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Nutritional Adequacy of Dietary Intake Among College Students Who Follow a Vegetarian Diet as Compared to Non-Vegetarian Students

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NUTRITIONAL ADEQUACY OF DIETARY INTAKE AMONG

COLLEGE STUDENTS WHO FOLLOW A VEGETARIAN

DIET AS COMPARED TO NON-VEGETARIAN

STUDENTS

by

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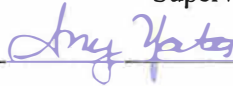**KayAnna L. Pulliam, B.S., R.D.N.**

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ABSTRACT

In recent years, forms of the vegetarian diet have been popularized for various reasons, including health benefits, support of animal rights, and greater sustainability claims. The purpose of this cross-sectional study was to examine the diet quality and adequacy and iron status of college students' diets, and compare eating disorder (ED) risk between self-proclaimed vegetarians and non-vegetarians. The study sample was a convenience sample of students at Louisiana Tech University who were 18 years of age or older ($N = 179$). Students were recruited via email, flyers, and classroom announcements. Participants completed an online questionnaire with multiple validated tests; The Rapid Eating Assessment for Participants – Shortened Version (REAP-S) for diet quality, the Bratman Test for Orthorexia, and the SCOFF Questionnaire for eating disorder risk.

There were 179 participants included in the analysis for this study. The mean age was 21 +/- 4.6 years; majority were female ($n = 129$, 72.07%) and White ($n = 134$, 74.86%). Body Mass Index (BMI) ranged from 16.8 to 46.4, with a mean BMI of 25.7 ($SD = 5.7$). Four (2.25%) participants were categorized as underweight, 94 (53.12%) as healthy weight, 46 (25.99%) as overweight, and 33 (18.64%) as obese.

A significant, inverse relationship was found between REAP-S scores and BMI; an increased diet quality was linked with a lower BMI. This is consistent with the literature supporting that a healthy diet can mitigate overweight and obesity among the

college population. Participants averaged a score of 27.1 out of 39 on the REAP-S,

indicating moderate diet quality, indicating that there are still improvements to be made.

A number of participants, 38.20% ($n = 68$), reported eating less than two servings of fruit

daily, and 29.21% ($n = 52$) reported eating less than two servings of vegetables daily.

The mean hemoglobin level for females was 14.09 g/dl ($SD =1.36$). Twenty-four

percent of the females were found to have below-normal hemoglobin levels (Hbg < 12.1

g/dl), 72.22% had normal hemoglobin levels (Hgb 12.1-15.1 g/dl), and 3.70% had high

levels (Hbg > 15.1 g/dl). The mean hemoglobin level for males was 15.87 ($SD =1.48$).

Three (6.25%) males had below-normal Hgb levels (Hgb < 13.1 g/dl), 62.50% had

normal hemoglobin levels (Hgb 13.1-16.6 g/dl), and 31.25% high levels (Hgb > 16.6

g/dl). There was a positive correlation found between BMI and Hemoglobin levels for

males r (48) = .348, $p = .018$. No significant correlations were found between Hgb and

the BOT, SCOFF, or REAP-S scores. There were no significant correlations found

between Hbg and BMI, BOT, SCOFF, or REAP-S scores for the female group.

A significant, positive correlation was found between SCOFF scores and Bratman

Test scores, $r (176) = .167, p = < .001$. As the risk of having an eating disorder increased,

so did the risk of experiencing orthorexia. A significant, positive correlation was also

found between REAP-S scores and Bratman Test scores, $r (171) = .382, p = < .001$,

indicating that higher diet quality scores were associated with higher risks for orthorexia.

A significant, inverse relationship was found between REAP-S scores and BMI, $r (158) =$

$-.167, p = .036$; as diet quality increased, BMI decreased. To further explore the

relationships among participant characteristics, participants were divided into health-

related or non-health-related groups. Both the REAP-S scores and Bratman Test results

were found to be significantly different between the groups, t (170) = 4.06, (p = < .001) and t (175) = 3.00, (p = .003), respectively. Health-related majors were found to have greater diet quality scores and a higher risk of eating disorders when compared to non-health-related majors.

Having a very small percentage of vegetarian and vegan participants limited full analysis related to vegetarianism. However, this study provides nutrition professionals with valuable information regarding diet adequacy, eating disorder risk, hemoglobin levels, as well as the prevalence of vegetarianism among college students at Louisiana Tech University. Specifically, these results indicate that students in health-related majors may be at greater risk for orthorexia as they strive for higher diet quality and might also be at greater risk for other eating disorders. Results also indicated that students who maintain a diet of higher quality might have lower BMIs than their peers.

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CHAPTER 1

INTRODUCTION

Background

The vegetarian diet is characterized by the dietary exclusion of all animal meats while including eggs and dairy products. There are many subcategories of vegetarianism, including but not limited to; ovo-vegetarian (excludes all animal meats and dairy, includes eggs), lacto-vegetarian (excludes all animal meats and eggs, includes dairy), pesco-vegetarian (excluding all animal meats, with the exception of seafood, while including eggs and dairy) and vegan (excluding all animal meats, eggs and dairy). All forms of vegetarianism include plant-derived foods such as fruits, vegetables, grains, beans, peas, legumes, and seeds.

In recent years, many forms of the vegetarian diet have been popularized by modern culture for various reasons, including health benefits, support of animal rights, and greater sustainability claims. This popularization has led to an increase in vegetarianism across the United States, and in 2020, an estimated 6% of the US population reported following a vegetarian or vegan diet, as compared to 3.3% reported in the 2016 survey from The Vegetarian Resource Group (*How Many Adults in the U.S. Are Vegetarian and Vegan | The Vegetarian Resource Group (VRG)*, n.d.). Research has supported the health benefits of vegetarianism, suggesting that this diet can lower the risk of heart disease, cancer and type two diabetes mellitus (Pawlak, 2018), and possibly

hypertension (Liu, 2018). However, the vegetarian diet cannot be said to be inherently healthier than diets containing animal products. Many plant-based options in today's food industry contain large amounts of saturated fats, sodium, and other nutrients deemed unhealthy. Vegetarians consistently consuming these products may not achieve the health benefits they expect. A diet high in these products may also be lacking overall nutritional adequacy.

As students transition from high school to college/university, they will likely gain newfound freedom in experiencing increased control over their diet choices. This new freedom has the potential to cause significant changes in dietary patterns, which may contribute to overall health. According to a recent survey created by *College Pulse*, one in 10 U.S. college students follow a vegetarian diet, making college students more likely to follow a vegetarian diet than the general public (*College Pulse*, n.d.). Though it seems that this diet is growing in popularity among young adults, it is unclear whether vegetarianism within this population can be deemed more nutritionally adequate than non-vegetarian diets due to the limiting of food groups, the potential for nutrient deficiencies, and the possible risk of disordered eating. Animal products, such as beef, eggs, organ meats, and some seafood, are rich in iron. So, when these products are excluded from the diet, iron depletion and deficiency are at risk, especially for menstruating women. Poor eating behaviors, which can lead to eating disorder risk, are also a concern among this population. According to the National Eating Disorders Association (NEDA), in 2013, 10 to 20% of female students and 4 to 10% of male students had developed an eating disorder (*Results of College Survey Show Unmet Need for Campus Resources for Eating Disorders*, 2013). Research that is more recent suggests

that students who follow a vegetarian diet, specifically those with the motivation to lose weight, may need to be evaluated for eating disorder risk (Zickgraf, 2020). These same authors also reported that those who became vegetarian after entering college were more likely to have adhered to this type of diet with the motivation of losing weight (Zickgraf, 2020).

The available research involving vegetarian college students, their iron intake, and eating behaviors is currently limited. For this reason, more research should be conducted to determine whether or not individuals following a vegetarian diet are meeting adequate dietary requirements and achieving healthy eating behaviors compared to their non-vegetarian counterparts. In order to guide this population effectively, nutrition professionals need additional research on this topic.

Research Purpose

It is known that diet changes made during college can influence lifelong behaviors. This study will evaluate dietary patterns as well as the timing by which diet changes were made, and in turn, create a more complete body of knowledge to empower nutrition professionals to work more actively within the college student population. Nutrition education in campus settings could create a more health-conscious body of young adults. The purpose of this study is to examine the nutritional adequacy of college students' diets and to compare non-vegetarian diets to various degrees of vegetarian diets for associations with eating disorder and iron deficiency risks.

Justification

Currently, there are limited studies completed in assessing diet adequacy and eating behaviors in college students focused on comparing vegetarianism to non-vegetarianism. Evaluating the nutritional adequacy of the vegetarian diet has grown in importance due to the growing number of college students choosing to follow a vegetarian diet. While in college, students develop dietary habits that lay the foundation for their future health. In order to effectively serve these students, nutrition professionals need evidence-based research to serve as a guide for proper education and counseling.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

Across the nation, college students are showing a growing interest in their health and diet. As this interest builds, the vegetarian diet has become increasingly popularized among young adults because of its association with better health, low environmental impact, and higher perceived moral standing, evidenced by the support of animal rights and religious or spiritual reasons (*College Pulse*, n.d.). This type of change in diet can have a wide range of implications when it comes to the future health and well-being of this population. Though the transition to vegetarianism is often selected to improve health, it is not inherently superior or more nutritionally adequate than a meat-consuming diet. This review aims to discuss the recent literature surrounding the typical diet choices of college students, the prevalence of vegetarianism, common student motivations for diet change, and the nutritional adequacy of the vegetarian diet, as well as the determine the risk of iron deficiency in vegetarians and review the association of eating disorder risk and vegetarian diet adherence.

Typical College Student Diet

Entering the new chapter of university life brings a highly anticipated increase in control over numerous aspects of health, such as fitness, sleep, socialization, and of equal importance, diet. One study, completed in the United Kingdom suggested that the diet of a college student will typically fall into one of "four major dietary patterns: 'vegetarian'; 'snacking'; 'health-conscious'; and 'convenience red meat and alcohol'" (Sprake et al., 2018). These authors found that those participants who had reported a diet of poor quality, such as the "convenience red meat and alcohol" category, also "incurred greater food costs and practiced unfavorable lifestyle behaviors" (Sprake et al., 2018). When students reported a vegetarian or health-conscience diet, they typically reported greater cooking ability than those consuming less nutritionally adequate diets (Sprake et al., 2018).

If considered in this study by Sprake et al., the Mediterranean diet would likely fall into one of these more favorable diet patterns. A study conducted in Cypress looked specifically at the Mediterranean diet and found that 26.9% of students were "high adherers," and a similar number of students, 21.8%, were "low adherers" (Hadjimbei et al., 2016). Those remaining participants fell somewhere in between. These 42 students in the "high adherence" to the Mediterranean diet category were more likely to consume vegetables more than once a day. Overall, the evidence showed rather low adherence to the Mediterranean diet, but it did show students starting to make steps in the right direction, with 56.5% answering that they ate vegetables daily (Hadjimbei et al., 2016). One food group where a majority of students reported consuming the recommended amounts was dairy. Students in Cyprus reported consuming at least two servings of dairy

products daily (Hadjimbei et al., 2016). Unlike young adults in the United States, who, are reported to fall short of the recommendations for dairy intake (Poddar, 2012). In Cyprus, many students also reported eating at fast-food restaurants multiple times each week, which may lead to an increase in sodium, saturated fat, added sugar, and an overall decrease in diet quality.

Winham et al. (2020) administered a survey to specifically assess the pulse intake amount US college students. The researchers defined pulses as "a subgroup of legumes, harvested solely for dry grain seeds within a pod," with examples being "dry beans, dry peas, lentils, and chickpeas" (Winham et al., 2020). After administering a survey to 1433 university students, it was found that higher numbers of pulses were consumed by students who were White, vegetarian/vegan, had higher cooking abilities, or had a greater intake of fruits, vegetables, and fiber (Winham et al., 2020). This study provides invaluable information regarding the culinary knowledge of college students, their attitudes toward pulses, and their experience with pulses. Unfortunately, this study suggested that many students lack the knowledge and experience that would encourage them to consume a variety of food groups. If students do not already have knowledge of different food groups, such as pulses, they may struggle to incorporate them into their diet if choosing to follow a vegetarian diet. A vegetarian diet low in pulse-containing foods may also lack adequate protein or fiber.

Further research is needed to understand the typical diet choices of college students, which includes a review of vegetarian practices. From the reviewed literature, it seems likely that many college students consume a nutritionally inadequate diet, high in fast food, saturated fat, added sugar, and alcohol, and low in fruit, vegetable, and plant

protein sources, as demonstrated by Sprake et al., 2018. As students become more engaged in making diet choices, it is important that professionals understand their perspectives and experiences in order to successfully guide them through this stage of life.

Vegetarianism: Prevalence and Types

The overall prevalence of vegetarianism in the United States has nearly doubled from the reported 3.3% in 2016 to 6% in 2020 (Poll Results | Vegetarian Journal | Vegetarian Resource Group, n.d.) and is most common among the collegiate population. Among those ages 18 to 34, this trend is also growing, with a reported 6% of individuals following a vegetarian or vegan diet in 2020, an increase from 5.3% in 2016 (Poll Results | Vegetarian Journal | Vegetarian Resource Group, n.d.). In a country of over 300 million individuals, this translates to nearly 18 million vegetarians.

Further evidence supports that vegetarianism is even more popular among the college population. A recent study published in the Journal of American College Health reports statistics congruent with the Academy, estimating again that 6% of young adults in college are following a vegetarian diet, while just 4% of the American population is vegetarian, a smaller overall percentage than that reported by The Vegetarian Resource Group (Olfert et al., 2020). This information suggests that vegetarianism is more prevalent among young people. A survey presented by *College Pulse* suggests the same trend, reporting a much higher prevalence, that 14% of the 2000 responding students followed a vegetarian diet (College Pulse, n.d.).

Due to these consistent trends, it is anticipated that the prevalence of vegetarianism will continue to increase, and as it does, more research will need to be

completed to get a better picture of the prevalence and nutritional adequacy of vegetarianism among multiple populations to ensure that nutrition education practices continue to be focused and meaningful. A higher prevalence of vegetarianism amongst college students may indicate a need for an increase in nutrition professionals working within this population to provide additional education and assist with shopping and cooking tips to promote an adequate diet.

Vegetarian, many times also termed lacto-ovo-vegetarian is defined as participants who reject all animal meats, including fish, seafood, beef, pork, and poultry but consume dairy products and eggs, as well as all plant-derived foods. Additional subgroups of vegetarianism include lacto-vegetarian, ovo-vegetarian, and pesco-vegetarian, which all consume plant-derived foods. Lacto-vegetarian is defined as participants who reject all animal meats and eggs but consume dairy products (Melina, 2016). Ovo-vegetarian is defined as participants who reject all animal meats and also reject dairy and dairy-based products but consume eggs (Melina, 2016). Pesco-vegetarian is defined as participants who exclude all meats, with the exception of fish and seafood, while including dairy and egg products. Vegan is defined as participants who reject all animal products, including meats, fish, seafood, poultry, pork, dairy, and eggs. Omnivore will be defined as any participant who includes all animal products in their diet, as well as plant-derived foods.

Motivations for Becoming Vegetarian and Patterns of Disordered Eating

As college students become more aware of their diet and overall health, they are likely to find interest in current diet trends through social media and other online information platforms. One example of this is the promotion of "Meatless Mondays" in

the United States or "Green Mondays" in France, as described by Bègue and Treich as a program for promoting the weekly substitution of meat and fish for other nutrients (Bègue & Treich, 2019). Bègue and Treich found that being young and educated was associated with adhering to these types of programs (Bègue & Treich, 2019). This suggests that choosing more plant-based options is increasingly prevalent within this population. As more students start to modify their diets, it is important that nutrition professionals understand the common motivations behind their diet choices. Understanding a student's motivation can help professionals recommend diet modifications that may better meet the student's nutritional requirements.

A 2019 study completed to determine the motivations behind vegetarian diet adherence suggested six common reasons for choosing this diet (Maxwell et al., 2019). These six reasons included animal rights/ethical reasons, documentaries, health reasons, friends/family influence, social media, and research (Maxwell et al., 2019). Documentaries were the second most popular reason for going vegetarian, with a few specifically reporting having watched the Netflix documentary "What the Health" before deciding to go vegetarian (Maxwell et al., 2019). With the current age of technology, this reason is likely a common experience among young adults today. Interestingly, only 4% of participants reported switching to a vegetarian diet after reading related research, and no participant reported speaking with a nutrition professional as a motivation for diet change (Maxwell et al., 2019).

A second study suggests a pattern that is more alarming; that college students who are motivated to adhere to vegetarianism for weight loss are more likely to exhibit disordered eating patterns (Zickgraf et al., 2020). This article, entitled *Examining*

vegetarianism, weight motivations and eating disorder psychopathology among college

students, suggests that those who become vegetarians after entering college are more

likely to report weight motives (Zickgraf et al., 2020). Those who turn to diet changes

exclusively as a way to control weight, or prevent weight gain, could have an underlying

eating disorder, especially at early adulthood when most students are starting college. The

authors of this research determined that "weight-motivated vegetarians reported higher

levels of restraint, shape/weight overvaluation, body dissatisfaction, and global eating

disorder psychopathology relative to other participants" (Zickgraf et al., 2020). This is a

concerning result for nutrition professionals who seek to better the health of this

population. After all, the vegetarian diet is supported by the Academy of Nutrition and

Dietetics in their position paper, where they state that vegetarian and vegan diets are

"healthful, nutritionally adequate, and may provide health benefits" (Melina et al., 2016).

A nutrition professional who supports a plant-based diet, even if not fully vegetarian,

should be aware of the differences in the motivation behind adherence, especially in

young adults with weight motives.

  Newly vegetarian students, motivated by any reason, may also find themselves

preparing meals with extra attention and care and may feel a significant sense of guilt or

failure when meals are not prepared in this way. As students focus more on their dietary

intake, they may also be at an increased risk for developing orthorexia nervosa (ON). ON

is defined as a "fixation on healthy eating" and is characterized by patterns of excessive

concentration on food quality, preparation, and ridged nutrition standards (Niedzielski &

Kaźmierczak-Wojtaś, 2021).

With limited research involving students, it is still somewhat unclear what the main motivations behind altering one's diet to embrace vegetarianism or veganism may be. The research discussed in this review suggests a wide variety of motivations unique to each individual. As professionals grow in support of a predominately plant-based diet grows, the research behind motivations should grow simultaneously.

Nutritional Adequacy

Once students choose to adhere to a vegetarian diet, there is a lack of research examining the nutritional adequacy of their typical daily intake. The position of the Academy of Nutrition and Dietetics suggests that in order to determine the adequacy of the vegetarian diet, a researcher must look at diet adequacy of specific nutrients that may be lacking in the vegetarian diet, including protein, n-3 fatty acids, iron, zinc, iodine, calcium, vitamin D, and vitamin B-12 (Melina et al., 2016). The Academy's position also suggests that vegetarians may actually meet or exceed recommendations for protein, iron, and calcium intake, while for the other nutrients, this might not be the case (Melina et al., 2016). The research completed to determine these recommendations, however, was not limited to young adults or college students but simply adult vegetarians. While this information is important, it is equally important to gain a sense of what vegetarianism looks like among the young adult population due to the possible differences in resources, time, cooking skills, and nutrition knowledge.

A recent systematic review of vegetarian diet quality suggests that diet quality differs by vegetarian subtype. Two classifications of vegetarianism, lacto-ovo-vegetarian and vegan, may result in a higher overall diet quality. According to the Healthy Eating Index 2010 (HEI-2010), lacto-ovo-vegetarians and vegans scored 4.5 to 16.4 points

higher than those reportedly non-vegetarians (Parker & Vadiveloo, 2019). Higher scores were reflective of higher diet quality. The authors found that multiple studies showed vegetarians had higher fruit and whole grain intake, while reported intake for protein was lower in vegetarians, and interestingly, intake for vegetables, dietary fat, and dairy were highly inconsistent across studies (Parker & Vadiveloo, 2019). The authors recommended that "more research controlling for known confounders like health consciousness is needed" (Parker & Vadiveloo, 2019).

When it comes to the nutritional adequacy of the vegetarian diet, the current research seems to be inconsistent. The majority of research completed has focused on the general population of vegetarians and not specifically college students. During college, students form dietary habits that have the potential to follow them throughout their lives. More research should be completed to determine nutritional adequacy at this age.

Iron Intake and Levels in the Population

Iron is a nutrient that contributes to numerous biological functions critical to human survival because of its inclusion in the makeup of hundreds of proteins and enzymes that support oxygen transport, energy production, and DNA synthesis (*Iron*, 2014). The recommended dietary allowance for iron varies by age, gender, pregnancy, or breastfeeding status. This study will consider the iron intake of both males and females ages 18 years or older. For males and females 18 years old and under, an intake of 11mg/day and 15mg/day, respectively, is recommended (Micronutrients, 2001). For males aged 19 or older, this recommendation decreases to 8mg/day, while for women ages 19 to 50, the recommended intake increases to 18mg/day (Micronutrients, 2001). Due to the amount of menstrual blood loss, it is recommended that females consume a

higher amount of iron daily until reaching the age of 51, when recommendations for men and women are equal at 8mg/day (Micronutrients, 2001).

Though serum iron levels are regulated by multiple factors, such as metabolism, hormones, and absorption, another important piece of the puzzle is dietary iron intake. Dietary iron is found in two forms: heme iron, found in animal products, and non-heme iron, found mainly in plant-derived products. Compared to non-heme iron, heme iron is more bioavailable and contributes to 40% of total absorbed dietary iron even when only contributing to 10 to 15% of total dietary iron intake (*Iron*, 2014). Heme iron is found in the hemoglobin and myoglobin of animal food sources. Those who include animal products in their diets will consume greater amounts of the more bioavailable heme iron, while those who follow a vegetarian or vegan diet will exclude many sources of heme iron from their diet.

Though specific recommendations have been determined, dietary intake is insufficient among US adults. Dietary data from the recent National Health and Nutrition Examination Survey (NHANES), a group of studies designed to monitor the nutritional status and overall health of the US adult population, shows that from 2003 to 2004, 31.2% of participants age 18 or older, did not meet dietary reference intakes for iron (Han et al., 2019). From 2015 to 2016, this percentage increased to 34.5% of these participants not meeting recommendations (Han et al., 2019). This data suggests that approximately a third of the United States adult population does not consume the recommended amount of iron daily, putting them at risk for depleted iron stores, iron deficiency, and disease.

In addition to limited intake of iron-rich foods, research completed among 137 participants in early adolescence, ages 10 to 19 years old, found that certain behaviors,

such as meal skipping and snacking, were positively associated with iron-deficiency anemia (Wiafe et al., 2020). Though most of this population was younger than that of the proposed study's sample, dietary patterns during early adolescence are likely to set the stage for intake and eating behaviors during the next phase of life, early adulthood. In this study, snacking was found to be consistent with low hemoglobin levels since many participants chose snacks that fell into the "iron-inhibiting" diet component category (Wiafe et al., 2020). This is important, as research at a U.K. university also suggests that a "snacking" diet pattern is common among college students (Sprake et al., 2018). In the university setting, snacking also correlated with the consumption of iron-inhibiting foods (Sprake et al., 2018). These studies suggest that "snacking" may start in early adolescence and has the potential to become a lifelong habit, potentially jeopardizing the individual's iron status. This again indicates the need to establish healthy dietary habits among young adults to see the rates of iron deficiency among the general population decline as students age. Providing nutrition education and promoting healthy dietary habits during this transitional period may be the key to preventing nutrient deficiency and disease.

Iron Deficiencies

Iron deficiency occurs in stages and may result from poor dietary iron intake and excessive intake of iron-inhibiting foods (such as coffee, tea, and dairy products high in calcium), combined with a depletion of iron stores. Vegetarianism greatly limits heme iron sources, the most bioavailable form of dietary iron, and as such, increases the risk of depleting iron stores. The possibility of iron deficiency in those who exclude heme iron

sources from their diets should be considered, as well as the consequences of iron deficiency and the overall rate of deficiency throughout the population.

According to the American Academy of Family Physicians, iron deficiency anemia (IDA), is the most common nutritional deficiency worldwide (Killip et al., 2007). In 2008, the World Health Organization estimated that 24.8% of the population was affected by anemia of some form, with the highest levels being in adult women (*WHO | Global Anaemia Prevalence and Number of Individuals Affected*, n.d.). This indicates that education regarding the importance of iron and its adequate intake should be at the forefront of diet education for a population vulnerable to developing lifelong poor dietary patterns.

Iron Intake, Levels, and Deficiencies in Vegetarians

As discussed, the difference between heme and non-heme iron intake has the potential to lead to iron deficiency in individuals who omit some or all animal products from their diet. Limited heme iron intake requires an increased intake of non-heme iron to make up for the lack of bioavailability. To account for the lack of bioavailability of non-heme iron, recommendations established by the National Food and Nutrition Institute of Poland advise vegetarians and vegans to increase recommended dietary iron intake by a factor of 1.8 (Śliwińska et al., 2018). A small study (n = 91) of females ages 22 to 42 aimed at assessing the dietary iron intake and iron metabolism of vegetarians, vegans, and omnivores and reported that less than 2% of vegetarian participants met the recommendations for dietary iron intake (Śliwińska et al., 2018). The results also suggested that vegetarians and vegans might also have lower iron stores, as indicated by

serum ferritin levels (Śliwińska et al., 2018). This finding is alarming considering the already heightened risk of iron deficiency in females of reproductive age.

A 2016 literature review aimed at reviewing the iron status of vegetarian adults reported similar results for female vegetarians. The authors reported that five of six studies evaluating serum ferritin levels showed that female vegetarians had lower mean levels of serum ferritin when compared to omnivores (Pawlak et al., 2016). Similar findings were also observed among males. Hemoglobin levels were also considered in several studies. Five studies compared the hemoglobin levels of vegetarian and non-vegetarian participants. It was reported that males showed lower rates of iron deficiency than females among non-vegetarians (Pawlak et al., 2016). The prevalence of iron deficiency as measured by hemoglobin levels was again higher in female vegetarians than female non-vegetarians (Pawlak et al., 2016). The studies in this review were not limited to young adults, as many included adults up to 50 years old or older. The research focused on the young adult population should be considered for further research.

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Measurement Tools

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Rapid Eating Assessment for Participants – Shortened Version (REAP-S)

The Rapid Eating Assessment for Participants – Shortened Version (REAP-S) is a self-administered and validated survey created to serve as a shortened version of the full Rapid Eating Assessment for Patients (REAP) and can identify three dietary plans: omnivore, vegetarian or vegan (Johnston, 2018). Included in the REAP-S are 16 questions quantifying whole grain, fruit, vegetable, dairy, meat consumption, and more. Responses to the first 13 questions are scored between 1 and 3 based on the frequency of food group consumption, then are summed for a total numerical score between 13 and 39.

Higher REAP-S scores are associated with higher overall diet quality. Scores from the REAP-S have been validated and shown to correlate with diet quality as assessed by the HEI-2010 survey (Johnston, 2018). This survey takes approximately 10 minutes to complete.

The SCOFF Questionnaire

The SCOFF Questionnaire is a self-administered five-question survey designed to screen for the risk of eating disorders. The SCOFF contains five questions requiring participants to answer "yes" or "no." Participants who answer "yes" to two or more questions are at risk for having or developing an eating disorder and should be further evaluated by a professional. This tool has been designed and validated for use with the college population and is highly sensitive for screening college females at risk of anorexia nervosa and bulimia nervosa (Kutz, 2019). This tool should take no more than two minutes to complete.

The Bratman Test for Orthorexia

The Bratman test is a self-administered, ten-question survey designed to screen specifically for ON. An answer of *yes* or *no* is required for each question. A participant who provides four or more "yes" answers is considered at risk for ON (Rogowska, 2021). The Bratman Test should take no longer than five minutes to complete.

Hemoglobinometer

The Masimo Hemoglobinometer is a noninvasive tool developed to detect hemoglobin concentrations. The Masimo Hemoglobinometer works by detecting the level of hemoglobin in a person's blood through the skin of the index finger. It is a convenient and reliable way of detecting iron deficiency by detecting low hemoglobin concentrations

above a minimum of 8 g/dl; the low end of normal hemoglobin levels in men and women are 13.5 and 11.6 g/dl, respectively (Low Hemoglobin: Causes & Symptoms, n.d.).

Research Purpose

As support for plant-based diets grows among the collegiate population, creating a well-developed body of knowledge surrounding these diets should be of priority for nutrition professionals. Without this knowledge, the prevalence, motivations, and nutritional adequacy of intake among young adults following a vegetarian diet will remain unclear. Dietary patterns formed among this population have the potential to determine life-long habits, which indicates a greater need for nutrition professionals to work and perform research within this area. Research regarding the nutritional adequacy of the vegetarian diet among college students would better equip professionals to counsel and educate the student population, in turn creating better health outcomes over the span of their entire lives.

The purpose of this study is to examine the diet adequacy, iron status of college students' diets, and compare ED risk between self-proclaimed vegetarian and non-vegetarians.

Hypotheses

Three main outcome variables will be compared among diet types in this study; nutritional adequacy, hemoglobin levels as a measure of iron deficiency risk, and risk for eating disorders.

HO: The nutritional adequacy of dietary intake, hemoglobin levels, or eating

disorder risk will not differ between vegetarian and non-vegetarian college

students.

- Scores for dietary intake adequacy, as measured by the REAP-S, will not differ between vegetarian and non-vegetarian students.

- Hemoglobin levels, measured in g/dl by a Masimo Hemoglobinometer, will not differ between vegetarian and non-vegetarian students.

- Scores associated with risk of eating disorder, as measured by the SCOFF questionnaire and Bratman Test, will not differ between vegetarian and non-vegetarian students.

H1:   There will be a difference in nutritional adequacy of diet, hemoglobin

levels, and eating disorder risk when vegetarian students are compared to

non-vegetarian students.

Objectives:

- Scores for dietary intake adequacy, as measured by the REAP-S, will differ between vegetarian and non-vegetarian students.

- Hemoglobin levels, measured in g/dl by a Masimo Hemoglobinometer, will differ between vegetarian and non-vegetarian students.

Scores associated with the risk of eating disorders, as measured by the SCOFF

questionnaire and Bratman Test, will differ between vegetarian and non-vegetarian

students.

CHAPTER 3

METHODS

Research Design

This study had a cross-sectional research design, using a one-time questionnaire to assess dietary intake and eating disorder risk. Non-invasive physical measurements, including height and weight, were used to determine BMI, and hemoglobin levels were measured with a hemoglobinometer. The self-administered questionnaire (Appendix C) included 52 items consisting of demographic items and researcher-developed questions that assessed iron intake along with three validated tools: The Rapid Eating Assessment for Participants – Shortened version (REAP-S), The SCOFF Questionnaire and The Bratman Test for Orthorexia.

Study Population, Sampling Design, and Method

The study population for this research was a convenience sample of students aged 18 years and older who were currently attending Louisiana Tech University. The sample was recruited via email, flyers, and classroom announcements.

Setting

The questionnaire used in this study was administered online through the Qualtrics survey software. Participants used their personal electronic device, or one provided by the researcher to access the questionnaire. Physical measurements were

obtained in the Nutrition and Dietetics Research and Measurement Laboratory at

Louisiana Tech University.

Detailed Procedure

Participants arrived at Louisiana Tech University's Nutrition and Dietetics

Research and Measurement Laboratory at a date and time specified by the researcher in

the recruitment email or flyer and by appointment. Appointments were made as needed

via the electronic scheduling software "sign-up genius" for additional researcher

availability. Multiple days and times were used for data collection based on the

availability of laboratory and student schedules and included weekend hours. Upon

arrival, participants were given electronic access with a QR code to the study consent and

questionnaire. Participants who indicated consent were then provided a unique study

identification number and a link or QR code that directed them to the questionnaire.

This unique number may have also been obtained by participants via email prior

to the meeting. This allowed participants the option to complete the online questionnaire

prior to the in-person meeting for physical measurements. Participants were instructed to

keep the identification number and present it to the researcher upon meeting. This

number allowed the researcher to match the questionnaire responses with the assessed

laboratory measurements while keeping the data de-identified. It is estimated that this

survey took 15 minutes to complete. Following completion of the questionnaire,

participants completed the physical measurements, which were obtained by the

researchers or trained research assistants. Hemoglobin levels were measured using the

non-invasive Masimo Hemoglobinometer. The Masimo Hemoglobinometer measures

hemoglobin levels through the skin with a small clamp-like sensor on the index finger of

the participant. One measurement was taken and recorded per the manufacturer's

recommended procedures. If no reading was obtained, the participant's finger was

warmed using warm water or heated gel packs, and the reading was repeated. This test

took approximately 10 minutes to complete. Height and weight were measured using the

InBody 770 Body Composition Analyzer. Physical measurements were recorded on a

data collection sheet with the unique participant identification number to match the

questionnaire data. The total time burden required for a visit was between 30 and 40

minutes.

As an incentive, participants received the body composition analysis report and

the hemoglobin level measurement for their personal use. A brief discussion on how to

read the report was provided, as well as a referral to the InBody website for additional

information on the measurements.

Statistical Analysis Plan

In order to determine the nutritional adequacy of dietary intake among college

students, multiple statistical tests were performed. These included measures of central

tendency for describing participant characteristics and tool scores. Correlations between

study variables were explored. Cronbach's alphas determined tool reliability.

Independent sample t-tests and ANOVAs were used to compare variables and tools

among diet types. Statistical significance for all tests was set at $p < .05$. Statistical tests

were performed using SPSS statistical software Version 29.

CHAPTER 4

RESULTS

A total of 187 students began the online questionnaire; however, eight were removed from the analysis as only a few demographic questions were attempted. Therefore, 179 participants were included in the analysis for this study. The mean age of participants was 21 +/- 4.6 years. Ages ranged from 18 to 53 years. A majority of the participants were female ($n = 129$, 72.07%) and White ($n = 134$, 74.86%). The calculated BMI from the measured height and weight ranged from 16.8 to 46.4, with a mean BMI of 25.7 ($SD = 5.7$). Four (2.25%) participants were categorized as underweight, 94 (53.12%) as healthy weight, 46 (25.99%) as overweight, and 33 (18.64%) as obese. A majority of participants reported being Food and Nutrition majors ($n = 69$, 38.55%), followed by Engineering or Math majors ($n = 20$, 11.17%) and Family Science majors ($n = 19$, 10.61%). A greater number of participants reported an academic standing of "Junior" ($n = 46$, 25.70%) than in other classes. Other classes included: Freshman ($n = 33$, 18.44%), Sophomore ($n = 28$, 15.64%), Senior ($n = 42$, 23.46%), and Graduate Level ($n = 30$, 16.76%). See Table 1 for additional characteristics of the participants.

Table 1

Characteristics of Study Sample (N=179)

Characteristic	*n*	%
Gender		
Male	50	27.93%
Female	129	72.07%
BMI		
Underweight (< 18.5)	4	2.25%
Healthy (18.5-24.9)	94	53.12%
Overweight (25-29.9)	46	25.99%
Obese (> 29.9)	33	18.64%
Race		
White, non-Hispanic	134	74.86%
White, Hispanic origin	11	6.15%
Black	18	10.06%
Black, Hispanic origin	4	2.23%
Native American or Alaskan Native	3	1.68%
Asian, Pacific Islander	2	1.12%
Bi-racial	5	2.79%
Multi-racial	2	1.12%
Academic Standing		
Freshman	33	18.44%
Sophomore	28	15.64%
Junior	46	25.70%
Senior	42	23.46%
Graduate level	30	16.76%
Primary Area of Study		
Food/Nutrition/Dietetics	69	38.55%
Family Science	19	10.61%
Fashion Merchandising	6	3.35%
Nursing	7	3.91%
Biology or Chemistry	7	3.91%
Engineering or Math	20	11.17%
Business	15	8.38%
Education	5	2.80%
Psychology/Sociology	4	2.23%
Liberal Arts	9	5.03%
Speech Pathology	7	3.91%
Other	11	6.15%

Notes: Mean Age = 21(SD= 4.6), Mean BMI = 25.7(SD= 5.7)

Vegetarian Participants

Only seven participants (3.91%) reported following a vegetarian or vegan diet, three of which specified following a vegan diet. The small number of vegetarians only allowed for descriptive statistics to be reported. The age of these participants ranged from 19 to 41 years, with a mean age of 26 years. Most vegetarian/vegan diet adherers were female ($n = 6$), and over half were White ($n = 4$). Two of the seven vegetarians reported taking a vitamin/mineral supplement and their chosen vitamin/mineral supplement contained iron. Most vegetarian/vegan participants reported being Food and Nutrition majors (71.43%). An overall mean REAP-S score for these participants was 32 (range: 29-36), of a maximum score of 39.

The mean SCOFF Questionnaire score for this group was 1.3 ($SD = 1.4$), with scores ranging from 0 to 3. Bratman Test scores ranged from 3 to 8, with a mean score of 5.7 ($SD = 1.6$). The lone male vegetarian had a hemoglobin level above the normal range at 16.2 g/dl; while the mean hemoglobin for five female vegetarians was 13.8 g/dl (12.4-14.6 g/dl), all within the normal range. Four vegetarian/vegan participants were categorized in the healthy BMI range, one as overweight and two as obese. The mean BMI for these participants was similar to the total participant sample at 25.4 ($SD= 6.2$). Five (71.43%) vegetarian/vegan participants reported perceiving themselves to be at a normal weight, and two (28.57%) reported perceiving themselves to be overweight. Only one of the seven participants who reported following a vegetarian or vegan diet also reported receiving nutrition education regarding vegetarianism from a registered dietitian. An additional seven from the total participant group also reported receiving education regarding vegetarianism from a registered dietitian.

Thirteen (7.26%) participants reported restricting meat intake on certain days (i.e., participating in "meatless Mondays"). Participants (approximately 2-12%) who did not report following a vegetarian/vegan diet still reported restricting intake of certain food groups such as red meats ($n = 17$, 9.50%), fish and seafood ($n = 13$, 7.26%), dairy ($n = 7$, 3.91%), eggs ($n = 4$, 2.23%), poultry ($n = 6$, 3.35%), and other ($n = 21$, 11.73%). A total of 115 (64.25%) participants reported that they did not currently restrict any animal products from their diet. Of the Nutrition and Dietetics majors who responded to this question ($n = 55$), 81.8% reported "other" restrictions including gluten, pork, processed meats, and a reduction in dairy intake.

Tool Internal Consistency

Cronbach's alpha was determined for both eating disorder risk tools. The Bratman Test for Orthorexia consisted of 17 items, and the value for Cronbach's alpha was .67. The SCOFF Questionnaire consisted of five items, and the value for Cronbach's alpha was .57.

Out of 179 participants, 172 were included in scoring for the REAP-S. The mean REAP-S score for participants was 27.1 ($SD = 4.9$), with scores ranging from 16 to 38. The possible total score was 39. One hundred seventy-six participants successfully completed the SCOFF Questionnaire. The mean SCOFF score was 1.1 ($SD = 1.2$), with scores ranging from 0 to 4 of a possible score of 5. Participants ($n = 177$) completing the Bratman Test had a mean score of 4.3 (SD 2.4), with scores ranging from 0 to 10 of a possible 10.

A significant, positive correlation was found between SCOFF and Bratman Test scores, $r(176) = .167$, $p = < .001$. As the risk of having an eating disorder increased, so

did the risk of experiencing orthorexia in this sample of participants. A significant, positive correlation was also found between REAP-S and Bratman Test scores, r (171) = .382, p = < .001, indicating that higher diet quality scores were associated with higher orthorexia risk. A significant, inverse relationship was found between REAP-S scores and BMI, r (158) = -.167, p = .036, indicating that higher diet quality is associated with lower BMI. See Table 2.

Table 2

Correlations among REAP-S, Bratman Test, SCOFF Scores, and BMI (N = 179)

Tool	*M (SD)*	REAP-S	Bratman Test	SCOFF	BMI
REAP-S[a]	27.14 (4.87)	1	-	-	-
Bratman Test	4.34 (2.39)	.38**	1	-	-
SCOFF[b]	1.05 (1.22)	-.01	.41**	1	-
BMI	25.68 (5.70)	-.17*	.14	.13	1

*Note: *p<.05; **p<.001; [a] The Rapid Eating Assessment for Participants – Shortened Version (score range: 13-39); [b]The Sick, Control, One Stone, Fat, Food Questionnaire (score range: 0-5), Bratman Test score range: 0-10.*

Correlations were analyzed by gender. A significant, positive correlation was found between REAP-S and Bratman Test scores for both males, r (108) = .363, p = < .001, and females, r (48) = .490, p = < .001, indicating that as diet quality increased, so did the participants risk for ON. A significant, positive correlation was also found between the SCOFF and Bratman Test scores for both males r (108) = .405, p = < .001, and females r (48) = .443, p = .001, indicating that as the risk of eating disorders increased, risk of ON increased.

Independent samples t-tests were used to compare results between females and males. Diet quality as measured by the REAP-S was significantly higher in the females

when compared to the males, t (170) = 2.47, p = .015. Females also had a significantly
higher BMI than males, t (170) =-2.49, p = .014. For comparisons between genders, see
Table 3.

Table 3

Gender Comparisons for BMI, REAP-S, SCOFF, and Bratman Test

Gender	Female	Male		
	M (SD)	*M (SD)*	*t*	*p* - value
REAP-S	27.70 (4.96)	25.69 (4.35)	2.47	.015*
SCOFF	0.82 (1.06)	1.14 (1.27)	1.59	.114
Bratman Test	4.28 (2.35)	4.49 (2.48)	-0.49	.623
BMI	27.47 (5.23)	25.02 (5.84)	-2.49	.014*

Notes: *p<.05

Hemoglobin Levels

Hemoglobin levels were obtained from 48 males and 108 females in this sample.
The mean hemoglobin level for females was 14.09 g/dl (*SD* =1.36). A total of 26
(24.07%) females were found to have below-normal hemoglobin levels (Hbg < 12.1
g/dl), 78 (72.22%) had normal hemoglobin levels (Hgb 12.1-15.1 g/dl), and four (3.70%)
had high levels (Hbg > 15.1 g/dl). The mean hemoglobin level for all males was 15.87
(*SD* =1.48). Three (6.25%) males had below-normal Hgb levels (Hgb < 13.1 g/dl), 30
(62.50%) had normal hemoglobin levels (Hgb 13.1-16.6 g/dl), and 15 (31.25%) high
levels (Hgb > 16.6 g/dl).

There was a positive correlation found between BMI and Hemoglobin levels for
males r (48) = .348, p = .018. No significant correlations were found between Hgb and
the BOT, SCOFF, or REAP-S scores. A one-way ANOVA was conducted to compare
mean hemoglobin levels among BMI categories. A significant difference was found

between groups [F (2.43) = 4.122, p = .023]. A Tukey post hoc test revealed that the normal (*p* = .038) and overweight (*p* =.045) BMI groups were significantly different from the obese group. For males with normal BMI or overweight BMI, mean hemoglobin levels were 15.45 g/dl and 15.53 g/dl, respectively. Males categorized as obese had an average hemoglobin level of 16.79 g/dl, significantly greater than both normal and overweight categories.

There were no significant correlations found between Hbg and BMI, BOT, SCOFF, or REAP-S scores for the female group. No significant differences were found for mean Hgb levels among BMI groups. No significance was found in mean scores for the REAP-S, SCOFF, and Bratman Test scores between BMI groups.

Health vs Non-Health Majors

To further explore the relationships among the variable measures and participant characteristics, participants were divided into two groups based on major, either health-related or non-health-related. Health-related majors included food and nutrition, nursing, psychology/sociology, biology/chemistry, and speech pathology. Non-health majors included fashion merchandising, family science, engineering, math and computer science, business, education, and liberal arts. For non-health majors, the mean Bratman Test score was 3.80 (*SD* = 2.31), the mean SCOFF score was 0.93 (*SD* = 1.15), and the mean REAP-S score was 25.71 (*SD* = 4.55). The mean BMI among non-health majors was 25.39 (*SD* = 5.58).

For health majors, the mean Bratman Test score was 4.86 (*SD* = 2.36), the mean SCOFF score was 1.17 (*SD* = 1.28), and the REAP-S score was 28.6 (*SD* = 4.78). The mean BMI among health majors was 26.02 (*SD* = 5.97). Between REAP-S scores for

non-health and health majors, the difference was found to be significant, t (170) = 4.06,

($p = < .001$). Bratman Test scores were also found to be significantly different between

health and non-health majors, t (175) = 3.00, ($p = .003$). The difference between SCOFF

scores of health and non-health was not significant t (174) = 1.29, ($p = .099$). There was

also no significant difference in BMI between majors ($p = .241$) (see Table 4).

Table 4

Comparisons between Health and Non-Health Majors

Majors	Health M (SD)	Non-Health M (SD)
REAP-S M	28.6 (4.78)*	25.71 (4.55)
SCOFF	1.17 *1.28)	0.93 (1.15)
Bratman Test	4.86 (2.36)**	3.80 (2.31)
BMI	26.02 (5.96)	25.39 (5.58)

Notes: *p < .001 **p < .05

CHAPTER 5

DISCUSSION

The results of this study provide insight into the dietary patterns of college students and show relevant correlations between diet adequacy, eating disorder risk, and hemoglobin levels. Unfortunately, the participant sample included a very small percentage (3.91%) of vegetarian and vegan participants ($N = 7$), limiting our ability to significantly compare plant-based diets to meat-eating diets. However, this chapter explores the significant findings that could be analyzed, the implications of these findings, limitations, and areas for future research.

Significant Findings and Implications

Diet Quality

A significant, inverse relationship was found between REAP-S scores and BMI; an increased diet quality was linked with a lower BMI. This reinforces the idea that a healthy diet can mitigate overweight and obesity among the college population. Scores for REAP-S were found to be associated with Healthy Eating Index 2010 scores (Johnston et al., 2018). Participants averaged a score of 27.1 out of 39 on the REAP-S, indicating moderate diet quality, and had a mean BMI of 25.7, indicating that there are still improvements to be made in diet. In fact, approximately 44% of this sample was either overweight or obese. This finding is similar to other reports of BMI in college

students. One study involving 404,987 students from 445 schools found that 37.4% of students were overweight or obese (Bailey et al., n.d.).

While breakfast has been suggested to be the most important meal of the day, only 37.29% (n = 66) of participants reported usually consuming this meal. This is a significantly lower percentage than reported for all US adults, $>/=$ 20 years old, reported by the CDC, which suggests that between 2015 and 2018, 84.4% of adults consumed breakfast regularly (CDCMMWR, 2021). Breakfast consumption has been reported to be associated with higher grade point averages, better cognitive function, and fewer mood changes (Javaid, 2020). In this population, there may be an element of food insecurity impacting meal skipping, as prior to the pandemic, 30% of college students reported being food insecure at some point during their college career (McCoy et al., n.d.). Following the pandemic, it was suggested by one study that food insecurity has heightened, leading to a greater risk of ED among students (Tavolacci et al., 2021). It is unclear how participants in this study may have defined breakfast, which may have led to under or over-reporting consumption. Participants for this study were not provided a definition to describe "breakfast," which may have led to over or under-reporting as the term "breakfast" may have a different meaning to each participant. Providing participants with a definition regarding meal timing or the number of meals per day would provide further insight into the typical breakfast consumption patterns among students.

After further research, this may be an area where nutrition professionals can provide encouragement to students to help promote healthy eating habits. Research should also be completed to determine the specific barriers to eating breakfast among college students. One study involving high school students found that students may

benefit from greater social support, meaning promotion by school staff and students other than friends, when it comes to eating breakfast (Mumm et al., 2017). This suggests that a student-led organization, such as the Student Dietetic Association, may be able to help promote breakfast eating among the greater student population.

A similar number of participants, 38.20% ($n = 68$), reported eating less than two servings of fruit daily, and 29.21% ($n = 52$) reported eating less than two servings of vegetables daily. The Dietary Guidelines for Americans recommend a daily intake of 1.5-2 C for fruits and 2-3 C for vegetables (Lee, 2022). A total of 46 (25.84%) participants reported usually consuming less than two servings of whole grains per day. Consumption of fortified grains should be considered in further research to determine overall nutrient intake; however, it can be argued that the foundation of a healthy diet is regular consumption of fruits, vegetables, and whole (or fortified) grains; therefore, nutrition professionals may promote healthy eating patterns among students by encouraging greater consumption of these than reported. One way of doing this may be to encourage or offer fruit at breakfast, which promotes both greater fruit intake and breakfast consumption.

Almost half of the participants (47.78%) reported rarely eating processed meats as opposed to low-fat processed meats; this is an encouraging finding as processed meats have been associated with lower diet quality. A similar number of participants (48.88%) reported "sometimes" eating fried foods, typically high in saturated fat, while 24.72% reported "often" consuming these foods.

Since overall REAP-S scores suggested moderate diet quality, further research regarding dietary adequacy may need to include a more detailed intake analysis, such as a

multiple pass 24-hour recall, to allow for more exact nutrient calculations rather than frequency of food group consumption.

Hemoglobin Levels

The range for normal hemoglobin levels varies by gender. In this study, the mean hemoglobin level for females was 14.09 g/dl (SD = 1.36), while the mean hemoglobin level for male participants was 15.87 (SD = 1.48). When hemoglobin levels were compared to the BMI category among males, these results suggested that as BMI increased above 24.9, hemoglobin levels increased. This is a conflicting result when considering a study completed among undergraduates in India, with results suggesting that both underweight and overweight/obese students are at a greater risk for anemia, as indicated by lower hemoglobin levels (Ahad et al., 2020). Consideration must be given to whether the Indian population also consumes fewer animal products when compared to those in the United States. Perhaps, it took a higher quantity of foods consumed to meet iron requirements in this study's participants, meaning the nutrient density of foods consumed may be lacking and warrants further investigation. Hemoglobin levels were also compared to participants' reports of whole grain intake on the REAP-S, and no correlation was found.

Eating Disorder Risk

The positive relationship between SCOFF Questionnaire and Bratman Test scores identified among participants suggests that as the risk of having an eating disorder increased, so did the risk of experiencing orthorexia (r (176) = .167, p = < .001). This was an expected finding; however, it heightens the need to be aware of eating disorder risk in general among this population. Interestingly, a significant, positive correlation was

also found between REAP-S scores and Bratman Test scores, $r\,(171) = .382$, $p = < .001$, indicating that higher diet quality scores were associated with higher risks for orthorexia. A Bratman Test score of 4 or more indicates risk for ON. Because this sample was highly influenced by Nutrition and Dietetics majors, these students may be hyper-focused on restrictive dietary habits; this focus can lead to obsession with diet quality, negatively influencing several areas of their overall health, including social, mental, and emotional. This is also true for vegetarian and vegan participants, whose mean SCOFF and Bratman Test scores showed a greater risk of disordered eating than other participants when comparing mean scores. This emphasizes the need for students following these plant-based diets to be screened for disordered eating behaviors, as suggested by Zickgraf et al. (2020).

Vegetarians

Only seven participants reported following a vegan or vegetarian diet. These participants made up 3.9% of the total participant pool, whereas statistics from the Journal of American College Health suggest that 6% of students are following a vegetarian diet nationwide (Olfert et al., 2020). The number of plant-based students at Louisiana Tech University falls short of the national average; however, when compared by mean REAP-S score, plant-based diet eaters ($M = 32$, $SD = 2.4$) reported following a diet of higher adequacy than meat-eating participants ($M = 27.1$, $SD = 4.9$).

When reporting motivations behind following a plant-based diet, most participants reported that they wanted to improve their health rather than change their body weight. This finding is encouraging, considering the implications of the study by Zickgraf et al. (2020), which suggested that those following a plant-based diet with

weight motivations were more likely to exhibit disordered eating patterns than non-weight-motivated vegetarians and nonvegetarians.

Health Versus Non-Health Majors

Those who reported enrollment in a health-related major were found to have greater diet quality scores and a higher risk of eating disorders when compared to non-health-related majors. More research is needed to determine and generalize these findings, as prior research has indicated no significant differences between students of health-related majors and non-health-related majors (Mealha et al., 2013).

This may be indicative of the approach to nutrition education, starting as early as grade school, where it is taught by educators other than nutrition professionals. Nutrition education may focus on dietary restrictions rather than encouraging healthy additions. Supporting the addition of fruits and vegetables in students' diets without creating fear of "unhealthy" foods is an important consideration for those teaching these topics. Social media can also play a role in creating food-related fear. Students who go on to develop a passion for nutrition may have already developed a restrictive mindset, likely putting them at a greater risk for ED even before declaring their major. Nutrition courses should be taught with additional caution to support the development of healthy eating patterns without promoting behaviors that may lead to disordered eating patterns, such as meal skipping, excessive meal planning, and guilt or anxiety around "unhealthy" food consumption. One way of promoting the addition of fruits and vegetables without villainizing "unhealthy" foods may be to take a hands-on approach by creating a college-level nutrition class with the addition of a kitchen lab, as determined by Matias et al. (2021). In this study, students reported a greater intake of fruits and vegetables, and

greater cooking ability after taking nutrition with the addition of a kitchen lab. Cooking frequency also increased, and the frequency of skipping meals decreased (Matias et al., 2021).

Research completed among college students following the COVID-19 pandemic suggests that the pandemic heightened the risk of ED among all students due to lower food security, depression, and academic stress, regardless of major, making it imperative that nutrition is taught by trained professionals with sensitivity in areas involving dietary restrictions (Tavolacci et al., 2021).

Limitations

Several limitations of this research were recognized. First, there were very few vegetarian participants. A greater amount of vegetarian or vegan participants would have allowed for more significant comparisons to be made between a plant-based diet and a meat-eating diet. Next, all participants were students of Louisiana Tech University. In order for findings to be applied to students across the country, additional College and University campuses must collect data in this area.

Future Research

From this research, it was noted that very few college students who participated in this study, at Louisiana Tech University follow a vegetarian or vegan diet, and very few seem to be increasing their fruit and vegetable intake currently. Because diets that are higher in plant-derived foods, such as vegetarianism, may provide better overall diet adequacy, future research is needed to determine the reasons and barriers for not moving toward a more plant-forward diet. A qualitative study may be beneficial to explore these

reasons in more detail. Along these same lines, this research also suggested that those who followed a vegetarian or vegan diet or those engaged in diet restrictions could be at a greater risk of developing disordered eating behavior. Of specific concern are the future health professionals. Additional research with health professionals related to motivations for restricted diets and plant-based diets may provide insight into ways to prevent eating disorders among this population, which is of equal or greater importance. A balance should be sought between promoting more plant-derived options and preventing disordered eating.

Some students following meat-eating diets may still exclude one or more animal products (i.e., eggs, dairy, and red meat). Investigating these exclusions and their impact on diet adequacy and eating disorder risk can assist dietitians in tailoring more specific recommendations to college students.

This research also gives researchers a baseline for diet adequacy, eating disorder risk, hemoglobin levels, and prevalence of vegetarianism at Louisiana Tech University. Continuing to complete similar research over time across different years may also give insight into how dietary habits among college students change over time, determine trends and patterns, and if the number of students following a plant-based diet is growing at the same rate as other universities.

CHAPTER 6

CONCLUSION

The present study provides nutrition professionals with valuable information regarding diet adequacy, eating disorder risk, hemoglobin levels, and the prevalence of vegetarianism and veganism among this sample of college students. Those who reported enrollment in health-related majors were found to have greater diet quality scores as well as a higher risk of eating disorders when compared to non-health-related majors; the same was found to be true for vegetarian and vegan participants when compared to meat-eating participants. Hemoglobin levels were found to be low in 20.2% of male participants for unknown reasons. For male participants, hemoglobin levels were significantly higher among those with overweight or obese BMIs, which may indicate the need for excess caloric intake to meet needs from diets that are lacking in nutrient density. These are key takeaways that dietitians can use to better tailor nutrition education to students on college campuses.

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APPENDIX A

OPERATIONAL DEFINITIONS

Term	Definition
College Students	Students enrolled at Louisiana Tech University, 18 years or older
Nutritional Adequacy	As measured by the Rapid Eating Assessment for Participants – Shortened Version
Vegetarian, or Lacto-ovo-vegetarian	Diets that reject all animal meats (including fish, seafood, beef, pork and poultry) – and include eggs and dairy
Lacto-vegetarian	Diets that reject all animal meats (including fish, seafood, beef, pork and poultry), and eggs – and includes dairy
Ovo-vegetarian	Diets that reject all animal meats (including fish, seafood, beef, pork and poultry), and dairy – and includes eggs
Pesco-vegetarian	Diets that reject beef, pork and poultry – and include fish, seafood – and may or may not include eggs and dairy
Non-vegetarian, or Omnivore	Diets that include all animal products
Vegan	Diets that reject all animal meats, eggs and dairy
*All diets include plant-derived foods including but not limited to fruits, vegetables, grains, beans/peas/legumes, nuts and seeds	

APPENDIX B

RESEARCH MATRIX

Study Title: Nutritional Adequacy of Dietary Intake Among College Students Who Follow a Vegetarian Diet as Compared to Meat-Eating Students

Purpose Statement	Hypotheses or Objectives	Study Design	Variables (+ Measurement Tool)	Type of Data	Statistical Test(s)
The purpose of this study is to examine the nutritional adequacy of college students' diets and to compare non-vegetarian diets to various degrees of vegetarian diets for associations with eating disorder and iron deficiency risks.	**Diet Adequacy:** College students following a vegetarian diet will show no difference in nutritional adequacy of dietary intake as measured by the REAPS, when compared to non-vegetarian students.	**Study Design:** Cross-sectional	**Variable 1:** Nutritional adequacy of diet -Measurement tool: REAP	**Type:** Quantitative	**Test:** Independent sample t-test
	Hemoglobin Levels: There will be no difference between the hemoglobin levels of college students who follow a vegetarian diet as measured by the Masimo Hemoglobinometer when compared to non-vegetarian students.	**Sampling Plan:** -Technique: Convenience sampling -Sample Size: 273 (15 variables) -Power: 0.95 -Level of Sig: 0.05 -Effect Size: 0.5	**Variable 3:** Hemoglobin levels -Measurement tool: Hemoglobinometer	**Type:** Quantitative	**Test:** Independent samples t-test
	Eating Behaviors: College students following a vegetarian diet will show no difference in eating disorder risk as measured by the SCOFF questionnaire or ORTO-6, when compared to non-vegetarian students.		**Variable 2:** Eating disorder risk -Measurement tool: SCOFF Questionnaire, Bratman Test for Orthorexia	**Type:** Quantitative, Descriptive	**Test:** Independent samples t-test, descriptive statistics

APPENDIX C

QUESTIONNAIRE

Annie Pulliam Questionnaire

Q1 consent verbiage here.

◯ I am 18 years of age or older and consent to participation in this study.

◯ I do not consent to participate in this study

Q2 Enter your unique study number here -- all numbers will begin with the letters SC.

_____

Q3 What is your age in years?

_____

Q4 What is your sex?

◯ Female

◯ Male

◯ transgender

◯ Prefer not to answer

Q5 What is your race/ethnicity?

○ White, non-Hispanic

○ White, Hispanic origin

○ African American or Black

○ Black, Hispanic origin

○ Native American or Alaskan Native

○ Pacific Islander or Hawaiian

○ Asian, Pacific Islander

○ Indian (Southeast or Subcontinental)

○ Middle Eastern

○ Biracial _____

○ Multiracial _____

Q6 How tall are you? Enter both feet and inches.
_____ Feet

_____ Inches

Q7 What is your weight (pounds)?

_____

Q8 How do you perceive your weight?

❍ Underweight

❍ Normal weight

❍ Overweight

Q9 What is your current academic standing?

❍ Freshman

❍ Sophomore

❍ Junior

❍ Senior

❍ Graduate level

Q10 What is your primary area of study?

❍ Food, Nutrition, Dietetics

❍ Fashion Merchandise

❍ Human Development and Family Science

❍ Nursing

❍ Health Information System

❍ Biology or Chemistry

❍ Engineering, Math, & Computer Science

❍ Business

❍ Education

❍ Psychology or Sociology

❍ Liberal Arts (Literature, Language, History, Art, Architecture)

❍ Speech Pathology

❍ Other _____

Q11 Do you follow a vegetarian or vegan diet?

○ Yes

○ No

Q12 If yes, at what age did you began to follow a vegetarian or vegan diet?

_____

Q13 What is your motivation for adhering to a vegetarian or vegan diet?

☐ Lose weight

☐ Improve health

☐ Respect animal rights

☐ Religious reasons

☐ Other:, please describe _____

Q14 Do you exclude eggs from your diet due to a food allergy?

○ Yes

○ No

Q15 Do you exclude dairy from your diet due to a food allergy?

○ Yes

○ No

Q16 Do you take vitamin or mineral supplement regularly?

○ Yes

○ No

Q17 Does your supplement contain Iron?

○ yes

○ no

○ I don't know

Q18 Is the iron provided as part of a multivitamin or alone?

○ Multivitamin

○ Iron alone

○ Both

Q19 How many days per week do take this supplement?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ Less than weekly, describe _____

Q20 Does your supplement contain Vitamin A or Carotenes?

○ Yes

○ No

○ I don't know

Skip To: Q21 If Does your supplement contain Vitamin A or Carotenes? = Yes
Skip To: Q23 If Does your supplement contain Vitamin A or Carotenes? = No

Q21 Is the Vitamin A or Carotenes part of a multivitamin or alone?

○ Multivitamin

○ Alone

Q22 How many days per week do you take this supplement?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ Less than weekly, describe _____

Q23 Do you take a calcium supplement regularly?

○ Yes

○ No

Q24 Is the calcium part of a multivitamin and mineral or is it a supplement alone?

○ multivitamin and mineral

○ alone

Q25 How many days per week do you take this Calcium supplement?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ Less than weekly, describe _____

Q26 Do you smoke cigarettes?

○ Yes, every day

○ Yes, Some Days

○ No, never smoke

Q27 Are you currently pregnant?
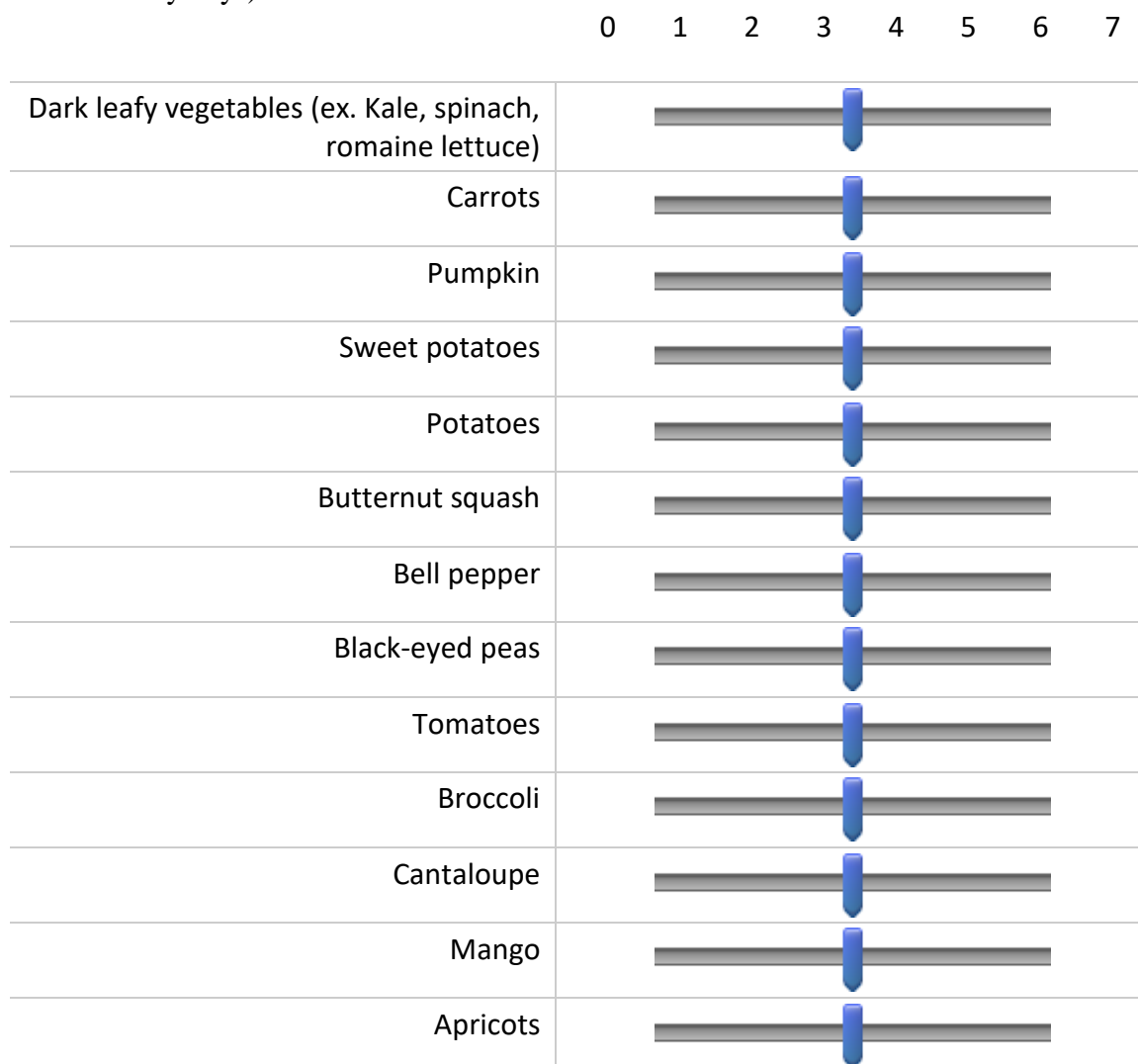
○ Yes

○ No

Q28 Are you currently breastfeeding?

○ Yes

○ No

Q29 Have you ever received nutrition counseling about vegetarianism or plant-based diets from a registered dietitian nutritionist?

○ Yes

○ No

Q30 In the past week, on how many days did you eat these food items? (Place the slider on how many days)

	0	1	2	3	4	5	6	7

Dark leafy vegetables (ex. Kale, spinach, romaine lettuce)	═══════╪═══════
Carrots	═══════╪═══════
Pumpkin	═══════╪═══════
Sweet potatoes	═══════╪═══════
Potatoes	═══════╪═══════
Butternut squash	═══════╪═══════
Bell pepper	═══════╪═══════
Black-eyed peas	═══════╪═══════
Tomatoes	═══════╪═══════
Broccoli	═══════╪═══════
Cantaloupe	═══════╪═══════
Mango	═══════╪═══════
Apricots	═══════╪═══════

Q31 In an average week, how often do you:

	Usually/Often	Sometimes	Rarely/Never	Does not apply to me
Skip breakfast?	○	○	○	○
Eat 4 or more meals from sit-down or take out restaurants?	○	○	○	○
Eat less than 2 servings of whole grain products or high fiber starches a day? Serving = 1 slice of 100% whole grain bread; 1 cup whole grain cereal like Shredded Wheat, Wheaties, Grape Nuts, high fiber cereals, oatmeal, 3-4 whole grain crackers, 1⁄2 cup brown rice or whole wheat pasta, boiled or baked potatoes, yuca, yams or plantain.	○	○	○	○
Eat less than 2 servings of fruit a day? Serving = 1⁄2 cup or 1 med. fruit or 3⁄4 cup 100% fruit juice.	○	○	○	○
Eat less than 2 servings of vegetables a day? Serving = 1⁄2 cup vegetables, or 1 cup leafy raw vegetables.	○	○	○	○
Eat or drink less than 2 servings of milk, yogurt, or cheese a day? Serving = 1 cup milk or yogurt; 1 1⁄2 - 2 ounces cheese.	○	○	○	○
Eat more than 8 ounces (see sizes below) of meat, chicken, turkey or fish per day? Note: 3 ounces of meat or chicken is the size of a deck of cards or ONE of the following: 1 regular hamburger, 1 chicken breast or leg (thigh and drumstick), or 1 pork chop.	○	○	○	○

Q31 In an average week, how often do you:

	Usually/Often	Sometimes	Rarely/Never	Does not apply to me
Use regular processed meats (like bologna, salami, corned beef, hotdogs, sausage or bacon) instead of low fat processed meats (like roast beef, turkey, lean ham; low-fat cold cuts/hotdogs)?	○	○	○	○
Eat fried foods such as fried chicken, fried fish, French fries, fried plantains, tostones or fried yuca?	○	○	○	○
Eat regular potato chips, nacho chips, corn chips, crackers, regular popcorn, nuts instead of pretzels, low-fat chips or low-fat crackers, air-popped popcorn?	○	○	○	○
Add butter, margarine or oil to bread, potatoes, rice or vegetables at the table?	○	○	○	○
Eat sweets like cake, cookies, pastries, donuts, muffins, chocolate and candies more than 2 times per day.	○	○	○	○
Drink 16 ounces or more of non-diet soda, fruit drink/punch or Kool-Aid a day? Note: 1 can of soda = 12 ounces	○	○	○	○

Q32 Do you or a member of your family usually (5 or more days per week) shop and cook rather than eating meals at a sit-down or take-out restaurant food?

○ Yes

○ No

End of Block: REAP-S

Start of Block: SCOFF Questionnaire

Q33 Do you make yourself sick because you feel uncomfortably full?

○ Yes

○ No

Q34 Do you worry you have lost control over how much you eat?

○ Yes

○ No

Q35 Have you recently lost more than 14lbs in a three-month period?

○ Yes

○ No

Skip To: Q37 If Have you recently lost more than 14lbs in a three-month period? = No

Q36 Was this weight loss intentional? (you were trying to lose weight)

○ Yes

○ No

Q37 Do you believe yourself to be fat when others say you are too thin?

○ Yes

○ No

Q38 Would you say food dominates your life?

○ Yes

○ No

Q39 Eating Habits

	Very Willing			Not at all Willing		
	1	2	3	3	4	5
How willing are you to make changes in your eating habits in order to be healthier?						

End of Block: SCOFF Questionnaire

Start of Block: Bratman Test for Orthorexia

X→

Q40 Do you spend more than 3 hours a day thinking about your diet?

○ Yes

○ No

Q41 Do you plan your meals several days ahead?
○ Yes

○ No

Q42 Is the nutritional value of your meal more important than the pleasure of eating it?
○ Yes

○ No

○ Click to write Choice 3

Q43 Has the quality of your life decreased as the quality of your diet has increased?

❍ Yes

❍ No

X→

Q44 Have you become stricter with yourself lately?

❍ Yes

❍ No

Q45 Does your self-esteem get a boost from eating healthily?

❍ Yes

❍ No

Q46 Have you given up foods you used to enjoy in order to eat the 'right' foods?

❍ Yes

❍ No

Q47 Does your diet make it difficult for you to eat out, distancing you from family and friends?

❍ Yes

❍ No

Q48 Do you feel guilty when you stray from your diet?

❍ Yes

❍ No

Q49 Do you feel at peace with yourself and in total control when you eat healthily?

❍ Yes

❍ No

End of Block: Bratman Test for Orthorexia

Start of Block: Vegetarian

Q50 Do you consider yourself a vegetarian?

❍ yes

❍ no

❍ partial vegetarian

Q51 Please select all the food groups that you restrict from your diet completely. All that apply.

☐ Eggs

☐ Dairy products (milk, cheese, yogurt made from animal milks)

☐ Red Meats

☐ Poultry

☐ Fish and other seafood

☐ Any animal product, I am vegan

☐ I do not restrict any animal products

☐ Please explain other restrictions

_____

Q52 If you restrict any animal products on some days of the week, such as "Meatless Mondays", please describe.

❍ Describe _____

❍ I do not restrict any animal products

End of Block: Vegetarian

APPENDIX D

INSTITUTIONAL REVIEW BOARD APPROVAL

Office of Research and Partnerships

MEMORANDUM

TO PI (s): Dr. Simone Camel
Kayanna Pulliam, Student Researcher
Jessica Putnam, Student Researcher

FROM: Dr. Walter Buboltz, Professor/Elva L. Smith Endowed Professor
buboltz@latech.edu

SUBJECT: Human Use Committee - Review DECISION

DATE: April 29, 2022

In order to facilitate your project, an EXPEDITED REVIEW has been completed for your proposed study:

HUC No.: 1413, 22-086

TITLE: Food frequency correlations with skin carotenoid scores, hemoglobin levels, eating disorder risks, and vegetarianism

HUC DECISION: APPROVED

The proposed study's procedures were found to provide reasonable and adequate safeguards against possible risks involving human subjects. The information to be collected may be personal in nature or implication. Therefore, diligent care needs to be taken to protect the privacy of the participants and to assure that the data are kept confidential. Informed consent is a critical part of the research process. The subjects must be informed that their participation is voluntary. It is important that consent materials be presented in a language understandable to every participant. If you have participants in your study whose first language is not English, be sure that informed consent materials are adequately explained or translated. Since your reviewed project appears to do no damage to the participants, the Human Use Committee grants approval of the involvement of human subjects as outlined. Projects should be renewed annually. *This approval was finalized on April 29, 2022 and this project will need to receive a continuation review by the IRB if the project continues beyond April 29, 2023.* ANY CHANGES to your protocol procedures, including minor changes, should be reported immediately to the IRB for approval before implementation. Projects involving NIH funds require annual education training to be documented. For more information regarding this, contact the Office of Sponsored Projects.

You are requested to maintain written records of your procedures, data collected, and subjects involved. These records will need to be available upon request during the conduct of the study and retained by the university for three years after the conclusion of the study. If changes occur in recruiting of subjects, informed consent process or in your research protocol, or if unanticipated problems should arise it is the Researchers responsibility to notify the Office of Research and Partnerships or IRB in writing. The project should be discontinued until modifications can be reviewed and approved.

Thank you for submitting your Human Use Proposal to Louisiana Tech's Institutional Review Board.