Scientific Journal of
Food Science & Nutrition

Research Article

Examination of Nutrition Knowledge, Attitude, and Dietary Behaviors of College Student Vegetarians, Semi-Vegetarians, and Non-Vegestarians -

Tiffany D. DeMay[1], Nweze Nnakwe[2], Ui-Jeen Yu[3]* and Julie Schumacher[2]

[1]Dietary Consultant for Cynthia Chow & Associates, LLC
[2]Food, Nutrition, and Dietetics (FND), Department of Family and Consumer Sciences, Illinois State University
[3]Fashion Design and Merchandising, Department of Family and Consumer Sciences, Illinois State University

*Address for Correspondence: Ui-Jeen Yu, Fashion Design and Merchandising, Department of Family and Consumer Sciences, Illinois State University, 203 Turner Hall, Campus box 5060 Normal, IL61790-5060, USA, Tel: +309-438-4680; Fax: +309-438-5659; E-mail: uyu@ilstu.edu

Submitted: **16 May, 2019;** Approved: **30 May, 2019;** Published: **05 June, 2019**

Citation this article: Ui-Jeen Yu, DeMay TD, Nnakwe N, Schumacher J. Examination of Nutrition Knowledge, Attitude, and Dietary Behaviors of College Student Vegetarians, Semi-Vegetarians, and Non-Vegestarians. Sci J Food Sc Nutr. 2019; 5(1): 006-014.

ABSTRACT

The present study examines the difference in nutrition knowledge, attitudes, and dietary intake among college students based on the presence of vegetarianism. A Web-based survey using 702 college students at a Midwest university collected data about participants' level of nutrition knowledge, attitudes toward nutrition and vegetarianism, and dietary patterns. Results showed vegetarians had a more positive attitude towards a vegetarian diet as opposed to non-vegetarians. Vegetarians also demonstrated greater nutrition knowledge specifically related to vegetarian nutrition as opposed to general nutrition, although their dietary intake did not prove to be of higher quality than non-vegetarians. Results from this study are applicable in the vegetarian community and those who work with vegetarians. Most notably, this study may be of great use to food service establishments, particularly college dining settings.

INTRODUCTION

The popularity of vegetarian diets is increasing. Approximately 2.3% of the United States population follow a vegetarian diet [1]. About six to eight million individuals, or 3.4% of the population in the United States practice a vegetarian lifestyle [2]. Those who do not follow a complete vegetarian diet are also taking an interest in this alternative style of eating [3]. The draw of vegetarianism continues to increase as products become more readily available and more nutrition-related information becomes accessible [3].

A vegetarian diet is capable of providing a nutritionally-adequate diet [1,3]. Bedford and Barr highlighted specific nutrients where a vegetarian diet meets or exceeds the level of nutritional needs, such as fiber, magnesium, and potassium [4]. Another study reported that a vegetarian diet met and sustained one's nutritional needs better than an omnivorous diet [5].

Individuals are motivated to follow a vegetarian diet because they want to be healthy and tend to have more concerns about animal welfare and the environment [6,7]. Additional incentives to follow a vegetarian diet include religious concerns, the concept of vegetarian ecofeminism, and weight control [7,8]. Many of these reasons may overlap or evolve over time to create a greater or different motivation for following vegetarianism. Whatever the reason, it is important to keep in mind the importance of careful planning and balancing foods to maintain a healthy vegetarian diet.

Previous studies found vegetarians not only demonstrated greater nutrition knowledge, but also showed a greater desire for more, improved information to apply to their eating habits [5,9]. Very few studies have investigated college students or adolescents' nutrition knowledge of vegetarians. Prior studies addressed and analyzed the dietary habits of vegetarians, but those studies did not look at college students and adolescents [10,11]. Thus, the purpose of this study was to compare college student vegetarians and non-vegetarians' nutrition knowledge, attitudes toward vegetarian diet, and nutrition attitudes as well as to determine if there was a difference in dietary patterns of college student vegetarians and non-vegetarians. A majority of college students are late adolescents still learning to make their own dietary decisions. During adolescence, logical reasoning and social cognition are still developing, which may affect their dietary choices [12]. This study may fill a gap in research related to both vegetarians and college students in hopes to provide more information about their nutrition knowledge, nutrition attitudes, and dietary patterns.

CONCEPTUAL FRAMEWORK

The Theory of Planned Behavior (TPB) in dietary choices was used to explain college students' attitudes toward a vegetarian diet and their dietary behaviors affected by their belief of vegetarian nutrition knowledge [13]. According to this theory, individual's behaviors are controlled by their intentions determined by attitudes toward the behavior, subjective norm, and perceived behavior control. Attitudes toward the behavior are the individual's negative or positive self-evaluation of the particular behavior. Subjective norm includes the individual's evaluation of the social pressures he or she should or should not perform the behavior. Perceived behavior control is the level of difficulty or ease the individual presumes to encounter with the pursuit of the behavior.

The Theory of Planned Behavior is a framework for determining and analyzing beliefs that impact health behaviors [14]. TPB is based on the concept that attitudes, norms, and intentions lead to an individual's behavior. This theory has been utilized to determine dietary behaviors in various populations of individuals and has successfully been used to determine consumption of snack food, sweets, chocolate, and fruit. In the case of vegetarianism, an individual must weigh many factors before deciding to adopt a dietary change. These factors include their own attitudes towards the altered vegetarian diet, the alteration of social norms the diet brings about, and difficulty or ease of having a vegetarian diet. In this study, TPB is applied to understand how college students' attitude towards a vegetarian diet relates to their dietary behaviors consuming vegetarian foods.

NUTRITION KNOWLEDGE

Few studies have addressed the nutrition knowledge of vegetarians. The vegetarian diet generally follows a pattern of more varied, nutritious intake; thus, creating a question of the possibility that vegetarians have greater nutrition knowledge than non-vegetarians. Many vegetarians follow healthy lifestyle patterns in greater frequency than non-vegetarians [15]. The most repetitive finding of this concept was fewer vegetarians were smokers than non-vegetarians. There was a difference between the incidence of smokers as vegetarians and non-vegetarians, with the lower percentage attributed to the vegetarians [15,16]. Vegetarians also consistently have a lower Body Max Index (BMI) and energy intake [17]. This leads to the belief that vegetarians aim to adopt healthy aspects in their lives, with the central aim being diet. Therefore, it is possible to see although diet may be the most direct exterior evidence, vegetarianism may often be a lifestyle shift towards overall healthy living.

Although there is minimal research on vegetarians' nutrition knowledge, there were many articles that looked at the dietary intake of individuals who chose to follow the vegetarian lifestyle. The most noted trend in this research was the lower energy intake in vegetarians; thus, leading to lower rates of overweight and obesity in this population, as well as a more acceptable BMI range. This is contrary to the finding that most non-vegetarians have a higher intake of energy, protein, total fat, and saturated fat as well as representing a greater BMI range [18,19]. One of the most common trends found

was that vegetarians were more likely to consume higher amounts of fruits and vegetables. Vegetarians consume less dairy and meats, and replacing these items with legumes, nuts, and vegetables [20].

A common worry among health practitioners, who work with vegetarian individuals, is the possibility of not reaching dietary recommendations for overall health. Vegetarians were shown to be more likely to meet these recommendations than non-vegetarians [20]. This study recognized vegetarians are twice as likely to consume within the correct allotment of dietary fat [20]. Additionally, vegetarians were found to be three times more likely to meet the requirements in relation to saturated fat and to consume greater varieties of vegetables. Most of these studies had a breakdown of the specific nutrients often found to be either high or low in the vegetarian diet. This was of special interest because many nutrients have an altered bioavailability in relation to vegetarian food sources [21]. Among nutrients commonly found to meet or exceed recommendations were potassium, vitamin D, vitamin E, vitamin C, thiamine, carotenoids, folate, calcium, magnesium, copper, and fiber [21].

There has been some suggestion that altered vitamin and mineral requirements be developed for vegetarians in relation to these low intake nutrients [22]. Foods typically consumed in higher amounts in vegetarian diets include items such as cereals, pasta, rice, grains, legumes, dark green and deep yellow vegetables, fruit, and dried fruit [17]. Foods found less common in the vegetarian diet included regular soda, fruit drinks, dairy, candy, chocolate, and fast food [20]. In relation to this altered intake per dietary lifestyle, it was found 45% of vegetarians and only 19% of non-vegetarians took a multivitamin or antioxidant supplement [23].

Attitudes towards a vegetarian diet

Attitudes towards vegetarians and societal acceptance of the altered dietary lifestyle have previously been examined. According to prior study [24,25], meat eaters were the only group of four groups—meat eaters, meat avoiders, vegetarians, and vegans—who stated a positive belief about a meat containing diet. However, these four groups described vegetarianism as a healthy diet. Furthermore, 28.3% of the population actually reduces their meat consumption [26]. Attitudes found to contribute to this reduction in meat consumption were health of the product, taste, and concern over the safety of additives and hormones. Meat is traditionally valued for its association with masculinity and aggression [27], as well as associated with a dominant social culture; thus, placing a low socioeconomical value on a diet based on vegetables. This suggests a growing level of acceptance and potentially even adoption of the vegetarian lifestyle.

A further study centered on a worksite nutrition program that followed employees who adopted a vegan lifestyle. No previous study determined the acceptance of a vegan diet outside clinical trials [28]. The study [28] found participants in the vegan diet group reported a greater satisfaction with their diet, as well as several other health benefits, including better sleep, improved digestion, and more energy. The vegans also reported increased physical function, vitality, and mental health [28]. This study showed a vegan diet could be highly acceptable outside of clinical trials.

There was a vast difference between attitudes shown towards male and female vegetarians. There is an association between masculinity and eating meat, as the grounding for ecofeminist vegetarianism, which would make one assume that men would experience more negativity when embarking on a vegetarian diet [29]. However, through study this was found not true. Men did not receive hostile reactions from friends and family; yet, it was shown that women were more likely to face very negative reactions from individuals around them when adopting a vegetarian diet [29]. It was seen that males, who take on a vegetarian diet, are following a path toward greater health, while women who adopt a vegetarian diet are often seen as unhealthy or struggling with body image [29].

MATERIALS AND METHODS

Sample

About 17,000 students at a large university in the Midwestern region of the United States were recruited for a web-based survey. Prior to conducting the research, the procedures were reviewed and approved by the university's Human Subject Institutional Review Board. All participants were enrolled in the university, at least eighteen years of age, and had access to a university assigned email account. A sample of 90% of the student population who opted in for research participation at the University was contacted through an email invitation that briefly described the objectives of the study, their rights as a participant in the study, and confidentiality. Participants were informed the survey would take no more than fifteen minutes and they may discontinue participation at any time.

Instruments

Instruments used in this study were validated and established from prior studies. The first set of questions was a generic question set about demographic data, including gender, year in college, practice of vegetarianism, type of vegetarianism, current and initial reason for choosing or not choosing vegetarianism, and, if reason to choose or not choose vegetarianism is the same currently as initially. A nutrition knowledge questionnaire measured participants' levels of nutrition knowledge using a three-point true, false, uncertain rating scale, with an additional five-point degree of certainty scale [30]. This questionnaire consisted of fourteen questions. Attitudes towards vegetarian diet were measured using a seven-point Likert-type scale [24]. The four semantic differential items to measure attitudes toward vegetarian diet were good versus bad, harmful versus beneficial, unpleasant versus pleasant, and unenjoyable versus enjoyable [24]. Attitudes towards nutrition were measured using a five-point Likert-type scale ranging from strongly agree (1) to strongly disagree (5) [30]. The last instrument used in the survey was a food frequency questionnaire adapted from Nnakwe [30]. This questionnaire listed seventeen foods or food groups. The participant could rate his or her intake of the food item as 2-3x/day, 1x/day, 2-3x/week, Seldom, or Never.

Data collection

The study used a web-based survey designed to compare nutrition knowledge, attitudes toward vegetarian diet, nutrition attitude, and dietary patterns of vegetarian and non-vegetarian college students. All participants were provided an informed consent prior to beginning the online survey. A mass email was sent out to about 17,000 university students through the Computer Infrastructure Support Services on campus. This email included an invitation to participate, a brief description of the research, an explanation of the survey, and a link to the online survey.

Once the survey was opened, the participants were asked to complete an informed consent to participate in the study. Those who

did not complete the consent form were unable to move forward with the survey and were routed to a separate page that discontinued their participation. Students who completed the survey were routed to a page that allowed participants to enter their email address in a drawing for one of two fifteen dollar gift cards to a local restaurant. Their survey responses were not connected to their email address. One week after the initial email inviting the student to participate in the study, a second mass email was sent as a reminder requesting participation in the study, the purpose of the study, the rights of the participants, and a link to the survey. The survey was closed for data collection two weeks after the initial email was sent.

Data analysis

All statistical analyses were conducted using PAWS Statistics, version 18.0; SPSS Inc., Chicago, IL. Preliminary analyses were conducted including descriptive analysis, exploratory factor analysis, and reliability. Data analysis included paired-samples t-test, Pearson's Chi-squared analysis, and one-way between groups Analysis of Variance (ANOVA).

RESULTS

The survey was distributed to a 90% sample of the university students who agreed to research participation for a total of 17,353 students. A total of 920 responses were received—a response rate of 5.3%. Many of the survey responses were incomplete, common with web-based surveys. Two hundred and eighteen responses were incomplete and unusable. After removing these data, 702 responses remained for data analysis. Preliminary analysis of the data for descriptive measures is listed in table 1. Participants in the study represented 70.5% (n = 493) females and 29.5% (n = 202) males, as well as 79.7% (n = 559) non-vegetarians, 8.7% (n = 61) vegetarians, and 11.6% (n = 81) semi-vegetarians. Table 1 also lists percentages for initial and current reasons to choose or not choose vegetarianism. One hundred and forty-six participants, (21.4%) claimed their current reason for choosing or not choosing vegetarianism is not the same as their initial reason. However, a paired samples t-test was performed and showed no statistical difference between participants' initial and current reason to choose or not choose vegetarianism $t(677) = 1.088$, $p>.05$.

Table 2 displays percentages for the entire survey population in relation to the nutrition knowledge survey tool. A significant difference was found for five questions regarding whether the individual was a vegetarian, non-vegetarian, or semi-vegetarian are shown in table 3. The percentage for each significant question was determined for each diet type. In two of the nutrition knowledge questions, vegetarians answered with the highest percentage of accuracy. Two of the remaining nutrition knowledge questions showed a statistical significance for semi-vegetarians, who answered with the highest percentage of accuracy. Thus, non-vegetarians only answered one question with a significantly greater amount of nutrition knowledge. The two questions the vegetarians answered with the highest amount of accuracy were most relative to vegetarian nutrition. The question the non-vegetarians answered with the highest accuracy was a very basic nutrition knowledge question relating to a varied diet. The two most complex of the nutrition knowledge questions were answered correct most often by the semi-vegetarians.

Table 4 shows one underlying factor emerged from exploratory factor analysis of the four items measuring participants' attitudes toward a vegetarian diet. The factor had an eigenvalue of 3.18 and explained 79.61% of the total variance. Factor loadings ranged from .84 to .92, and Cronbach's *alpha* was .91, meaning the survey tool produced reliable results. A one-way between-groups ANOVA revealed a significant difference in the attitudes toward a vegetarian diet among vegetarian, non-vegetarian, and semi-vegetarian: $F(2, 676) = 180.98$, $p < .001$ (see table 4). Using eta squared, the effect size calculated was .35, which means the actual difference in the mean scores among these three groups was distinct. *Post-hoc* analysis comparisons using the Tukey HSD test indicated vegetarians (M = 24.83, SD = 3.30) and semi-vegetarians (M = 24.58, SD = 3.03) showed greater positive attitudes towards a vegetarian diet than non-

Table 1: Percentage of the demographic and characteristic variables for all respondents.

Characteristics	Number	Percent
Gender		
Male	202	29.5%
Female	493	70.5%
Follows Vegetarianism		
Yes	61	8.7%
No	559	79.7%
Part of the time	81	11.6%
College Year		
Freshman	93	13.2%
Sophomore	110	15.7%
Junior	194	27.6%
Senior	175	24.9%
Graduate	130	18.5%
Vegetarianism Type		
Vegan	12	1.7%
Lacto-Vegetarianism	12	1.7%
Ovo-Vegetarianism	11	1.6%
Lacto-Ovo Vegetarianism	64	9.6%
None	569	81.3%
Others	29	4.1%
Initial Reason for Vegetarianism		
Health Reasons	201	29.5%
Environmental Causes	19	2.8%
Animal Cruelty	47	6.9%
Religion	9	1.3%
Ecofeminism	0	5.6%
Weight Loss	38	0%
Others	368	46.0%
Current Reason for Vegetarianism		
Health Reasons	213	31%
Environmental	23	3.3%
Animal Cruelty	37	5.4%
Religion	9	1.3%
Ecofeminism	0	0%
Weight Loss	34	4.9%
Others	372	54.1%

Table 2: *Chi*-squared analysis of nutrition knowledge and diet type and answer percentages for nutrition knowledge questionnaire.

Nutrition Knowledge				Pearson *Chi*-squared tests
	% Correct	% Incorrect	% Undecided	*Chi*-squared value (*df*)
1. A sound nutritional practice is to eat a wide variety of different food types from day-to-day	85.9%	7.6%	6.6%	.143(4)*
2. Most plant oils are better for body health than most animal oils	70.8%	7.9%	21.3%	12.052(4)*
3. A diet low in cholesterol and saturated fats may aid in the prevention of heart disease	94.6%	2.9%	2.6%	1.480(4)
4. A diet is incomplete without milk or meat	57.1%	38%	4.9%	66.215(4)***
5. Oranges are an excellent source of Vitamin C	96.7%	2%	1.3%	.300(4)
6. Foods enriched with Vitamin D help ensure the normal development of bones and prevention of rickets	81.2%	4.7%	14.1%	1.962(4)
7. If a person eats at least three regular meals a day, his or her diet is certain to be nutritionally complete	85.7%	10.3%	4%	3.323(4)
8. It is impossible to consume sufficient protein from non-meat sources	75.9%	18.3%	5.9%	9.778(4)*
9. Milk and meat are the only dietary sources of protein, calcium, and phosphorus	94.1%	2.3%	3.6%	.056(4)
10. Antioxidants protect body cells from damage caused by free radicals in the body	74.5%	2.3%	23.3%	12.336(4)*
11. Egg whites are a good source on insoluble fiber	21.7%	30.9%	47.4%	.869(4)
12. Trans fat is beneficial for the body because it helps vital organs function and promotes proper blood circulation	57.9%	15.1%	27%	1.868(4)
13. Healthy, active individuals require some concentrated sweets, such as candy for energy	76.5%	14.3%	9.2%	9.271(4)
14. Fruit juices or smoothies provide the same nutritional benefits as whole fruit	77.7%	14.8%	7.4%	4.731(4)

*p <.05, **p <.005, ***p <.001

Table 3: Percent of correct answers based on diet type

	Vegetarian	Non-Vegetarian	Semi-Vegetarian
1. A sound nutritional practice is to eat a wide variety of different food types from day-to-day	85.2%	85.9%	85.2%
2. Most plant oils are better for body health than most animal oils	75.4%	68.2%	84%
4. A diet is incomplete without milk or meat	91.8%	49.9%	76.5%
8. It is impossible to consume sufficient protein from non-meat sources	90.2%	74.4%	74.1%
10. Antioxidants protect body cells from damage caused by free radicals in the body	70.5%	72.9%	88.9%

Table 4: Factor analysis of attitudes towards vegetarian diet and one-way between-group ANOVA testing a difference of attitude toward vegetarian diet among vegans, semi = vegetarians, and non-vegetarians.

Attitude Variable	Factor Loading	Mean	*SD*	*F*(2, 676)
Bad/Good	.92	4.56	1.71	180.98***
Harmful/Beneficial	.91	4.63	1.55	
Unpleasant/Pleasant	.90	3.83	1.93	
Unenjoyable/Enjoyable	.84	3.30	1.74	
Eigenvalue: 3.18 %variance explained: 79.61 Cronbach's *alpha*: .91				

*p <.05, **p <.005, ***p <.001

vegetarians (M = 14.53, *SD* = 5.26). Vegetarians have the highest or most positive attitude toward a vegetarian diet. Semi-vegetarians follow with the second highest positive attitude toward a vegetarian diet. Non-vegetarians have the lowest positive attitude, showing this diet type has the least positive attitude toward a vegetarian diet.

Table 5 addresses the nutrition attitudes questionnaire. An exploratory factor analysis was conducted on 10 items. Table 5 shows three identified factors. These three factors were named Vegetarian Nutrition Attitudes, General Nutrition Attitudes, and Individual Nutrition Attitudes. Reliability was tested for each factor, resulting in Vegetarian Nutrition Attitudes α = .82, General Nutrition Attitudes α = .80, and Individual Nutrition Attitudes α = .45. Due to its low reliability, Individual Nutrition Attitudes was not used in further analyses. One-way between groups ANOVAs were conducted to determine differences of the vegetarian nutrition attitudes and general nutrition attitudes among vegetarians, non-vegetarians, and semi-vegetarians. A statistically significant difference was found in the Vegetarian Nutrition Attitudes factor $F(2, 671) = 110.53$, $p<.001$ as well as in the General Nutrition Attitudes factor $F(2, 671) = 4.58$, $p <.05$ *Post-hoc* comparisons using the Tukey HSD test indicated the mean scores of vegetarian nutrition attitudes were all statistically different from each other: vegetarians (M = 4.92, *SD* = 1.83), non-vegetarians (M = 10.77, *SD* = 3.17), and semi-vegetarians (M = 5.99, *SD* = 2.62). Additionally, there was a statistically significant difference of general nutrition attitudes between semi-vegetarians (M = 14.53, *SD* = 1.40) and non-vegetarians (M = 13.99, *SD* = 1.69), but not with vegetarians (M = 14.50, *SD* = 1.17). Strongly agree is rated as one on this survey instrument, while strongly disagree is rated as five; thus, a smaller number denotes a more positive attitude. Confirming the results of the attitude toward a vegetarian diet survey tool, this study found vegetarians had the most positive attitude towards vegetarian nutrition with the lowest mean. Semi-vegetarians had the second lowest mean showing this diet group had the second most positive attitude towards vegetarian nutrition. The non-vegetarians, the highest mean, had the least positive attitude toward vegetarian nutrition.

Table 6 displays percentages for the food frequency questionnaire for all participants and Pearson's *Chi*-squared values to determine

Table 5: Exploratory Factor Analysis of Nutrition Attitudes Questionnaire

Factor Title and Items	Factor Loading			Mean	*SD*	*F* (2,673)
Factor 1 Vegetarian Nutrition Attitudes						110.53***
• Vegetarians do not get sufficient nutrients or calories	.84			3.52	1.09	
• A diet without meat is satisfactory and nutritious	-.81			2.82	1.22	
• Vegetarians are often weak and tired	.80			3.55	1.01	
• A vegetarian diet provides a variety of nutrients	-.74			2.25	1.05	
Factor 2 General Nutrition Attitudes						4.58*
• Nutrition is an essential component of total health care		.88		1.15	.51	
• A varied, nutritious diet promotes good health		.85		1.30	.64	
• Diet is an important factor in the prevention of diseases		.81		1.44	.73	
Factor 3 Individual Nutrition Attitudes						
• I would support my family member or close friend following a fad diet			.74	3.40	1.22	
• Individuals must take vitamins to meet their nutrition needs			.69	3.13	1.20	
• Eating healthy is expensive and time consuming			.62	2.82	1.29	
Eigenvalue	3.09	1.94	1.32			
% Variance Explained	30.91	19.30	13.22			
Cronbach's *alpha*	.82	.80	.45			

*p <.05, **p <.005, ***p <.001

differences for each dietary intake category, vegetarian, non-vegetarian, and semi-vegetarian. Table 7 displays the mean intakes for the food categories indicated significantly different according to whether the participant was vegetarian, non-vegetarian, or semi-vegetarian. Although there were many food items that showed a significant difference in intake among diet types, no individual diet type came across as superior in dietary intake with the use of this survey tool.

DISCUSSION

This study explored differences in knowledge, attitudes, and intake among college students based on their diet choice in relation to vegetarianism. As with many studies relating to vegetarianism, the majority of the participants were female-70.5% of the study population. Additionally, the majority of the vegetarians in the study were females, 93.4%, a common theme in vegetarian populations [4,31,32]. The overall presence of vegetarianism in the participating student population was 62 (8.7%) of the 702 participants. Participants who considered themselves semi-vegetarians were 81 (11.6%). Although these numbers seem low, as a nation about 3.4% of the population reports following a vegetarian diet [2]. The large percentage of vegetarians and semi-vegetarians is likely due to participant interest in the topic, since participation was voluntary. In this study, the majority of vegetarians were juniors in college (27.6%). At the university where this study occurred, the junior year is the first year students are allowed to live off-campus. The presence of vegetarianism may reflect an ability to make their own choices and explore a world of food outside of campus dining centers or changing ideas on health.

The nutrition knowledge questionnaire showed a significant difference in percentages between diet types and nutrition knowledge, which scored in five of the questions on the survey. Two of these five questions related directly to animal versus plant topics, where all of the vegetarians scored a higher percentage of correct answers. This survey showed vegetarians know more about their own diet type. However, this did not hold true for general or complex nutrition knowledge questions, since they did not score with the highest percent of accuracy on these questions. Non-vegetarians answered a general nutrition question with more accuracy than either the vegetarians or semi-vegetarians; thus, showing a solid base of nutrition knowledge, yet did not answer any of the other significant questions with the highest percentage of accuracy. Semi-vegetarians were able to answer the two more complex questions with the highest percent of accuracy above both the vegetarians and non-vegetarians. The results of this survey did not suggest a specific diet type as having the most nutrition knowledge. However, semi-vegetarians showed a grasp of complex nutrition knowledge concepts and only answered with the lowest percent of accuracy on one of the five significant questions within one percent of the next lowest answer percentage. This indicated semi-vegetarians had a wider range, more in-depth level of nutrition knowledge over vegetarians and non-vegetarians. Previous research stated vegetarians tend to demonstrate a higher level of nutrition knowledge than non-vegetarians [5,33]. However, most data were based on vegetarian-related questions. This can be noted in this survey since vegetarians demonstrated more nutrition knowledge only related to their own diets.

Findings for attitudes toward a vegetarian diet were not unexpected. There was a strong relationship between diet type and attitude toward a vegetarian diet. Mean values using the computed variable for all attitudes toward vegetarian diet questions showed seven-point Likert-type scale vegetarians had the strongest positive attitude, while non-vegetarians had a less positive attitude toward a vegetarian diet. Semi-vegetarians had a positive attitude. However, their attitude was not as strong as vegetarians. This study shows the participants who follow a vegetarian diet have the most positive attitude toward the diet. Additionally, non-vegetarians, who follow an

Table 6: Chi-Squared and Percentage of Dietary Intake of All Participants.

	2-3x/Day		1x/Day		2-3x/Week		Seldom		Never		
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*Chi*-squared value (*df*)
Milk, cheese, yogurt, or cottage cheese	314	45.4%	248	35.8%	89	12.9%	15	3.8%	15	2.2%	10.827(8)
Meats, fish, chicken, turkey, eggs, peanut butter, dry beans, luncheon meats – lean/low-fat	238	34.6%	258	37.5%	128	18.6%	53	7.7%	11	1.6%	78.137(8)***
Meats, fish, chicken, turkey, eggs, peanut butter, dry beans, luncheon meats – regular/full-fat	153	22.1%	222	32.1%	165	23.9%	121	17.5%	30	4.3%	114.179(8)***
Beans/legumes	15	2.2%	86	12.4%	284	41%	252	36.4%	55	7.9%	67.424(8)***
Soy-based foods	10	1.5%	56	8.1%	140	20.3%	298	43.3%	185	26.9%	130.2(8)***
Fruit or vegetable juice	93	13.4%	180	26%	198	28.6%	173	25%	49	7.1%	180.034(8)*
Fresh vegetables	173	25%	193	27.9%	230	33.3%	85	12.3%	10	1.4%	58.541(8)***
Canned or frozen vegetables	41	5.9%	140	20.4%	278	40.2%	198	28.6%	35	5.1%	16.994(8)*
Fresh fruit	183	26.4%	232	33.5%	204	29.4%	63	29.4%	11	1.6%	33.781(8)***
Dried fruit	8	1.2%	57	8.2%	134	19.4%	3411	49.3%	151	21.9%	19.631(8)*
Whole grain/wheat pasta, cereal, rice, bread	242	35%	244	35.3%	132	19.1%	13	1.9%	60	8.7%	28.391(8)***
White pasta, cereal, rice, bread	93	13.8%	201	29.2%	222	32.3%	54	7.4%	119	17.3%	20.136(8)*
Sweets, candy, baked goods, desserts	50	7.3%	198	28.8%	264	38.4%	28	4.1%	147	21.4%	12.199(8)
Soft drinks, sweetened juices, Kool-aid	64	9.2%	100	14.5%	152	22%	155	22.4%	221	31.9%	15.952(8)*
Potato chips	6	0.9%	37	5.4%	185	26.8%	125	18.1%	338	48.9%	15.588(8)*
French fries	2	0.3%	24	3.5%	162	23.6%	105	15.3%	105	57.3%	15.097(8)
Fast food or convenience food	2	0.3%	23	3.3%	187	27%	100	14.4%	381	55%	24.588(8)**

opposite diet type, show the least positive attitude toward a vegetarian diet. This finding supports Povey, Wellens, and Conner's study [24]. They found individuals who ate meat were determined to display more negative beliefs towards a vegetarian diet. The *post-hoc* Tukey HSD analysis goes farther to show vegetarians have a significantly more positive attitude than both non-vegetarians and semi-vegetarians, and semi-vegetarians have a significantly more positive attitude than non-vegetarians. However, semi-vegetarians have a significantly less positive attitude than vegetarians. Non-vegetarians have a significantly less positive attitude than both vegetarians and semi-vegetarians. This study shows vegetarians, semi-vegetarians, and non-vegetarians' attitudes toward a vegetarian diet are affected by their own diet type.

Dietary patterns among the different diet types were measured using a food frequency questionnaire. Pearson's *chi*-squared analysis showed a significant difference in the intake of fourteen food items in relation to diet type. It was shown that vegetarians selected meat products on the food frequency questionnaire with less frequency. However, this number was not entirely reflective of the never category suggesting some self-claimed vegetarians still ate meat. Similar findings, previously discovered by Bedford and Barr, showed not all vegetarians rigidly adhered to strict dietary rules [4]. Vegetarians also had a lower intake of canned or frozen vegetables, white pasta, cereal, rice, or bread, soft drinks, sweetened juices, Kool-Aid, and less fast food or convenience food. Vegetarians had a smaller intake of fruit or vegetable juice and potato chips than non-vegetarians, but more than semi-vegetarians. They also consumed less fresh fruit and whole grain/whole wheat pasta, cereal, rice or bread than non-vegetarians, but more than semi-vegetarians. Vegetarians consumed more beans and legumes than all other diet types as well as more soy-based foods, fresh vegetables, and dried fruit. This suggests college vegetarians do not always have a more nutritious diet overall than non-vegetarians or semi-vegetarians. However, since college vegetarians were examined, this could contribute to the choice of foods, since time, cost, peer influence, and convenience constraints often become a factor in dietary choices during college years. No diet group was shown to have a healthier diet with this survey; however, several differences in dietary intake among diet groups were found.

None of the survey strongly reflects a dietary or nutrition knowledge advantage to choosing a vegetarian lifestyle, since vegetarians only showed greater knowledge related to their own diet type. The survey's results determined semi-vegetarians fell at high or midline levels choosing both varied and nutritious foods, as well as displaying solid nutrition knowledge across all levels, and appropriate nutrition and vegetarian attitudes. The results from this study showed vegetarians had a more positive attitude towards a vegetarian diet than non-vegetarians. Vegetarians also showed greater knowledge in questions specifically related to vegetarian nutrition compared to general nutrition questions. The results of dietary intake did not show vegetarians consume higher quality foods than non-vegetarians; however, there were differences in the participants' intake of specific foods (soy-based products, fresh vegetables, whole grain products, fast food).

CONCLUSION

This study provided information about the choices for each diet type as well as a large variance of attitudes toward a vegetarian diet and vegetarian nutrition based on diet type. The results from

Table 7: Mean Values and Standard Deviation of Dietary Intake Based on Diet Type

	Vegetarian		Non-Vegetarian		Semi- Vegetarian	
	Mean	***SD***	**Mean**	***SD***	**Mean**	***SD***
Meats, fish, chicken, turkey, eggs, peanut butter, dry beans, luncheon meats – lean/ low-fat	3.18	1.08	2.70	1.25	2.45	1.04
Meats, fish, chicken, turkey, eggs, peanut butter, dry beans, luncheon meats – regular/ full-fat	3.45	1.04	4.00	1.3	3.55	1.21
Beans/legumes	2.45	2.2%	2.60	.52	4.00	.89
Soy-based foods	2.64	1.12	3.30	.68	3.64	.67
Fruit or vegetable juice	3.00	1.41	2.20	1.40	3.09	1.14
Fresh vegetables	1.36	.92	1.80	1.32	1.80	.63
Canned or frozen vegetables	2.45	1.13	2.30	.95	2.82	1.33
Fresh fruit	1.5	.93	1.44	.73	2.18	.75
Dried fruit	3.00	.89	3.30	1.16	3.82	1.08
Whole grain/wheat pasta, cereal, rice, bread	1.82	1.25	1.80	.63	2.64	1.75
White pasta, cereal, rice, bread	3.64	1.36	3.00	1.33	3.45	1.64
Soft drinks, sweetened juices, kool-aid	4.00	1.18	4.30	1.06	3.64	1.29
Potato chips	4.45	.93	4.50	.85	4.36	.81
Fast food or convenience food	4.64	.67	4.50	.85	4.09	1.04

this study are applicable in the vegetarian community and those who work with the vegetarian community. Most notably, this study could be of great use to food service establishments, particularly the college dining setting. Information from this study can be used to determine not only the dietary choices to serve on the menu, but also how to make vegetarian customers feel welcome. Since vegetarians are often the minority in a food service establishment, they are often overlooked and may feel unwelcome and uncomfortable. This study can help food service managers develop strategies to address attitudes towards the positive promotion of a vegetarian diet. It also helps to stress proper education of food products by the food service staff, since vegetarians do not have more nutrition knowledge than other diet types. Also, there are limited resources available to vegetarians to provide proper education, guidance, and support. This information could additionally be used in simple publications to provide greater knowledge to those interested in this topic.

Some limitations within this study should be noted. Participation in this study was voluntary, which may denote participant bias or special interest in the subject matter. The study was also limited to one university; thus, it cannot represent the entire Midwest nor the entire nation. Over two-thirds of the population were female. Participants' age and race were undetermined. Additionally, vegetarian status was determined on a self-reported basis. Within the literature and this study, there have been discrepancies of what constitutes vegetarianism. Therefore, this should be addressed in future research. All future research should consider the limitations of this study to gain greater, significant findings.

Future research with the vegetarian population should look at many variables brought to light through this study. A study focusing on the term 'vegetarian' may be beneficial, since many issues and discrepancies arise with a self-reported diet status for vegetarian. Additionally, looking at vegetarians both outside the university and college setting could provide a different prospective on the variables in relationship to vegetarianism. Focusing on general nutrition in nutrition knowledge questionnaires, rather than vegetarian nutrition, may provide a greater scope on the actual variance of nutrition knowledge in the study population.

REFERENCES

1. Craig WJ, Mangels AR. Position of the American dietetic association: vegetarian diets. J Am Diet Assoc. 2009; 109: 1266-1282. https://bit.ly/2giva6e
2. Forestell C, Spaeth A, Kane S. To eat or not to eat red meat: a closer look at the relationship between restrained eating and vegetarianism in college females. Appetite. 2011; 58: 319-325. https://bit.ly/2HMcnwP
3. Craddock JC, Neale EP, Peoples GE, Probst YC. Vegetarian-based dietary patterns and their relation with inflammatory and immune biomarkers: a systematic review and meta-analysis. Adv Nutr. 2019; 10: 433-451. https://bit.ly/2KgFdqL
4. Bedford J, Barr S. Diets and selected lifestyle practices of self-defined adult vegetarians from population-based sample suggest they are more health conscience. Int J Behav Nutr Phys Act. 2005; 2: 4-6. https://bit.ly/2YXzV7E
5. Shickle D, Lewis P, Charny M, Farrow S. Differences in health, knowledge and attitudes between vegetarians and meat eaters in random population sample. J R Soc Med. 1989; 82: 18-20. https://bit.ly/2KgsV1F
6. Leite AC, Dhont K, Hodson G. Longitudinal effects of human supremacy beliefs and vegetarianism threat on moral exclusion (*vs.* inclusion) of animals. Eur J Soc Psychol. 2019; 49: 179-189. https://bit.ly/30Xz5JR
7. Largen KJ. A Christian rationale for vegetarianism. Dialog. 2009; 48: 147-157. https://bit.ly/30TVeIZ
8. Huang R, Huang C, Hu FB, Charvo JE. Vegetarian diets and weight reduction: a meta-analysis of randomized controlled trials. J Gen Intern Med. 2016; 31: 109-116. https://bit.ly/2EGcerH
9. Hoffman SR, Stalling SF, Bessinger RC, Brooks GT. Differences between health and ethical vegetarians: strength of conviction, nutrition knowledge, dietary restriction, and duration of adherence. Appetite. 2013; 65: 139-144. https://bit.ly/30WE6Cm
10. Menal-Puey S, Martínez-Biarge M, Marques-Lopes I. Developing a food exchange system for meal planning in vegan children and adolescents. Nutrients. 2019; 11: 43-57. https://bit.ly/2Z0obRY
11. Robinson-O'Brien R, Perry LP, Wall MM, Story M, Neumark-Stanizer D. Adolescent and young adult vegetarianism: better dietary intake and weight outcomes but increased risk of disordered eating behaviors. J Am Diet Assoc. 2009; 109: 648-655. https://bit.ly/2JO1IUA

12. Bissonnette M, Contento I. Adolescents' perspectives and food choice behaviors in terms of the environmental impacts of food production practices: application of a psychosocial model. J Nutr Educ. 2001; 33: 72-82. https://bit.ly/2KaWjq2

13. Ajzen I. From intentions to actions: a theory of planned behavior. In Kuhl J, Beckmann J. Action Control: from Cognition to Behavior, Berlin. Heidelberg: Springer; 1985. P. 11-39. https://bit.ly/2XnNkFx

14. Backman DR, Johnston PK, Hodgkins GE, Haddad EH, Lee JW. Psychosocial predictors of healthful dietary behavior in adolescents. J Nutr Educ Behav. 2002; 34: 184-192. https://bit.ly/2WCPbJH

15. Parker HW, Vadiveloo MK. Diet quality of vegetarian diets compared with nonvegetarian diets: a systematic review. Nutr Rev. 2019; 77: 144-160. https://bit.ly/2KosjqS

16. Dyett PA, Sabate J, Haddad E, Rajarma S, Shavlik D. Vegan lifestyle behaviors: an exploration of congruence with health-related beliefs and assessed heath indices. Appetite. 2013; 67: 119-124. https://bit.ly/2JSnAOI

17. Haddad E, Tanzman J. What do vegetarians in the United States eat? Am J Clin Nutr. 2003; 78: 626S-632S. https://bit.ly/2Z4yT9M

18. Spencer E, Appleby P, Davey G, Key TJ. Diet and body mass index in 38000 EPIC-Oxford meat-eaters, fish-eaters, vegetarians and vegans. Int J Obes Relat Metab Disord. 2003; 27: 728-734. https://bit.ly/2MNVHoL

19. Ashwini. A comparative study of metabolic profile, anthropometric parameters among vegetarians and non-vegetarians - do vegetarian diet have a cardio protective role? Int J Res Med Sci. 2016; 4: 2240-2245. https://bit.ly/2WGXfJk

20. Segovia-Siapco G, Burkholder-Cooley N, Haddad Tabrizi S, Sabaté J. Beyond meat: a comparison of the dietary intakes of vegetarian and non-vegetarian adolescents. Front Nutr. 2019; 6: 86. https://bit.ly/315nskg

21. Chiplonkar SA, Tupe R. Development of a diet quality index with special reference to micronutrient adequacy for adolescent girls consuming a lacto-vegetarian diet. J Am Diet Assoc. 2010; 110: 926-931. https://bit.ly/2JSUO0g

22. Kniskern M, Johnston C. Protein dietary reference intakes may be inadequate for vegetarians if low amounts of animal protein are consumed. Nutrition. 2011; 27: 727-730. https://bit.ly/310yE1D

23. Haldar S, Rowland I, Barnett Y, Bradbury I, Robson P, Powell J, Fletcher J. Influence of habitual diet on antioxidant status: a study in a population of vegetarians and omnivores. Eur J Clin Nutr. 2007; 61: 1011-1022. https://bit.ly/2W6jGDv

24. Povey R, Wellens B, Conner M. Attitudes towards following meat, vegetarian and vegan diets: An examination of the role of ambivalence. Appetite. 2001; 37: 15-26. https://bit.ly/315oHzW

25. DeBoer J, Schösler H, Aiking H. Towards a reduced meat diet: mindset and motivation of young vegetarians, low, medium and high meat-eaters. Appetite. 2017; 113: 387-397. https://bit.ly/2W4Uygk

26. Richardson JH, Macfie JJ, Shepherd R. Consumer attitudes to meat eating. Meat Sci. 1994; 36: 57-65. https://bit.ly/2wAbCQY

27. Gvion L. Who's afraid of cooking vegetables? Changing conceptions of American vegetarianism – 1850-1990. Euro J Amers Culs. 2002; 21: 146. https://bit.ly/2W5BM8E

28. Katcher HI, Ferdowsian HR, Hoover VJ, Cohen JL, Barnard ND. A worksite vegan nutrition program is well-accepted and improves health-related quality of life and work productivity. Ann Nutr Metab. 2010; 56: 245-252. https://bit.ly/315pSiQ

29. Merriman B. Gender differences in family and peer reaction to the adoption of a vegetarian diet. Fem Psychol. 2010; 20: 420-427. https://bit.ly/2KnqWZp

30. Nnakwe N, Kies C. Nutrition attitudes and knowledge of Nigerian nurses and physicians. Nutrition Report International. 1985; 31: 765-776. https://bit.ly/2WcU4Vo

31. Deriemaeker P, Aerenhouts D, Hebbelinck M, Clarys P. Nutrient based estimation of acid-base balance in vegetarians and non-vegetarians. Plant Foods Hum Nutr. 2010; 65: 77-82. https://bit.ly/2Z4i0wg

32. Deriemaeker P, Alewaeters K, Hebbelinck M, Lefevre J, Philippaerts R, Clarys P. Nutritional status of Flemish vegetarians compared with non-vegetarians: a matched samples study. Nutrients. 2010; 2: 770-780. https://bit.ly/2WI2yYZ

33. Leonard AJ, Chalmers KA, Collins CE, Patterson AJ. Research report: the effect of nutrition knowledge and dietary iron intake on iron status in young women. Appetite. 2014; 81: 225-231. https://bit.ly/2WgIzBg