operators. Lastly, this reach was conducted in the U.S. in relation to customers' experiences in commercial restaurants only. Therefore, results may not reflect attitudes and behaviors of customers in different countries or of onsite and other foodservice establishments.

Declarations of interest

None.

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