

Self-Reported Perceptions and Practices of University Students Who Adhere to Special  
Restrictive Diets: A Pilot Study

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**Abstract**

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*Background:* The Dietary Guidelines for Americans recommends consuming a variety of foods from each of the major food groups to support a healthy diet. However, usage of special restrictive diets that exclude specific foods or food groups appears to be common. Some studies suggest restrictive diets may have negative nutritional, monetary, and psycho-social ramifications. Given these potential challenges, it is important to learn more about special restrictive diet usage and the perceptions and practices of individuals following these diets to understand how to more effectively engage with these individuals.

*Objective:* This cross-sectional study assessed what types of special restrictive diets a sample of university students self-reported to follow. The study further investigated associations of different restrictive diet types with a) demographic characteristics; b) dietary perceptions; c) importance of food issues during food choice; and d) frequency of considering food issues during food purchase. This study also investigated associations between the perceived importance of

food issues during food choice and the frequency of considering the same respective food issues during food purchase.

*Methods:* An anonymous, web-based survey was conducted amongst 38 University of Washington students who self-reported to follow a special restrictive diet. Associations between variables were tested by using a Fisher's exact test of proportions.

*Results:* The most predominant self-reported special restrictive diets amongst this university student population were the dairy-free (50%) and vegan or vegetarian diets (39.5%), followed by the gluten-free (31.6%), "other"-type (31.6%), wheat-free (18.4%), and paleolithic-type (13.2%) diets. Half of respondents followed two or more types of restrictive diets. Over three-quarters of those on a dairy-free diet reported to be an undergraduate student, whereas 22.2% were graduate or professional students ( $p=0.02$ ). No one on a paleolithic-type diet agreed that the nutrition recommendations of health/nutrition experts are sound and can be trusted compared to 80% who disagreed and 20% who felt neutral ( $p=0.01$ ). The majority (75%) of gluten-free dieters agreed that the US food supply is safe ( $p=0.04$ ). None of those on a vegan/vegetarian diet agreed that food manufacturers and the agricultural system are trustworthy and open about their practices ( $p=0.02$ ). Genetic modification of food was rated as important during food choice by 53.3% of vegan/vegetarian diet followers compared to 26.7% who felt neutral, and the 20% who rated this as unimportant ( $p=0.03$ ). More (66.7%) participants on an "other"-type diet reported to sometimes take food processing and preparation contamination into consideration during food purchase than they reported to frequently (33.3%) consider this issue ( $p=0.04$ ). Across all issues, the reported *importance* of each food issue (i.e., food additives, agricultural contamination, and food processing and preparation contamination) during *food choice* was significantly associated

with the *frequency* of considering the same respective food issue during *food purchase* ( $p < 0.05$ , each).

*Conclusion:* This sample of university students engaged in a variety of special restrictive diets. Association testing showed specific diet types to be associated with demographic, dietary perception and dietary practice variables. Also, the associations found between the perceived importance of food issues during food choice and the frequency of considering the same food issues during food purchase imply a potential link between food issue perceptions and behavior. Clinicians and public health professionals could benefit from the results of this study in supporting patient and population nutritional health. These results could also be used to inform larger, well-designed studies that aim to further elucidate these associations and directionality between diet type and perception variables.

## INTRODUCTION

According to the Dietary Guidelines for Americans (DGAs), national evidence-based nutrition recommendations made by health and nutrition experts, a healthy diet involves the consumption of a variety of foods from each of the major food groups [1]. However, adherence to dietary patterns that exclude specific foods or food groups, termed special restrictive diets, appears to be common. According to recent research, prevalence of the gluten-free diet in persons lacking celiac disease (CD) has grown significantly to 1.69% of Americans in 2013-2014, exceeding the prevalence of CD (0.53%) [2]. Wheat and dairy avoidance in Australia has been estimated to have an age- and gender-weighted prevalence of 10.7% and 16.6%, respectively and the presence of numerous best-selling books, websites, and magazines dedicated to the paleolithic diet are indicative of its prominence as a popular eating pattern [3, 4].

Avoidance of specific foods is the chief treatment for adverse reactions to food [5]. Yet, many individuals who avoid specific foods due to adverse reactions may be doing so without the aid of a medical expert or based on their own self-diagnosis [3, 4, 6]. Within the United States (US), a growing number of adults self-identify as possessing a food allergy, but the number of medically-diagnosed food allergies reported have remained relatively stable [7]. Evidence of this was reported by a study that found a significant rise in both 2010 (13%) and 2006 (14.9%) in the prevalence of self-diagnosed food allergy when compared to 2001 (9.1%), whereas the 2010 (6.5%) prevalence of food allergies diagnosed by medical doctors did not change significantly compared to 2001 (5.3%) or 2006 (7.6%) [7]. Additionally, adoption of special restrictive diets is suggested to extend beyond adverse reactions to food. A preliminary study of university students' knowledge of the gluten-free diet reported that over 50% believed the diet to be used for general health and over 25% for weight management [8]. Previous researchers investigating

wheat avoidance have reported non-medical explanations for diet adoption, including possessing a relative with celiac disease, weight-based motivations and individualistic taste preferences [3]. Likewise, various motivations for eliminating dairy foods such as, weight control and taste preference, in addition to saturated fat content and the perception that it is inappropriate to include dairy in an adult dietary pattern have also been documented [4]. Moreover, proponents of the paleolithic diet argue that humans are not genetically evolved to process our modern agriculturally-based diet, which is purported to cause a large number of the chronic diseases associated with modern society [9].

### ***Restrictive Diet Challenges***

Regardless of motivations for adoption of special restrictive diets, there are negative aspects to these restrictive eating patterns that are a cause for concern. Avoidance of specific foods has the potential to result in nutritional deficiencies and poor health outcomes [10-12]. Dairy avoidance could produce deficiencies in calcium and vitamin D, important nutrients for healthy bones [13]. Wheat and other grains are significant sources of complex carbohydrates, fiber and micronutrients, including thiamin, niacin, riboflavin, iron, and folic acid [10]. Women with celiac disease have been shown to not meet the daily recommendations for servings of grains set by the food guide pyramid, fiber advised by the nutrition facts label, nor the dietary reference intakes for calcium and iron [11]. These same nutrient deficiency concerns are raised for individuals following a paleolithic-type diet, which is grain, legume and dairy-free [14]. A study comparing the paleolithic diet to a diet based on the Australian Guide to Healthy Eating (AGHE) showed significantly lower intakes of iodine and calcium with the paleolithic-type eating pattern [12].

Restrictive diets can be more expensive to follow [15, 16]. Gluten-free products were reported to be pricier than conventional (gluten-containing) foods in a grocery store comparison study [15]. Likewise, researchers investigating the feasibility of the paleolithic diet compared to an AGHE diet found those following a paleolithic diet reported higher food costs more frequently than their counterparts [16].

Special restrictive diets may negatively impact psychological and social aspects of an individual's life [17-19]. As outlined by one review, food allergy has been documented to have many adverse quality of life implications for youth and their families [17]. In a sample of 254 people with celiac disease, who participated in a survey study, gluten avoidance was reported to have negative consequences on quality of life, such as 86% reported gluten avoidance to negatively affect dining out and 82% reported travel being impacted [18]. Furthermore, self-report of following a special restrictive diet was found to be linked to disordered eating and orthorexia nervosa, a condition characterized by an obsession with healthy eating [19].

### ***The Present Study***

Given the challenges of following a special restrictive diet, it is important to elucidate the characteristics, perceptions, and practices of individuals who adopt restrictive diets in order to better understand how to more effectively engage and communicate with this population. For this reason, an investigation was conducted that focused on the eating perceptions and behaviors of students enrolled at the University of Washington who self-report following a restrictive diet.

With their newfound autonomy university students may be more receptive to change [20]. This is also a notable developmental period marked by life exploration as individuals transition into adulthood [21]. Health behaviors, such as dietary patterns, are forged during this time and may

solidify into enduring habits that influence health later on in life [22]. Furthermore, university students have also been documented to partake in dieting behavior and follow various diets [23-26]. Collectively, these attributes of university students made them the ideal population for the present study investigating the dietary perceptions and food choice behavior of special restrictive diet adoptees.

### ***Characterization of Special Restrictive Diet Adoptees***

Previous research has investigated demographic characteristics associated with following various special restrictive diets, such as wheat, gluten, and dairy avoiding diets, as well as special eating patterns such as the vegetarian diet [2-4, 24, 27]. Elimination of wheat and concurrent elimination of wheat and dairy have been found to be significantly predicted by sex as more females reported following these respective diets, whereas dairy elimination has been negatively predicted by age [3, 4]. However, both these studies assessing predictors of wheat or dairy-free diets were within adults who reported food avoidance due to symptom-related reasons [3, 4]. Alternatively, another study characterized the growing prevalence of gluten avoidance amongst individuals without celiac disease by age, sex, and ethnicity, reporting significant increases in both males and females, age groups 6-19 and 20-39, and amongst non-Hispanic whites according to a comparison of NHANES data from 2009-2010 to 2013-2014 data [2]. In a population of university students, the usage of different diets was observed to differ by sex with more females reporting trying various diets, such as low-carbohydrate, low-fat, and vegetarian diets than males [24]. However, none of these studies inquired about GMO-free, grain-free, or paleolithic-type dietary patterns and not all assessed dietary associations of race or ethnicity so gaps remain in the literature [2-4, 24, 27].

### ***Perceptions of The National Dietary Recommendations***

In order to promote population nutritional health, up-to-date nutrition research within the DGAs are translated into programs and nutrition guides, such as the current guide MyPlate or the former guides, such as MyPyramid and the Food Guide Pyramid [1, 28, 29]. Despite these efforts, there is poor adherence to the national dietary recommendations [30]. Thus, it is important to understand how these nutritional guidelines are perceived by individuals. Much research on the national dietary recommendations or nutrition guides has focused on awareness or adherence to said recommendations, while few studies have described attitudes towards them [30-33]. Attitudes amongst mothers towards MyPlate, with regards to relevancy, ease of understanding, and helpfulness have been previously investigated [31]. Similarly, a preliminary study assessed belief and trust in the food guide pyramid [33]. Meanwhile, other studies have investigated perceptions towards general nutrition recommendations, including perceived fitness of the government in providing dietary recommendations and general expert advice on food and nutrition [34-36]. However, none of these aforementioned studies recruited participants based on their adherence to special restrictive diets [31, 33-36].

### ***Food Trust & Special Restrictive Diets***

Food trust is a complex area of study [37]. Previous research on food trust has examined trust in experts, the food system and trust in its key players, food safety, food choice, and food issues [35, 36, 38-43]. However, there is a paucity of research investigating whether any of these areas of trust are associated with adoption of special restrictive eating patterns. That said, trust has been shown to shape dietary choice and therefore has important health implications [36, 39-41]. Navigating mixed dietary messaging and our enigmatic modern food system spurs distrust, anxiety and confusion amongst the general public [41]. Moreover, as qualitative research has

found, individuals may adopt various behaviors, including restricting certain food groups or processed foods, to increase trust and manage perceived risk [39, 44].

### ***Trust of Health & Nutrition Experts***

Perceiving health and nutrition experts as trustworthy can influence food choice, as a positive relationship has been shown between trust in expert food recommendations and a tendency to make food choices that are perceived to be healthy [36]. Moreover, health experts, such as doctors, have been reported by qualitative research to be trusted sources of information, while survey evidence has also confirmed high trust in expert recommendations [35, 44]. Yet, experts such as doctors or dietitians may be utilized infrequently for information by those on a gluten-free diet or rated as low influencers in the case of wheat avoidance [3, 6, 18, 45]. In fact, it has been reported that only approximately one-fifth of individuals found dietary instruction on a gluten-free diet from a dietitian to be helpful [18]. The poor utilization and low perceptions of helpfulness of experts may impact trust in expert advice and the efficacy of their recommendations. Thus, there is a need for more information on how individuals on restrictive diets perceive health and nutrition experts as sound and trustworthy sources of information.

### ***Food System***

Focus groups exploring food choice have noted that anxiety ensues when making dietary choices due to ever-changing nutrition information and uncertainty of the inherent risks of consuming foods from a non-transparent, industrialized food system [41]. Additionally, the globalization of our food system has distanced consumers from where their food is produced [46]. Consumers are therefore compelled to rely on external parties, such as institutions, illustrating how vital it is that consumers trust these parties involved in the food chain [46, 47]. Trust in the food system and/or

the key players belonging to the food system, including government entities, environmental organizations, food manufacturers, farmers, retailers, scientists, politicians and the media, have been researched by previously published studies [38, 40, 48-50]. Farmers and university scientists have been documented to be amongst the most trusted key players, whereas retailers, such as supermarkets, have been viewed as one of the least trusted agents of the food system [38, 40, 49]. Likewise, food manufacturers have been observed to be one of the most poorly trusted food system actors [49]. Yet, trust in food manufacturers has also been found to have the most impact upon consumer confidence with regards to food safety compared to trust in any other key player of the food system [48]. Thus suggesting damage to trust in certain food system actors may have greater implications on consumer perceptions of food safety [48].

### ***Access to Information***

Distance from the food system is suggested to create an information gap amongst the public as seen by a study carried out in Norway [35]. Those living in more urban places demonstrated higher desire for greater information on topics such as, how food is cultivated, livestock care, and environmental contaminants, compared to persons in less populated locations [35]. However, in this same survey study of 1,050 Norwegian consumers, over half reported to feel they received adequate information to purchase healthy and high quality food [35]. Although, consumers in interviews and focus groups have also been reported to be highly suspicious of how well the safety and quality of food is ensured by governmental regulatory entities and to question the efficacy of these control processes when they are largely unseen by the consumer [39]. Poor awareness of how food additives are regulated has been suggested to raise risk perceptions connected to eating foods containing food additives [43]. To this point, signs of good food risk management amongst consumers include identifiable control processes and the provision of

information that supports consumers in making informed food choices [50]. In this way, food labels can serve as a conduit for consumer interaction with the food system, and thereby influence trust of the system and its key actors [42]. Analysis of in-person interviews have shown that consumer interactions with food labels may weaken trust, such as when the label uses unclear messaging, demonstrating the need for good communication that strengthens trust [42].

### ***Food Safety***

Countrywide food safety scandals have been suggested to influence consumer trust in food [51]. Although prior research has investigated consumer perceptions of food safety or food safety management amongst consumers in several countries these studies did not describe food supply safety perceptions amongst special restrictive diet followers [35, 36, 50, 52]. However, a survey study conducted in the US saw that those with higher overall food safety concern also reported higher concern around food issues related to chemical substances, microbiologic aspects of food safety, and food regulation [52]. These results suggest that some individuals have a heightened concern as to food risks than others, yet there is a gap in the literature as to how this may relate to special restrictive diet adoption or vice versa.

### ***Food Issues & Food Choice***

It is thought that consumer concerns may be indicative of a decline in trust [46]. Food-related issues that are concerning or important to consumers include food additives, genetic modification of food, consumption of foods seen as unhealthy, food allergies, environmental contaminants, and the methods used to cultivate food, raise livestock or process food [35, 52-54]. Trust relates as higher trust in the collective food system has been associated with greater acceptance of GM foods [40]. Consumers have also reported to eat less of certain foods, such as milk, meat,

poultry, soybeans and corn, due to concern about irradiation, antibiotic or hormone usage, and genetic modification [52]. Moreover, consumers who report lower confidence as to the risks associated with the food they purchase have been found to want greater action from regulatory bodies and a larger amount of high quality information on various food issues [35]. In the context of our contemporary society, responsibility of dietary choice is shifted onto the individual who will endure the health consequences [41]. Yet, making informed food choices can be challenging as individuals are overwhelmed by conflicting information in a complex, non-transparent food system [41]. As found by one qualitative study, women have reported to build their own systems of control in food choice by joining dietary programs and continuously seeking new nutritional information [41]. Moreover, a higher inclination towards alternative food networks have been found amongst special diet followers by a survey study [19]. This was assessed by evaluating participant's tendency to prefer non-conventional foods, such as local, sustainable, or organic opposed to foods originating from the current mainstream and industrial system [19]. Gaining insight into the food issues that are considered important to this subpopulation can help develop communication strategies on such topics to help better inform food choice and strengthen trust.

With all this said, the aforementioned topics suggest there are many factors that underlie dietary perceptions and food choice in our current food environment. These factors most likely do not operate in isolation, but are instead interwoven prompting the need for further research in this area. This shows that there is much to be gained by understanding how these factors relate to special restrictive diets. The present study aimed to increase this knowledge base to inform both clinical and public health experts on how to better support the nutritional health of this population.

## *Study Goals*

As previously mentioned, the present study set out to investigate the perceptions and practices of university students who self-report following a special restrictive dietary pattern. More specifically, this study aims to answer the following research questions:

- Aim 1: To describe a university student population in terms of the types of special restrictive diets they follow and investigate whether there is any association between diet type and demographic characteristics.
- Aim 2: To describe a university student population in terms of their perceptions of the national dietary recommendations and health/nutrition experts and investigate whether there is any association between these perceptions and diet type.
- Aim 3: To describe a university student population in terms of their perceptions of the safety of food, openness and trustworthiness of representatives of the food system, and accessibility to information of how food is produced/processed and investigate whether there is any association between these various perceptions and diet type.
- Aim 4: To describe a university student population in terms of their perceptions and practices with regards to food issues (food additives, genetic modification of food, agricultural contamination, and food processing/preparation contamination) during food choice and purchase and investigate whether there is any association between these perceptions/practices and diet type.
  - Sub-aim: To investigate if any association exists between perceived importance of various individual food issues during food choice and frequency of consideration of the same respective food issues during food purchase.

## **METHODS**

This thesis project was a cross-sectional study whose overall goal was to investigate the eating habits of students at the University of Washington (UW). As a part of the Food and Health Study, The Diet and Food Choice Survey was a web-based self-administered survey conducted amongst University of Washington students. The study protocol and materials were reviewed by the Fred Hutchinson Cancer Research Center Institutional Review Board and given exempt status.

Participants were anonymously recruited from the UW Seattle campus who self-identified as meeting the inclusion criteria to participate in the survey study. Eligibility criteria including being a minimum of 18 years of age, a UW student, non-pregnant, and self-reported following a special restrictive diet, such as gluten-free, wheat-free, grain-free, dairy-free, Paleolithic-type, GMO-free, or other-type of restrictive diet. Recruitment occurred by the usage of flyers displayed within buildings on the UW Seattle campus. Recruitment flyers included a shortened web address and QR code created using online tools Bitly (<https://bitly.com>) and QR Code Generator ([www.qr-code-generator.com](http://www.qr-code-generator.com)), respectively. A copy of the recruitment flyer can be found in the appendix. Another method of recruitment included in-class, verbal advertising with the permission of course instructors. During class advertisement, a graduate student researcher verbally read aloud the survey recruitment flyer that was displayed on a PowerPoint™ slide and students were also verbally directed to the location of nearby posted flyers.

Participants accessed The Diet and Food Choice Survey by using either the shorted web address or QR code obtained from the recruitment flyer or presentation slide. Upon visiting the survey website, potential participants were presented with a message providing them with additional details related to study participation. This message included statements informing potential

participants that proceeding with the survey would be considered as both implied consent and confirmation that they met the study's eligibility criteria. Participants were also reminded by the message of their right to not respond to any question that they were not willing to answer.

### ***Survey Instrument***

*The Diet and Food Choice Survey* was designed to gather data on what types of special restrictive diets students self-report (i.e., gluten-free, wheat-free, grain-free, paleolithic-type pattern, dairy-free, genetically modified organism-free, or “other”-type diet) and investigate the dietary perceptions and practices of this population. The survey was a 24-item questionnaire consisting of a mix of Likert-scale, multiple choice, matrix and short answer questions. The UW's Catalyst web-based tool was used to build the online-survey (<https://itconnect.uw.edu/learn/tools/catalyst-web-tools/>). Survey design incorporated several adapted questions from previously published studies and/or question development was informed by the results of these same studies [3, 35, 36, 54]. In addition, data on respondent demographic characteristics were collected. A copy of the survey questions can be found in the appendix.

Apart from the section containing demographic questions, the survey was comprised of 6 domains:

Domain 1: This initial part of the survey assessed special diet or eating pattern usage amongst students. The first question utilized a skip-logic branching feature that directed participants onto different survey paths depending on their response to a yes/no question. This question asked participants whether they were following any special diet or eating pattern. A “no” response directed participants to the demographic questions at the end of the survey and then onto survey exit, whereas a “yes” response guided participants on to the next question pertaining to dietary

practice. This subsequent question, asked respondents to report what types of special diet(s) they follow.

Domain 2: This next section of the survey contained 4 questions not included in results presented in this analysis. For the first two questions, respondents reported the primary and secondary reasons for following each self-reported diet type [3]. The second two questions asked respondents to identify their major and supplementary sources of information regarding each self-reported diet [3].

Domain 3: This domain asked three questions that gathered data on: specific health conditions; formal diagnosis per health condition; and the type of diagnosing health professional per health condition [3]. The last question in this domain also collected information on study participant's knowledge of gluten. Data from domain three were not included in this analysis.

Domain 4: Three questions in this domain assessed the perceptions of the national dietary recommendations made by health/nutrition experts. The first question asked about the importance of following the DGAs for optimal health and the next question assessed whether the national nutrition recommendations were seen as flawed by participants [36]. The third question asked participants if the national recommendations help them follow a healthy diet. Respondents also answered a question about whether they perceive the nutrition recommendations made by health/nutrition experts to be sound and trusted [36]. Response options for this domain were all on a five point Likert scale.

Domain 5: Four different food issues (i.e., food additives, genetic modification of food, agricultural contamination, and food processing and preparation contamination) were investigated by matrix questions in this domain [35, 54]. Each question was inserted into a

matrix along with each separate food issue to allow participants to rate each food issue on a five point Likert scale based off the same base question. The first matrix question asked participants to rate the importance of these different food issues during food choice. The second matrix question asked respondents to rate how often they consider these same food issues when they purchase food.

Domain 6: This last part of the survey contained three questions to assess participant's perceptions on different topics of perceptions. Participants were presented with a statement and asked to evaluate the statement on a five point Likert scale. The first question asked participants if they perceive the US food supply to be safe [36]. The second question assessed trust and transparency by asking participants to rate how strongly they found food manufacturers and the agricultural system (i.e., representatives of the food system) to be trustworthy and open about their practices. The final question also evaluated transparency by asking respondents if individuals have easy access to information about how food is produced/processed [36].

### *Data Analysis*

The raw data were imported into Microsoft Excel 2016™. The first step in the data analysis was to examine the distributions of the data, collapse response categories due to low overall survey response, study missing data and confirm skip pattern responses. Missing data due to not all respondents answering all questions were reported throughout the paper and excluded from analysis. Data were sorted into two different categories based on each individual's response to the yes/no question, "Do you follow any kind of special diet or eating pattern?". The present data analysis only included data from those who responded in the affirmative to this question, however the number of respondents who answered "no" were counted and this number was reported.

Next, constructed variables and the data dictionary were created. Demographic variables included: age, sex, Hispanic/Latino(a) identity, race/ethnicity, and student status. The continuous variable age was recoded into a categorical variable with two response categories: “18-24” and “25+” years old. The variable sex had two response options “Male” and “Female” that were not modified. All response categories, not including “White or Caucasian”, for the variable race/ethnicity were collapsed and recoded into one category named “Non-White/Caucasian or More Than One Race”. The remaining response category, “White or Caucasian”, for the race/ethnicity variable was left unaltered. However, each unique response for the individual groups “Non-White/Caucasian” or “More Than One Race” was counted and reported in the table. For the variable student status, the response categories “Freshman”, “Sophomore”, “Junior”, and “Senior” were collapsed into one category recoded as “Undergraduate Student”, whereas the “Graduate/Professional Student” category remained unchanged.

Additionally, Likert scale questions were collapsed from five to three response categories to create stable cell sizes due to very low or zero responses for some categories and recoded. Likert questions assessing how strongly participants agreed or disagreed with a statement included the following response categories: “Strongly Agree”, “Slightly Agree”, “Neutral”, “Slightly Disagree”, and “Strongly Disagree”. The level of importance that participants gave different food issues when making food choices were rated using the response categories: “Very Important”, “Somewhat Important”, “Neither Important nor Unimportant”, “Somewhat Unimportant”, and “Very Unimportant”. Furthermore, frequency of considering certain food issues when making food purchases were rated on a Likert scale using the response categories: “Always”, “Very Often”, “Sometimes”, “Rarely”, and “Never”.

Collapse and recoding of Likert scale questions was accomplished by combining the two positive response options into one positive recoded response category and the two negative response options into one negative recoded response category. Neutral Likert scale response options, including “Neutral”, “Neither Important nor Unimportant”, and “Sometimes” did not undergo collapse or recoding. For example, “Strongly Agree” and “Slightly Agree” response options were recoded into a new category named, “Agree” and the options “Strongly Disagree” and “Slightly Disagree” were combined into a new category called, “Disagree”. However, the response category “Neutral” was not altered in any way.

Another step in the data analysis was reviewing the short answer responses participants provided when specifying their “other”-type dietary pattern. During this review, a theme emerged in which respondents reported following either a vegan or vegetarian diet, prompting the creation of a new variable called, “Vegan/Vegetarian”. For anyone who selected the “other”-type diet option whose response did not describe a vegan or vegetarian diet, each unique response was recoded, counted, and reported. Similarly, another new variable was created called, “Two or more diets” to describe the number of respondents who self-reported following more than one type of restrictive diet. Respondents were determined to be following more than one diet based on their response to the check-all-that-apply question that asked them to identify which dietary pattern(s) they follow.

Demographic information was reported as both a count and percentage. The mean age of respondents was also calculated and reported. The check-all-that-apply question assessing the various types of special restrictive diets students report to follow was analyzed and the results reported by diet type as a count of responses and percent of total respondents. Calculation of the

percent of total respondents was carried out by totaling the number of responses to each diet type and dividing by the total number of respondents to the check-all-that apply question (n=38).

Fisher's exact test of proportions was performed using STATA/SE 14™ to investigate relationships between variables. A p-value of 0.05 or smaller was pre-determined to signify a statistically significant association. Statistical testing was not adjusted for multiple comparisons, as all associations were based on a priori hypotheses. The different special restrictive diet types were tested for relationships with each demographic variable, as well as with different perception and dietary practice variables. Results of these association tests were reported as p-values with the percentage frequency. Statistical analysis also utilized Fisher's exact test of proportions to determine whether or not there was a significant association between the perceived importance of food issues during food choice and the frequency of considering these same respective foods issues during food purchase.

## **RESULTS**

In total, 50 individuals completed the survey and 76% (n=38) of all participants self-reported following some form of a restrictive diet or eating pattern. A total of 12 individuals were excluded from analysis because they reported no special diet or eating pattern. Table 1 shows the demographic information of all survey respondents who did affirm that they adhere to a special restrictive diet. The mean age of those following a special restrictive diet was 23.2 years old, with 68% falling into the range of 18 to 24 years of age. Most respondents on a restrictive diet were female (87%), non-Hispanic/Latino(a) (89%), and identified as white or Caucasian (79%). Over half (57%) were undergraduate students and 43% were either a graduate or professional student. All survey participants answered all demographic questions with the exception of one respondent who did not report their student status.



<b>Table 1. Demographic Information of Survey Respondents Who Self-Reported Following a Special Restrictive Diet or Dietary Pattern (n=38)</b>		
	<b>(n)</b>	<b>Percent (%)</b>
<b>Age Range</b>		
18-24	26	68%
25+	12	32%
Total	38	100%
<b>Sex</b>		
Male	5	13%
Female	33	87%
Total	38	100%
<b>Hispanic or Latino(a)</b>		
Yes	4	11%
No	34	89%
Total	38	100%
<b>Race/Ethnicity</b>		
White or Caucasian	30	79%
Non-White/Caucasian* or More Than One Race**	8	21%
Total	38	100%
<b>Student Status***</b>		
Undergraduate Student	21	57%
Graduate/Professional Student	16	43%
Total	37	100%
*refers to anyone who selected either Asian or American Indian/Alaska Native (n=2). **refers to anyone who selected more than one option for race/ethnicity (n=6). Counts of each different response category reported provided in parentheses: Asian, More than one Race (1); Asian, White or Caucasian (2); Asian, White or Caucasian, More than one race (1); More than one race (1); White or Caucasian, Native Hawaiian or other Pacific Islander, More than one race (1). ***Indicates missing data. Total survey respondents possible equal to 38. Not all respondents answered all questions.		

Table 2 presents data on the various types of self-reported dietary patterns indicated by survey respondents. Half of survey respondents (50%) reported following a dairy-free eating pattern and 39.5% adhered to either a vegan or vegetarian type diet. Slightly less than a third participants (31.6%) indicated that they followed an eating pattern that was not listed as a response choice and therefore selected the “other” option for diet type. Additional special restrictive diet types were reported as follows: gluten-free diet (31.6%); wheat-free diet (18.4%); paleolithic-type pattern (13.2%); grain-free (2.6%); and GMO-free (2.6%). Furthermore, fifty percent of survey respondents also reported adhering to two or more different types of special restrictive diets.

<b>Table 2. Self-Reported Special Restrictive Diets in A Population of University Students, (n=38).</b>		
<b>Diet</b>	<b>Responses (n)</b>	<b>Percent of Total Respondents (%)</b>
Gluten-Free	12	31.6%
Wheat-Free	7	18.4%
Grain-Free	1	2.6%
Paleolithic-type Pattern	5	13.2%
Dairy-Free	19	50%
GMO/GE-Free	1	2.6%
Vegan or Vegetarian	15	39.5%
Other*	12	31.6%
Two or more diets	19	50%
*Other type of special restrictive diets that participants self-reported (n=12): Acid Reflux (1), Food Sensitivity Diet (1), Ketogenic Diet (1), Lactose-Free & Egg-Free (1), Low Starch (1), Low Sugar or Refined Sugar-Free (2), Organic (1), Ostomy Diet (1), Other Not Defined (1), Legume-Free, Bean-Free, Lentil-Free (1), Red Meat-Free (1)		
Percentages represent the proportion of responses per diet type to the check-all-that-apply question divided by the total number of respondents to the question (n=38). More than one response option was permitted for this question.		

Associations of demographic characteristics and types of special restrictive diets are given in Table 3. Since there was only one respondent each following the grain-free and gluten-free diets these data were not included in any of the ensuing tables reporting data analysis results. As previously mentioned, one participant did not indicate their student status, who self-reported to follow both a dairy-free diet and vegan/vegetarian diet. Overall, no associations of demographic characteristics with special diets were found with the exception of student status with dairy-free diets. Slightly over three-quarters of dairy free diet adoptees identified themselves as being an undergraduate student, whereas 22.2% were graduate or professional students (p=0.02). Gluten-free dieters were more likely to be white or Caucasian (58.3%), while less (41.7%) were non-white or more than one race, a relationship that neared significance (p=0.08).

<b>Table 3. Associations of Demographic Characteristics with Types of Special Restrictive Diets, (n=38).</b>						
	<b>Gluten-Free</b>	<b>Wheat-Free</b>	<b>Paleolithic-like Pattern</b>	<b>Dairy-Free</b>	<b>Vegan/Vegetarian</b>	<b>Other Diet</b>
	(%)	(%)	(%)	(%)	(%)	(%)
<b>Age</b>						
18-24	<i>83.3</i>	<i>85.7</i>	<i>60</i>	<i>73.7</i>	<i>66.7</i>	<i>75</i>
25+	<i>16.7</i>	<i>14.3</i>	<i>40</i>	<i>26.3</i>	<i>33.3</i>	<i>25</i>
p-value	0.27	0.40	0.64	0.73	1.00	0.71
<b>Sex</b>						
Male	<i>8.3</i>	<i>14.3</i>	<i>20</i>	<i>10.5</i>	<i>6.7</i>	<i>16.7</i>
Female	<i>91.7</i>	<i>85.7</i>	<i>80</i>	<i>89.5</i>	<i>93.3</i>	<i>83.3</i>
p-value	1.00	1.00	0.53	1.00	0.63	0.64
<b>Hispanic/Non-Hispanic</b>						
Yes	<i>8.3</i>	<i>0</i>	<i>20</i>	<i>10.5</i>	<i>13.3</i>	<i>0</i>
No	<i>91.7</i>	<i>100</i>	<i>80</i>	<i>89.5</i>	<i>86.7</i>	<i>100</i>
p-value	1.00	1.00	0.45	1.00	1.00	0.29
<b>Race/Ethnicity</b>						
White/Caucasian	<i>58.3</i>	<i>57.1</i>	<i>80</i>	<i>68.4</i>	<i>80</i>	<i>83.3</i>
Non-White or More than one race	<i>41.7</i>	<i>42.9</i>	<i>20</i>	<i>31.6</i>	<i>20</i>	<i>16.7</i>
p-value	<b>0.08</b>	0.15	1.00	0.23	1.00	1.00
<b>Student Status*</b>						
Undergraduate Student	<i>75</i>	<i>71.4</i>	<i>40</i>	<i>77.8</i>	<i>57.1</i>	<i>50</i>
Graduate/Professional Student	<i>25</i>	<i>28.6</i>	<i>60</i>	<i>22.2</i>	<i>42.9</i>	<i>50</i>
p-value	0.17	0.67	0.63	<b>0.02</b>	1.00	0.73
Numbers represent percentages (italicized). P-value pertain to Fisher's exact test results.						
*Indicates missing data. Total survey respondents possible equal to 38. Not all respondents answered all questions.						

Table 4 displays the associations of various dietary perceptions with each type of special restrictive diet. All 38 survey respondents on a special restrictive diet answered all dietary perception questions represented in table 4. Participants were asked about the importance of following the national Dietary Guidelines for Americans for optimal health. A third of those following either a gluten-free, vegan/vegetarian, or “other”-type diet agreed with this statement, whereas slightly fewer (28.5%) following a wheat-free diet and slightly more on a dairy-free diet agreed. The one notable observation was that only 20% of those following a paleolithic diet agreed versus 80% who disagreed (p=0.08). Subsequently, participants were asked to evaluate the statement, “The national nutrition recommendations made by health/nutrition experts are

flawed”. Survey results for this statement showed two-thirds of individuals on either a vegan/vegetarian or “other”-type diet agreed with this statement, whereas half on a gluten-free diet and slightly more (57.1%) on a wheat-free diet agreed. The paleolithic-type diet had the highest proportion (80%) of individuals who agreed that the national nutrition recommendations are flawed, while the dairy-free diet had the smallest proportion (42.1%).

Respondents were then asked to report on how helpful they found the national recommendations in helping them follow a healthy dietary pattern. A quarter of participants on a gluten-free or “other”-type diet agreed with the statement and slightly more (26.3%) of those on a dairy-free diet also agreed. In contrast, slightly fewer participants following a vegan or vegetarian diet (20%) or wheat-free diet (14.3%) agreed, whereas no one on a paleolithic-type diet agreed that the national nutrition recommendations help them follow a healthy dietary pattern.

Next, participants were asked if they agreed that the recommendations made by health/nutrition experts are sound and can be trusted. Two-thirds of participants on a gluten-free diet agreed the most with the statement and a slightly smaller proportion on a dairy-free (57.9%), wheat-free (57.1%), vegan/vegetarian (53.3%), or “other”-type diet (41.7%) agreed. Notably, none of the individuals on a paleolithic-type diet agreed with the statement compared to 80% who disagreed and 20% who felt neutral ( $p=0.01$ ).

Participants were next asked if they thought the food available in the US is safe. Most participants agreed that food in the US is safe, as over half of individuals on each of the diet types reported to agree. Of note, most (75%) individuals on a gluten-free diet agreed that the US food supply is safe ( $p=0.04$ ). Furthermore, slightly over half (53.3%) of participants following a vegan or vegetarian diet reported to agree that the food available in the US is safe compared to the 40% of vegans/vegetarians who felt neutral or the 6.7% who did not agree ( $p=0.07$ ). The diet

type with the largest proportion of respondents who agreed (83.3%) with the food safety statement was the “other”-type diet. Of those following a wheat-free diet, 71.4% agreed with the food safety statement with slightly less (60%) paleolithic-type and dairy-free (57.9%) diet followers reporting to also agree.

Survey respondents were also asked if they agree that representatives of the food system (food manufacturers and the agricultural system) are trustworthy and open about their practices. No one following a vegan/vegetarian ( $p=0.02$ ), gluten-free ( $p > 0.05$ ) or wheat-free ( $p > 0.05$ ) diet agreed with the statement, whereas 40%, 25%, and 15.8% of those following a paleolithic-type, “other”-type, or dairy-free diet, respectively agreed. Lastly, dietary perceptions of special restrictive diet followers were assessed by asking participants if they agree that individuals have easy access to information about how food is produced and/or processed. None of the participants on a paleolithic-type diet agreed with the statement, while a few respondents on a vegan/vegetarian (26.7%), dairy-free (26.3%), “other”-type (16.7%), wheat-free (14.3%), or gluten-free (8.3%) diets reported to agree.

**Table 4. Associations of Dietary Perceptions with Special Restrictive Diet Types, n= (38).**

	<b>Gluten-Free</b>	<b>Wheat-Free</b>	<b>Paleolithic-type Pattern</b>	<b>Dairy-Free</b>	<b>Vegan/Vegetarian</b>	<b>Other Diet</b>
	(%)	(%)	(%)	(%)	(%)	(%)
<b>Perceived Importance of the National Dietary Recommendations for Optimal Health</b>						
Agree	<i>33.3</i>	<i>28.6</i>	<i>20</i>	<i>42.1</i>	<i>33.3</i>	<i>33.3</i>
Neutral	<i>41.7</i>	<i>42.9</i>	<i>0</i>	<i>21.1</i>	<i>26.7</i>	<i>25</i>
Disagree	<i>25</i>	<i>28.6</i>	<i>80</i>	<i>36.8</i>	<i>40</i>	<i>41.7</i>
p-value	0.41	0.58	<b>0.08</b>	0.84	0.91	0.91
<b>Perceived Flaws in the National Dietary Recommendations</b>						
Agree	<i>50</i>	<i>57.1</i>	<i>80</i>	<i>42.1</i>	<i>66.7</i>	<i>66.7</i>
Neutral	<i>16.7</i>	<i>14.3</i>	<i>0</i>	<i>26.3</i>	<i>20</i>	<i>8.3</i>
Disagree	<i>33.3</i>	<i>28.6</i>	<i>20</i>	<i>31.6</i>	<i>13.3</i>	<i>25</i>
p-value	0.89	1.00	0.82	0.11	0.43	0.80
<b>Perceived Helpfulness of National Dietary Recommendations</b>						
Agree	<i>25</i>	<i>14.3</i>	<i>0</i>	<i>26.3</i>	<i>20</i>	<i>25</i>
Neutral	<i>25</i>	<i>42.9</i>	<i>20</i>	<i>31.6</i>	<i>40</i>	<i>25</i>
Disagree	<i>50</i>	<i>42.9</i>	<i>80</i>	<i>42.1</i>	<i>40</i>	<i>50</i>
p-value	0.90	0.87	0.19	1.00	0.70	0.90
<b>Perceived Soundness &amp; Trustworthiness of Nutrition Recommendations made by Health/Nutrition Experts</b>						
Agree	<i>66.7</i>	<i>57.1</i>	<i>0</i>	<i>57.9</i>	<i>53.3</i>	<i>41.7</i>
Neutral	<i>8.3</i>	<i>0</i>	<i>20</i>	<i>15.8</i>	<i>26.7</i>	<i>16.7</i>
Disagree	<i>25</i>	<i>42.9</i>	<i>80</i>	<i>26.3</i>	<i>20</i>	<i>41.7</i>
p-value	0.38	0.30	<b>0.01</b>	0.77	0.69	0.34
<b>Perceived Safety of Food in the US</b>						
Agree	<i>75</i>	<i>71.4</i>	<i>60</i>	<i>68.4</i>	<i>53.3</i>	<i>83.3</i>
Neutral	<i>0</i>	<i>0</i>	<i>20</i>	<i>21.1</i>	<i>40</i>	<i>8.3</i>
Disagree	<i>25</i>	<i>28.6</i>	<i>20</i>	<i>10.5</i>	<i>6.7</i>	<i>8.3</i>
p-value	<b>0.04</b>	0.15	0.80	1.00	0.07	0.40
<b>Perceived Trustworthiness &amp; Openness of Representatives of the Food System</b>						
Agree	<i>0</i>	<i>0</i>	<i>40</i>	<i>15.8</i>	<i>0</i>	<i>25</i>
Neutral	<i>8.3</i>	<i>0</i>	<i>0</i>	<i>5.3</i>	<i>0</i>	<i>8.3</i>
Disagree	<i>91.7</i>	<i>100</i>	<i>60</i>	<i>78.9</i>	<i>100</i>	<i>66.7</i>
p-value	0.21	0.46	0.21	1.00	<b>0.02</b>	0.59
<b>Perceived Ease of Access to Information on How Food is Processed/Produced</b>						
Agree	<i>8.3</i>	<i>14.3</i>	<i>0</i>	<i>26.3</i>	<i>26.7</i>	<i>16.7</i>
Neutral	<i>0</i>	<i>0</i>	<i>20</i>	<i>5.3</i>	<i>0</i>	<i>0</i>
Disagree	<i>91.7</i>	<i>85.7</i>	<i>80</i>	<i>68.4</i>	<i>73.3</i>	<i>83.3</i>
p-value	0.29	1.00	0.19	0.84	0.51	0.71

Numbers represent percentages (italicized). P-value pertains to Fisher's Exact Test Results.

Associations of the *importance* of specific food issues during *food choice* and special restrictive diet types are presented in table 5. Of the 38 survey respondents on a special restrictive diet, three individuals did not provide complete responses to the matrix question assessing the importance of various food issues during food choice. Two participants, both self-reporting to follow gluten-free, wheat-free, and dairy-free diets while one also reported to follow an “other”-type diet, did not rate the importance of agricultural contamination when making food choices. The remaining participant, self-reporting a paleolithic-type dietary pattern, did not rate the importance of food processing and preparation contamination when choosing food. Across all diet types, most respondents (71.4% to 83.3%) reported that food additives were important when making food choices. The genetic modification of food was considered the least important food issue during food choice by 40% to 75% of participants across all diets. More notably, genetic modification of food was rated as important during food choice by 53.3% of vegan/vegetarian diet followers compared to 26.7% who felt neutral, and the 20% who felt genetic modification of food to be unimportant ( $p=0.03$ ). Agricultural contamination of food was another food issue considered important during food choice by the majority of special restrictive diet followers regardless of diet type (82.4% to 100%). Similarly, throughout all diet types, food processing and preparation contamination was reported as important when making food choices by the majority of participants (83.3% to 100%).

<b>Table 5. Associations of The Importance of Food Issues During Food Choice with Special Restrictive Diet Types.</b>						
	<b>Gluten-Free</b>	<b>Wheat-Free</b>	<b>Paleolithic-like Pattern</b>	<b>Dairy-Free</b>	<b>Vegan/Vegetarian</b>	<b>Other Diet</b>
	(%)	(%)	(%)	(%)	(%)	(%)
<b>Food Additives (n=38)</b>						
Important	<i>83.3</i>	<i>71.4</i>	<i>100</i>	<i>73.7</i>	<i>80</i>	<i>83.3</i>
Neutral	<i>8.3</i>	<i>14.3</i>	<i>0</i>	<i>15.8</i>	<i>20</i>	<i>8.3</i>
Unimportant	<i>8.3</i>	<i>14.3</i>	<i>0</i>	<i>10.5</i>	<i>0</i>	<i>8.3</i>
p-value	1.00	0.77	1.00	0.74	0.29	1.00
<b>Genetic Modification or Engineering of Food (n=38)</b>						
Important	<i>75</i>	<i>57.1</i>	<i>40</i>	<i>63.2</i>	<i>53.3</i>	<i>50</i>
Neutral	<i>8.3</i>	<i>14.3</i>	<i>0</i>	<i>10.5</i>	<i>26.7</i>	<i>0</i>
Unimportant	<i>16.7</i>	<i>28.6</i>	<i>60</i>	<i>26.3</i>	<i>20</i>	<i>50</i>
p-value	0.41	1.00	0.35	0.89	<b>0.03</b>	0.19
<b>Agricultural Food Contamination (n=36)*</b>						
Important	<i>90</i>	<i>80</i>	<i>100</i>	<i>82.4</i>	<i>93.3</i>	<i>100</i>
Neutral	<i>0</i>	<i>0</i>	<i>0</i>	<i>5.9</i>	<i>6.7</i>	<i>0</i>
Unimportant	<i>10</i>	<i>20</i>	<i>0</i>	<i>11.8</i>	<i>0</i>	<i>0</i>
p-value	0.64	0.37	1.00	0.10	0.31	1.00
<b>Food Processing &amp; Preparation Contamination (n=37)*</b>						
Important	<i>91.7</i>	<i>85.7</i>	<i>100</i>	<i>89.5</i>	<i>86.7</i>	<i>83.3</i>
Neutral	<i>8.3</i>	<i>14.3</i>	<i>0</i>	<i>5.3</i>	<i>6.7</i>	<i>16.7</i>
Unimportant	<i>0</i>	<i>0</i>	<i>0</i>	<i>5.3</i>	<i>6.7</i>	<i>0</i>
p-value	1.00	0.59	1.00	1.00	0.74	0.50
Numbers represent percentages (italicized). P-value pertains to Fisher's Exact Test Results. *Indicates missing data. Total survey respondents possible equal to 38. Not all respondents answered all questions.						

Table 6 shows associations of how *often* individuals consider specific food issues when making food *purchases* and special restrictive diet types. Out of the 38 study participants on a special restrictive diet, two participants did not respond to all parts of the matrix question evaluating how frequently certain food issues are taken into account when making food purchases. One of these participants, self-reporting multiple restrictive diets (e.g., gluten-free, wheat-free, and

dairy-free), did not provide a response to how frequently they consider genetic modification of food during food purchase. The second participant, self-reporting a dairy-free diet, did not give a response as to how often they consider agricultural contamination when buying food. Across all diets, food additives were frequently taken into consideration by most participants (57.1% to 80%). Moreover, regardless of diet type, the least frequently (20% to 54.5%) considered food issue during food purchase was the genetic modification of food. Meanwhile, agricultural contamination of food was found to be frequently (57.1% to 80%) taken into consideration during food purchase by the majority of participants within each diet category. Of all special restrictive diet followers, the frequency of considering food processing and preparation contamination during food purchase varied between different diets (33.3% to 80%). Eighty percent of those on a paleolithic-type diet reported taking food processing and preparation contamination into consideration frequently, whereas slightly less on a dairy-free (68.4%), gluten-free (66.7%), wheat-free (57.1%), and vegan/vegetarian (53.3%) diet also reported to frequently do so. Of note, more (66.7%) participants on an “other”-type diet reported to sometimes take food processing and preparation contamination into consideration during food purchase than they reported to frequently (33.3%) consider this type of contamination ( $p=0.04$ ).

**Table 6. Associations of The Frequency of Considering Food Issues During Food Purchase with Special Restrictive Diet Types.**

	<b>Gluten-Free</b>	<b>Wheat-Free</b>	<b>Paleolithic-like Pattern</b>	<b>Dairy-Free</b>	<b>Vegan/Vegetarian</b>	<b>Other Diet</b>
	(%)	(%)	(%)	(%)	(%)	(%)
<b>Food Additives (n=38)</b>						
Frequently	<i>75</i>	<i>57.1</i>	<i>80</i>	<i>57.9</i>	<i>60</i>	<i>58.3</i>
Sometimes	<i>16.7</i>	<i>28.6</i>	<i>20</i>	<i>21.1</i>	<i>26.7</i>	<i>25</i>
Infrequently	<i>8.3</i>	<i>14.3</i>	<i>0</i>	<i>21.1</i>	<i>13.3</i>	<i>16.7</i>
p-value	0.69	0.84	0.80	0.81	0.64	0.88
<b>Genetic Modification or Engineering of Food (n=37)*</b>						
Frequently	<i>54.5</i>	<i>50</i>	<i>20</i>	<i>44.4</i>	<i>33.3</i>	<i>33.3</i>
Sometimes	<i>18.2</i>	<i>16.7</i>	<i>20</i>	<i>22.2</i>	<i>26.7</i>	<i>25</i>
Infrequently	<i>27.3</i>	<i>33.3</i>	<i>60</i>	<i>33.3</i>	<i>40</i>	<i>41.7</i>
p-value	0.73	1.00	0.48	0.84	0.51	0.73
<b>Agricultural Food Contamination (n=37)*</b>						
Frequently	<i>66.7</i>	<i>57.1</i>	<i>80</i>	<i>72.2</i>	<i>60</i>	<i>58.3</i>
Sometimes	<i>16.7</i>	<i>14.3</i>	<i>20</i>	<i>11.1</i>	<i>26.7</i>	<i>33.3</i>
Infrequently	<i>16.7</i>	<i>28.6</i>	<i>0</i>	<i>16.7</i>	<i>13.3</i>	<i>8.3</i>
p-value	0.75	0.28	1.00	0.27	0.68	0.56
<b>Food Processing &amp; Preparation Contamination (n=38)</b>						
Frequently	<i>66.7</i>	<i>57.1</i>	<i>80</i>	<i>68.4</i>	<i>53.3</i>	<i>33.3</i>
Sometimes	<i>33.3</i>	<i>42.9</i>	<i>20</i>	<i>26.3</i>	<i>33.3</i>	<i>66.7</i>
Infrequently	<i>0</i>	<i>0</i>	<i>0</i>	<i>5.3</i>	<i>13.3</i>	<i>0</i>
p-value	0.75	1.00	0.72	0.40	0.29	<b>0.04</b>
Numbers represent percentages (italicized). P-values pertain to Fisher’s Exact Test Results. *Indicates missing data. Total survey respondents possible equal to 38. Not all respondents answered all questions.						

Relationships were tested between the *importance* of food issues (i.e., food additives, agricultural contamination, and food processing and preparation contamination) during *food choice* and the *frequency* of considering the same respective food issues during *food purchase*. As previously mentioned, not all study participants following a special restrictive diet (n=38) answered all parts of the matrix questions assessing perceptions and practices with regards to the various food

issues. One response each was missing for relationship testing for the genetic modification of food and the food processing and preparation contamination issues (n=37, respectively), while three responses were missing for the agricultural food contamination issue (n=35). However, both sub-questions about food additives were completed by all participants. Of those who considered food additives important during food choice (n=30) most (80%) also frequently took food additives into consideration during food purchase, whereas 16.7% sometimes and 3.3% infrequently considered this food issue when buying food (p=0.00). Similarly, of those who considered genetic modification of food important (n=22), the majority (72.7%) also frequently considered this issue during food purchase and fewer sometimes (22.7%) and infrequently (4.5%) reported taking GM food into consideration during food purchase (p=0.00). Notably as well, the majority of participants reported agricultural contamination to be important during food choice (n=33), out of these individuals 69.7% frequently considered this same issue during food purchase and much less (24.6%) sometimes or infrequently (6.1%) thought about the genetic modification of food when buying food (p=0.01). Lastly, of the participants who considered food processing and preparation contamination to be important during food choice (n=33), 63.6% frequently, 33.3% sometimes, and 3.0% infrequently took this food issue into consideration when buying food (p=0.012).

## **DISCUSSION**

This study assessed a sample of university students engaging in special restrictive diets. The study cohort consisted of mostly female (87%), young adults ages 18-24 years old (68%), who were non-Hispanic (89%), white or Caucasian (79%), and undergraduate students (57%). To the author's knowledge, no other study has described a sub-group of special restrictive diet adoptees, amongst a population of university students, leaving few studies for comparison. Yet, these

results are consistent with findings from a small sample of individuals following politically-motivated alternative diets, such as vegetarian, vegan, GMO-free/organic, and gluten-free, where the majority were found to be female, 19-34 years old, and Caucasian [55]. However, the present study differs by comparison because it did not exclude individuals based on motivation for specific diet adoption.

Amongst this cohort, the most frequently reported dietary patterns were the dairy-free (50%) and vegan or vegetarian diets (39.5%), followed by the gluten-free or “other”-type diets (31.6%, each). Few participants reported restricting wheat (18.4%) or adhering to a paleolithic-type pattern (13.2%). Meanwhile, only one participant each self-reported being grain-free or GMO-free. The higher report of dairy avoidance compared to wheat in this study is consistent with results from prior studies [3, 4]. Higher report of milk and/or dairy food allergies have also been documented over wheat and/or gluten food allergies [7]. Moreover, in another study of special diets the most frequently reported eating pattern was the vegetarian diet (22 out of 71 participants) [19].

Within this sample, it was found that half of the participants reported following two or more restrictive diets, thus indicating a very restrictive eating pattern. While this study did not investigate how frequently particular diets overlap, other literature has reported slightly over half of symptomatic wheat-avoiding individuals to be simultaneously avoiding dairy foods [3]. As discussed previously, this is noteworthy given the nutritional, financial and psycho-social challenges of following special restrictive dietary patterns. This highlights the importance of helping patients identify which foods are responsible for their symptoms to allow for liberalization of their diet when possible [3, 4, 10]. Though some may choose to avoid foods for

non-medical reasons, it still within reason for clinicians to work with patients to ensure nutritional adequacy of their diets.

In the present study, relationships between demographic traits and specific diet types were not observed. However, there was one exception to this, which was that 77.8% of those on a dairy-free diet were undergraduate students compared to 22.2% who were graduate or professional students ( $p=0.02$ ). Furthermore, a relationship that neared significance was found between the gluten-free diet and race/ethnicity in which over half (58.3%) of persons on a gluten-free diet reported being white or Caucasian ( $p=0.08$ ). By comparison, previous studies have reported significant associations between demographic characteristics and one or two different restrictive diets [2-4]. The lack of associations within this present study, may be due to the low sample size, especially amongst specific diet types, that underpowered statistical testing. This is one reason why readers should not make broad inferences from these results.

Overall, 20% to 42.1% of special restrictive diet followers in this cohort reported to agree that it is important to follow the national dietary recommendations for optimal health. Meanwhile, fewer (0% to 26.3%) participants across all diets reported to agree that the national recommendations are helpful and even more (42.1% to 80%) agreed that these recommendations are flawed. Collectively, these findings suggest that regardless of diet, special restrictive diet adoptees do not have high perceptions of the national dietary recommendations. Despite this, across all diets many (41.7% to 66.7%) agreed that the recommendations made by experts were sound and can be trusted, with the exception of participants on a paleolithic-type diet in which none reported to agree with this statement. For comparison, a previous study conducted amongst the general public assessed only the perceived importance of following nutrition expert advice but did not inquire specifically about national dietary recommendations [35]. In some ways the

findings from this prior study are consistent with our results with respect to nutrition experts, as most consumers believed it to be important to follow nutrition expert advice and analysis of this same survey showed consumers had higher trust in nutrition experts [35]. However, in contrast to the present study, few (23.2%) consumers reported to agree that the nutrition recommendations made by experts lack what is important [35]. Although it should be mentioned that experts may be perceived differently than the national dietary recommendations made by experts, a differentiation that should be made in future studies.

As suggested by previous literature, it may take more than just transparency and supplying individuals with information to be considered trustworthy, but also clarification of the values that drive actions [47]. Consumers view food system actors as less trustworthy when they believe the actors are financially motivated, whereas more trustworthy actors are those who are believed to value the welfare of consumers [50]. Within this study population, distrust was shown towards food system actors across all diets when only 0% to 25% agreed that food manufacturers and the agricultural system were trustworthy and open about their practices. Moreover, across all diets few (0% to 26.7%) agreed that individuals have easy access to information about how food is produced and/or processed. These findings may suggest that those on a special restrictive diet have little trust in these specific food system actors and poor perceptions of their transparency. As previously mentioned, food manufacturers have been noted to not be well trusted by consumers, which may have been a strong enough perception to elicit the observed results of this study [49]. With regards to openness, these results differ from previous research which showed most consumers to feel they were able to get the information they needed to purchase healthful and good quality food [35]. However, despite these findings of poor trust and low perceptions of

transparency, most (53.3% to 83.3%) participants agreed that the food available is safe—a perception that has been documented by other studies on consumer food concerns [35, 52].

Amongst this study cohort, it was demonstrated that the majority (80%) of those on a paleolithic-type diet did not find it important to follow the national dietary recommendations for optimal health ( $p=0.08$ ). Moreover, paleolithic-type diet followers also were found to largely (80%) disagree that the nutrition recommendations made by health/nutrition experts are sound and can be trusted ( $p=0.02$ ). Together, these findings suggest that individuals on paleolithic-type diet may not perceive the national dietary recommendations as health promoting, nor do they view health/nutrition experts as sound and trusted sources of information. Comparatively, a paleolithic-type diet, which restricts grains, legumes, and dairy, differs greatly from a DGA-based diet that encourages consumption of these same foods as a part of a healthy eating pattern [1, 14]. However, paleolithic-type diet supporters contend that our modern diet promotes chronic disease, a view which may help to explain these present findings [9].

Within our sample, 75% of gluten-free dieters perceived food in the US to be safe ( $p=0.02$ ). In addition, when asked to rank the importance of different food issues during food choice, across all issues most gluten-free diet adoptees rated each issue as important (75% to 91.7%,  $p > 0.05$ ). This was similar for how frequently gluten-free diet adoptees reported to consider each food issue during food purchase (54.5% to 75%,  $p > 0.05$ ), but to a lesser degree. Little is known about gluten-free individual's perceptions with regards to food safety and food issues for comparison. These results suggest that while those on a gluten-free diet perceive food in the US to be safe, they also consider food issues to be important and to a high but slightly less extent consider food issues often when buying their food.

Amongst this population, a somewhat similar pattern was seen when comparing the perceptions of vegans or vegetarians with respect to food safety and the genetic modification of food. Over fifty percent of vegan or vegetarian dieters agreed that the food in the US is safe ( $p=0.07$ ). In addition, 53.3% of those on a vegan or vegetarian diet considered genetic modification of food important during food choice ( $p=0.03$ ), though only a third reported to frequently consider this food issue during food purchase ( $p > 0.05$ ). The perception that GMOs are concealed within food may impact consumer trust [39]. In another study, those who reported higher general concern for food safety ranked mandatory labeling of GM foods as a high priority food safety assurance issue [52]. Moreover, politically motivated eaters have self-reported vegan, vegetarian and GMO-free/organic diets amongst other eating patterns [55]. While one study reported only a small percentage (5%) of vegans attributing capitalistic and food industry concerns as their primary motivation for avoiding animal products, another study showed over a third of politically motivated alternative diet adoptees to cite lack of trust in the food industry [55, 56]. Interestingly, within this study every individual (100%) on a vegan or vegetarian diet did not believe that representatives of the food system (food manufacturers and the agricultural system) were trustworthy and open about their practices ( $p=0.02$ ). Prior research has shown that vegans and vegetarians have poor trust in food system actors like farmers and regulatory bodies, in addition to expressing concern surrounding animal farming practices [57]. Another study reported meat-restrictive special diet followers to have a significantly higher preference for non-conventional food network products (e.g., local, sustainable, and organic) than special restrictive dieters who do not exclude meat from their eating pattern [19]. Moreover, participation in food networks that shorten the supply chain may aid consumers in building food trust through added

transparency and by connecting consumers and producers, as indicated by consumer focus groups [57].

Those with lower overall food safety concerns have been reported to have low concern with regards to microbiological issues, such as restaurant sanitation and microbiologic contamination [52]. Yet, within this study, over 80% of individuals on an “other”-type diet agreed that food in the US is safe and reported food processing and preparation issues to be important during food choice ( $p > 0.05$ ). Meanwhile, only one-third of “other”-type diet followers reported to frequently consider food processing and preparation contamination during food purchase ( $p=0.04$ ). These data suggest higher trust in the general safety of food may allow for less frequent attentiveness towards food issues seen as important when making food purchase decisions. This may be explained by who participants view as being responsible for the safety of food at different points of the food chain, which can include the consumer after they have purchased food [50].

Within this cohort of special restrictive diet adoptees, we evaluated relationships between their attitudes of various food issues (i.e., food additives, GM of food, agricultural contamination, food processing and preparation contamination) and frequency of purchase behavior regarding these same respective food issues. Across all food issues, the rated importance of considering a specific food issue during food choice and the reported frequency of considering the same respective food issue during food purchase was significantly associated ( $p < 0.05$ ). Most (71.4% to 83.3%) individuals across all diets, not only regarded food additives important during food choice but also frequently (57.1% to 75%) considered this same food issue during food purchase ( $p=0.00$ ). This finding was similar with respect to agricultural contamination across all diets, where the majority (80% to 100%) of participants rated this issue as important during food

choice and many (57.1% to 72.2%) frequently considered agricultural contamination during food purchase ( $p=0.01$ ). Food processing and preparation contamination was also rated as important during food choice by the majority of special restrictive diet adoptees (83.3% to 100%) yet, across all diets 33.3% to 80% of participants reported to frequently consider this same food issue during food purchase ( $p=0.01$ ).

Genetic modification of food was less concerning to special restrictive diet followers compared to other food issues. Regardless of diet type, 40% to 75% of participants rated this issue as important during food choice and only 20% to 54.5% of individuals reported to frequently consider this food issue during purchase ( $p=0.00$ ). While genetic modification of food has been reported to be important amongst the public, other literature has demonstrated less concern amongst consumers [53, 54]. Despite this issue being rated as less important relative to the other food issues in this study, it was still considerably concerning within this sample of the population. These findings suggest that beliefs do not predict practice entirely. For instance, in one European study 75.3% of consumers reported negative feelings towards genetically modified foods, but less than one-third reported to actively avoiding purchasing genetically modified foods [58]. It may also be that adoption of a special dietary pattern in itself reduces the need for vigilance during food purchase, as individuals are able to avoid foods they find unsafe through their practices as suggested by prior research [39]. This is a potential avenue for future research to explore whether avoiding specific foods or adhering to a special restrictive dietary pattern modifies the food trust relationship.

Of note, prior literature has shown food issue concerns to be predicted by age, with older adults (over 30 years) being more concerned with or attribute greater importance to food issues than younger adults [51, 54]. Although this study did not investigate associations between food issue

concerns and age, all food issues were concerning within this university sample of special restrictive diet followers. Since the majority of participants in this study were between 18-24 years of age these data may suggest young adults on special restrictive diets may be more concerned about food issues than their counterparts who do not engage with special diets. However, this is something to be further investigated by prospective studies, since this one did not use a non-restrictive diet comparison group.

## **STRENGTHS AND LIMITATIONS**

This study adds to the literature as it investigates the dietary perceptions and practices of university students following special restrictive diets (i.e., gluten-free, wheat-free, grain-free, paleolithic-type, dairy-free, vegan or vegetarian, or other-type diet). As previously mentioned, there is a paucity of research on special restrictive diet adoptees and their dietary perceptions, which the present study aimed to fill. A major strength of this research is that it is hypothesis generating. Moreover, the anonymity of the survey may have reduced subjective bias created by self-report.

However, there are several limitations to this study. First, there are constraints on generalizability. By drawing from a population of university students the study cohort may not be representative of special restrictive diet adoptees. University students are already on a path of higher education, which could result in over-representation of this and other demographic characteristics. Second, the small sample size limits statistical power and may have negatively impacted the study's ability to detect more relationships between diet types and other measured variables. Third, this study's sample did not include individuals who do not report following a special restrictive diet for use as controls. Thus, assessment of differences between special restrictive diet followers and those who do not follow restrictive diets cannot be made.

Moreover, the cross-sectional study design prevents the ability to determine causation. Lastly, a weakness in this study lies within the design of the survey, in which inconsistent language was used within survey questions. While question 11 referred to the national dietary recommendations as (The Dietary Guidelines for Americans), subsequent questions 12 and 13 referred to the “national nutrition recommendations” and the “national recommendations”. Thus, care should be taken when trying to apply these results to one particular nutrition guide or national nutrition program.

## **FUTURE DIRECTIONS**

Given the limitations of the present study, future research should draw large, randomized samples from the general population. Study design should also utilize a control group to assess differences in perceptions with that of the study group(s) of interest.

While this study did investigate a variety of types of special restrictive diets, it did not assess motivations for dietary adoption. Future studies would benefit from investigating motivational predictors of dietary adoption and assessing relationships between motivations for special restrictive diet adoption and dietary perceptions. Additionally, although the majority of participants reported to perceive food as safe, they still considered food issues important during food choice and to a lesser degree frequently considered these same food issues during food purchase. Thus, future studies should also explore whether adoption of special restrictive diets strengthen or weaken trust with respect to perceived safety of the food they consume.

## **CONCLUSION**

To summarize, this study demonstrated that university students engage in a variety of different special restrictive diets. The most predominant amongst this cohort being the dairy-free and

vegan or vegetarian diets, while half reported to be following two or more types of restrictive diets. Except for observing a significant relationship between following a dairy-free diet and student status, the present study did not find other significant associations between special restrictive diet types and demographic characteristics. Attitudes towards the importance of adhering to the national dietary recommendations for optimal health were mixed. That said, the majority did view these national recommendations as both flawed and unhelpful in following a healthy eating pattern. Despite these perceptions, most did believe the nutrition recommendations from health/nutrition experts are sound and can be trusted. Meanwhile, the majority did not perceive representatives of the food system to be trustworthy and open about their practices, whereas most did not feel there was easy access to information on how food is processed or produced. In sum, this suggests that individuals on a special restrictive diet do not believe food manufacturers and the agricultural system are trustworthy, while they also do not believe that they are transparent. Even still, the majority of special restrictive diet followers perceived food in the US to be safe. Additionally, food issues were considered important during food choice and were for the most part also taken into consideration frequently during food purchase by this population. Association testing did find some of the specific diets (i.e., gluten-free, vegan or vegetarian, paleolithic-type pattern and “other”-type diet) to be significantly associated with certain dietary perception and food issue variables. These associations suggest that diet type may influence dietary perceptions or vice versa. Large and well-designed studies should be conducted in the future to further explore these relationships, taking into account the present study’s findings and limitations. Lastly, these results may serve to aide both clinicians in optimizing the nutrition status of those who on a special restrictive diet or public health professionals in customizing messaging for this same population.

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## APPENDIX

*The Diet and Food Choice Survey* was comprised of the following questions:

1. Do you follow any kind of special diet or eating pattern?
2. Do you currently use any of the following diet patterns? *Please check all that apply.*  
Response options included: gluten-free; wheat-free; grain-free; paleolithic-type pattern; dairy-free; genetically modified organism or genetically engineered organism-free; and other (short answer additional information requested for this final option).
3. Matrix question: For each diet you are currently following, please select your main reason for using each eating pattern. *Single response per individual diet option.* Response options included: Personal Medical Reasons (or medical-related symptoms); weight control or weight loss; taste preference; a member of my household follows this diet; environmental, societal, or political reasons; and other reasons not defined here. Diet options included: gluten-free; wheat-free; paleolithic-type; dairy-free; GMO-free; and other diet previously indicated).
4. Matrix question: For each diet you are currently following, please select any additional reason(s) for using each eating pattern, *other* than your main reason previously indicated in question 3. *Please check all that apply.* Response options included: Personal Medical Reasons (or medical-related symptoms); weight control or weight loss; taste preference; a member of my household follows this diet; environmental, societal, or political reasons; and other reasons not defined here. Diet options included: gluten-free; wheat-free; paleolithic-type; dairy-free; GMO-free; and other diet previously indicated).
5. Matrix question: For each diet you are currently following, please select the major source of information you used for each eating pattern. *Single response per individual diet option.* Response options included: prescription or advice from a qualified health or nutrition professional; information from a book, magazine, news article, or television show; internet (web page, blog, web forum, or podcast); recommendation from a friend or family member; and other source not defined here). Diet options included: gluten-free; wheat-free; grain-free; paleolithic-type; dairy-free; GMO-free; and other diet previously indicated).
6. Matrix question: For each diet you are currently following, please select additional source(s) of information you used for each eating pattern, *other* than your major source of information previously indicated in question 5. *Please check all that apply.* Response options included: prescription or advice from a qualified health or nutrition professional; information from a book, magazine, news article, or television show; internet (web page, blog, web forum, or podcast); recommendation from a friend or family member; and other source not defined here). Diet options included: gluten-free; wheat-free; grain-free; paleolithic-type; dairy-free; GMO-free; and other diet previously indicated).
7. Do you have any of the following conditions? *Please check all that apply.* Response options included: celiac disease; non-celiac gluten sensitivity; wheat allergy; dairy allergy; lactose intolerance; and no, I do not have any of the above conditions).
8. Have you ever received a formal diagnosis from a qualified health professional for the following

conditions? *Please check all that apply.* Response options included: celiac disease; non-celiac gluten sensitivity; wheat allergy; dairy allergy; lactose intolerance; and no, I have never received a formal diagnosis from a qualified health professional for any of the above conditions).

9. Matrix question: Please indicate for each health condition the type of health professional that provided you with your diagnosis. *Please select one response per row.* Response options included: medical doctor; naturopath; nurse practitioner; and other). Health condition options included: celiac disease; non-celiac gluten sensitivity; wheat allergy; dairy allergy; and lactose intolerance).
10. Gluten is: *Please check all that apply.* Response options included: a contaminant of food processing; a toxin found in wheat and other grains; a naturally occurring protein in wheat, barley and rye; an ingredient in processed foods that causes belly fat; and other (short answer additional information requested for this final option).
11. It is important to follow the national dietary recommendations (The Dietary Guidelines for Americans) made by nutrition experts for optimal health. Response options included: strongly agree; slightly agree; neutral; slightly disagree; strongly disagree.
12. The national nutrition recommendations made by health/nutrition experts are flawed. Response options included: strongly agree; slightly agree; neutral; slightly disagree; strongly disagree.
13. The national recommendations made by nutrition experts help me follow a healthy dietary pattern. Response options included: strongly agree; slightly agree; neutral; slightly disagree; strongly disagree.
14. Generally speaking, the nutrition recommendations made by health/nutrition experts are sound and can be trusted. Response options included: strongly agree; slightly agree; neutral; slightly disagree; strongly disagree.
15. Matrix question: How important are the following issues to you when you make food choices: *Please select one response per row.* Response options: very important; somewhat important; neither important nor unimportant; somewhat unimportant; and very unimportant. Inquired food issues included: food additives, such as preservatives and food coloring; genetic modification or engineering of food; agricultural food contamination, such as chemicals (e.g., pesticides, dioxins) and micro-organisms (e.g., illness-causing bacteria); and food processing & preparation contamination, such as unsanitary food-handling practices (e.g., cross-contamination with illness-causing bacteria or allergens, temperature abuse, unclean equipment or lack of hand-washing).
16. Matrix question: How often do you consider the following issues when you making food purchases: *Please select one response per row.* Response options: always; very often; sometimes; rarely; and never. Inquired food issues included: food additives, such as preservatives and food coloring; genetic modification or engineering of food; agricultural food contamination, such as chemicals (e.g., pesticides, dioxins) and micro-organisms (e.g., illness-causing bacteria); and food processing & preparation contamination, such as unsanitary food-handling practices (e.g., cross-contamination with illness-causing bacteria or allergens, temperature abuse, unclean equipment or lack of hand-washing).

17. Generally speaking, the food available in the United States is safe. Response options included: strongly agree; slightly agree; neutral; slightly disagree; strongly disagree.
18. Generally speaking, food manufacturers and the agricultural system are trustworthy and open about their practices. Response options included: strongly agree; slightly agree; neutral; slightly disagree; strongly disagree.
19. Generally speaking, individuals have easy access to information about how food is produced and/or processed. Response options included: strongly agree; slightly agree; neutral; slightly disagree; strongly disagree.
20. What is your age? *Short answer response.*
21. What is your sex? *Single response.* Response options included: Male and Female.
22. Do you identify as either Hispanic or Latino(a)? *Single response.* Response options included: yes; no; or unknown.
23. To which racial or ethnic group(s) do you most identify? *Please check all that apply.* Response options included: American Indian or Alaska Native; Asian; Black or African American; White or Caucasian; Native Hawaiian or other Pacific Islander; Unknown or Not Reported; More than one race.
24. Please indicate your current student status at the University of Washington. *Single response.* Response options included: freshman; sophomore; junior; senior; and graduate/professional student.

**Study Recruitment Flyer:**



**VOLUNTEERS NEEDED!**

If you are a **non-pregnant University of Washington student who is at least 18 years old AND following one or more of the diets listed below**, you may be able to help researchers learn more about these special dietary patterns.




**Are you:**

- Gluten-free?
- Paleolithic?
- Dairy-free?
- GMO-free?
- Using another diet?

Scientists at the UW and Fred Hutch would like to hear from you!

To participate, visit <http://bit.ly/1RHCsuS>  
 For more info, call (206)–667–4779 and ask about the  
 Diet & Food Choice Study.  
**Participation is anonymous and voluntary!**



<a href="http://bit.ly/1RHCsuS">http://bit.ly/1RHCsuS</a> 206-667-4779 tom@uw.edu	<a href="http://bit.ly/1RHCsuS">http://bit.ly/1RHCsuS</a> 206-667-4779 tom@uw.edu	<a href="http://bit.ly/1RHCsuS">http://bit.ly/1RHCsuS</a> 206-667-4779 tom@uw.edu	<a href="http://bit.ly/1RHCsuS">http://bit.ly/1RHCsuS</a> 206-667-4779 tom@uw.edu	<a href="http://bit.ly/1RHCsuS">http://bit.ly/1RHCsuS</a> 206-667-4779 tom@uw.edu	<a href="http://bit.ly/1RHCsuS">http://bit.ly/1RHCsuS</a> 206-667-4779 tom@uw.edu	<a href="http://bit.ly/1RHCsuS">http://bit.ly/1RHCsuS</a> 206-667-4779 tom@uw.edu
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