Eating Perceptions Of University Students Who Are Following A Special Restrictive Diet: The Food And Health Survey

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Abstract

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Background: Many consumers follow food restrictions, sometimes based on unregulated sources of information. The goal of this study was to evaluate the eating perceptions of university students who are following a restrictive diet.

Methods: The Food and Health survey was a cross-sectional study of students of the University of Washington (UW). Inclusion criteria were being a non-pregnant student older than 18 years and following a diet described by at least one of the following characteristics: gluten-free, dairy-free, genetically modified organisms-free, Paleolithic or other. The survey included questions on socio-demographics, diet restrictions, food- and health-related knowledge, diagnosis, sources of diet information and perceptions of RDs. Results were summarized with descriptive statistics. The Fisher's Exact test ($\alpha=0.05$) calculated an exact probability value for the relationship between: 1) single socio-demographic variables and single diet features, 2) expected and observed physical improvement since diet initiation, and 3) medical necessity for and adherence to a gluten-free diet.

Results: A total of 47 participants completed the survey. The typical respondent was female (72.4 %), younger than 24 (44.7%), non-Hispanic (93.6%), white (72.3%), undergraduate (46.8%) and with sufficient funds for monthly food purchases (61.7%). Respondents followed varied combinations of diet restrictions, with "gluten-free" the most frequently reported (42.6%). A higher percentage of females than males was following a diet that was at least gluten-free ($p<0.05$). The majority of the respondents had started their diet to improve physical symptoms (63.8%) and a significantly higher percentage of these

respondents than those with other reasons to start a diet achieved such goal ($p<0.01$). Also, two thirds of the respondents reported a medical condition and a significantly higher percentage of those with gluten-related disorders than other diagnoses reported following a gluten-free diet ($p<0.01$). The most common diagnosis providers were medical doctors (58.1%) and self (32.3%) while only 19.4% received a diagnosis by RDs. The internet was the most common source of diet information (68.9%). Finally, respondents had a neutral opinion about the time (36.9%) and money (54.5%) required to visit RDs. **Conclusion:** Although the sample size is small, the study provides a better understanding of food avoidance in university students following a restrictive diet. Future research should explore how RDs could utilize online resources to support individuals with restrictive diets.

BACKGROUND

Diets excluding gluten, dairy products, genetically modified organisms (GMO) or foods resulting from the development of agriculture (i.e. Paleolithic) have become extremely popular (1-4). For example, 30% of all Americans are now avoiding foods that contain gluten (2). However, the percent of consumers that avoid gluten exceeds the estimated population-level prevalence of diseases, allergies, and intolerances (e.g. celiac disease, wheat allergy, gluten intolerance) that would require a gluten-free diet (5). As these restrictive diets increase in popularity, it is unclear whether they are in response to adverse reactions to foods and/or for other perceived reasons, such as better health. The latter is often not well-supported by scientific evidence (6). Knowledge of these different pathways and why individuals decide to follow restrictive diets and where they obtain diet and health information will provide important insights to nutrition professionals who work with patients and clients who follow these diets.

An estimated one-fifth of the United States (U.S.) population self-report adverse reactions to food (2, 7, 8). Complaints include common, generic symptoms such as pain, discomfort, bloating, flatulence and/or bowel movement changes (9) without being able to differentiate between allergy, intolerance, or even mild food poisoning (7). In response to these adverse reactions, many individuals self-diagnose and then seek information about what to do for this self-diagnosed condition. Many tend to self-prescribe special restrictive diets, fueled at least partially by online resources or industries that promote the purchase of various specialty food products or diets that will alleviate symptoms (2, 10, 11). For example, some individuals remove milk and milk byproducts from their diets to prevent lactose malabsorption, lactose intolerance or milk allergy (11).

At the same time, some popular restrictive diets are encouraging avoidance of multiple food groups for other reasons. For instance, the word “Paleo”, the most searched diet-related term on Google in 2014, refers to the eating pattern of our Stone Age ancestors (and its modern version, the Paleolithic diet), which excludes legumes, grains, fatty meat, dairy products and processed foods (12). This eating plan blames the agricultural revolution for promoting unpleasant symptoms or even the onset human chronic diseases due to excessive consumption of “modern” foods (12). Similarly, most U.S. consumers would be willing to pay a 45% mean premium for food products of plant and/or animal origin that were grown with genetically modified seeds (13). Lastly, although the definition of “vegetarianism” varies in literature, many

individuals who report to avoid meat associate beef consumption with weight gain, increased risk of chronic disease, ethical issues about the killing of animals and damage to the environment (14).

Altogether, these data support the widespread, unjustified assumption that diets or food products identified as 'free' of something (e.g. gluten-free, dairy-free or GMO-free) must be healthier (11). However, whether the increasing trends in self-diagnosis and/or self-diet prescription represent a new epidemic or a new myth is still unknown (2). Similarly, it is unclear whether individuals who follow restrictive diets are able to meet their initial expectations.

While recognizing individual food-related needs, preferences and beliefs, RDs emphasize that good nutrition can be gradually achieved thanks to a balanced eating pattern. Furthermore, like many other health care professionals, RDs are concerned that the purchase of specialty food products can bring about unforeseen financial (1, 15) and psycho-social stress (16-18) and a variety of nutrient deficiencies (19, 20). Although it is hard to estimate the risk of nutrient deficiencies due to the limited research in this area and the fact that deficiencies may depend on individual combinations of food restrictions, RDs could help prevent or minimize them. Accordingly, even if some individuals followed a special restrictive diet owing to personal values rather than medical needs, the consequences of certain food choices could still impact their biological balance due to the possible lack of nutrients that are necessary to maintain human health. For example, by eliminating gluten, consumers may reduce carbohydrates or fiber intake while risking to ingest more fat or sugar to compensate for their diet restriction (20). Likewise, dairy-like products may lack adequate amounts of magnesium, high-quality protein, calcium, phosphorus and vitamins A and D (21); GMO-free foods may not necessarily provide more nutrients than their non-modified counterparts (22, 23) and vegetarian diets may cause deficiencies of vitamins B12 and D unless these nutrients are properly supplemented. Finally, the obsession to consume only "right" foods may contribute to a growing eating disorder called orthorexia nervosa (from "ortho", straight; "orexia", appetite) (1).

Data regarding the eating perceptions of university students in the U.S. are particularly sparse. University students represent a suitable sample for investigating food consumption behaviors due to their new autonomy in making their own food choices. In fact, this demographic group is known to receive

information from a variety of sources, frequently of digital nature, where many of these restrictive diets are popularized (24, 25).

In addition, because there is little research to guide RDs on the patterns and motivations for following restrictive diets, studying the context of the food choices of university students in the U.S. who are following a special restrictive diet could help provide insight.

GOAL, SPECIFIC AIMS AND HYPOTHESES

The goal of the present thesis project was to evaluate the eating perceptions of University of Washington (UW) students who are following a special restrictive diet. The specific aims were:

- To investigate the eating habits of and the reasons why university students eliminate certain foods or food components from their diet including, but not limited to, gluten, dairy, foods made with GMO ingredients and other food groups that result from the development of modern agriculture (e.g. legumes, grains, fatty meat, dairy products and processed foods).
- To study how the perceived health and overall wellbeing of students following a special restrictive diet has changed since they started their dietary regimen,
- To establish what students following a special restrictive diet think about the RD profession as opposed to other sources of diet information.

The hypotheses were that the majority of university students following a special restrictive diet did not receive a diagnosis from qualified professionals such as RDs for a condition that may necessitate dietary changes and would not rely on RDs as much as other sources of information to make their food choices.

METHODS

Study design and recruitment

The study is a cross-sectional, primary data analysis of the Food and Health survey. Between January 2016 and March 2016, upon completion of the online Collaborative Institutional Collaborative Initiative (CITI) training and approval of the Institutional Review Board (IRB) Committee of the Fred Hutchinson Cancer Research Center (FHCRC), flyers for the Food and Health survey (attached in the Appendix) were posted in common areas in buildings of the Seattle campus of the UW. Verbal in-class

advertisement was conducted in order to highlight the existence of the flyers. Potential participants were UW undergraduate and graduate students older than 18 and non-pregnant and self-reported following a special restrictive diet with at least one of the following characteristics: gluten-free, dairy-free, Paleolithic, GMO-free and other. Students were eligible to participate regardless of gender, age, race, ethnicity and health status. The flyers reported also the URL (Uniform Resource Locator) of the survey, which was shortened via the free on-line service "Bit.ly", and a QR code, which was developed via a free QR code generator available at http://www.qr-code-generator.com/. Both resources were meant to facilitate survey access. In addition, the flyers welcomed potential participants to call a voicemail box to ask more information, if needed. A registered message was set to greet potential participants and inform them that their call would be returned within two days without any identification requirements. Potential participants were notified that there were neither risks nor direct benefits to them from their participation and that their consent was implied when they started the survey. They were also informed that it would take less than 15 minutes for them to complete the survey and that they could skip the questions they didn't feel comfortable answering. The voluntary and anonymous nature of the participation was reinforced in the flyers, in-class advertisement and consent statement (see Appendix). The expected sample size of n=30 or greater respondents was the target as is typically required as the minimum for pilot studies (26).

Survey instrument

The survey instrument (see Appendix) was developed using Catalyst tool, a software that is open access and free of charge to use. A general content message asked students to refer to their usual food intake rather than focusing on seasonal eating habits. This message was followed by 18 questions with the following answer formats: single choice, multiple choice (as indicated by the phrase "check all that apply" at the end of the question) and Likert-scale matrix allowing one answer per row. The addition of an "other" textbox to some close-ended questions allowed respondents to either offer additional information about their choice, or provide an alternative answer if the available answer choices did not apply to them. The questions were then grouped into 6 categories for analytical purposes: 1) confirmation of inclusion criteria, 2) diet restrictions examination, 3) food- and heath- related knowledge, 4) diagnosis and sources of diet related information, 5) perceptions of the RD profession and 6) socio-demographics. Branching

helped create custom response paths in two specific situations. First, participants who accessed the survey but answered “no” to the question “Do you follow any kind of special eating plan?” were directed to the demographic questions as they were not eligible for the rest of the survey. Second, respondents who answered “none” to the question “What was your diagnosis when you started your current eating plan”? were flipped over the question: “Which of the following gave you the diagnosis? (check all that apply)”.

Variables

Socio-demographic variables included: age, sex, ethnicity, race, student status and funds availability for monthly food purchases. Age was collected categorically as less than 24 years, 25-34 years, and 35-44 years and more than 45 years. For analytical purposes, this variable was collapsed to less than 24 years, 25-34 years, and more than 35 years in order to create large enough and stable age groups for analysis. Sex was collected and analyzed as male or female and ethnicity was collected and analyzed as Hispanic/Latino or not Hispanic/Latino. Race was collected as white or Caucasian, black or African American, Asian, native Hawaiian other Pacific Islander, American Indian, or Alaska native; however due to small sample size, it was collapsed as white or non-white for final analysis. Student status was collected and analyzed as undergraduate or graduate. Funds for monthly food purchases was collected as always sufficient, often insufficient, sometimes insufficient and always insufficient; however, this variable was collapsed as sufficient or insufficient for final analysis.

Diet-related variables included type of diet features and frequency of food consumption. Respondents following a special restrictive diet described their eating pattern by selecting one or more of the following 5 options: “gluten-free”, “dairy-free”, “Paleolithic”, “GMO-free or “other”. However, for analytical purposes, diet characteristics implying some kind of meat restriction, such as “vegetarian”, “vegan”, “pescatarian”, “plant-based” or “limiting the amount of meat”, were collapsed to “meat restricted” while all those diet features that could not be otherwise categorized were grouped into the category “other”. While following a specific diet restriction was considered as a dichotomous variable, frequency of food consumption was coded using the following scale: “never”, “1-2/ month”, “once/ week”, “3-4 times/ week” and “1 or more times/day”. All respondents were asked to complete the same matrix; however, separate tables were created to analyze adherence to the gluten-free, dairy-free, Paleolithic, GMO-free

and meat-restricted diet restrictions. Published articles served a reference to establish what food categories of the original matrix would be addressed per table (7, 12, 20, 23, 27-31).

The survey addressed also other variables that were re-defined as dichotomous variables in the analytical phase of the study. For instance, responses regarding the expected improvement(s) from diet initiation were collected via a multiple choice question; however, for analytical purposes, the variable "expected physical improvement" was re-defined as "yes" (to indicate that respondents expected that their diet would reduce physical symptoms) and "no/undefined" (indicating that respondents did not know what to expect or did not expect that their diet would reduce physical symptoms). Similarly, observed improvement since diet initiation was investigated via a Likert scale question so that the answers were collected as "agree", "somewhat disagree", "neutral", "somewhat disagree" and "disagree". Nonetheless, the variable "observed physical improvement" was re-defined as "yes" (to comprise the options "agree" and "somewhat agree") and "no/undefined" (to comprise the options "neutral", "somewhat disagree" and "disagree"). Lastly, responses regarding gluten definition and self-reported diagnosis were collected categorically; however, responses were defined as "correct gluten definition", "incorrect gluten definition", "medical necessity for a gluten-free diet" (diagnosis of celiac disease, non-celiac gluten sensitivity or wheat allergy) (32) and "no/unknown medical necessity for a gluten-free diet".

Statistical analysis

Descriptive statistics provided frequency distributions and cross-tabulations of variables. Due to the low sample size, the Fisher's exact test calculated a exact probability value for the relationship between 1) single socio-demographic variables and single diet features, 2) expected physical improvement (from diet initiation) and observed physical improvement (since diet initiation) and 3) medical necessity for a gluten-free diet and following a gluten-free diet. Statistical significance was obtained when the probability of obtaining the observed result or a more extreme result was less than 0.05. Microsoft Excel 2010 and the statistical software package Stata SE 12 were utilized for the analysis.

RESULTS

Socio-demographics

Of the 52 potential participants who accessed the survey, 5 were not eligible for the remainder of the survey since they reported no special restrictive diet. Therefore, 47 respondents represented the analytical sample for the study. The overall sample distribution by socio-demographic features is shown in Table 1. The majority of the respondents were younger than 24 years of age (44.7 %) and females (72.4%). Most of them (93.6%) identified themselves as neither Hispanic nor Latinos and 72.3% percent reported to be White. Almost half (46.8%) were undergraduate students, 44.7% were graduate students while 8.5% did not report their student status. The majority (85.1%) reported to have sufficient funds for monthly food purchases while 12.8% stated that such funds were insufficient and 2.1% did not respond.

Table 1. Socio-Demographics of the Food and Health survey respondents

	(n)	Percent (%)
Age (years)		
18-24	21	44.7
25-34	18	38.3
Older than 35	8	17.0
Total	**47**	**100**
Sex		
Male	12	25.5
Female	34	72.4
No response	1	2.1
Total	**47**	**100**
Ethnicity		
Hispanic or Latino	1	2.1
Neither Hispanic nor Latino	44	93.6
Unknown	2	4.3
Total	**47**	**100**
Race		
White	34	72.3
Non White	13	27.7
Total	**47**	**100**
Student status		
Undergraduate	22	46.8
Graduate	21	44.7
No response	4	8.5
Total	**47**	**100**
Funds availability for food purchases		
Sufficient	40	85.1
Insufficient	6	12.8
No response	1	2.1
Total	**47**	**100**

Diet restrictions

Diet restrictions were queried using a multiple choice question: “Which of the following describes your current eating plan? ”. The most frequently selected option was “gluten-free” (42.6%), followed by the “dairy-free” (38.4%), “meat-restricted” (34%), “other” (17%), “GMO-free” (12.8%) and “Paleolithic” (10.6%) (data not shown). Table 2 reports the number and type of diet restrictions per survey respondent, including open-ended responses (“other”). Fourteen of the 26 respondents who were following a diet that involved only one kind of diet restriction selected the options gluten-free (14.9% of the total respondents) or meat-restricted (14.9% of the total respondents). Eight of the 15 respondents who were following a diet that involved two kinds of diet restrictions selected at least the option “dairy free” (17% of the total respondents). Lastly, 3 of the 6 respondents who were following a diet with three kinds of restrictions selected at least the options “gluten-free” and “dairy-free” (10.6% of the total respondents).

Table 2. Distribution of survey respondents by combination of diet restrictions

	(n)	**Percent (%)**
Participants reporting one diet restriction		
Gluten-free	7	14.9
Meat-restricted*	7	14.9
Dairy-free	4	8.5
Paleolithic	3	6.4
GMO-free	3	6.4
Other (i.e. “High Fat Low Carb” or “PHP meal plan for ED Recovery”)	2	4.3
Total	**26**	**55.4**
Participants reporting two diet restrictions		
Gluten-free, Dairy Free	4	8.5
Dairy-free, Meat-restricted	4	8.5
Gluten-free, Meat-restricted	2	4.3
Meat restricted, Other (i.e. “Restricted in Western foods” or “Low FODMAP”	2	4.3
Gluten-free, GMO-free	1	2.1
Gluten-free, Other (i.e. “Elimination diet”)	1	2.1
GMO-free, Other (i.e. “No nitrites or nitrates”)	1	2.1
Total	**15**	**31.9**
Participants reporting three or more diet restrictions		
Gluten-free, Dairy-free, Other (i.e. “Nut free, soy free” or “Fruit free, egg free” or Low FODMAP”)	3	6.4
Gluten-free, Dairy-free, Paleolithic	1	2.1
Gluten-free, Dairy-free, Meat-restricted	1	2.1
Paleolithic, GMO-free, Other (i.e. “Wheat free”)	1	2.1
Total	**6**	**12.7**
Total	**47**	**100**

* this category has been created after grouping participants who reported one of the following diet features: “vegetarian”, “vegan”, “pescatarian”, “plant-based”, “limited amount of meat” “no beef, pork”

The relationship between socio-demographic variables of interest (sex, age, ethnicity, race, UW student status and funds availability for monthly food purchases) and single diet restriction are reported in Table 3 and in the Appendix (Table 16). Table 3 focuses on sex, indicating that the probability of obtaining the observed result or a more extreme result was less than the conventional 0.05 when gluten-free diet and the GMO-free diet were considered. In fact, there were significantly more females than males who were following a gluten-free diet ($p=0.045$) while there were significantly more males than females who were following a GMO-free diet ($p < 0.01$). Table 16 in the Appendix shows that no statistically significant relationships ($p>0.05$) were found between single diet restrictions and other socio-demographic variables.

Table 3. Relationship between sex* and single diet restrictions in the Food and Health survey

Diet Type	**Sex***				**Fisher's exact test**
Gluten-free	**Male**	**Female**	**No response**	Total	
Yes	2	18	0	20	**p = 0.045**
No	10	16	1	27	
Total	12	34	1	47	
Dairy-free	**Male**	**Female**	**No response**	Total	
Yes	4	14	0	18	p = 0.839
No	8	20	1	29	
Total	12	34	1	47	
Meat-restricted	**Male**	**Female**	**No response**	Total	
Yes	3	12	1	16	p = 0.358
No	9	22	0	31	
Total	12	34	1	47	
GMO-free	**Male**	**Female**	**No response**	Total	
Yes	5	1	0	6	**p < 0.01**
No	7	33	1	41	
Total	12	34	1	47	
Paleolithic	**Male**	**Female**	**No response**	Total	
Yes	3	2	0	5	p = 0.198
No	9	32	1	42	
Total	12	34	1	47	
Other	**Male**	**Female**	**No response**	Total	
Yes	3	6	1	10	p = 0.221
No	9	28	0	37	
Total	12	34	1	47	

* Results regarding other socio-demographic are reported in the Appendix.

Respondents were also asked to report their diet duration by choosing among the following options: less than one year, 1-2 years, 2-5 years and more than 5 years. More than one third of respondents selected the option "1-2 years" (38.3%) while the percentages related to the other options

were 19.2%, 19.2% and 23.3%, respectively (data not shown).

Table 4 shows to what extent respondents agreed with some common reasons to follow a special restrictive diet (22, 33, 34). Most of them agreed that they started their current diet to reduce their physical symptoms (63.8%) or have a healthier lifestyle (61.7%). However, the majority disagreed that they expected to adjust to the needs of a family member (63.8%) and varied opinions were reported for the other possible reasons.

Table 4. Frequency of survey respondents' agreement with reasons to start a special restrictive diet (Respondents were asked: "Please indicated to what extent you agree or disagree with the following items as to why you started your current eating plan")

	Agree	**Somewhat agree**	**Neutral**	**Somewhat disagree**	**Disagree**	**Total**
To reduce physical symptoms (e.g. headache, fatigue, nausea and/or GI discomfort)						
(n)	30	7	3	0	7	47
Percent (%)	63.8	14.9	6.4	0	14.9	100
To have a healthier lifestyle						
(n)	29	7	6	1	4	47
Percent (%)	61.7	14.9	12.8	2.1	8.5	100
To limit environmental damage						
(n)	17	5	7	3	15	47
Percent (%)	36.2	10.6	14.9	6.4	31.9	100
To improve mental wellbeing						
(n)	15	8	18	0	6	47
Percent (%)	31.9	17	38.3	0	12.8	100
To promote animal welfare						
(n)	12	6	8	2	19	47
Percent (%)	25.5	12.8	17	4.3	40.4	100
To improve appearance (e.g. body shape, skin, hair)						
(n)	11	15	11	2	8	47
Percent (%)	23.4	31.9	23.4	4.3	17	100
To control body weight						
(n)	10	16	8	1	12	47
Percent (%)	21.3	34.1	17	2.1	25.5	100
To adjust to the needs of a family member						
(n)	1	5	8	3	30	47
Percent (%)	2.1	10.7	17	6.4	63.8	100

Table 5A documents responses to the multiple-choice question “By following a special eating plan have any of the following improved?”. Among the most common benefits of following a special restrictive diet (15, 17, 18, 33), about one third (34%) of the survey respondents endorsed better physical wellbeing a combination of better physical and psychological wellbeing (19.1%) or even simultaneous improvements in physical wellbeing, psychological wellbeing and social activities (14.1%). In addition, Table 5b shows that a higher percentage of those respondents with expectations about physical wellbeing than those with other expectations were able to achieve their goal. In fact, the P-value, which indicates the probability of obtaining the observed result or a more extreme result, is lower than 0.01.

Table 5. Analysis of reported improvements since diet initiation (Respondents were asked: By following a special eating plan have any of the following improved? (check all that apply)”)

a) Frequency and distribution of survey respondents by reported improvements since diet initiation

Improvements	**(n)**	**Percent (%)**
Physical wellbeing	16	34
Physical wellbeing, Psychological wellbeing	9	19.1
Physical wellbeing, Psychological wellbeing, Social activities	7	14.9
Physical wellbeing, Psychological wellbeing, Financial resources/funds	4	8.5
Physical wellbeing, Social activities	3	6.4
Psychological wellbeing	2	4.3
Physical wellbeing, Psychological wellbeing, Financial resources/funds, Social activities	2	4.3
Unknown	2	4.3
Physical wellbeing, Financial resources/funds	1	2.1
None	1	2.1
Social activities	0	0
Financial resources/funds	0	0
Total	**47**	**100**

b) Relationship between expected improvement in physical symptoms and observed improvement in physical wellbeing since diet initiation

		Observed physical improvement			
		No/undefined (n)	Yes (n)	Total	Fisher’s exact test
Expected physical improvement	No/undefined (n)	5	5	10	**p < 0.01**
	Yes (n)	0	37	37	
	Total	5	42	47	

Tables 6-10 document actual food choices with the purpose of exploring any food-related misconceptions. Table 6 indicates that most of the survey respondents who were following a gluten-free

diet denied consumption of the most common sources of gluten: wheat (85%), rye (95%) or barley (85%). The majority consumed oats at least once a day (30%) and gluten-free grain products (10%) or rice (65%) three to four times a week.

Table 6. Frequency of consumption of selected foods as part of a gluten-free diet (Respondents were asked: "Please indicate how often you consume each of the following foods or food components")

Gluten-free diet	**Never**	**1-2/ month**	**1/ week**	**3-4/ week**	**>1/ day**	**N/A**
Wheats (e.g. spelt, semolina, durum) and wheats products						
(n)	17	2	0	0	0	1
Percent (%)	85	10	0	0	0	5
Rye and rye products						
(n)	19	0	1	0	0	0
Percent (%)	95	0	5	0	0	0
Barley and barley products						
(n)	17	2	1	0	0	0
Percent (%)	85	10	5	0	0	0
Rice and rice products						
(n)	1	0	3	13	3	0
Percent (%)	5	0	15	65	15	0
Bread, pasta and biscuits labeled as "gluten-free"						
(n)	1	2	5	10	2	0
Percent (%)	5	10	25	50	10	0
Corn and corn-based products (e.g. flour, meal and syrup)						
(n)	3	5	3	7	2	0
Percent (%)	15	25	15	35	10	0
Oats and oats products						
(n)	3	3	3	5	6	0
Percent (%)	15	15	15	25	30	0
Other grains (e.g. buckwheat) and related products						
(n)	10	4	2	3	1	0
Percent (%)	50	25	10	15	5	0

Table 7 addresses the respondents who were following a dairy free-diet. Most of them denied consumption of foods that are rich in lactose such as cow's milk (94.6%), sheep/goat's milk products (77.8%) and soft cheese (72.2%). On the other hand, the majority of the respondents on a dairy-free diet documented low consumption of dairy products with little or no lactose such as lactose-free cow's milk (72.2%), yogurt (72.2%), hard cheese (66.7%), butter (55.6%), cream (89%) and ice cream (77.8%).

Furthermore, 8 respondents consumed soy-based products (44.4%) once a week and 5 respondents consumed dairy-type products made from plant sources once a week (27.8%).

Table 7. Frequency of consumption of selected foods as part of a dairy-free diet (Respondents were asked: "Please indicate how often you consume each of the following foods or food components")

Dairy-free diet	Never	1-2/ month	1/ week	3-4/ week	>1/ day	N/A
Soy and soy products (e.g. oil, flour and soy milk)						
(n)	0	2	8	5	2	1
Percent (%)	0	11.1	44.4	27.8	11.1	5.6
Lactose containing cow's milk (whole fat, lowfat, nonfat)						
(n)	17	1	0	0	0	0
Percent (%)	94.4	5.6	0	0	0	0
Lactose-free cow's milk						
(n)	13	0	1	2	1	1
Percent (%)	72.2	0	5.6	11	5.6	5.6
Sheep's or goat's milk						
(n)	14	2	0	2	0	0
Percent (%)	77.8	11.1	0	11.1	0	0
Dairy-type products made from plant sources (e.g. from almond, rice and coconut)						
(n)	2	1	5	4	6	0
Percent (%)	11.1	5.6	27.8	22.2	33.3	0
Yogurt						
(n)	13	3	0	2	0	0
Percent (%)	72.2	16.7	0	11.1	0	0
Soft and semi-soft cheese (e.g. cottage cheese, fresh mozzarella)						
(n)	13	2	1	2	0	0
Percent (%)	72.2	11.1	5.6	11.1	0	0
Hard and semi-hard cheese (e.g. parmesan, cheddar)						
(n)	12	2	1	3	0	0
Percent (%)	66.7	11.1	5.6	16.6	0	0
Butter						
(n)	10	3	3	2	0	0
Percent (%)	55.6	16.7	16.7	11	0	0
Cream						
(n)	16	2	0	0	0	0
Percent (%)	89	11	0	0	0	0
Ice Cream						
(n)	14	3	1	0	0	0
Percent (%)	77.8	16.7	5.5	0	0	0

Table 8 focuses on adherence to the Paleolithic way of eating. Many survey respondents who were following a Paleolithic diet reported no consumption of food products that are the result of modern agriculture, such as lactose-containing cow's milk (40%), lactose-free cow's milk (100%), sheep/goat's milk (60%), soft cheese (60%), sugar-sweetened beverages (80%) and added sugar (80%). The majority of them consumed lean meat at least once a day (80%). However, most of the followers of the Paleolithic way of eating consumed hard cheese (60%), ice-cream (60%), cream (60%) and shellfish (60%) once or twice a month and, processed meat (40%) or added salt (60%) at least three or four times a week. Other Paleolithic foods (e.g. eggs, wild-caught fish and self-grown products) as well as non-Paleolithic options (e.g. soy and soy-related products, dairy-like products, yogurt and ready-to-eat processed foods) were consumed with varied frequency.

Table 8: Frequency of consumption of selected foods as part of a Paleolithic diet (Respondents were asked: "Please indicate how often you consume each of the following foods or food components")

Paleolithic diet	Never	1-2/ month	1/ week	3-4/ week	>1/ day	N/A
Soy and soy products (e.g. oil, flour and soy milk)						
(n)	1	2	0	2	0	0
Percent (%)	20	40	0	40	0	0
Lactose containing cow's milk (whole fat, lowfat, nonfat)						
(n)	2	1	1	1	0	0
Percent (%)	40	20	20	20	0	0
Lactose-free cow's milk						
(n)	5	0	0	0	0	0
Percent (%)	100	0	0	0	0	0
Sheep's or goat's milk						
(n)	3	2	0	0	0	0
Percent (%)	60	40	0	0	0	0
Dairy-type products made from plant sources (e.g. from almond, rice and coconut)						
(n)	0	0	1	2	2	0
Percent (%)	0	0	20	40	40	0
Yogurt						
(n)	1	1	1	0	1	1
Percent (%)	20	20	20	0	20	20
Soft and semi-soft cheese (e.g. cottage cheese, fresh mozzarella)						
(n)	3	2	0	0	0	0
Percent (%)	60	40	0	0	0	0
Hard and semi-hard cheese (e.g. parmesan, cheddar)						
(n)	2	3	0	0	0	0
Percent (%)	40	60	0	0	0	0
Butter						
(n)	2	1	2	0	0	0
Percent (%)	40	20	40	0	0	0
Cream						
(n)	2	3	0	0	0	0
Percent (%)	40	60	0	0	0	0
Ice Cream						
(n)	2	3	0	0	0	0
Percent (%)	40	60	0	0	0	0
Eggs						
(n)	2	1	0	0	2	0
Percent (%)	40	20	0	0	40	0
Lean meat (e.g. skinless chicken, turkey and lean beef)						
(n)	0	0	0	1	4	0
Percent (%)	0	0	0	20	80	0
Other meat and meat products (e.g. hamburger meat, marbled meats)						
(n)	1	0	1	2	1	0

Percent (%)	20	0	20	40	20	0
Wild-caught fish						
(n)	0	2	0	1	2	0
Percent (%)	0	40	0	20	40	0
Shellfish						
(n)	0	3	1	1	0	0
Percent (%)	0	60	20	20	0	0
Self-grown produce						
(n)	1	1	3	0	0	0
Percent (%)	20	20	60	0	0	0
Ready-to-eat processed foods (e.g. spread, sauces, baked goods, frozen foods)						
(n)	2	1	2	0	0	0
Percent (%)	40	20	40	0	0	0
Sugar-sweetened beverages (e.g. soft drinks, sports drinks, fruit drinks)						
(n)	4	1	0	0	0	0
Percent (%)	80	20	0	0	0	0
Added sugar (in coffee, tea and cereal)						
(n)	4	1	0	0	0	0
Percent (%)	80	20	0	0	0	0
Salt added in cooking or at the table						
(n)	0	0	0	3	2	0
Percent (%)	0	0	0	60	40	0

Table 9 focuses on the survey respondents who were following a GMO-free diet. However, half of them did not consume corn, a crop that is likely to be grown from seeds containing genetically modified components in the U.S. Also, the majority reported frequent consumption of foods that are most likely GMO-free such as lean meat (3-4 times/week in 80% of cases), foods labeled as “non-GMO” (3-4 times/week in 66.7% of cases), foods labeled as USDA organic” (3-4 times/week in 50% of cases) or self-grown produce (once a week in 50% of cases) (22)

Table 9. Frequency of consumption of selected foods as part of a GMO-free diet (Respondents were asked: "Please indicate how often you consume each of the following foods or food components")

GMO-free	**never**	**1-2/ month**	**1/ week**	**3-4/ week**	**>1/ day**	**N/A**
Corn and corn-based products (e.g. flour, meal and syrup)						
(n)	3	0	1	2	0	0
Percent (%)	50	0	16.7	33.3	0	0
Soy and soy products (e.g. oil, flour and soy milk)						
(n)	2	1	1	2	0	0
Percent (%)	33.3	16.7	16.7	33.3	0	0
Lean meat (e.g. skinless chicken, turkey and lean beef)						
(n)	0	1	1	1	3	0
Percent (%)	0	16.7	16.7	16.7	50	0
Other meat						
(n)	1	0	1	1	3	0
Percent (%)	16.7	0	16.7	16.7	50	0
Wild-caught fish						
(n)	1	0	2	1	2	0
Percent (%)	16.7	0	33.3	16.7	33.3	0
Fruits (any kind, including 100% juice)						
(n)	0	0	0	5	1	0
Percent (%)	0	0	0	83.3	16.7	0
Vegetables (any kind, including 100% juice)						
(n)	0	0	0	4	2	0
Percent (%)	0	0	0	66.7	33.3	0
Foods labeled "USDA organic"						
(n)	0	0	1	2	3	0
Percent (%)	0	0	16.7	33.3	50	0
Foods labeled "non-GMO"						
(n)	1	0	0	1	4	0
Percent (%)	33.3	0	0	33.3	66.7	0
Self-grown produce						
(n)	0	1	3	2	0	0
Percent (%)	0	16.7	50	33.3	0	0

Table 10 gives results for those who reported some kind of meat restriction (i.e. self-identified as vegetarian, vegan, pescatarian or following a meat restriction). Of them, 54.2% reported no consumption of lean meat while 58.3% denied consumption of other kinds of meat.

Table 10. Frequency of consumption of selected foods as part of a meat-restricted diet (Respondents were asked: "Please indicate how often you consume each of the following foods or food components")

Meat-restricted diet	**never**	**1-2/ month**	**1/ week**	**3-4/ week**	**>1/ day**	**N/A**
Lean meat (e.g. skinless chicken, turkey and lean beef)						
(n)	13	1	1	1	0	0
Percent (%)	81.1	6.3	6.3	6.3	0	0
Other meat and meat products (e.g. hamburger meat, marbled meats)						
(n)	14	2	0	0	0	0
Percent (%)	87.5	12.5	0	0	0	0

Food- and health-related knowledge

After assessing food consumption, the Food and Health survey tested participants' knowledge about adverse food reactions and gluten, regardless of the diet they were following. The majority of the respondents (72.4%) correctly recognized that food allergies involve the immune system in contrast to food intolerances or food poisoning (data not shown). Table 11 presents data on the definition of "gluten", showing that almost all of the survey respondents (85.1%) selected the only correct answer, "a naturally occurring protein in wheat, barley and rye". However, the relationship between following a gluten-free diet and reporting the correct definition of gluten was not statistically significant ($p>0.05$,table reported in the Appendix).

Table 11. Distribution of survey respondents by reported gluten definition (Respondents were asked: "Gluten is: (check all that apply)")

Reported gluten definition	**(n)**	**Percent (%)**
A naturally occurring protein in wheat, barley and rye	40	85.1
A toxin found in wheat and other grains	3	6.4
A contaminant of food processing	1	2.1
An ingredient in processed foods that causes belly fat	1	2.1
A toxin found in wheat and other grains AND A naturally occurring protein in wheat, barley and rye	1	2.1
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 Other: It's is everywhere	1	2.1
Other	0	0
Total	**47**	**100**

Diagnosis and sources of diet-related information

Table 12a shows that when participants were asked to define their medical diagnosis at diet initiation, 16 survey respondents (34%) did not have a diagnosis whereas, of those who reported a diagnosis, 21.3% selected the option “other” and typed in their own answer (as reported in the Table). In particular, three respondents who selected the option “other” reported a combination of two diagnoses that were separately listed as possible responses (“lactose intolerance and celiac disease”, “gluten sensitivity and lactose intolerance” and “cows milk allergy and non-celiac gluten sensitivity”). Also, Table 12b shows the statistically significant relationship between gluten consumption and medical necessity for a gluten-free diet as the probability of obtaining the observed result or a more extreme result was less than 0.01.

Table 12. Analysis of reported diagnosis at diet initiation (Respondents were asked: "What was your diagnosis when you started your current eating plan?" - single choice question)

a) Distribution of responses by reported diagnosis at diet initiation

Responses regarding self-reported diagnosis		**(n)**	**Percent (%)**
No diagnosis		16	34
Positive Diagnosis	Non-celiac gluten sensitivity	6	12.8
	Celiac disease	5	10.6
	Lactose intolerance	5	10.6
	Irritable bowel syndrome	3	6.4
	Inflammatory bowel disease (ulcerative/other colitis,Chron's)	2	4.3
	Lactose malabsorption	0	0
	Milk allergy	0	0
	Wheat allergy	0	0
	Other: • "Nausea" • "Lactose intolerance and celiac disease" • "Gluten sensitivity and lactose intolerance" • "High Hgb A1C (6.9)" • "Fruit, gluten, milk, egg, turkey intolerance" • "Diabetes" • "Psoriasis" • "Anorexia nervosa, b/p subtype" • "IBS, colitis and fibromyalgia" • "Cows milk allergy and non-celiac gluten sensitivity"	10	21.3
Total		**47**	**100**

b) Distribution of respondents by medical necessity for a gluten-free diet and reported gluten consumption

		On a gluten-free diet			
		No (n)	Yes (n)	Total	Fisher's exact test
Medical necessity for a gluten-free diet	No or unknown (n)	27	6	33	**p < 0.01**
	Yes (n)	0	14	14	
	Total	27	20	47	

The 31 survey respondents who reported a diagnosed medical condition at diet initiation were asked to select their diagnosis provider(s) from a list of options which included health workers (35) and self. The most frequently mentioned providers were MD (18 out of 31 cases, or 58.1%), followed by self (10 out of 31 of cases, or 32.3%), traditional/complementary medicine professionals (6 out of 31 cases, or 19.4%) and RDs (6 out of 31 cases, or 19.4%) (data not shown). Since this was a multiple choice question, Table 13 reports actual responses per participant. Accordingly, the most frequent responses were MD (38.7% of the cases), self (19.4% of the cases), traditional or complementary medicine professional (9.7% of cases), RD (6.5% of cases), MD and self (6.5% of cases).

Table 13. Distribution of survey respondents by combination of diagnosis providers* (Respondents were asked: “Which of the following gave you the diagnosis? (check all that apply)”)

Combination of diagnosis providers	(n)	Percent (%)
MD	12	38.7
Self	6	19.4
Traditional or complementary medicine professional	3	9.7
RD	2	6.5
MD, self	2	6.5
MD, RD	1	3.2
RD, Traditional or complementary medicine professional	1	3.2
NP, self	1	3.2
MD, RD, Traditional or complementary medicine professional	1	3.2
MD, Traditional or complementary medicine professional, self	1	3.2
MD, RD, NP, Other	1	3.2
NP	0	0
Other	0	0
Total	**31**	**100**

*MD=Medical Doctor, RD=Registered Dietitian (i.e. a food and nutrition expert whose RD or RDN credential is noted after the name), NP= Nurse Practitioner

Table 14 shows that, when the survey respondents were asked to list all of the sources of information they consulted for diet selection regardless of their diagnosis, the internet (68.9%), family/friends (48.9%), MD (44.4%), RDs (35.6%) and traditional/complementary medicine professionals (28.9%) were the most frequently selected options. The question allowed more than one response option, and thus, most respondents (23.4%) consulted a combination of at least four sources of diet information, one of which included RDs (data not shown).

Table 14. Frequency of reported sources of diet information regardless of diagnosis* (Respondents were asked: “No matter who gave you the diagnosis, if any, please rate all the professionals or other sources of information you consulted in order to select your current eating plan. (check all that apply)”

Source of diet information	(n)	Percent (%)
Internet	31	68.9
Family/friends	22	48.9
MD	20	44.4
RD	16	35.6
Traditional or complementary medicine professional*	13	28.9
Popular press books	10	22.2
Newspapers/magazines	9	20
NP	8	17.8
Trainer/coach	7	17.8
University class/course	5	15.6
TV show	3	6.7
No response	2	4.2

* Traditional or complementary medicine professional = naturopath, homeopath, acupuncturist etc.

Perceptions of the RD profession

Table 15 provides data on participant perceptions regarding the RD profession no matter whether survey respondents were ever seen by an RD. Most respondents (63.8%) disagreed that RD merely provide weight loss advice. Similarly, most respondents agreed or somewhat agreed with the statements "RD interpret medical information to make it easier for people when they eat" (51%) and "RD recognize emotional or psychological issues with food" (52.2%). Instead, more than one third (36.9%) had neutral opinions regarding the travel distance to an RD office or the amount of money charged by an RD for consultation (54.4%).

Table 15. Frequency of RD-related perceptions (Respondents were asked: "Please indicate the extent you agree or disagree with the following statements about Registered Dietitians based on either your experience or your perceived expectations of their profession. Registered Dietitians:")

	Agree	**Somewhat agree**	**Neutral**	**Somewhat disagree**	**Disagree**	
Provide only weight loss advice						**Total**
(n)	1	7	4	5	30	47
percent	2.1	14.9	8.5	10.6	63.8	100
Interpret medical information to make it easier for people when they eat						
(n)	22	20	2	1	1	46
percent	51	29	15	5	0	100
Recognize emotional or psychological issues with food						
(n)	24	13	7	2	0	46
percent	52.2	28.3	15.2	4.4	0	100
Require time-consuming commute for a visit						
(n)	2	9	17	9	9	46
percent	4.3	19.6	36.9	19.6	19.6	100
Charge too much money						
(n)	3	8	25	5	5	46
percent	6.5	17.4	54.4	10.9	10.9	**100**

DISCUSSION

Little is known about how university students who follow restrictive diets select foods to eat or how they perceive and/or utilize dietary guidance from nutrition professionals, such as RDs. RDs provide tailored nutrition advice based on individual needs, beliefs and preferences to promote a healthy lifestyle with nutritional balance. Understanding the patterns and reasons why university students follow restrictive diets could help RDs as they guide individuals. This is important because restrictive diets are known to provide unforeseen costs, including nutrient deficiencies. Thus, the Food and Health survey explored the context of food avoidances of university students who are following a restrictive diet in one university setting in Washington State.

While exploratory, the Food and Health survey provided preliminary data about the age, racial/ethnic distribution and funds available for monthly food purchases of university students who follow a restrictive diet (36). Study results are consistent with published evidence indicating the higher proportion of females than males in this population. For example, in a study by Davy et al., 286 undergraduate students completed a 21-item questionnaire showing that a significantly larger percentage of males than females (79.1% vs 65.6%) had never tried a restrictive diet such as Atkins, Weight Watchers, low-fat, low- carbohydrate, South Beach, vegetarian or other (37).

The Food and Health survey found that a gluten-free restrictive diet was the most frequently reported in this sample, in particular by females. This may be related to the fact that the female-to-male ratio of patients affected by gluten-related disorders is at least 2:1 (38) (39). It is also of interest that almost half of the respondents with two or more diet restrictions avoided both gluten and dairy products, which is consistent with the common development of lactose intolerance in individuals with adverse reactions to gluten(20). The survey also found that male survey respondents had a significantly higher level of acceptance of genetic modification than females. However, this result may not be generalized to other populations as only six Food and Health survey respondents were following a GMO-free diet (40).

The most commonly cited reason to follow a diet in this study was a willingness to reduce physical symptoms (e.g. headache, fatigue, nausea and/or GI discomfort), which suggests a level of health consciousness not found in other studies. For example, in a survey of 1,500 American adults claiming to avoid gluten, 35% of the participants were avoiding gluten for “no reason” while the others justified their

diet choice with the following reasons: “healthier option” (26%), “digestive health” (19%) “someone in my family has a gluten sensitivity” (10%) and “I have a gluten sensitivity” (8%) (32). Regardless of the kind of food restrictions involved, the majority of the Food and Health survey respondents had followed their diet for at least one year, which is thought to be enough to appreciate physical improvements (11).

Consistency between one’s diet definition and reported food choices was assessed by means of a simplified food frequency questionnaire. In this regard, the fact that almost all of the survey respondents on a gluten-free diet reported the avoidance of wheat, barley and rye highlighted their awareness in making appropriate food choices. Other studies have found dissimilar results. In a study of 87 consumers who were following a gluten-free diet due to self-reported celiac disease showed that only 30% could identify at least 14 out of 17 gluten-containing foods (41). However, many Food and Health survey respondents on a gluten-free diet were consuming oats and their byproducts, which is difficult to interpret as only pure oats contain less than 20 ppm of gluten and can ensure diet variety and tolerance in the setting of adverse reactions to gluten (42). Also, gluten withdrawal may reduce the intake of other offending agents contained in wheat products, such as fructans, which can also produce GI symptoms (43). With regards to the other diet characteristics reported, the study showed that survey respondents on a dairy-free diet had limited or no consumption of dairy products regardless of their lactose content. This suggests that dairy food avoidance either may be due to value-based rather than medical reasons or that individuals were not aware that lactose found in foods varied by dairy type product; it is also unclear if respondents with physical symptoms knew that most individuals with lactose intolerance can tolerate up to 12 g of lactose a day without experiencing GI symptoms (44). Furthermore, the majority of those who described their diet as vegetarian, vegan, pescatarian, plant-based or featuring limited amount of meat reported no consumption of any kind of meat. Although meat restriction is frequently thought to improve health, associations with vitamin B12 deficiency or disordered weight control behaviors are reported in vegetarians (45) and the risk may be higher if meat avoidance is combined with other diet restrictions. It is also of interest that most of the survey respondents who were following a GMO-free diet reported frequent consumption of organic food products. Negative attitudes towards chemicals have been associated with interest for more “natural” food (46). Finally, survey respondents on a Paleolithic diet did not seem to strictly adhere to its original philosophy. While modern versions of the diet allow for wild-

caught fish, grass-fed meat and organic produce, more conservative versions require a hunter-gatherer style of food procurement (47).

Data about questions that examined food- and health-related knowledge, suggested that the respondents of the Food and Health survey are more knowledgeable than the general public. Most respondents showed awareness that food allergies involve the immune system contrary to food poisoning or food intolerances (7). Other studies suggest that consumers ignore such distinction (7). Also, most of the Food and Health survey respondents correctly defined the term “gluten” regardless of their diet while other studies have only indirectly assessed participants’ perceptions about gluten and the latter turned out to be negative in most cases. For example, Dunn et al asked 97 participants from the University of Florida to compare perceptions of pairs of food products where one item was labeled as “gluten-free” and one as “conventional”, even if they were both gluten-free. No significant differences in taste or textures were noted but the majority reported that gluten-free foods are healthier (48).

Of the two thirds of respondents who reported a diagnosis at diet initiation, the majority mentioned non-allergic food reactions. In particular, the two most common diagnoses were gluten-related. A national survey conducted in 2010 by U.S. Food and Drug Administration (FDA) involved 574 adult respondents and found that dairy products, shellfish and fruits are the three most common triggers of adverse food reactions in the U.S. population (49). Regardless, all of the Food and Health survey respondents who reported a diagnosis that necessitates gluten avoidance (11) demonstrated health-consciousness as they reported to be on a gluten-free diet contrary to all those with other diagnoses.

As stated in one of the two a-priori hypotheses, less than a third of the respondents received an RD-based diagnosis while MD-based and self-diagnoses were the most common. This is possibly because physicians can diagnose adverse food reactions independently from RDs; alternatively, many respondents might have been medical students or other students in health sciences based on where the flyers were posted at the University of Washington. Of 147 adults enrolled in a clinical trial and self-reporting non-celiac gluten sensitivity, 44% stated that they self-initiated a gluten-free diet while only 21%, 19% and 16% of the respondents had been prescribed a diet by alternative health professionals, dietitians and general practitioners, respectively (50). Also, in such trial, 69% of the respondents who initiated the diet by themselves, experienced inadequate celiac investigation due to gluten avoidance at

the time of the diagnosis (50). Another alternate explanation is that if the diet were selected for values-based rather than medical reasons, a diagnosis would not be needed.

No matter whether survey respondents had a diagnosis, if any, most of them were more likely to consult the internet for diet selection or information. This is consistent with the second hypothesis of this study: the majority of university students following a restrictive diet would not rely on RDs as much as other sources of information to make their food choices. A similar survey of 286 undergraduate students reported that family members, classes, magazines/newspapers and friends were the most common sources of diet information while health professionals such as RDs were almost at the end of the list (37). On the other hand, an online survey of 190 Australian consumers showed that dietitians are rated as most trustworthy, credible or effective even if the internet is the most utilized nutrition information source (51).

No matter whether survey respondents consulted with an RD, data from the Food and Health survey suggest that the respondents were relatively knowledgeable about what RDs do. However, the typical survey respondent did not know how to rate common barriers to RD visits, such as the commuting or the visit cost (51) (52). Thus, RD visits might have been influenced by other criteria, such as insurance coverage in the case of adverse food reactions. Alternatively, some might have had an internet-based consultation with a nutrition expert. In fact, a study on women's perceptions toward healthy eating blogs showed that 33 young adults had a high level of confidence in online resources developed by RDs contrary to random nutrition info on social media (53).

The Food and Health survey had several limitations. The sample size was small and not representative of the whole population of interest. Although flyers were spread in a variety of areas of the UW campus, the proportion of students enrolled in programs with an emphasis on health or nutrition could not be accounted due to the anonymous nature of the survey. In addition, the inclusion criteria allowed room for a variety of restrictive diets, thus complicating the process of diet categorization and data analysis. Not only is it unclear whether diet selection preceded or followed nutrition-related diagnosis, if any, but also responses regarding medical diagnosis or reasons to follow a restrictive diet might have been affected by self-report or health conditions with overlapping signs and symptoms. Furthermore, the survey question meant to investigate frequency of food consumption was not

comprehensive and the related responses might have been influenced by recall bias or season (54-56). Lastly, the survey was based on the assumption that university students meeting the inclusion criteria would be willing to share personal, non-identifying data such as age, beliefs about food, health conditions and availability of financial resources. However, the lack of incentives might have prevented survey respondents from providing comprehensive information about themselves.

In spite of the aforementioned limitations, the Food and Health survey had several strengths. While many published studies have examined eating perceptions, few of them focused on university students following a variety of food restrictions or addressed perceptions of the RD profession. The limited selection of food categories addressed in the survey was meant to reduce participation time by combining food categories that were separately investigated in past studies on eating perceptions and diet selection. Also, the social desirability bias (i.e. overestimated consumption of fruits and vegetable) is unlikely considering the anonymity of the survey (57). Lastly, as the survey completion rate may be an indicator of data quality (49), it is remarkable that almost all of the survey respondents answered the totality of questions being asked.

Data from the Food and Health survey suggest several future perspectives and implications for research for RDs who seek to support university students who follow restrictive diets. For example, RDs could research how foods can cause symptoms and how RDs can provide effective support in the setting of adverse food reactions. RDs could also invest in continuing education to provide tailored diet advice as they align personal values with diet to address individuals who follow a restrictive diet for value-based reasons. Regardless, further examination of poly-avoidances (i.e. the simultaneous avoidance of multiple food categories) could help RDs better understand the risk of nutritional imbalances in the target population, which may be higher if the diet is self-prescribed. Also, it would be well worth identifying the clinics where the target population goes to the most in order to promote RD-led nutrition visits. Similarly, study findings showing that the internet is the most commonly used resource for diet information could provide insights to RDs considering the value of self-promotion online via the same channels (social networks, websites sharing resources, etc). Last but not least, further investigation of the expectations and needs of students about the cost, time and location of RD visits could further inform RDs' practice.

In summary, this study confirmed that restrictive diets are popular among university students.

Although most survey respondents seemed to be health-conscious and motivated when making their food choices, MD-based and self-diagnoses were more frequently reported than RD-based diagnosis. Also, although most of the respondents had a basic knowledge of what RDs do, the internet was the most frequent source of diet advice while commuting and visit cost were not described as barriers to RD visits by the majority of the respondents. All of these insights will help RDs and other health professionals support individuals who need or want to change their diet.

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APPENDIX

Food and Health survey flyer

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UNIVERSITY of WASHINGTON

VOLUNTEERS NEEDED!

How do you select what to eat?

If you are **a non-pregnant University of Washington student aged 18 or older** and **following one or more of the special eating patterns listed above** you can help researchers answer this important question.

To take **The Food and Health Survey,**
please visit http://bit.ly/1Ka1wV2 or use the QR code below.
Participation is **voluntary** and **anonymous.**
For more info, call 206-667-4779 specifying the survey name.

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fs32@uw.edu

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fs32@uw.edu

The Food and Health survey: informed consent and survey Instrument

The Food and Health Survey

Investigators at the Fred Hutchinson Cancer Research Center and the University of Washington are interested in how people make food choices and we need your help.

You are invited to participate in this study by completing this short survey. There are no direct benefits to you from your participation, however the data will be useful for enriching the tools that professionals use to assist people with special nutrition needs. There are no risks associated with taking this survey.

There will be approximately 15-25 questions and it will take approximately 15 minutes to complete the survey. The questions will be multiple choice or short answer.

Your participation is entirely voluntary. If you agree to participate, you may choose not to answer any questions you do not wish to answer. Your identity will be kept anonymous. You will be assigned a number. All your responses will be associated with this number. If data from this study are presented or published, it will be as grouped data; your identity will not be traced in any way. To decline consent simply exit the webpage and do not proceed to the survey. Participation in the survey implies consent.

In order to qualify to participate you must be at least 18 years of age, non-pregnant, and a current student enrolled at the University of Washington. By proceeding with the survey you are confirming that you are at least 18 years of age, non-pregnant and a current student at the University of

If you have any additional questions about the purpose of this research, contact Dr. Neuhouser, Fred Hutchinson Cancer Research Center, 1100 Fairview Ave N., Seattle WA 98109-1024, 206-667-4797 Seattle, WA. If you have any questions about the treatment of human subjects in this study you may call or write Karen Hansen, Director of Institutional Review Office, Fred Hutchinson Cancer Research Center, 1100 Fairview Ave N., Seattle WA 98109-1024, 206-667-4867.

Thank you for participating in this important study.

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Please answer these questions based on your usual intake rather than focusing on seasonal eating habits.

Question 1.
Do you follow any kind of special eating plan?

- ◯ Yes
- ◯ No

Question 2.
Which of the following describes your current eating plan? (check all that apply)

- ☐ Gluten-free
- ☐ Dairy-free
- ☐ Paleo
- ☐ GMO-free
- ☐ Other: _____

Question 3.
How long have you been on your current eating plan?

- ◯ Less than 1 year
- ◯ 1-2 years
- ◯ 2-5 years
- ◯ More than 5 years

Question 5.
Please indicate how often you consume each of the following foods or food components.

	Never	1-2/ month	Once/ week	3-4 times/ week	1 or more times/day
Bread, pasta and biscuits labeled as "gluten-free"	○	○	○	○	○
Corn and corn-based products (e.g. flour, meal and syrup)	○	○	○	○	○
Rice and rice products	○	○	○	○	○
Oats and oats products	○	○	○	○	○
Wheats (e.g. spelt, semolina, durum) and wheats products	○	○	○	○	○
Rye and rye products	○	○	○	○	○
Barley and barley products	○	○	○	○	○
Other grains (e.g. buckwheat) and related products	○	○	○	○	○
Soy and soy products (e.g. oil, flour and soy milk)	○	○	○	○	○
Other beans/legumes (e.g. kidney, black and pinto beans)	○	○	○	○	○
Eggs	○	○	○	○	○
Lactose containing cow's milk (whole fat, lowfat, nonfat)	○	○	○	○	○
Lactose-free cow's milk	○	○	○	○	○
Sheep's or goat's milk	○	○	○	○	○
Dairy-type products made from plant sources (e.g. from almond, rice and coconut)	○	○	○	○	○
Yogurt	○	○	○	○	○
Soft and semi-soft cheese (e.g. cottage cheese, fresh mozzarella)	○	○	○	○	○
Hard and semi-hard cheese (e.g. parmesan, cheddar)	○	○	○	○	○

Butter	○	○	○	○	○
Cream	○	○	○	○	○
Ice cream	○	○	○	○	○
Lean meat (e.g. skinless chicken, turkey and lean beef)	○	○	○	○	○
Other meat and meat products (e.g. hamburger meat, marbled meats)	○	○	○	○	○
Wild-caught fish	○	○	○	○	○
Shellfish	○	○	○	○	○
Fruits (any kind, including 100% juice)	○	○	○	○	○
Vegetables (any kind, including 100% juice)	○	○	○	○	○
Foods labeled "USDA organic"	○	○	○	○	○
Foods labeled "non-GMO"	○	○	○	○	○
Self-grown produce	○	○	○	○	○
Peanuts	○	○	○	○	○
All other nuts (e.g. almonds, walnuts, pecans)	○	○	○	○	○
Ready-to-eat processed foods (e.g. spread, sauces, baked goods, frozen foods)	○	○	○	○	○
Sugar-sweetened beverages (e.g. soft drinks, sports drinks, fruit drinks)	○	○	○	○	○
Added sugar (in coffee, tea and cereal)	○	○	○	○	○
Salt added in cooking or at the table	○	○	○	○	○

Question 6.
By following a special eating plan have any of the following improved? (check all that apply)

- ☐ Physical wellbeing
- ☐ Psychological wellbeing
- ☐ Social activities (e.g. dining out, travel, family life)
- ☐ Financial resources/ funds
- ☐ Don't know
- ☐ None

Question 7.
To the best of your knowledge, which of the following adverse reactions to food involves the immune system? (check all that apply)

- [ ] Food allergy
- [ ] Food intolerance
- [ ] Food poisoning
- [ ] None of the above
- [ ] I don't know

Question 8.
Gluten is (check all that apply):

- [ ] 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
- [ ] Other:

Question 9.
What was your diagnosis when you started your current eating plan?

- ( ) None
- ( ) Celiac disease
- ( ) Non celiac gluten sensitivity
- ( ) Wheat allergy
- ( ) Inflammatory bowel disease (includes ulcerative colitis, other colitis, Chron's)
- ( ) Irritable bowel syndrome
- ( ) Milk allergy
- ( ) Lactose intolerance
- ( ) Lactose malabsorption
- ( ) Other:

Question 10.
Which of the following gave you the diagnosis?

- [ ] Medical Doctor
- [ ] Registered Dietitian (i.e. a food and nutrition expert whose RD/RDN credential is noted after the name)
- [ ] Nurse Practitioner
- [ ] Traditional or complementary medicine professional (e.g. naturopath, homeopath, acupuncturist)
- [ ] Self
- [ ] Other

Question 11.
No matter who gave you the diagnosis, if any, please rate all the professionals or other sources of information you consulted in order to select your current eating plan.

- [ ] Medical Doctor
- [ ] Registered Dietitian
- [ ] Nurse Practitioner
- [ ] Traditional or complementary medicine professional (e.g. naturopath, homeopath, acupuncturist)
- [ ] Family/friends
- [ ] Trainer/coach
- [ ] University class/course
- [ ] Internet
- [ ] Newspapers/magazines
- [ ] TV show
- [ ] Popular press books

Question 12.
Please indicate the extent you agree or disagree with the following statements about Registered Dietitians based on either your experience or your perceived expectations of their profession. Registered Dietitians:

	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree
Provide only weight loss advice	○	○	○	○	○
Interpret medical information to make it easier for people when they eat	○	○	○	○	○
Recognize emotional or psychological issues with food	○	○	○	○	○
Require time-consuming travel distance for a visit	○	○	○	○	○
Charge too much money	○	○	○	○	○

Question 13.
How old are you?

- ○ Less than 24 years
- ○ 25-34 years
- ○ 35-44 years
- ○ 45 years or older

Question 14.
What is your sex?

- ◯ Male
- ◯ Female

Question 15.
Do you identify as either Hispanic or Latino(a)?

- ◯ Yes
- ◯ No
- ◯ Unknown

Question 16.
To which racial or ethnic group(s) do you most identify?

- ◯ 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 races

Question 17.
What is your current status at the University of Washington?

- ◯ Undergraduate student
- ◯ Graduate student

Question 18.
Would you say that the amount of money you are able to spend on food each month is:

- ◯ Always sufficient
- ◯ Sometimes insufficient
- ◯ Often insufficient
- ◯ Always insufficient

Additional Tables

Table 16. Relationships between socio-demographic variables of interest and single diet restrictions

a)

Diet Type	**Age (years)**			Total	**Fisher's exact test**
Gluten-free	**< 24**	**25-34**	**>35**		
Yes	9	8	3	20	p=1.000
No	12	10	5	27	
Total	21	18	8	48	
Dairy-free	**< 24**	**25-34**	**>35**	Total	
Yes	10	6	2	18	p=0.565
No	11	12	6	29	
Total	21	18	8	47	
Meat-restricted	**< 24**	**25-34**	**>35**	Total	
Yes	7	6	3	16	p=1.00
No	14	12	5	31	
Total	21	18	8	47	
GMO-free	**< 24**	**25-34**	**>35**	Total	
Yes	3	2	1	6	p=1.00
No	18	16	7	41	
Total	21	18	8	47	
Paleolithic	**< 24**	**25-34**	**>35**	Total	
Yes	2	2	1	5	p=1.00
No	19	16	7	42	
Total	21	18	8	47	
Other	**< 24**	**25-34**	**>35**	Total	
Yes	5	2	3	10	p=0.326
No	16	16	5	37	
No response	0	0	0	47	
Total	21	18	8	47	

b)

Diet Type	**Ethnicity**				**Fisher's exact test**
Gluten-free	**Hispanic/ Latino**	**Not-Hispanic/Latino**	**No response**	Total	
Yes	0	19	1	20	p=1.00
No	1	25	1	27	
Total	1	44	2	47	
Dairy-free	**Hispanic/ Latino**	**Not-Hispanic/Latino**	**No response**	Total	
Yes	0	17	1	18	p=1.00
No	1	27	1	29	
Total	1	44	2	47	
Meat-restricted	**Hispanic/ Latino**	**Not-Hispanic/Latino**	**No response**	Total	
Yes	0	14	2	16	p=0.11
No	1	30	0	31	
Total	1	44	2	47	
GMO-free	**Hispanic/ Latino**	**Not-Hispanic/Latino**	**No response**	Total	
Yes	0	6	0	6	p=1.00
No	1	38	2	41	
Total	1	44	2	47	
Paleolithic	**Hispanic/ Latino**	**Not-Hispanic/Latino**	**No response**	Total	
Yes	0	4	1	5	p=0.115
No	2	40	0	42	
Total	2	44	1	47	
Other	**Hispanic/ Latino**	**Not-Hispanic/Latino**	**No response**	Total	
Yes	0	9	1	10	p=0.521
No	1	35	1	37	
Total	1	34	2	47	

c)

Diet Type	Race			Fisher's exact test
Gluten-free	**White**	**Non-white**	Total	
Yes	15	5	20	p=1.00
No	19	8	27	
Total	34	13	47	
Dairy-free	**White**	**Non-white**	Total	
Yes	15	3	18	p=0.161
No	19	10	29	
Total	34	13	47	
Meat-restricted	**White**	**Non-white**	Total	
Yes	5	11	16	p=0.473
No	8	23	31	
Total	13	34	47	
GMO-free	**White**	**Non-white**	Total	
Yes	4	2	6	p=0.538
No	30	11	41	
Total	34	13	47	
Paleolithic	**White**	**Non-white**	Total	
Yes	4	1	5	p=0.574
No	30	12	42	
Total	34	13	47	
Other	**White**	**Non-white**	Total	
Yes	3	7	10	p=0.569
No	10	27	37	
Total	13	24	46	

d)

Diet Type	**UW status**				**Fisher's exact test**
Gluten-free	**Undegraduate**	**Graduate**	**No response**	Total	
Yes	10	10	0	20	p= 0.252
No	12	11	0	27	
Total	22	21	0	47	
Dairy-free	**Undegraduate**	**Graduate**		Total	
Yes	11	7	0	18	p= 0.136
No	11	14	4	29	
Total	22	21	4	47	
Meat-restricted	**Undegraduate**	**Graduate**		Total	
Yes	8	6	2	16	p= 0.658
No	14	15	2	31	
Total	22	21	4	47	
GMO-free	**Undegraduate**	**Graduate**		Total	
Yes	4	1	1	6	p= 0.303
No	18	29	3	41	
Total	22	21	4	47	
Paleolithic	**Undegraduate**	**Graduate**		Total	
Yes	1	4	0	5	p= 0.362
No	21	17	4	42	
Total	22	21	4	47	
Other	**Undegraduate**	**Graduate**		Total	
Yes	5	3	2	10	p= 0.261
No	17	18	2	37	
No response	0	0	0	0	
Total	22	21	4	47	

e)

Diet Type	**Funds availability**				**Fisher's exact test**
Gluten-free	**Sufficient**	**Insufficient**	**No response**	Total	
Yes	18	2	0	20	p = 0.818
No	22	4	1	27	
Total	40	6	1	47	
Dairy-free	**Sufficient**	**Insufficient**	**No response**	Total	
Yes	17	1	0	18	p = 0.485
No	23	5	1	29	
Total	40	6	1	47	
Meat-restricted	**Sufficient**	**Insufficient**	**No response**	Total	
Yes	15	1	0	16	p = 0.768
No	25	5	1	31	
Total	40	6	1	47	
GMO-free	**Sufficient**	**Insufficient**	**No response**	Total	
Yes	5	0	1	6	p = 0.147
No	35	6	0	41	
Total	40	6	1	47	
Paleolithic	**Sufficient**	**Insufficient**	**No response**	Total	
Yes	4	1	0	5	p = 0.571
No	36	5	1	42	
Total	40	6	1	47	
Other	**Sufficient**	**Insufficient**	**No response**	Total	
Yes	6	3	1	10	p = 0.029
No	34	3	0	37	
Total	40	6	1	47	

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