FOOD ALLERGIES IN COLLEGE STUDENTS: KNOWLEDGE, SYMPTOM MANAGEMENT, AND RESPONSE TIMES

A thesis submitted to the
Kent State University Honors College
in partial fulfillment of the
requirements for University Honors

by

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May, 2024

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ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my mentor and Thesis Chair Dr. Jo A. Dowell for her invaluable guidance and expertise during this process. Thank you to the members of my committee Drs. Susan Roxburgh, Amy Sato, and Andrea Warner who have provided me their knowledge and experience as I completed my defense. A special thank you to Kristin Yeager the Head of Statistical Consulting for the Kent State Library who guided me through the process of data analysis.

I am also grateful to the College of Nursing for allowing me the opportunity to complete my research and the resources they have provided me. A special thanks to the S.U.R.E. program and Ann Gosky who supported me throughout the research process and provided me opportunities to present my research. I would like to thank RAS and the URC division of research and economic development for funding my research.

I would also like to thank my parents Mary and Rob, sister Clare, and friends Audrey Ernst, Claire Ebner, Teresa Raba, Zoe McConnaha, and Faith Taylor for their love and support throughout this process.

ABSTRACT

Introduction: College students with allergies to food face unique challenges regarding their knowledge of food allergies, allergy and symptom management, the time it takes them to respond to an allergic reaction. Subsequently there is a gap in the literature surrounding these topics that this study and survey aims to address and fill the gap in the literature.

Methods: The cross-sectional design using a survey developed for the study examined the knowledge, symptom management, and emergency response times using a prescribed EpiPen of college students by utilizing questionnaires designed specifically for the study and the FAQLQ-AF questionnaire. Analysis assessed the constructs of knowledge, symptom management, and response times in the chosen population. Demographic data included age and class rank. All personal information were de-identified from the participants to protect privacy. Consent was obtained before participating in the survey.

Procedure: 75 Kent State students ages 18-22 that fulfilled the inclusion criteria took part in the survey. Instructions for the completion of the survey, consent, and the survey uploaded to Qualtrics.

Analysis and Results: Data cleaning was completed by the honor student and Dr. Dowell in preparation for data analysis. Data analysis was completed using Statistical Package for the Social Sciences (SPSS) with the help of campus statistician Kristin Yeager. Data analysis included descriptive analysis, means and standard deviations, as well as analysis of variance with regression models.

Keywords: knowledge, symptom management, response time, EpiPen, demographic data, FAQLQ-AF questionnaire

CHAPTER I

INTRODUCTION

In the United States, approximately twenty-six million Americans live with food allergies (Lee et al., 2022). The most serious food allergy reactions relate to nine major food allergens -- milk, eggs, peanuts, tree nuts, shellfish, soy, fish, wheat, and sesame (Lee et al., 2022). The number of young people living with food allergies has been surging over the last decades. Every year, teenagers head off to college and begin living independently as newly young adults. When dropping off a college-age child with food allergies, their parents certainly worry about issues that other parents do not. Most importantly, they think about whether their child is ready to manage their food allergies and allergic reactions on their own. In their new college environment, young students face greater risks of a severe allergic reaction while the student adapts to life away from home without parental guidance. Since the diagnosis of their child's food allergies, parents have been protecting their child from all the effects of exposure to those allergens. However, as these students leave the protective living environment of their childhood and step into their college environment, students with allergies must build a new set of do’s and don'ts for safe everyday living. Allergic reactions in college can happen easily and unexpectedly just like it did when these students were first diagnosed as an infant or child.

As an infant, my parents struggled to manage my first allergic reactions to solid

food allergies. After an awful episode of skin-prick allergy testing, the allergist confirmed my major food allergens and the severity of my reaction to each of them. As a child with food allergies, my parents faced daily challenges of preparing my meals. They kept me healthy and safe by buying only dairy and gluten-free foods, eliminating all exposures to my allergens, and educating every daycare center, school, extracurricular group, and organization on how to help us manage these frustrating allergies. During my childhood, we learned to make different food choices, eat at specific restaurants that cater to individuals with food allergies, take daily prescriptions, and keep constant vigilance over what food I ate. We were fortunate that the strength of my food allergies faded as I became a teenager.

Heading off to college was a wonderful milestone moment for me. I felt eager to live on my own and begin exploring all that my college campus offered. However, I did also feel apprehensive about being solely responsible for keeping myself safe while managing my remaining food allergies. As a college freshman starting in post-pandemic August 2020, I endeavored to avoid exposure to my various food allergens as well as COVID-19. Other college students living with more severe food allergies encounter greater challenges away from home. Without their parents or usual support systems in place, those highly allergic college students must learn how to manage their allergies and respond both quickly and appropriately if they have a sudden allergic reaction.

After living this experience myself, I wanted to use my access to research given to me by the Honors College and College of Nursing to bridge this critical gap among college students struggling with food allergies. The purpose of this study is to examine

the knowledge of college students, their management of their food allergy symptoms, and their access to treatment during an allergic reaction. This study aims to investigate the practices of college students to further define specific areas where there is a gap in understanding allergy management for intervention. The title of my study is: *"Food Allergies in College Students: Knowledge, Symptom Management, and Response Times"*.

Center for Disease Control and Prevention (CDC)

According to the CDC, 8% of children in the United States report having a food allergy (CDC, 2022). That statistic breaks down to 1 in 13 children, or two kids in every school classroom affected by a food allergy in which there is no cure (CDC, 2022). After ingesting an allergen, an allergic reaction occurs when the body creates an immunologic response ranging from mild to severe or anaphylactic in strength (CDC, 2022). Most often reactions present as hives, hypotension, respiratory distress, and/or swelling of the tongue or lips (CDC, 2021). Allergic reactions present as neurological symptoms and affect major body systems like the respiratory tract, cardiovascular system, gastrointestinal system, skin, and mucosal system (CDC, 2021). To manage the more severe reactions, healthcare providers often prescribe an epinephrine auto-injectors (EAI) such as an EpiPen, Auvi-Q or generic form. Even if someone has only ever experienced mild symptoms, there is still a chance they can undergo an anaphylactic reaction. In the event of such a reaction, the food allergic person needs to know how to correctly administer this counteractive medication to stop the swelling in their airway and raise their blood pressure (American College of Allergy, Asthma & Immunology, 2022).

Food Allergies & Anaphylaxis

Often resulting in death, anaphylactic reactions are rapid onset systemic hypersensitivity reactions triggered by food allergens (Jiang et al., 2021). To prevent these reactions from occurring or advancing, healthcare providers (HCP) usually prescribe a self-injectable fast acting epinephrine for patients to use in emergencies. However, after receiving this life saving medication, most children, adolescents, and parents of children with allergies do not know how to accurately administer the medication or may not have it available for use in the first place (Sicherer et al., 2000). For patients and families, they report feeling burdened by carrying their EpiPens and being tied to the device affecting their compliance with treatment (Saleh-Langenberg et al., 2016). This feeling of burden was particularly popular in adolescents as they were most likely to have this feeling of burden combined with not carrying their EpiPen (Saleh-Langenberg et al., 2016). This is concerning as adolescents are the age group with highest risk for allergy related fatalities (Saleh-Langenberg et al., 2016). There is literature detailing the management of allergies for school-aged kids and their parents, but there is little information for adolescents and college students especially. There is limited information on food allergy management among college students, most available literature focuses on food allergies in the pediatric and school-age patients. The purpose of this study is to examine college students' knowledge, how they manage allergy symptoms, and the time it takes to access emergency response (primarily administration of an EAI, as well as going to the Emergency Room, or other form of treatment) at a local university. Thus, this thesis aims to investigate these questions: 1) What is the knowledge

of college students related to food allergies and knowledge about symptom management? 2) What is the response time to access an emergency plan such as administration of auto-injectable EpiPen or emergency room?

Operational Definitions for the Study Constructs

Knowledge

Commonly, one-fifth of college-aged students are diagnosed with food allergies for the first time (Lee et al., 2022). Their diagnosis in college forces the student to figure out how to live with these allergies, the changes they need to make to their diet, and how to medicate themselves if necessary (Lee et al., 2022). There is also a lack of training and preparedness from both patients as well as their caregivers on how to effectively administer EpiPens. In a study led by Shih-Wen Huang, participants response to yes or no questions gauging whether they knew the individual steps of the EpiPen administration process, as the questions progressed fewer and fewer participants responded saying they knew that step (1998). In a more recent study done in 2020, only 39 (30.2%) of the 129 college-aged participants and their families reported knowing how to administer their EAI (Hassan et al., 2020). EpiPen alternatives like the Auvi-Q report to be easier to administer than the EpiPen, but are not as popular due to their price point. What happens when these students go to college? When faced with a different environment, these students alone are in charge of managing themselves without the help of a parent or their usual health care provider (HCP). Combined with this lack of knowledge, there often comes a lack in ability to administer their EpiPens or other EAIs when needed, delaying the administration of lifesaving medication. This lack of

knowledge also translates into how college students manage their food allergies. For this study, knowledge is defined as understanding food allergies, identification of items, allergens they are sensitive to, symptoms related to food allergies, and what to do if an allergic reaction occurs. In this study, knowledge of the participant contributes to how the individual takes care of themselves. By understanding participant knowledge, it gives a better chance to understand their needs and create a plan for an intervention.

Symptom Management

For college students with allergies, there are ways to manage an individual's food allergies depending on the symptoms of their reactions and their severity. College Students can become selective on what foods to buy at the grocery store, what foods to avoid in a dining hall, and pick allergy friendly options when out to eat with friends. Students even go as far as making versions of dishes without allergens at home. The largest part of symptom management comes from identifying when you are having a reaction and deciding how you will manage it. Does that mean going to the emergency room or to a healthcare facility, or does it mean taking the appropriate antihistamine or even administering an EpiPen based on the severity of your symptoms (American College of Allergy, Asthma & Immunology, 2022). Symptom management is defined as what it takes for the college student to manage their allergies. This is further relating to behaviors and choices made by the student to prevent a reaction and avoid their allergen after diagnosed with a food allergy.

Response Time

Access and accessibility of epinephrine is vital to the management of food allergies. The combination of having the medication on hand, being able to respond quickly in the event of a reaction, and being able to administer the medication correctly can be the difference between life or death for patients. Having access to their EAI as well as correct and prompt administration of the EpiPen, Auvi-Q, or EAI alternative is also a major area in which college students lack expertise. The limited literature on how long it takes a college student to administer their medication and respond to their allergic reaction is one of the areas this study is attempting to supplement. As soon as the symptoms of anaphylaxis or a suspected reaction has been identified, the epinephrine should be given as soon as possible (Sicherer et al., 2017c; Sicherer et al. 2023a), but how long it takes for the medication to be administered is variable. Many factors play into response timing and can delay administration, such as not having a place to store or carry an EpiPen or EAI due to its size, social pressures from peers, and an inability to pay for an adequate supply of EpiPens or EAIs. In a 2020 study with 129 participants of college age, 79.9% reported not carrying their EpiPen or rarely carrying it (Hassan et al., 2020). There are also psychological stressors associated with managing food allergies and reluctance to carry and access EpiPens in students (Lee et al., 2022). Without access to their EpiPen or EAI during an allergic reaction, how are these college students expected to receive the treatment they need as soon as possible? Without access patients can die from anaphylactic reactions within minutes to thirty minutes after ingesting a food trigger they are allergic to (Estelle & Simons 2010). A study by Hansen et al. shows that

delaying treatment using epinephrine leads to serious cardiac effects, neurological effects, and anaphylaxis (Hansen et. al, 2018). Every minute of delay in administering epinephrine is related to decreased percentages of survival and unfavorable neurologic outcomes (Hansen et. al, 2018). Response time for this study is defined as access to the epinephrine auto-injectable EpiPen, time from when the allergic symptoms begin to the administration of the EpiPen, and time it takes to seek emergency care if needed.

Common-Sense Model for Self-Regulation

The Common-Sense Model (CSM) for self-regulation will help to explain the college student's ability to self-regulate food allergies or not. The Common-Sense Model (CSM) provides a framework for understanding the *processes* involved in initiating and maintaining behaviors regarding health and chronic illness (Leventhal, Philips, & Burns, 2016). The model was originally designed to describe dynamic interactions among variables that control health behaviors and provide a framework for predicting an individual's adherence to treatments and lifestyle changes in relation to managing health threats (Leventhal, Philips, & Burns, 2016). The CSM also functions to describe changes in behavior from non-adherence to adherence and from adherence to non-adherence, and the transitional process associated with those changes (Leventhal, Philips, & Burns, 2016).

Students must learn to self-regulate their food allergies by themselves once they leave for college, and the gap in current research is how they do so. When first diagnosed with these allergies during college, the student has a tough time knowing what to do and lack of understanding of the consequences that come with their food allergies. Those

consequences may be whether foods are safe or need to avoid, how to administer their EAI medication, what foods they can buy, and the risks associated with going into anaphylaxis. Recognizing and managing the consequences of their food allergies (having knowledge of food allergies) and understanding the consequences of their allergies (symptom management) are ways in which students work to self-regulate their allergies.

By using multi-level concepts, CSM focuses on the perceptual and behavioral references individuals assign to abstract concepts and interactions (Leventhal, Philips, & Burns, 2016). As individuals manage their chronic illnesses, the CSM looks at (1) patients' representations of illnesses and treatments and (2) how patients appraise somatic changes (McAndrew et al., 2008). Individuals rely on a set of 'mental tools' or prototypes to evaluate the meaning of somatic stimuli: location, duration, sensory pattern, severity, to understand chronic conditions that need frequent monitoring like food allergies (McAndrew et al., 2008). These prototypes formed by these processes affect the individual's emotional state and influence what they will do in response to those symptoms if they choose to act at all (McAndrew et al., 2008).

The process of the CSM is initiated by somatic sensations, deviations from normal function, observation, and discussion of illness with others, occasionally mass media, and other environmental cues (Leventhal, Philips, & Burns, 2016). These stimuli create prototypes (memory structures) or representations (mental models dictating behavior) of the individual's functioning self, the past experiences with illness and treatment, the representations of threats to them associated with their illness, and the treatments and action plans (Leventhal, Philips, & Burns, 2016). These prototypes and

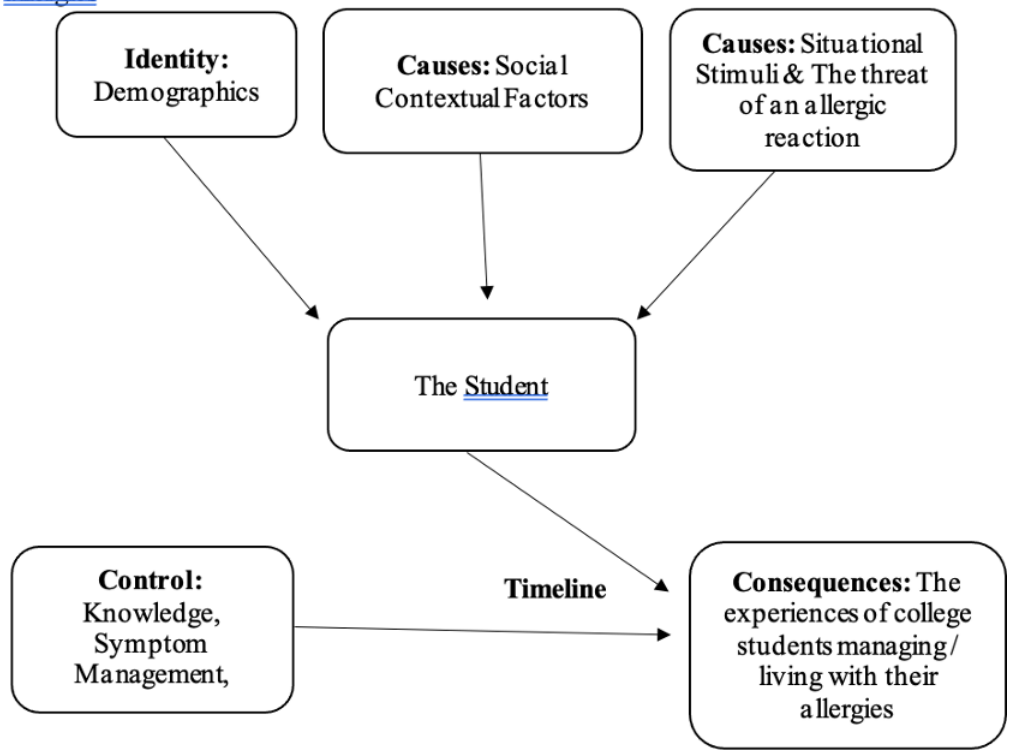
representations are formed from the individual's history of somatic, physical, and cognitive functioning which evolve episodically as the individual creates new experiences from living with their illness (Leventhal, Philips, & Burns, 2016). These prototypes and representations of allergy/health threats are divided into five areas including (1) *Identity* or a name, (2) *Timeline*, (3) *Consequences*, (4) *Causes*, and (5) *Control* (Leventhal, Philips, & Burns, 2016).

The Common-Sense Model developed by Howard Leventhal provides an explanation in the context of this study in the figure below. This figure (Figure 1) describes the path to self-regulation which is extremely applicable to the management of food allergies. Figure 1 also describes aspects of the Common-Sense Model the regulation of health threats as becoming aware of the danger, finding affective responses to it, understanding the threat, forming potential treatment plans, creating plans to address the threat, and integrating feed-back on the efficacy of those plans continuously to improve the health outcomes for the student (Leventhal, Philips, & Burns, 2016).

The college student experiences these stimuli in the context of the identity that they form once they know they have a food allergy. The student is impacted first by the social contextual factors, next by the situational stimuli and finally, by threat of an allergic reaction. Then affected by the environment that they exist which, in the context of the study, is a college campus as a college student with food allergies. These factors affect a students' circumstances and how they experience life. As an example, a student knows they have a food allergy, this student decides to go to the library and after sitting down to study, realizes that the person next to them is eating a food containing their

allergen. The student has identified their food allergy, is functioning under the social context that they are at the Kent State campus library, the situational stimuli is that their food allergen is present creating the threat of a reaction, and all of which is taking place in the college environment. This creates the consequences of the situation, which include a possible allergic reaction which is controlled by the modifiable levels of knowledge, symptom management, and response time to a reaction that the student has as they choose how to act in this scenario. All of this occurs within a timeline of events in which the college student must live with and manage their food allergies. This research study aims to measure the level of the constructs which exists because of the student managing their food allergies already.

Figure 1: Common Sense Model and Self-regulation in college students managing food allergies



CHAPTER II

LITERATURE REVIEW

Food Allergies

Food allergy is defined as an immune-mediated adverse reaction to food and its resulting IgE-mediated immediate hypersensitivity reactions (Tordesillas, 2017). When someone has a food allergy, their immune system reacts to an allergen by producing antibodies called Immunoglobulin E (IgE) (*Immunoglobulin E (IgE) Defined |AAAAI*, n.d.). The IgE antibodies then travel to cells that release chemicals histamine, tryptase, carboxypeptidase A, and proteoglycans causing an allergic reaction (Peavy & Metcalfe, 2008 & *Immunoglobulin E (IgE) Defined | AAAAI*, n.d.). Thus, sensitization to food antigens occur in the gastrointestinal tract, oral cavity, and skin, and occasionally in the respiratory tract (Sampson et. al, 2018).

Avoiding food allergens is a full-time job for an allergic person. The list of the nine major food allergens includes wheat, eggs, soy, peanuts, tree nuts, shellfish, fish, milk, and sesame (Lee et al., 2022). It is these nine allergens that make up 90% of all food related reactions in the United States (Allergy & Asthma Network, 2023). For students first diagnosed in college, learning about and managing their allergies is extremely challenging for the majority of them (Lee et al., 2022). In most cases, the only

way to prevent allergic reactions in patients is to practice strict food avoidance of the allergen that the patient is sensitive to (Centers for Disease Control and Prevention, 2022). Avoidance is often challenging to any patient with food allergies regardless of age. Maintaining an avoidance of their allergen(s) is often an issue for college students as they are more likely to participate in risk behaviors like eating unsafe foods on purpose or eating foods that indicate that they may contain allergens they react to (Lee et al., 2022). Once they move to campus, college students also face another challenge when forced to try and cope with their allergies away from their home environment and the foods they know are safe for them (Lee et al., 2022).

Food Allergies in the College Student Population

"Food allergy may affect 7 to 11 percent of college-age individuals and can involve life-threatening or fatal reactions" (Sicherer et. al, 2024). As adolescents prepare to leave home for college or become independent and take ownership of their food allergies and medical conditions, it is imperative that they have a clarity on their food allergy diagnosis, which foods they can eat, and which foods they need to avoid (Lee et al., 2024). Often these students' allergies originate in childhood, but there is a rare possibility that allergies can develop as new onset allergies in adulthood (Lee et al., 2024).

In a study of 513 college students from the United States, 57% reported having a food allergy of those students, there was a low rate of maintenance of any SIE (self-injectable epinephrine) emergency medication (Greenhawt et al., 2009). This is a dangerous trend seen across all college campuses as students are not always carrying

their EAIs or even have an EAI prescribed to carry. In the same study, it was found that students were not alerting close campus contacts, campus health services, or dining services of their food allergies (Greenhawt et al., 2009) leaving them vulnerable to having an allergic reaction and possibly having no assistance at the time. The findings of that study indicated that campus dinning services could benefit from using food items that are clearly labeled with food ingredients, modifying cooking areas to prevent cross-contamination, and providing more allergen-free foods to students (Greenhawt et al., 2009). Screening students for food allergies was also advised by the study using intake forms before students arrived on campus (Greenhawt et al., 2009).

In a study conducted by Lee et al. 2022, 26 college students were interviewed with self-reported or clinically diagnosed food allergies measuring food allergies' effect on behavior and quality of life. In the findings of the study, food allergies affected the participants' food-related behaviors which included eating, food preparation and shopping as well as aspects of their quality of life (Lee et al. 2022). There was a higher level of efficacy and self-control between the students who knew what they can and cannot eat (Lee et al. 2022). Students described preparing food for events in the case there was nothing safe for them to eat, being extra careful while eating out at restaurants, making a majority of their own food at home to avoid their food allergens as well as a common theme of students being worried and afraid while managing their allergies (Lee et al. 2022).

Knowledge

Having knowledge over their allergies effects the student's management and future experiences of their food allergies. Being able to have an understanding over the allergies can have a direct effect on how the symptoms are managed by the student not just on a college campus, but wherever they are. In a survey study done by Kethan M. Bajaj, an undergraduate at Northwestern University, it showed that food allergy education and knowledge are essential to improving allergy management on a college campus (Richard Gawel, 2023). In his findings, 36.4% of respondents would be interested in being involved with a food allergy awareness organization on campus, and 79.8% said they wished they knew more about assisting someone during an allergic reaction (Richard Gawel, 2023). He concluded that increasing the level of knowledge within college students about their food allergies could decrease the exclusion, awkwardness, and feeling of burden felt by these students when it comes to functioning on a college campus with food allergies (Richard Gawel, 2023). The study showed that 68.9% (N = 193 total college students) of all respondents reported that increased food allergy awareness training for college students would improve life for students with food allergies on campuses (Richard Gawel, 2023).

In a study by McLaughlin et. al, it was also found that there is a link between knowledge of food allergies and allergy management where knowledge significantly predicted food allergy management behaviors above food allergy severity and recent reactions (McLaughlin et al., 2021). In that study, it was also found that college students with food allergies did not show greater knowledge than control groups and suggested

that students undergo a psychoeducational intervention targeting allergy knowledge (McLaughlin et al., 2021). N = 51 students with food allergy of N = 382 total college students completed a survey study and demonstrated a mean food allergy knowledge score of .73 (SD = 0.19) (McLaughlin et al., 2021). When compared then to non-allergic students, there was no statistical significance between individuals with a food allergy (M = 0.72, SD = 0.19) and individuals without a food allergy (M = 0.65, SD = 0.17) in food allergy knowledge (McLaughlin et al., 2021). The study concluded that since knowledge level in these students is modifiable and related directly to allergy management, intervention needs to be done to directly increase the level of knowledge for college students (McLaughlin et al., 2021).

Symptom Management

The student's behaviors and choices to prevent a reaction and to avoid their allergen are what is being done by students to manage their symptoms because of having a food allergy. Actively choosing how to manage themselves is what makes up symptom management in this study. Transitioning from adolescence to young adulthood in college signifies a developmental period where the college-aged adult is now responsible for managing their food allergy instead of their adult caregivers (Dyer et al., 2018). In a recent study, it was found that students demonstrated only moderate adherence to common food allergy management recommendations (M = 3.69, SD = 0.96, range 1–5) (McLaughlin et al., 2021). Most participants reported they strongly agree or agree with the following: "I ask about ingredients in food/drinks, especially when it's unclear" (92.2%), and "I read food labels on food I am not familiar with" (90.2%) (McLaughlin et

al., 2021). Participants were least likely to agree with the following: “I inform my professors about my food allergy at the start of each semester” (19.6% agree), “I am careful about kissing/hooking up with others because of my food allergy” (41.2%), “I carry an auto-injector (e.g., EpiPen) or some other emergency medication with me when I go to parties or bars” (45.1%), and, “I inform my roommate(s)/ hallmates/residential staff about the presence of my food allergy” (47.1%) (McLaughlin et al., 2021). Given these findings, it can be said that food allergy management, i.e., symptom management, is present in college students and can be predicted to be beyond the severity of the food allergy and recent allergic reaction count in college students (McLaughlin et al., 2021).

Treatments for Allergic Reactions

Mild Symptoms & Their Treatments

Mild symptoms of food allergic reactions include hives over the neck and face, itching, nasal congestion, rashes, and watery red eyes (*Allergic reactions Information | Mount Sinai—New York*, n.d.). The common treatments for these symptoms during an allergic reaction often include taking antihistamines, nasal sprays, decongestants, and asthma medications (*Allergies: Symptoms, Reaction, Treatment & Management*, n.d.).

Severe Symptoms & Their Treatments

Severe symptoms of a food allergy reaction called anaphylaxis include, consist of trouble breathing or wheezing, feeling that the throat is closing or the lips and tongue are swelling, flushing of the skin, itching of palms and soles of feet, feeling faint, nausea, fast pulse, low blood pressure, loss of consciousness (*Food Allergies*, 2019). The common treatment for these types of reactions includes the use of epinephrine, a call to 911, and a

trip to the emergency department (*Food Allergies*, 2019). If a patient is undergoing anaphylaxis or anaphylactic shock the treatment includes epinephrine or adrenaline, oxygen, intravenous antihistamines or cortisone, and beta-agonists to relieve breathing symptoms (*Anaphylaxis-Anaphylaxis—Diagnosis & treatment*, n.d.).

Epinephrine.

Usually released when you are stressed, epinephrine is a hormone that triggers the fight or flight response (*What is epinephrine?* 2022). Affecting both alpha and beta-adrenergic receptors, the mechanism of action on alpha-1 receptors is to increase smooth muscle contraction, increased pupillary dilator contraction, and increase contraction on the intestinal sphincter muscle (Dalal R. & Grujic D., 2022). Beta-1 receptors respond to epinephrine by increasing the heart rate, myocardial contractility, and the release of renin (Dalal R. & Grujic D., 2022). In terms of treating anaphylaxis epinephrine is used to relax the muscles in the airway (*Epinephrine (adrenaline): What it is, function, deficiency & side effects*, 2022). Epinephrine reduces and reverses the swelling, difficulty breathing, dropping blood pressure, hives, other symptoms of allergic reactions, and prevents the release of histamine causing the reaction (*What is epinephrine*, 2022). Once administered via injection, epinephrine works in as little as 5-10 minutes, and starts to wear off in 20-30 minutes with the side effects wearing off within 30 minutes to hours (*What is epinephrine?*, 2022). It is common to need a second dose of epinephrine during an allergic reaction as the medication may start to wear off before the reaction is over (*What is epinephrine?*, 2022). The common side effects of epinephrine include tremors, tachycardia, palpations, hypertension, headache, anxiety,

depression, diaphoresis, apprehension, nausea, vomiting, and weakness (Dalal R. & Grujic D., 2022).

The EpiPen.

The name brand EpiPen® made by Pfizer, is a disposable and pre-filled automatic injection device that functions to relax the muscles in the airway and combat the rapid decrease in blood pressure during an allergic reaction in a user-friendly way (*How EpiPen® Works | Epipen.Ca*, n.d.). Made in two different doses based on weight, one with 0.3 mg of epinephrine for older children and adults, as well as the EpiPen Jr which contains 0.15 mg of epinephrine intended for young children 15 kg – 30 kg (Sicherer S. H., 2022 & *How EpiPen® Works | Epipen.Ca*, n.d.). In order to use the device according to the manufacturer, the user will remove the EpiPen® Auto-Injector from the carrier tube, grasp the device with the orange tip facing down, remove the blue safety cap by pulling straight up from the device, place the orange tip against the middle of the outer thigh, swing and push the auto-injector firmly into the thigh until it "clicks", hold firmly in place for three seconds, and call 911 or go to the emergency room (*How to Use EpiPen® | Epipen.Ca*, n.d.) To prevent overdose, the user must not inject more than two injections right after each other (*How to Use EpiPen® | Epipen.Ca*, n.d.)

In the study completed by Kessler et. al, in a study comparing the usability and preference of EpiPen and Auvi-Q EAIs by utilizing simulated injections participants preferred the Auvi-Q at 91.7% vs the EpiPen Jr at 6.3% (2019). The same study only 19.8% of 85 participants (age 18-65) were able to complete all injection tasks related to the EpiPen Jr per the instructions on the device while the Auvi-Q had 85.4% completion

(Kessler et. al, 2019). These tasks included “a) Remove the auto-injector from the carrier tube, b) Remove blue safety release by pulling straight up without bending or twisting it, c) Swing and push firmly the orange tip against outer thigh so the auto-injector “clicks,” and d) Hold firmly in place for 3 seconds” (Kessler et. al, 2019). The most common errors involving the EpiPen Jr included “did not hold firmly in place for 3 seconds” (36.5%) and “did not swing and push the orange tip firmly against outer thigh until the auto-injector clicks” (70.8%) (Kessler et. al, 2019). When measuring key injection tasks, the EpiPen improved its completion rate, Auvi-Q (94.8%) vs EpiPen Jr (72.9%) (Kessler et. al, 2019).

AUVI-Q.

As a popular alternative to the EpiPen, the Auvi-Q is another disposable and prefilled epinephrine auto-injector device designed for allergic and anaphylactic reactions. Manufactured for infants/toddlers and children/teens/adults, the Auvi-Q comes in 0.1 mg, 0.15 mg, and 0.3 mg doses of epinephrine (*How to Use AUVI-Q® (Epinephrine Injection, USP)*, n.d.). The device itself is small, rectangular, and about the size of a cellphone (Sicherer S. H., 2022). What is unique to the Auvi-Q is that once activated after the outer covering of the device is pulled, the device begins giving the user audio instructions on how to safely use the device in easy-to-understand steps which are as follows: Step 1- pull the red safety guard down and off Auvi-Q, Step 2- place black end against outer thigh then press firmly until you hear a click and hiss sound and hold in place for two seconds, and Step 3- the device will announce when the injection is complete and instructs the user to seek emergency medical attention while describing the

proper way to dispose of the device (*How to Use AUVI-Q® (Epinephrine Injection, USP)*, n.d.). When comparing the Auvi-Q and the more established EpiPen, general opinion is that the Auvi-Q is the preferred EAI device amongst patients of all ages.

In Kessler et al. (2019) study, it was found that overall participants took less than one minute to complete the simulated injection with the Auvi-Q or EpiPen device, though average completion time was faster with Auvi-Q (2019). During this study, the Auvi-Q had an 85.4% completion rate of the following tasks "a) Pull device up from outer case, b) Pull red safety guard down and off, c) Place black end against outer thigh, and d) Push firmly and hold for 2 seconds" (Kessler et. al, 2019). At the end of the study by Kessler et al., Auvi-Qs were preferred at a higher rate to EpiPens 91.7% to 6.3% and 2.1% of participants reported no preference (2019).

In the RACE Survey which included 2,000 participants [children, n = 597; adults, n = 403], it was found that Auvi-Q respondents were more likely to always carry their device in the last 7 days versus EpiPen respondents (Portnoy et. al, 2019). In the same survey study, adults in the Auvi-Q group were more likely to feel "very confident" about correctly using their EAI as well as someone else correctly using their device versus the EpiPen group (Portnoy et. al, 2019).

In a similar 2013 study including college students, adults, caregivers, and children which compared the Auvi-Q and the EpiPen, it was found that the Auvi-Q was preferred by all 693 participants on all end points used in the study (Camargo et. al). These end points included categories such as method of instruction, device most prefer to carry,

device size, device shape, easier to use, easier to carry, easier to follow instructions, and device preferred to use overall (Camargo et. al).

Burden of Treatment

Burden of Treatment (BoT) is especially high in adolescents, of whom reported not always carrying their EpiPen or EAI with them, leaving them vulnerable to a reaction (Saleh-Langenberg et al., 2016). This BoT is an unwillingness to participate in treatment or have emergency medication present at the time of a reaction. There are other factors that play into BoT such as having no place to store or carry an EpiPen or EAI due to its size, social pressures from peers, and an inability to pay for an adequate supply of EpiPens or EAIs. In one study with 93 participants, the overall response to EAIs was extremely positive, it is despite this positive attitude towards the EAI that there is a lack of compliance with carrying the device resulting in 11 of the 31 participants who had reactions during the study to be without their medication (Kenma et al., 2011).

Costs

The price of the EpiPen and other EAIs of that nature has been steadily increasing since 2003 when they became more widely available (Simmons, 2009). In the past, the cost of these Epi Pens ranged from $30-$100 dollars, with the mean price of an unsubsidized pen costing $97.87 (Simmons, 2009). According to the University of Michigan, the peak of EpiPen costs was in 2016 when prices for the pens reached $116 then dropped in 2019 to $76 (*Costs for emergency allergy injectors still high for some*, n.d.). Despite this price drop, 1 in 13 people still paid $200 for EpiPens in 2019 (*Costs for emergency allergy injectors are still high for some,* n.d.). If a patient is to follow the

recommendation of having two pens at a time the intermediate cost would come out to be $750 per person (Murata & Yamamoto, 2021). In comparison to the EpiPen, the Auvi-Q manufacturer reports that consumers can pay as little as $35 for a copay or the balance due after meeting your deductible on a high deductible plan (*FAQs | AUVI-Q® (Epinephrine Injection, USP*, n.d.). The manufacturer also states that if insurance does not cover the cost or if you have not met your annual deductible on a high-deductible plan, you'll pay no more than $150 (*FAQs | AUVI-Q® (Epinephrine Injection, USP*, n.d.). Since its launch in 2013, the Auvi-Q's price has mirrored the EpiPen between 2013 and 2015 (Herper, 2016). Other sources report that the cost for Auvi-Q injectable kit is around $664 for two kits depending on the pharmacy you visit. (*Auvi-Q Prices, Coupons, Copay & Patient Assistance*, n.d.). These high prices are a contributing factor to how college students manage their food allergies as students not only have to find a way to meet their needs and self-manage their allergies, but also fund a necessary supply of EAI.

Training

Whether or not a patient is trained in the administration of their EpiPen has a major factor in the outcome of their allergic reactions if they were to have one. In a 2019 study, led by Portnoy, Wade, & Kessler, it was found in their data that participants felt that they were not confident in their own or another person's ability to administer an EpiPen correctly (Portnoy et al., 2019). In the same study, researchers found that lack of training and knowledge of administration for EAIs was a reason patients do not use their EAI even when it is available to them during an allergic reaction (Portnoy et al., 2019). In a 2020 study focusing on the caregivers of pediatric patients, it was found that training

adrenaline auto-injector (AAI) users every six months results in the proper application of their AAI and proper usage of the device with 96% reliability (Sirin Kose et al., 2019). This trend of inadequate training and administration skills is a major issue as these patients and college students are unable to properly respond to an allergic reaction and administer their medication if they are not properly trained or trained within an acceptable period of time.

Response Times

The greatest lack of information in terms of college students with food allergies comes in the form of access to epinephrine. Not only are college students not carrying their lifesaving medication with them, but their decreased understanding of how to administer their epinephrine leads to decreased response times. Despite EpiPens and other EAIs being the most common form of treatment for anaphylactic and hypersensitivity reaction to food allergens, there is an identifiable gap in the delayed usage of these treatments and inadequate training (Waserman et. al, 2017). Epinephrine works best when administered in the first few minutes of a severe allergic reaction and should be administered as soon as possible when having a reaction (Sicherer et al., 2023b). While there is a lack of literature focusing on how long it takes someone to react to an allergic reaction, it takes on average 8–10 milliseconds for auditory stimuli and 20 – 40 milliseconds for visual stimuli to reach the brain (Jain et. al, 2015). While the time that allergic reactions take to occur vary from patient to patient, most severe allergic reactions begin in seconds or minutes after the exposure to the allergen (*Allergic Reactions Information | Mount Sinai - New York*, n.d.)**.** In one 2018 study, it was shown

that delaying treatment using epinephrine leads to serious cardiac effects, neurological effects, and oftentimes, leads to anaphylaxis (Hansen et al.). Every minute of delay in administering is related to decreased percentages of survival and unfavorable neurologic outcomes (Hansen et. al, 2018). Even for well-trained individuals, there is a hesitation to properly act and respond to the allergic reaction when one occurs (Chooniedass et al., 2018). In a study focusing on children with food allergies, this hesitation is prevalent in the form of self-doubt for the parents, thoughts about how well trained they are, assessing how severe the reaction really is, and determining the cause of the reaction often affect response time for the administration of epinephrine (Chooniedass et al., 2018). If there is such a strong urge to wait and delay treatment for well-trained adults, what must it be like for college students who are administering this medication on their own?

With continuously increasing prices, an already limited budget, and a lack of insurance, a substantial portion of college students will not be able to afford epinephrine auto injectable medication for any allergic reactions. This will hinder the student's ability to respond in a timely manner to their allergic reaction and leads to an emergency.

Burden is also a factor when it comes to response times in this population. As reported by Sicherer et al., 39% of their sample population ages 15-21 do not carry their EpiPens (2023a). College students do not carry their EpiPens with them due to their feeling it is a burden for them. This further leads to more negative allergic reaction outcomes due to not having the proper medication needed for this life-threatening emergency.

From lack of proper training in students for food allergy issues, college students are rendered helpless in the event of an allergic reaction. Trained students were asked to demonstrate their understanding of the administration process and results showed they had a decreased level of success for each step of the process indicating a greater need for increased training efforts for these administration devices (Shih-Wen Huang, 1998). In a 2021 study surveying 697 participants, including physicians, dentists, pharmacists, and school staff, it was found that many of the participant's EpiPen prescribers did not demonstrate how to use the device (Arga et al.). In that study, only 31.1% of the participants demonstrated the correct EAI usage while other participants commonly missed steps such as `Place the appropriate injection tip into outer thigh/Press the trigger so it `clicks`` and `Turn the trigger to arrow direction` at 60.3% and 34.9%, respectively (Arga et al., 2021).

Researchers have shown that there is limited data on how quickly it takes an individual to respond to an allergic reaction for themselves or others. EpiPen administration research is limited in reaction even though the time for administration of the medication needs to be as short as possible to create the best possible outcome for the patient. Despite this limitation there are other factors involved such as how long it takes to recognize the reaction, the availability of medication, and the ability of the individual to administer their medication. The time it takes to not only determine that the patient needs to go to the hospital for their reaction but to travel to the hospital and receive treatment, that also plays a role in how long it takes a patient to respond are factors as well.

CHAPTER III

METHODS

The study is a cross-sectional design using a survey to examine the knowledge, symptom management, and emergency response times using a prescribed EpiPen of college students with food allergies. Kent State Institutional Review Board (IRB) approval was achieved before beginning data collection.

Geographical Area & Setting

The target population for the study was sourced from the Northeast Ohio region, a suburban community. Kent State being the prominent public university for the region, hosting up to 33,680 undergraduate and 5,451 graduate students in the 2022-2023 academic year (Kent State University, 2023).

Recruitment of Participants

Recruitment included a convenience sample from Kent State University. Kent State University has over six regional satellite locations. The recruitment goal for the study was 50 college students. Multiple recruitment strategies were utilized to reach the number of participants needed for the survey. Primary methods for recruitment included email, flyers detailing the study within the university community, and Kent, Ohio, and plus word of mouth from other students. The participants received a $15 gift card incentive upon completion of the study.

Sample

Participants satisfied specific inclusion criteria to be eligible for participation in the study. A sample number of fifty college students ages 18-22 for this study was recruited from Kent State University. With the current literature on food allergies and effect size, the sample needed for the study was determined (McLaughlin et al., 2021). Using G*Power software with an effect size of 0.45, a 0.05, and power (1-b err prob), the sample size needed for this study N=55. For ease of convenience sampling and funding, the target recruitment number was 50 participants for this study. Inclusion criteria to be eligible for participation in the study included students being between the ages 18-22 years old, enrolled as student at Kent State University, and having food allergies diagnosed by a healthcare provider or not.

Measures

College Student Demographics for Food Allergies Questionnaire

Demographics Sheet for Food Allergies in College Students Questionnaire is a 23-item instrument of my own design. The questionnaire focused on measuring the demographics of the participants as they relate to their food allergies. The measure was developed from multiple choice, short answer, and yes or no questions. The participants were asked to describe their knowledge about allergies, how the student manage the symptoms, and reaction it takes to access emergency services or access to an EpiPen. The demographic questionnaire designed for this study was used to assess age, gender, types of food allergy, and what year in college as well as the symptoms of their allergic

reactions. Means and standard deviations were completed using Qualtrics electronic software.

The depth of the participants' knowledge of food allergies was assessed as it relates to themselves. Techniques for symptom management and management of the participants' allergies was assessed for, as well as how each participant responds to the event of an allergic reaction and how quickly they do so.

An understanding of the participant's response timing was assessed as it relates to their experiences having allergic reactions. Participants were asked to assess how comfortable they are administering their EAI, describe the instruction and training they received, the time it takes for them to notice their symptoms during a reaction, and the length of time it takes the participant to administer their EAI.

Food Allergy Quality of Life Questionnaire (FAQLQ-AF)

The Food Allergy Quality of Life Questionnaire (FAQLQ-AF) is a 29-item with a 6-point Likert-like scale. The measure was developed from interviews with twenty-two individuals and the use of the Food Allergy Independent Measure (FAIM) and a generic HRQL questionnaire (RAND-36) (Flokstra-de Blok et al., 2009). The validity was further established using cross-sectional validity as well as convergent and discriminant validity (Flokstra-de Blok et al., 2009). The FAQLQ-AF test-retest reliability during the development reveal Cronbach's alpha 0.96. The measures have been translated and back translated in multiple languages. The FAQLQ-AF is an adult version meant for participants over 18 years of age. Knowledge, symptom management, and response timing in the participants was be assessed.

Epinephrine Auto-Injector (EAI) Response Time Use Questionnaire

The *Epinephrine Auto-Injector (EAI) Response Time Use Questionnaire* is a 16-item questionnaire created for the purpose of this study and has not been assessed for reliability. Developed based on the *Real-World Assessment of Patient's Carrying Time and Confidence with Epinephrine Auto-Injector Devices (RACE)*, this questionnaire will collect valuable information about the participant's response timing to allergic reactions they have experienced in the past. This instrument was designed to measure the participant's confidence administering their EAI, the quality of instructions and/or training they received for treating reactions with the EAI, and the time it takes to notice and recognize the symptoms of an allergic reaction and respond to it by administering the EAI.

Procedure

Participants were informed that their participation was completely volunteer based, and no part of the study affected their college grades and/or work-related position. They had the ability to withdraw at any time during the research study. The procedure for the study will occur in steps as followed:

Step 1. Recruit the participants from Kent State University (KSU) using fliers distributed all over campus, fliers distributed by email, and word of mouth.

Step 2. Upload instructions, study consent, demographic questionnaire, FAQLQ-AF questionnaire, and the response time questionnaire into the KSU Qualtrics system for the purpose accessibility through iPhone, iPad, Android phones, laptop computers or any other electronic device for the student to complete the study.

Step 3. Upon gathering consent from the individual participant, the participants will complete the survey.

Step 4. Data cleaning was completed by the honor student under the direction of Dr. Dowell to prepare data for analysis. If a participant left more than 32% of items unanswered, their survey response was not analyzed as part of the results of this study to preserve overall data analysis.

Step 5. Data analysis was completed using Statistical Package for the Social Sciences (SPSS). Data analysis included descriptive analysis, means and standard deviations as well as analysis of variance with regression models.

Data Analysis

Analysis assessed trends related to the constructs such as knowledge, symptom management, and response time in the chosen population. Demographic data will also be considered such as age and year in college, and food allergens. All personal information will be de-identified to protect the participants protective health information (PHI) and consent for participation will be obtained. The findings will further provide information about the challenges related to knowledge, food allergies symptom management, and response time that leads to high mortality for these populations. This pilot study will guide the next steps in planning an intervention study tailored for this population.

Human Subjects

Voluntary

Taking part in this research study was entirely voluntary. Each participant had the ability to choose not to participate or could discontinue participation at any time without penalty. This study had no effect on your university benefits or grades.

Privacy and Confidentiality

No identifying information was collected in the survey. The signed consent was kept separate from study data, and responses were not linked to the participants. By participating in the study, human subjects completed a Qualtrics survey asking them to share their experiences with food allergies with their consent and the ability to be contacted in the future. Identifying information will not be made available in publications and/or presentations of the research data. All personal information was de-identified to protect the participants' protective health information (PHI).

The research team will keep the information confidential within the limits of the law, but due to the nature of the internet, there is a chance that someone could access information that may be identified without permission. The research information may, in certain circumstances, be disclosed to Kent State University Institutional Review Board (IRB), which oversees research at Kent State University, or to certain federal agencies. Confidentiality may not be maintained if there is an indication that the participant may be in danger, such as experiencing any type of abuse or expressing thoughts of harming self or others. All private health information (PHI) associated with this study as previously mentioned was de-identified and protected in a secure location within an encrypted

computer system within Dr. Dowell, PhD, PI office with password protected access only to Dr. Dowell and Mary Grace Vavruska, BSN undergraduate honor student.

Benefits

This research will not have benefits directly. However, the student's participation in this study will help to better understand food allergies, symptoms of food allergy, time to apply an EAI and if they have access to one. Participation in this study will assist in the development of a specific intervention that could prepare other students in managing food allergy symptoms.

Risks and Discomforts

There is minimal risk to participants in this study. College students could withdraw at any time or refuse to answer any questions during the study when completing the questionnaires. The participant may experience emotional distress because of disclosure of experiences that are personally challenging. However, the risk is not greater than those encountered during daily life, physical or psychological tests or procedures.

CHAPTER IV

RESULTS

N = 58 participant pool after data cleaning. Due to the phrasing of the items in the questionnaires, not all participants answered every item causing a fluctuation in sample size.

Limitations to the Study

The *Epinephrine Auto-Injector (EAI) Response Time Use Questionnaire* was created for the purpose of this study and has not yet been assessed for reliability.

The sample collected for this study was specific to college students in Northeast Ohio. The data and results of this study may not be applicable to students outside of this region.

We discovered upon data cleaning that the participants were not asked definitively whether they had an EAI or not. This led participants to not answer items in the survey pertaining to EpiPens To avoid the increased number of blank items in the data of a future survey, the participants should be asked whether they have an EAl or not, and then should sort the patients into one of two versions of the survey, one for those with an EAI and one for those without.

There were multiple items within the questionnaires that participants consistently left blank within the survey due to a presumed lack of understanding of the question. In the future these items should be examined, and the language clarified for easier understanding.

In both items "*After the beginning of a reaction, how long does it take you to notice the symptoms and recognize that you are having an allergic reaction?*" and "*If you think you're having a reaction, how long does it take you to get injector and administer?*" measuring response time the lowest timed answer option is fifteen minutes. It is possible that the participants who selected this option were able to respond under fifteen minutes and quicker. In future research, participants should have more options for shorter time categories.

Demographic Data

Demographic data for the study consisted of participants' age and class rank.

Table 1. Age of Participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**18**	9	15.5	15.5	15.5
	19	14	24.1	24.1	39.7
	20	15	25.9	25.9	65.5
	21	13	22.4	22.4	87.9
	22	7	12.1	12.1	100.0
	Total	58	100.0	100.0	

N	**Valid**	58
	Missing	0
Mean		19.91
Std. Deviation		1.261
Minimum		18
Maximum		22

After analysis of the item "What is your current age?", The largest percentage of participants reported being twenty years old (15%) with a standard deviation of 1.261. The next largest category of participants reported being by the nineteen years old (14%) and then twenty-one years old (13%) as the next largest categories.

Table 2. Class rank of Participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Freshman**	9	15.5	15.5	15.5
	Sophomore	18	31.0	31.0	46.6
	Junior	11	19.0	19.0	65.5
	Senior	20	34.5	34.5	100.0
	Total	58	100.0	100.0	

N	**Valid**	58
	Missing	0
Mean		2.72
Std. Deviation		1.105
Minimum		1
Maximum		4

After analysis of the item “What year in college are you?”, The largest percentage of participants were the Senior class (34.5%) with a standard deviation of 1.105. The next largest categories were the Sophomore class (31.0%) followed by the Junior class (19.0%) and finally, the Freshman class (15.5%).

Allergen Data

Participants were instructed to report the allergens to which they were sensitive. Participants had the option to pick from a list of allergens as applied to them as well as write in any allergens not listed.

Table 3. Allergy Frequencies

Allergy Frequencies				
		Responses		
		N	**Percent**	**Percent of Cases**
Allergies	**Tree nuts**	22	21.0%	39.3%
	Peanuts	21	20.0%	37.5%
	Milk	12	11.4%	21.4%
	Shellfish	8	7.6%	14.3%
	Wheat	8	7.6%	14.3%
	Fish	5	4.8%	8.9%
	Eggs	4	3.8%	7.1%
	Soy	4	3.8%	7.1%
	Sesame	3	2.9%	5.4%
	Other	18	17.1%	32.1%
Total		105	100.0%	187.5%

Knowledge Findings

On the scale 0 = Not, 1 = Barely, 2 = Slightly, 3 = Moderately, 4 = Quite, 5 = Very, 6 = Extremely the participants answered a Likert-like question which measured their level of knowledge about their food allergies. Participants were asked to rate themselves based on their knowledge of completing the listed activities and how troublesome they find doing them. These included knowledge related markers such as, being alert to what they are eating (4.67 ± 1.864), being able to eat fewer products (4.37 ± 1.789), reading food labels (4.75 ± 2.011), knowing what items to refuse during social activities (3.79 ± 2.177), checking the ingredients of a dish while eating out (4.22 ± 2.217), and others. See Appendix A for individual item level analysis.

Table 4. Knowledge

Q27 Sums		
N	**Valid**	57
	Missing	1
Mean		4.0095
Median		3.7500
Std. Deviation		1.66024
Range		6.00
Minimum		1.00
Maximum		7.00

After completing the item participants showed a higher level of knowledge as the mean response to the item was 4.0095 with a standard deviation of 1.66024. This score indicates a higher level of knowledge about food allergies.

Symptom Management Findings

On the scale 0 = Not, 1 = Barely, 2 = Slightly, 3 = Moderately, 4 = Quite, 5 = Very, 6 = Extremely the participants answered a Likert-like question which measured their ability to manage the symptoms of their food allergies. Participants were asked to rate themselves based on behaviors which occur when someone is managing the symptoms of their allergies and how troublesome they find doing them. These behaviors include checking the ingredients of food items for changes (3.56 ± 1.845), assessing for incomplete food labels (3.91 ± 1.967), assessing the risk of food items whose labels say “may contain (traces of) …” (4.05 ± 2.098), explaining to those around them they have a food allergy etc. (4.40 ± 2.118) and others. See Appendix B for individual item level analysis.

Table 5. Symptom Management

Q28 Sums		
N	**Valid**	57
	Missing	1
Mean		3.6374
Median		3.6667
Std. Deviation		1.39499
Range		5.67
Minimum		1.00
Maximum		6.67

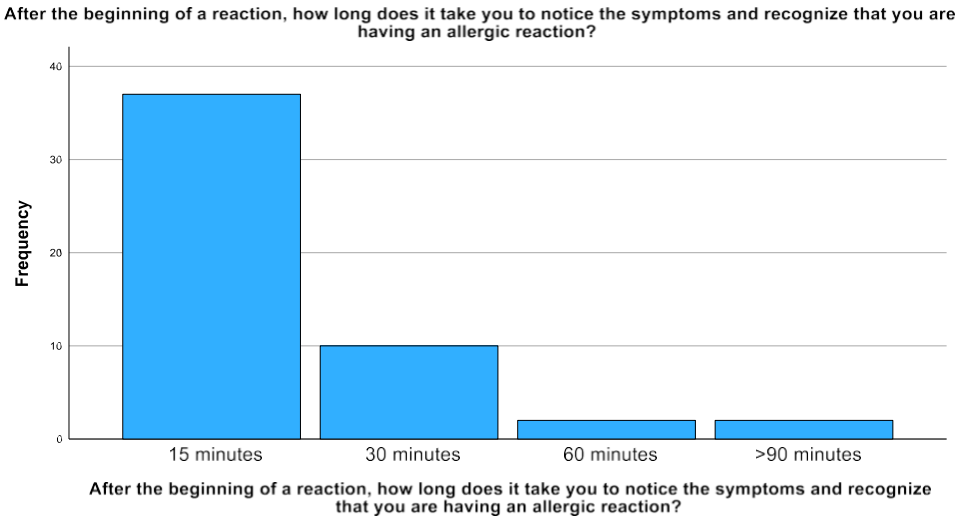
After completing the item, participants showed a moderate level of symptom management as the mean response to the item was 3.6374 with a standard deviation of 1.39499. This score indicates a moderate to quite high level of symptom management after scoring in the middle of the scale for the item.

Response Time Findings

Table 6. Response Time

After the beginning of a reaction, how long does it take you to notice the symptoms and recognize that you are having an allergic reaction?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**15 minutes**	37	63.8	72.5	72.5
	30 minutes	10	17.2	19.6	92.2
	60 minutes	2	3.4	3.9	96.1
	>90 minutes	2	3.4	3.9	100.0
	Total	51	87.9	100.0	
Missing	**System**	7	12.1		
Total		58	100.0		

Figure 2. Identifying Symptoms for allergic reactions

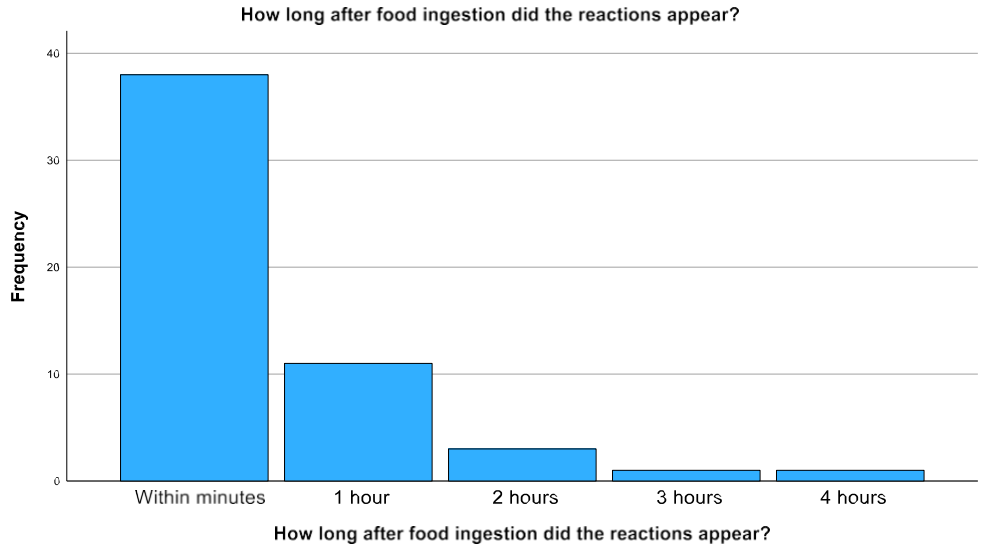


With the limited time options available to the participants, the majority reported that they can recognize the symptoms of an allergic reaction in under 15 minutes. This finding classes 72.5% of participants into the quickest time category available to them, followed by 19.6% in the second quickest category of 30, and 3.9% in the 60 minutes and >90-minutes categories, respectively as described in Table 6 and Figure 2.

Table 6.1

How long after food ingestion did the reactions appear?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Within minutes**	38	65.5	70.4	70.4
	1 hour	11	19.0	20.4	90.7
	2 hours	3	5.2	5.6	96.3
	3 hours	1	1.7	1.9	98.1
	4 hours	1	1.7	1.9	100.0
	Total	54	93.1	100.0	
Missing	**System**	4	6.9		
Total		58	100.0		

Figure 3. Appearance of a Reaction

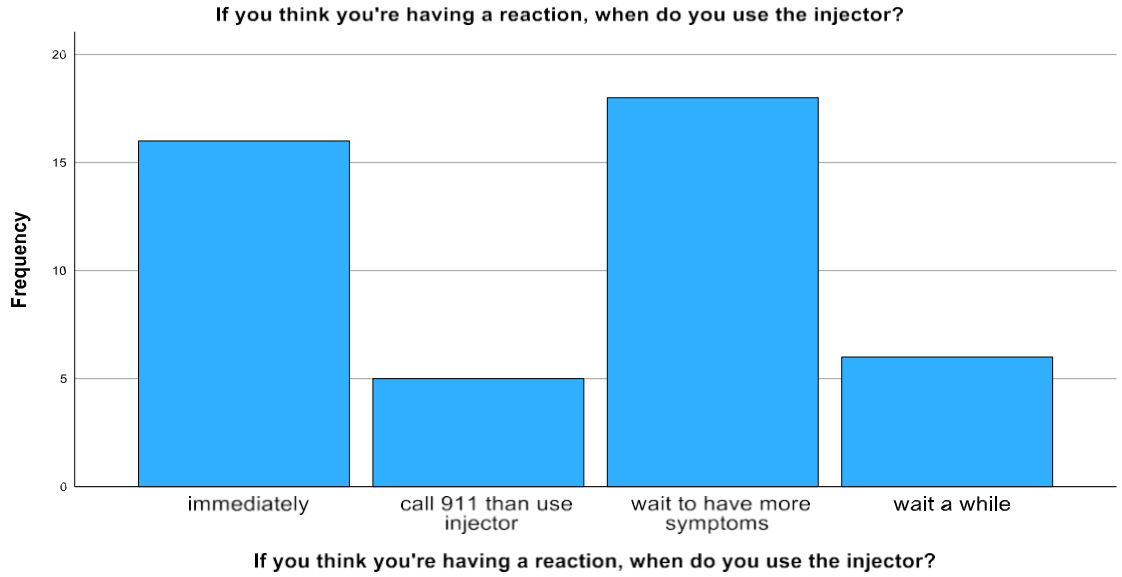


Data showed 70.4% of participants selected that they experience their allergic reactions within minutes of ingesting the allergen followed by 20.5% reporting reactions in one hour, 5.6% in two hours, 1.9% in three and four hours, respectively as described in Table 6.1 and Figure 3.

Table 6.2.

If you think you are having a reaction, when do you use the injector?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**immediately**	16	27.6	35.6	35.6
	call 911 than use injector	5	8.6	11.1	46.7
	wait to have more symptoms	18	31.0	40.0	86.7
	wait a while	6	10.3	13.3	100.0
	Total	45	77.6	100.0	
Missing	**System**	13	22.4		
Total		58	100.0		

Figure 4. When Participants use their Injector

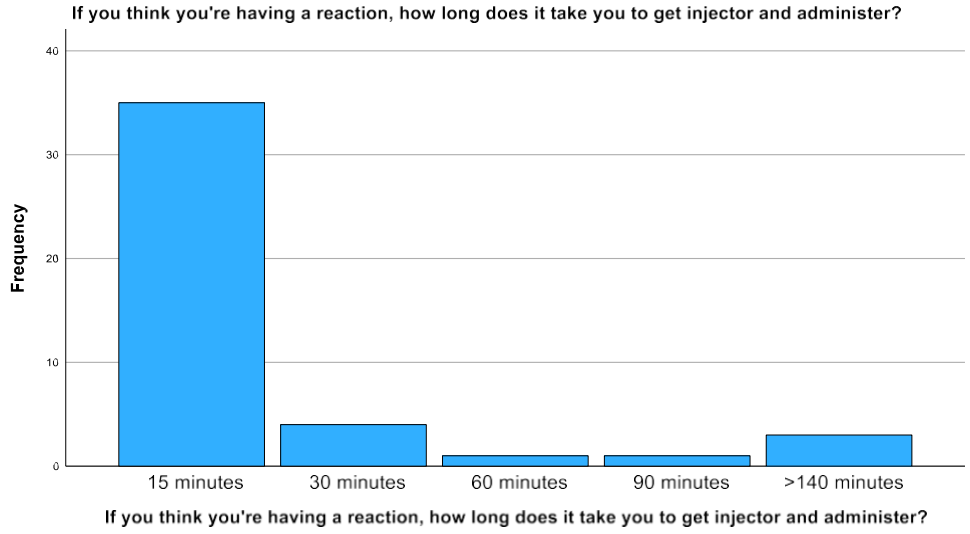


Measuring the response time of participants based on when they would use their injector, 35.6% said immediately, 11.1% said after calling emergency services, 40% said after waiting to have more symptoms, and 13.3% said they would wait a while as described in Table 6.2 and Figure 4.

Table 6.3.

If you think you are having a reaction, how long does it take you to get injector and administer?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**15 minutes**	35	60.3	79.5	79.5
	30 minutes	4	6.9	9.1	88.6
	60 minutes	1	1.7	2.3	90.9
	90 minutes	1	1.7	2.3	93.2
	>140 minutes	3	5.2	6.8	100.0
	Total	44	75.9	100.0	
Missing	**System**	14	24.1		
Total		58	100.0		

Figure 5. Response Time During a Reaction



With the limitation of the time options available to the participants, the majority reported that they can access their injector and administer in 15 minutes. This classes 79.5% of participants into the quickest response time available to them followed by 9.1% in the second quickest category of 30 minutes, 2.3% in 60 minutes and 90 minutes categories respectively, and 6.8% in the >140 minutes category as described in Table 6.3 and Figure 5.

Regression Models

For the study, descriptive data such as age and class rank included in the regression analysis to measure if increasing age and class rank influenced both knowledge and symptom management. Response time not included in the regression model since the main goal is to assess response time on its own as a construct.

Knowledge & Age

Table 7. Knowledge & Age *Model Summary*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.052[a]	.003	-.015	1.67300

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	**Regression**	.416	1	.416	.149	.701[b]
	Residual	153.942	55	2.799		
	Total	154.358	56			

Coefficients

		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
1	**(Constant)**	2.652	3.528		.752	.455

There was no statistical significance between age and knowledge. However, the trend in the data showed that with an increase in age comes an increase in the level of knowledge.

Knowledge & Class Rank

For the purposes of analysis, the data from the Freshman demographic was used as the constant in the regression model. For each of the higher class ranks they were compared to this constant. This included the Sophomore, Junior, and Senior class standings with their accompanying data.

Table 7.1. Knowledge & Class Rank *Model Summary*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.212[a]	.045	-.009	1.66795

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	**Regression**	6.908	3	2.303	.828	.485[b]
	Residual	147.449	53	2.782		
	Total	154.358	56			

Coefficients

		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
1	**(Constant)**	3.870	.556		6.961	<.001
	Q7=Sophomore	.470	.681	.133	.690	.493
	Q7=Junior	-.499	.750	-.120	-.666	.508
	Q7=Senior	.261	.675	.075	.387	.700

There was no statistical significance between class rank and knowledge found. The data shows an overall trend of increasing levels of knowledge as class rank increases in comparison to the first-year Freshman class students who are the constant. However, the Junior class is an exception to this trend as they show a lower level of knowledge.

Symptom Management & Age

Table 8. Symptom Management & Age *Model Summary*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.014[a]	.000	-.018	1.40748

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	**Regression**	.021	1	.021	.011	.918[b]
	Residual	108.955	55	1.981		
	Total	108.976	56			

Coefficients

		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
1	**(Constant)**	3.330	2.968		1.122	.267
		.015	.149	.014	.104	.918

There was no statistical significance between age and symptom management found. However, the trend in the data showed that with an increase in age, there is an increase in the level of symptom management.

Symptom Management & Class Rank

For the purposes of analysis, the data from the first-year Freshman class demographic was used as the constant in the regression model.

Table 8.1. *Symptom Management & Class Rank Case Processing Summary*

Cases					
Included		**Excluded**		**Total**	
N	**Percent**	**N**	**Percent**	**N**	**Percent**
57	98.3%	1	1.7%	58	100.0%

Report

	Mean	N	Std. Deviation	Median	Minimum	Maximum
Freshman	3.6914	9	1.88298	4.0000	1.00	6.22
Sophomore	3.9691	18	1.64619	3.7778	1.00	6.67
Junior	3.1111	11	.70097	3.0000	2.00	4.00
Senior	3.6023	19	1.16788	3.6667	1.22	6.00
Total	3.6374	57	1.39499	3.6667	1.00	6.67

ANOVA Table

		Sum of Squares	df	Mean Square
	Between Groups (Combined)	5.077	3	1.692
	Within Groups	103.899	53	1.960
	Total	108.976	56	

ANOVA Table

		F	Sig.
	Between Groups (Combined)	.863	.466
	Within Groups		
	Total		

Measures of Association

Eta	Eta Squared
.216	.047

There was no statistical significance between class rank and symptom management found. The data shows that as class rank increases, the levels of symptom management increases with it except for the Junior class again. Once more, the Junior class shows a lower level of symptom management than every other grade level.

Chapter V

DISCUSSION

Literature suggested that there is a relation between knowledge and symptom management. The relationship is limited to the association between knowledge, symptom management, and response time. Response time relates to the student's ability to gather their EAI when the allergic symptoms begin, to administer the EAI, and to seek emergency care if needed. For this pilot study, the honor student researcher focused on the response time of college students' ability to obtain the EAI as well as their level of knowledge and symptom management.

The descriptive statistics revealed that there is a level of knowledge and symptom management using means and standard deviation. The response time was established through percentage and frequency.

For knowledge, the participants showed a knowledge level higher than the median. Participants' sum score of knowledge was recorded at 4.0095 with a standard deviation of 1.66024 to a 0-6 scale. This was consistent across participants as age and class rank increase except for the Junior class which had the lowest level of knowledge when compared to the other divisions of undergraduates. While the results from the regression analysis using the demographic data were not statistically significant, they

showed that there are increasing levels of knowledge with increased age and class rank excluding the Junior class.

In terms of symptom management, the results of the participants showed a level of symptom management higher than the median, but lower than what was recorded for their knowledge of food allergies. Participants' sum score of symptom management was recorded at 3.6374 with a standard deviation of 1.39499 on the same 0-6 scale used to measure knowledge. This sum score of symptom management was consistent across participants as both age and class rank increase except for the Junior class which had the lowest level of symptom management when compared to the other divisions of undergraduates.

For response time, the participants recognized the symptoms of an allergic reaction in under 15 minutes, classing 72.5% of participants into the quickest response time available to them followed by 19.6% in the second quickest category of 30 minutes. Not surprisingly, 70.4% of participants selected the that they experience their allergic reactions within minutes of ingesting the allergen which is consistent with current literature on food allergic reactions beginning in seconds to minutes after exposure to the allergen (*Allergic Reactions Information | Mount Sinai - New York*, n.d.). After measuring how soon students use their EAI when they believe they are having an allergic reaction 35.6% responded immediately, 11.1% responded after calling emergency services, 40% responded after waiting to have more symptoms, and 13.3% responded they would wait a while. These responses indicate that most students know to use their injector immediately, this is secondary to students who reported that they wait to have more

symptoms. This is an unexpected finding in the data which should be investigated further as part of a future study.

When asked about their response time, most participants reported that they have access to their injector and administer within 15 minutes. This group of participants (79.5%) selected the quickest response time available to them. Indicating that out of the available options, the participants achieved a response time of fifteen minutes or under. The response time provides information about the student participants understanding the necessity for quickly responding to their symptoms during an allergic reaction and reported as such by selecting the fastest time category available to them.

There is already a pre established connection between knowledge of food allergies and the management of symptoms when it comes to food allergies (McLaughlin et al., 2021 & Richard Gawel, 2023), but not enough literature was found to change practice which is why knowledge and symptom management was investigated through this study alongside response time. In this relationship, knowledge significantly predicts food allergy management behaviors over the severity of the allergy and recent reactions as well as management for students on a college campus (McLaughlin et al., 2021 & Richard Gawel, 2023). This is present within the data of this study also as participants demonstrated higher than the median amounts of both knowledge and symptom management. The sum score of symptom management was lower than the sum of knowledge for the study indicating that there is a drop in symptom management from the participants' knowledge level of their food allergies on campus. Aside from the Junior class who showed decreased amounts of knowledge and symptom management,

knowledge and symptom management increased with age and class rank indicating that students at Kent State can adapt, gain knowledge, and improve their management of their food allergies while on campus.

For the study, response time was consistently in the lowest categories showing the quickest form of response time available. Most participants reported feeling symptoms of an allergic reaction within minutes of encountering their allergen(s) showing that having a quick response time is vital to most participants. After measuring when students decide to use their EAI during an allergic reaction, the responses were divided between using it immediately, after calling emergency services, and after waiting to have more symptoms. While reporting that waiting to have more symptoms was an unexpected finding for the study, the rest of the participant responses show that students are responding quickly to their reaction by using their EAI or calling for medical attention. Based on the results of the study, it took less than 15 minutes to recognize the symptoms of an allergic reaction and to access the injector and administer their EAI for most participants. For this study, college students on Kent State's campus are responding promptly, within 15 minutes or less, to their allergic reactions by either using the EAI or by calling emergency services for treatment.

Limitations to the Study

The study was conducted in northeast Ohio. This limits the generalizability. This means further work would be needed to determine if the results would be the same with other college students in other parts of the United States. The plan is to replicate in other regions of the United States.

A second limitation relates to the *Epinephrine Auto-Injector (EAI) Response Time Use Questionnaire.* This response time questionnaire was developed for this study and has not been evaluated for reliability. One of the proposed future steps would be to develop the response time questionnaire and conduct factor analysis. This would provide evidence that the questionnaire is reliable.

Future and Implications

This pilot study's purpose was to establish the status of college students' knowledge, symptom management, and response time as it relates to food allergic reactions. Although there was limited information on the significance for relationship between knowledge and symptom management with food allergies among college students, there is a need to understand the challenges for college students in responding to their food allergies. Food allergies is among the most common problems in this population. Yet, we have limited information on the challenges faced during their college years. Therefore, nurses need to establish an intervention that meets these challenges.

This pilot study did provide information on experiences of college students with food allergies. Intervention needs to be focus on increasing the knowledge and symptom management and response time. Further study needed to determine knowledge and symptom managements effect on response time. Nurses need to be more engaged in research related to college students and the impact on their health.

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APPENDIX A

Item Level Analysis for Measuring the Construct of Knowledge

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
4 must read labels?	57	1	7	4.75	2.011
12 hesitate eating a product when you have doubts about it?	56	1	7	4.73	1.940
1 must always be alert as to what you are eating?	57	1	7	4.67	1.864
2 Are able to eat fewer products?	57	1	7	4.37	1.789
9 are less able to taste or try various products when eating out?	56	1	7	4.29	2.033
11 must personally check whether you can eat something when eating out?	55	1	7	4.22	2.217
3 Are limited as to the products you can buy?	57	1	7	4.16	1.720
5 have the feeling that you have less control of what you eat when eating out?	57	1	7	4.07	1.926
6 must refuse many things during social activities?	57	1	7	3.79	2.177
8 are less able to accept spontaneously an invitation to stay for a meal?	57	1	7	3.28	2.016
7 sometimes frustrate people when they are making an effort to accommodate your food allergy?	57	1	7	3.18	2.036
10 can eat out less?	55	1	7	2.87	1.816

APPENDIX B

Item Level Analysis for Measuring the Construct of Symptom Management

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
21 for your host or hostess should you have an allergic reaction?	57	1	7	3.39	1.908
20 that you must explain to those around you that you have a food allergy?	57	1	7	4.40	2.118
19 that it is unclear to which foods you are allergic?	56	1	7	2.82	1.723
18 that people underestimate your problems caused by food allergy?	57	1	7	4.44	2.044
17 that ingredients are different in other countries (e.g., during vacation)?	57	1	7	3.72	2.041
16 that the label states: "may contain (traces of)..."?	57	1	7	4.05	2.098
15 that the lettering on labels is too small?	57	1	7	2.47	1.511
14 that labels are incomplete?	57	1	7	3.91	1.967
13 that the ingredients of a product change?	57	1	7	3.56	1.845