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Examining body composition differences between vegetarian and non-vegetarian women

Carlie Mapp

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Examining body composition and lifestyle factors between vegetarian and non-vegetarian
women

By

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A Thesis
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Master of Science
in Nutrition
in the Department of Food Science, Nutrition, and Health Promotion

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2020

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Diet and lifestyle choices play a vital role in the overall health of an individual. There are many types of diets with varying instructions on what kind and how much of a food, or food group, should be eaten. This cross sectional study focused on possible health benefits of a vegetarian diet in regards to the body composition of non-vegetarian and vegetarian women. Total meat, poultry, seafood, and fish (MPSF) intake were separated into three categories to compare low-to-very-low, moderate, and high intake. Anthropometric measurements collected included waist to hip ratio (WHR), weight, height, and percentage of body fat. No significant differences were found between the vegetarian and non-vegetarian categories BMI, body fat percentage, or WHR. Conclusions found by previous research were not supported by the results of this research. Factors including geographic location and socioeconomic status could impact the availability of healthy food for both vegetarians and non-vegetarians.

DEDICATION

To my mother, father, brother, and family. Thank you for all the support, encouragement, and patience. I could not have completed this without you

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CHAPTER I

INTRODUCTION

The rate at which the American population identifies as a vegetarian has not changed in the past twenty years (Reinhart, 2018). In a 2018 Gallup poll, only 5% of Americans reported being vegetarian, which showed no change from the previous poll in 2012 (Hrynowski, 2019). The same poll showed that only 3% of Americans claimed to be vegan in 2018, which was a 1% increase from the previous poll in 2012 (Reinhart, 2018). A study conducted on Flemish vegetarians and non-vegetarians indicated that vegetarian women had a lower body mass index (BMI) than those of their omnivore (meat-eating) counterparts (Alewaeters, 2005). Additionally, lower BMIs are associated with lower risks of developing certain metabolic diseases like heart disease and diabetes (Kim, 2012).

Moreover, while the risks of developing these diseases are reduced, vegetarians, vegans especially, are at risk of having low intakes of vitamin B12, calcium, iron, and zinc. The resulting effect is the supplementation of vitamins and minerals may be needed to compensate for what is not obtained in the diet to avoid deficiencies. For example, vitamin B12 is found almost exclusively in animal food sources, therefore, supplementation or fortified foods are necessary. A vitamin B12 deficiency can be masked by folate, a vitamin that is rich in vegetarian and vegan diets, so a deficiency can be difficult to diagnose (Vegetarian Diet, 2019). Additionally, a number of studies report those who consume little to no meat have a lower body fat percentage, fat-free mass, and a lower risk of developing metabolic diseases than those who

consume meat on a regular basis. As a result of these climbing obesity rates, and more Americans are diagnosed with metabolic diseases, alternative diets are being investigated.

In addition to the previously mentioned studies, the relationship between personality traits and dietary behaviors are being analyzed to better understand diet choices. These studies found that greater impulsivity is connected to greater consumption of a Western-style diet (Lumley, 2016). In fact, researcher Sara Weston observed eating healthy foods was associated with higher agreeableness, conscientiousness, emotional stability, and openness while eating unhealthy foods was associated with lower agreeableness, conscientiousness, emotional stability, and openness (Weston, 2020).

The aim of this research was to analyze the differences in body composition, body fat percentage, fat-free mass, and personality traits between vegetarian and non-vegetarian women.

CHAPTER II

LITERATURE REVIEW

Western Diet Defined

Studies conducted by both U.S. and international institutions into the western diet have shown a steady rise in poor nutrition leading to an increased risk of health problems to include obesity, cancer, and diabetes. These studies have found the western diet to be defined by “chronic overconsumption of diets high in fats and sugars” (Perez, 2018). It also includes the overconsumption of cholesterol, protein, salt, and processed foods (Manzel, 2014). Furthermore, this diet increases the risk of developing metabolic diseases such as type-2 diabetes, cardiovascular diseases (CVD), and may possibly trigger autoimmune diseases like type 1 diabetes (Manzel, 2014). Additionally, it is important to be aware of the differences in nutrient profiles when comparing dietary patterns and possible associations with diseases (Rizzo, 2013).

For example, the Korea National Health and Nutrition Examination Survey-IV reported that, in 1969, the consumption of animal food, or animal products, was only 3% of total calories but had risen to 20.2% by 2009. Korea also saw an increase in obesity from 26% in 1998 to 31.3% in 2009 with an increase of deaths caused by cancers, diabetes, and CVD in people 65 years and older (Kim, 2012). The same trend can be seen in the U.S which has seen a steady increase in obesity from 1988-2016. The most recent National Health and Nutrition Examination also reported that nearly 40% of adults were obese in 2015-2016 (Warren, 2018), while The Center for Disease Control and Prevention reported the leading causes of death in the U.S. to be

heart disease and cancer (Heron, 2016). Both of these conditions may be related to poor diet and nutrition (Center for Disease Control, 2009). Accordingly, the medical community has increased the amount of research it conducts into combating the rise in obesity to include examining various regions around the world.

Blue Zone Diet Patterns

In examining the worldwide obesity epidemic, researchers have categorized certain areas based on people who have lived to the age of one hundred without heart problems, obesity, cancer, or diabetes. These areas are known as Blue Zones and include Ikaria, Greece; Okinawa, Japan; Ogliastra Region, Sardinia; Loma Linda, California; and Nicoya Peninsula, Costa Rica. Additionally, the diets in each of these places show similarities in how many vegetables, fruits, legumes, and lean meat, mainly fish, are consumed. Vegetables and other plant-based foods, such as oils, make up 95% of each meal. Fish are the main meat that is consumed, but even then it is consumed in fewer than three ounces up to three times a week. Those who live in the Blue Zones limit their intake of eggs to two to four times a week and typically consume one egg at a time. Moreover, legumes and beans are a staple in this diet with at least half a cup being consumed daily while the types of beans that are eaten vary between each zone. Sugar that is found naturally in fruits and vegetables is not avoided while the amount of added sugar consumed is about seven teaspoons daily, so sweets as snacks are not consumed (Blue Zones, 2019).

In addition to this, the American Heart Association specifically recommends that men consume no more than nine teaspoons (36 grams) and women consume no more than 6 teaspoons (25 grams) of added sugar per day (American Heart Association, 2020). The preferred snack is usually a variety of nuts with a portion size being two handfuls on average. The bread

that is consumed in this diet is 100% whole wheat or sourdough. Sourdough has health benefits that include low levels of gluten making it ideal for those with gluten sensitivity, while also lowering the glycemic load of meals. This is beneficial because it can make the body burn foods slower, allowing the body to use those calories instead of being stored as fat. The drinks that are consumed include mostly water, wine, coffee, and tea (Blue Zones, 2020). Identifying these Blue Zones has led to other discoveries as well, such as the 80% rule.

The 80% rule was discovered in Okinawa, Japan, one of the aforementioned Blue Zones. This rule states that a person should stop eating when their stomach is 80% full. Furthermore, the largest meal is eaten in the morning with the smallest meal eaten in the late afternoon. Also in some regions, alcohol was consumed regularly but moderately, consisting of one or two glasses per day (Buettner, 2009). However, Blue Zones are not the only example of suggesting a mostly plant-based diet leads to longevity and fewer diseases.

A large, prospective, observational study that included 72,113 female nurses was conducted to document the relationship of two dietary patterns, the prudent and Western diet (Appel, 2008). The nurses in both diets were free of coronary heart disease (CHD), stroke, diabetes, and cancer at the beginning of the study. The prudent diet consisted of vegetables, fruits, legumes, fish, poultry, and whole grains. The Western diet consisted of high consumption of red meat, processed meats, refined grains, french fries, sweets, and desserts. A collection of baseline data began in 1984 with a follow-up that lasted 18 years. During this time, a total of 6,011 deaths occurred with 3,319 due to cancer, 1,154 due to CVD, and 1,718 due to other causes not listed. Further investigation and multivariate analysis revealed that those who strictly adhered to the prudent diet had the lowest mortality rate with a 17% lower risk. Those who adhered to the Western diet had the highest mortality rate with a 21% increase. The Western diet

was also associated with an increased risk of cardiovascular disease by 22%. This study was limited in that there was no guarantee either pattern met nutrient requirements for the individuals participating. However, it should be noted that, regardless of this limitation, a diet that emphasized fruits and vegetables showed a considerable decrease in the likelihood of developing cardiovascular diseases (Appel, 2008).

In studying the relationship between the Blue Zone diet pattern and the prudent diet pattern, some similarities between the two have become obvious. For example, both patterns emphasize consuming a mostly plant-based diet consisting of fruits, vegetables, and legumes, with limited to no intake of meat. A closer look at a similar diet pattern limited in, or totally excluding, meat offers a variety of health benefits. These benefits have included lower blood pressure, lower BMI, and body fat percentage, lower plasma cholesterol concentration, and significantly lower lipid levels (Rauma, 2000).

Vegetarianism Defined

Consequently, this has led to research into the benefits associated with a vegetarian diet with both the Blue Zone diet pattern and the prudent diet pattern falling into the vegetarian category. However, the term “vegetarian” can have many different definitions. The different types include lacto-ovo-vegetarians, lacto-vegetarians, ovo-vegetarians, and vegans (Mondor, 2017). The prefixes on each type of vegetarian diet give insight into what each specific vegetarian pattern a person would follow.

For instance, lacto-ovo-vegetarians consume a diet that includes both dairy products and eggs. The prefix –lacto means ‘milk’ and –ovo means ‘egg’. Lacto-vegetarians consume dairy products but avoid the consumption of eggs. Ovo-vegetarians consume eggs but avoid the consumption of dairy products. A pesco-vegetarian is a type of semi-vegetarian and will eat fish

but will avoid the intake of any other kind of meat. A vegan will not consume any animal-derived products but adheres to a very strict plant-based diet. For comparison, an omnivore is the opposite of a vegetarian and will consume both plant and animal products.

As can be seen, there is some inconsistency in how people define what vegetarianism is which makes it difficult for empirical study (Ruby, 2012). However, despite the difficulty of empirical study, a vegetarian diet appears to avoid a significant amount of issues faced by those diets based primarily on animal products. Animal fat, which is known to be high in cholesterol, was previously associated with causing high serum cholesterol levels. Recent research has shown that the intake of dietary cholesterol does not raise serum cholesterol levels. Instead, it is the saturated fatty acids in animal protein that causes high serum cholesterol levels (Soliman, 2018). Serum cholesterol is the total amount of cholesterol in the blood, which includes high-density lipoprotein cholesterol (HDL-C, good cholesterol), and low-density lipoprotein cholesterol (LDL-C bad cholesterol). Triglycerides also contribute to total fat in the blood. Elevated triglycerides can be caused by poor diet and obesity (Heart, 2018). Still, this is not to say that the consumption of some animal products is not beneficial.

Meat, specifically red meat, contains high biological value protein. Red meat also contains all essential amino acids, vitamins B6 and B12, and riboflavin and niacin (Williams, 2007). Red meat is also higher in saturated fat than other lean meats such as chicken or fish. A systematic review conducted by Clifton and Keogh concluded that replacing saturated fat with polyunsaturated fatty acids (PUFA) in the diet lowered the risk of CHD events, CVD, and total mortality. The study also concluded that replacing saturated fats with any carbohydrates and monounsaturated fatty acids (MUFA) did not lower CHD events or CVD mortality, but reduced total mortality (Clifton, 2017).

Consumption Patterns and Lifestyle Factors

To compensate for the nutrients not being obtained by meat, vegetarians will need other sources of these nutrients, which may include taking supplements. However, the need for vegetarians to take supplements depends on which vegetarian pattern is followed and how well the diet is planned. For example, ovo-, lacto- and pesco- vegetarians, if the diet is well planned to include fortified foods along with the allowed animal-based protein, may not need additional supplementation because B12 is provided. Strict vegans may need to consume adequate amounts of fermented food as a source of vitamin B12 or use a supplement. However, if a wide variety of fortified foods, vegetables, fruits, legumes, and leafy greens are consumed, then all nutritional values can be met without the need for supplementation (Vegetarian Diet, 2019).

Along this same line, multiple studies have been conducted to ascertain whether vegetarians meet the nutritional requirements of a healthy diet. Regarding certain body composition measurements in vegetarians and omnivores, it appears that vegetarians have lower BMI and body fat. The cross-sectional analysis of BMI and some lifestyle variables compared Flemish vegetarians and non-vegetarians. The study consisted of 206 vegetarian women and 120 vegetarian men with a reference population of 4,993 women and 4,666 men. Vegetarian women had a BMI of 22.1 +/- 3.1 kg/m² compared with 24.6 +/- 4.8 kg/m² in the reference population. Vegetarian men showed to have a BMI of 22.6 +/- 3.6 kg/m² compared with 25.7 +/- 4.0 kg/m² in the reference population.

Lifestyle factors such as physical activity, avoidance of harmful practices, medication use, smoking, and drinking were reported in the study (Alewaeters, 2005). The reference group was not involved in as much intensive physical activity (over 4 hours per week) compared to the

vegetarian groups, while the reference group was more involved in moderate physical activity (up to 4 hours per week) compared to the vegetarians.

The study also revealed that vegetarians smoked less than the reference group (13.5% compared with 28.5% respectively) (Alewaeters, 2005). In regards to alcohol consumption, vegetarians showed no comparable differences in how much alcohol was consumed during the week nor was a difference observed in how much alcohol vegetarians consumed on the weekends (Friday – Sunday). In contrast, non-vegetarians did show a difference. The non-vegetarian males consumed the most alcohol during the week and on the weekends when compared to their female counterparts and the vegetarians (Alewaeters, 2005).

The same study also reported the use of prescribed and non-prescribed drug usage. Nearly half of the reference group (non-vegetarians) (47.3%) reported using a prescribed drug during the last two weeks while only a quarter (25.5%) of the vegetarians reported any usage. The use of non-prescribed drugs, including homeopathic medication, vitamin and mineral supplements, and nonsteroidal anti-inflammatory, was comparable between the two groups, 34.1%, and 28.2%, respectively. Also, more subjects in the vegetarian population reported viewing their health to be ‘good’ to ‘very good’ when compared to the non-vegetarian population (Alewaeters, 2005).

In a study published by Korean Nutrition, the biomarkers of oxidative stress, antioxidant capacity, and lipid profiles of sex and age-matched long-term vegetarians and omnivores were compared (Kim, 2012). It was designed to investigate ways to prevent chronic diseases using a plant-based diet by evaluating the health status of those who have maintained a vegetarian-based diet for more than a decade. Twenty-three men and twenty-two women were compared with a mean age of 49.5 +/- 5.3 years. The vegetarians had maintained the diet for a minimum of 15

years. It was observed that the vegetarians had a significantly lower body fat percentage (21.6 +/- 6.4%) than the omnivores (25.4 +/- 4.6%). The dietary assessment also showed that fat intake was significantly higher in omnivores than in vegetarians. Moreover, the percentage of energy vegetarians obtained from carbohydrates, protein, and fats was 66.1%, 18.6%, and 15.3%, respectively. In omnivores, carbohydrate, protein, and fat were 58.3%, 16.6%, and 25.1%, respectively (Kim, 2012).

Also, a study published in the Journal of the American Dietetic Association showed omnivores had the highest BMI and the highest proportion of obese participants compared to vegetarians. This particular study was conducted to evaluate how dietary patterns between vegetarians and omnivore diets may contribute to the development of the disease. It is important to take into account that the population evaluated was the religious group known as Seventh Day Adventist, a population mentioned as living in Blue Zones.

This religious group is associated with having a higher than average vegetarian population. All different types, lacto-ovo-, pesco-, semi- and strict-, vegetarians were taken into consideration and evaluated. Similar to previous studies, this study indicated there was significant variance between the nutrient intakes of the different dietary patterns (Rizzo, 2013). However, regardless of the varying nutrient intake, non-vegetarians had the highest BMI values at 28.7 percent and strict vegetarians had the lowest BMI values at 24.0 percent.

This is important to note, as non-vegetarians did not have the highest caloric intake even though their BMI values were the highest. Pesco-vegetarians had the highest median value at 1,937 calories consumed per day while the non-vegetarian median value was 1,890 calories per day (Rizzo, 2013). The reason for the disproportion in BMI could be related to the difference in the nutrient profiles. This is because the main source of protein for pesco-vegetarians was mostly

derived from plants while non-vegetarians had a significantly higher intake of protein from animal-derived sources. There was also a significant contrast in total fiber intake, dairy protein intake, and soy protein intake.

Additionally, all types of vegetarians had a significantly higher intake of fiber, dairy protein, and soy protein when compared to their non-vegetarian counterparts. Non-vegetarians had an average of 30.4 grams of total fiber intake while semi-, pesco-, lacto-ovo-, and strict vegetarians all averaged above 34 grams per day (Rizzo, 2013). To give perspective, the average American has an intake of about 15 grams a day (UCSF, 2019). This is important as adequate fiber intake has proven to aid in achieving a healthy weight (Dietary Fiber, 2018).

Moreover, another study reported in the Journal of the American Dietetic Association compared twenty-three vegetarians and twenty-two non-vegetarians, all of whom were women. The women volunteered to participate in a six-month prospective study to evaluate the frequency of subclinical ovulatory disturbances among vegetarians and non-vegetarians (Janelle, 1995). No differences were observed in ovulatory disturbances. While the focus of this study differs from the previous two, the same lifestyle factors and measurements were obtained and compared. The vegetarians had maintained their diet from a range of two to fifteen years. The study showed that vegetarians had lower BMI and body fat percentages than non-vegetarians. Each woman kept a three-day food record with an emphasis placed on the importance of accuracy. Nine days of records were kept in total, three sets of three-day records. Results indicated that energy and fat intake between the groups did not differ but vegetarians consumed less protein (Janelle, 2005).

In more recent studies, researchers have looked at low, moderate, and high intakes of meat to determine if there are any health discrepancies among the three categories. The World Cancer Research Fund recommends twelve to eighteen ounces of red meat per week and even

less, if any, processed meat (World Cancer Research Fund, 2018). A study published in the International Journal of Epidemiology found supporting evidence for the World Cancer Research Fund recommendations. This study found that those who ate 25 gm/day of processed meat had a 19% increased risk of colorectal cancer and those who consumed 50 gm/day of red meat had an 18% increased risk of colorectal cancer. Lifestyle factors were also observed. Alcohol intake of 10 gm/day was also associated with an 8% increased risk of colorectal cancer (Bradbury, 2020).

Dietary Patterns and Personality Traits

The reason as to why people choose different diets to follow is currently being investigated to better predict future behaviors. People adopt vegetarianism for a variety of reasons that includes animal welfare, environmental sustainability, personal health, concerns about the safety of the food supply, and religion (Barr, 2002). Accordingly, as people change, the reason for maintaining a vegetarian diet pattern tends to change with them over time. Those who refrain from eating meat for animal welfare and environmental sustainability typically associate meat with disgust and emotional distress resulting in a more likely transition toward veganism eventually (Barr, 2002). Those who switched to a vegetarian diet for personal health reasons did so due to the risks of developing potential diseases (Ruby, 2012).

Additionally, personality traits are now being associated with specific dietary and exercise patterns. The personality traits most often looked at are extraversion (tendency to seek fulfillment from sources outside the self), conscientiousness (tendency to be honest and hardworking), openness (tendency to seek new experience and intellectual pursuits), agreeableness (tendency to adjust behavior to suit others), and neuroticism (tendency to be emotional), which are collectively called the Big Five (Goldberg, 1992). Research in this area is still relatively new with the available research varying in its findings. The inconsistency may be

due to studies using different personality measures that emphasize different aspects of the Big Five traits (Sutin, 2016).

However, as previously mentioned, the consumption of more healthy foods was associated with higher levels of agreeableness, conscientiousness, and openness, and lower levels of neuroticism (Weston, 2020). A similar study conducted by Sutin found that neuroticism and conscientiousness had the strongest associations with BMI. Results showed neuroticism was related to a higher BMI and conscientiousness was related to a lower BMI. Extraversion had the strongest correlation with exercise (Sutin, 2016). In addition to this, a study conducted by Jordan Lumley analyzed impulsivity alone and found that greater impulsivity positively correlated to consuming a more Western-style diet (Lumley, 2016). Even with these variances, as more research is conducted, studying personality traits will eventually be able to predict the types of dietary habits that can be expected from an individual, making early intervention much more effective.

In closing, each study represented a different population, and sometimes a different decade, across the globe but still had similar results. Moreover, regardless of the study, when it was conducted, or who is studied, the resulting conclusion in each revealed that vegetarians had a lower risk of developing chronic diseases that are plaguing Western society. This can be associated with vegetarians having, on average, a lower BMI and total body fat. Importantly, the results of these studies present other options worth exploring in combating cardiovascular diseases, obesity, type-2 diabetes, and other metabolic diseases. While other factors, such as genetics, should be taken into consideration, it is clear a vegetarian-based diet has significant health benefits that can aid in decreasing the incidence (or prevalence) of chronic illnesses in the Western world.

CHAPTER III

METHODS

Study Design

This study was a cross-sectional design using retrospective data (primary objective) and prospective case-control data (secondary objectives). Retrospective data were collected using the database Body AP: Biological factors for Obesity Development in Young Adults Project provided by Dr. Tolar-Peterson Lab. It was not until after the prospective data questionnaire had been created that this data set decided to be used due to time restraints and the COVID-19 pandemic. This is the reason for the discrepancies among the data. DHQ III was used for collecting dietary data. The International Physical Activity Questionnaire (IPAQ) long form was used for collecting physical activity data. The Big Five Personality survey was used to analyze personality traits. The retrospective data eligibility criteria for inclusion in the study included falling into the designated age range (18 years and older), being a woman, prior completion of a dietary questionnaire, lifestyle factor questionnaire, and body composition assessment. Exclusions were made for any individual who did not fall within the designated age range, did not complete the body composition assessment, and men. Each participant was divided into three separate categories based on total meat, poultry, and seafood (MPSF) intake as defined by the World Cancer Research Fund. The meat intake categories were defined as followed: low to very-low meat intake of 0.1-11.9 gm/week, moderate meat intake of 12-17.9 gm/week, and high meat intake of 18 gm/week or more (Table 3.1) (World Cancer Research Fund, 2018).

For the prospective data collection, social media was the primary platform used to accrue participants. Advertisements for participants were sent to vegetarian social group-messages, vegetarian Facebook groups, and Instagram, and emails were sent to vegetarian groups at Mississippi State University, the concentration in Food Science in the Department of Food Science, Nutrition and Health Promotion at Mississippi State University, and to the nursing, dentistry, and medical school at the University of Mississippi. Participants prior to data collection signed a consent form. Eligibility criteria for inclusion in the study included being a woman 18 years or older, being a vegetarian for one year or longer, ability to complete a dietary restriction questionnaire, lifestyle factor questionnaire, and body composition assessment. Exclusions were made for any individual who was not at least 18 years old, men, women who were pregnant (self-reported), those who have been a vegetarian for less than 12 months, history of bariatric surgery, or inability to complete the diet history questionnaire, personality test, or body composition assessment. The questionnaire had a brief definition of each type of vegetarian and asked the participant to identify as one of the five different kinds of vegetarians if she was a vegetarian. A personality test was given to find similarities and differences between vegetarians and non-vegetarians. The IPAQ long form was used for physical activity data collection. The Big Five Personality survey was used to analyze personality traits. Exercise habits, alcohol consumption, smoking habits, and supplemental vitamin use was surveyed as lifestyle factors. The anthropometric measurements included waist to hip ratio (WHR), weight, height, and BMI. The TBF-300A TANITA scale was originally used to collect body fat percentage, fat free mass, and weight. An NHANES food frequency questionnaire was used to collect dietary similarities

and differences. Due to the COVID-19 pandemic, all aspects of the study had to be adapted to be completed online. Participants were required to self-report height, weight, hip, and waist measurements. The student investigator calculated BMI and waist-to-hip ratios. This study was approved by the Mississippi State University Institutional Review Board (IRB) as Protocol ID: IRB-19-522.

Aims Of Research

The aim of this research was to investigate the difference in body composition and personality traits of vegetarian and non-vegetarian women.

Objective:

Primary objective:

To analyze body mass index (BMI) and body fat percentage of vegetarian, low to-very-low total MPSF intake, moderate total MPSF intake, and high total MPSF intake women.

Secondary Objectives:

1. Investigate the personality traits between vegetarian and non-vegetarian women.
2. Investigate the differences in the waist to hip ratio between vegetarian and non-vegetarian women.

Data Collection

Existing data were used to answer the primary objective. Database of Body AP: Biological factors for Obesity Development in Young Adults Project provided by Dr. Tolar-Peterson Lab, subjects collected between 2015-2019 years. The participant's total meat, poultry, seafood, and fish consumption were analyzed and divided into low to very-low intake, moderate intake, and high intake categories. Total meat, poultry, seafood, and fish (MPSF) consumption category was chosen due to it providing a more comprehensive look at animal protein intake excluding milk, eggs, and cheese.

New data were collected to answer secondary objectives. The sample size was calculated using the rule of thumb equation $N \geq 30 + 8m$, where m is the number of predictor (independent) variables, with 80% power and a significance level of .05 (Green, 1991). Therefore, with nine independent variables, at least 102 total participants who completed all parts of the study was the goal for this study. Participants were first asked to complete the diet history questionnaire (Appendix A). This survey assessed which type of vegetarian the participant identified as. Next, the participants were asked to complete the validated personality test (Goldberg, 1992) (Appendix B). The purpose of the test was to examine the similarities between vegetarians and how they differed from non-vegetarians. Initially, after each survey was completed, the participants were asked to complete a body composition analysis with the TBF-100A TANITA®, a foot-to-foot bioelectrical impedance scale. The scale measures lean body mass and body fat measurements and account for age, sex, and body type (standard or athlete). Due to the pandemic, COVID-19, anthropometric measurements were no longer allowed to be collected in person. Each participant had to self-report height, weight, hip, and waist measurements. Alcohol consumption and exercise data were collected but not used for this research.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (IBM Corp. 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.).

Pearson Chi-Square tests were conducted when analyzing whether the amount of total meat, poultry, seafood, and fish consumed had a relationship with body composition, specifically BMI, fat percentage, and waist-to-hip ratio categories. Prospective data were checked for outliers using the Explore function in SPSS. If outliers occurred, they would be omitted as the extreme values that outliers exhibit can distort results. There were two outliers observed in the vegetarian data. Two participants reported eating meat more often than was allowed to be included in the research.

CHAPTER IV
RESULTS

Table 4.1 Demographics and body composition results

	Vegetarian Women (N=32) (M±SD)	Non- Vegetarian Very Low/Low Meat Intake (N=226) (M±SD)	Non- Vegetarian Moderate Meat Intake (N=152) (M±SD)	Non- Vegetarian High Meat Intake (N=306) (M±SD)
Age (years)	30.2±10.57	19.9±2.44	20.1±19.99	19.9±1.85
Weight (pounds)	151.3±28.12	143.9±34	155.8±104.75	147.2±41.48
Body Mass Index (BMI) kg/m²	25.3±4.18	26.7±10.75	27.8±10.30	27.4±27.24
Body Fat %	26.6±12.2	26.7±10.75	27.8±10.30	27.4±27.24

Table 4.1 (Continued)

	Vegetarian Women (N=32) (M±SD)	Non- Vegetarian Very Low/Low Meat Intake (N=226) (M±SD)	Non- Vegetarian Moderate Meat Intake (N=152) (M±SD)	Non- Vegetarian High Meat Intake (N=306) (M±SD)
Fat Mass (pounds)	44.1±25.6	41.2±26.30	44.8±32.90	43.8±30.5
Hip/Waist Ratio	0.82±0.058	0.80±0.063	0.80±0.062	0.81±0.068

Table 4.2 Body mass index and total MPSF classification frequency between vegetarian and non-vegetarian categories

	Vegetarian	Non-Vegetarian	Non-Vegetarian	Non-Vegetarian	Total
		Very Low/Low Meat Intake	Moderate Meat Intake	High Meat Intake	
	n(%)	n(%)	n(%)	n(%)	(n)
Underweight (<18.51 kg/m)	1 (3.8%)	23 (46.9%)	10 (20.4%)	16 (32.6%)	49
Normal (18.51-24.99 kg/m)	17 (65.4%)	135 (32.1%)	100 (23.8%)	186 (44.2%)	421
Overweight (25.00-29.99 kg/m)	8 (30.8%)	49 (37.1%)	23 (17.4%)	60 (45.5%)	132
Obese (Class I) (30.00-34.99 kg/m)	0 (0%)	16 (41.0%)	8 (20.5%)	15 (38.5%)	39

Table 4.2 (Continued)

	Vegetarian	Non-Vegetarian Very Low/Low Meat Intake	Non-Vegetarian Moderate Meat Intake	Non-Vegetarian High Meat Intake	Total
	n(%)	n(%)	n(%)	n(%)	(n)
Obese (Class II) (35.50-39.99 kg/m)	0 (0%)	4 (22.2%)	2 (11.1%)	12 (66.7%)	18
Obese (Class III) (40>kg/m)	0 (0%)	6 (20.7%)	9 (31.0%)	14 (48.3%)	29
Total	26	233	152	303	688

Very low/low meat, poultry, seafood, fish intake = 0.1-11.9 oz./day, moderate intake = 12-17.9 oz./day, high intake = >18 oz./day. Pearson Chi-Square determined a non-significant relationship between BMI and type of non-vegetarian (P = 0.171).

Table 4.3 Body fat percentages and Total MSPF classification, ages, Chi-Square Percentages

	Vegetarian n(%)	Non- Vegetarian Very Low/Low Meat Intake n(%)	Non- Vegetarian Moderate Meat Intake n(%)	Non- Vegetarian High Meat Intake n(%)	Total (n)
Underfat					
Age (years) 18-39					
<21.99%	5 (2.4%)	70 (33.9%)	43 (20.9%)	88 (42.7%)	206
Healthy					
Age (years) 18-39					
22-33.99%	2 (0.6%)	106 (32.0%)	75 (22.7%)	148 (44.7%)	331

Table 4.3 (Continued)

	Vegetarian n(%)	Non- Vegetarian Very Low/Low Meat Intake n(%)	Non- Vegetarian Moderate Meat Intake n(%)	Non- Vegetarian High Meat Intake n(%)	Total (n)
Overfat					
Age (years)					
18-39	5	32	13	35	
34-39.99	(5.9%)	(37.6%)	(15.3%)	(41.2%)	85
Obese					
Age (years)					
18-39	1	23	19	32	
>40	(1.3%)	(30.7%)	(25.3%)	(42.7%)	75
Total	13	232	151	303	699

Percentages (Analysis, 2013). Pearson Chi-Square determined a non-significant relationship among body fat percentage and type of non-vegetarian (P=3.62) and vegetarian.

Table 4.4 Waist to Hip Ratio frequencies and Total MPSF (oz./day) (Crosstabulation)

	Vegetarian	Non-Vegetarian	Non-Vegetarian	Non-Vegetarian	Total
		Very Low/Low Meat Intake	Moderate Meat Intake	High Meat Intake	
	n(%)	n(%)	n(%)	n(%)	(n)
Low Risk <0.80	10 (13.3%)	27 (36%)	13 (17.3%)	25 (33.3%)	75
Moderately Increased Risk 0.81-0.85	10 (20.0%)	13 (26.0%)	7 (14.0%)	20 (40.0%)	50
Substantially Increased Risk 0.81-0.85	9 (24.3%)	9 (24.3%)	6 (16.2%)	13 (35.1%)	37
Total	29	49	26	58	133

Waist to hip ratio is the waist measurement (in) divided by hip measurement (in) and used to evaluate body fat carried on hips, waist, and buttocks. Percentages (Analysis, 2013). Pearson Chi-Square determined a non-significant relationship among waist to hip ratio and type of non-vegetarian (0.786).

Table 4.5 Frequency of type of vegetarianism reported

Type of Vegetarian	Lacto-ovo- (n)	Lacto- (n)	Ovo- (n)	Pesco- (n)	Vegan (n)	Total (N)
Total	12 (37.5%)	1 (3.1%)	3 (9.4%)	5 (15.6%)	11 (34.4%)	32

The total amount of each type of vegetarian as reported by participants.

Table 4.6 B12, iron, and zinc intakes for vegetarian and non-vegetarian women

Vitamin or Mineral	Vegetarian Women (n=32) Mean ± SD	Non-vegetarian Women (n=704) Mean ± SD	Recommended Dietary Allowance
Vitamin B12 (mcg/day) ^a	N/A	3.9 ± 3.5	2.4
Iron (mg/day)	N/A	11.9 ± 8.9	18.0
Zinc (mg/day)	N/A	9.3 ± 7.1	8.0
Number (%) of women taking supplements			
Supplemental B12	12 (37.5%)	38 (5.4%)	N/A ^b
Supplemental Iron	2 (6.3%)	286 (40.6%)	N/A
Supplemental Zinc	2 (6.3%)	258 (36.6%)	N/A
Multivitamin	20 (62.5%)	Not reported as multivitamin	

^aB12, iron, and zinc intakes are from food, supplemental intakes not included.

^bNot applicable

Table 4.7 Big 5 Personality Survey (M±SD)

	Vegetarian	Non-Vegetarian
Extraversion	20.9±14.1	30.8±8.3
Agreeableness	26.6±18.5	40.9±5.0
Conscientiousness	25.6±17.5	38.1±5.2
Emotional Stability	22.2±16.0	28.2±6.2
Intellect/Imagination	26.1±17.2	34.9±5.3
Total	43	82

The mean of each personality-type category.

CHAPTER V

DISCUSSION

Demographics

All participants were women between the ages of 18 years and 50 years old. A total of 704 non-vegetarian women were used from a previously collected dataset (Table 1.1). A total of 43 vegetarians volunteered, but only 32 volunteers completed the survey in its entirety. Ethnicity was not a factor taken into consideration. Overall, high-meat, poultry, seafood, and fish intake consisted of the majority of non-vegetarian participants (n=307). Followed by very low/low meat intake (n=226) and moderate meat intake (n=152) (Table 1.1). Vegetarians were on average older than non-vegetarians, which was significant (Table 4.1). The very low/low meat intake participants had the lowest BMI of the non-vegetarian participants, but it was not statistically significant (Table 4.2). Vegetarians had the lowest mean (26.6 ± 12.2) body fat percentage, but it was not statistically significant (Table 4.3).

Body Mass Index vs. Body Fat Percentage

This study did not find any statistically significant differences between BMI and body fat percentage between vegetarians and non-vegetarians (Table 4.1). There were also no significant differences between the three categories of total meat, poultry, seafood, and fish intake (Table 4.1).

Total MPSF Consumption and Its Relationship to Body Composition Among Vegetarian and Non-Vegetarian Women

Comparing the total meat intake categories to body composition in regards to BMI and body fat percent. The low-very-low meat intake category had the highest rate of underweight participants by BMI categories (n=23). High meat intake had the highest amount of normal BMI (n=186), overweight BMI (n=60), obese class I (n=12), and obese class III (n=14) (Table 4.2) by BMI categories. High meat intake also had the highest amount of underfat (n=88), healthy (n=148), overfat (n=35), and obese (n=32) participants by body fat percent categories. There were not enough vegetarian or non-vegetarian women in the 40-59 year old age group for valid use of Chi-Square. The body fat percentage of the majority of vegetarian participants was not able to be collected due to COVID-19 pandemic restrictions. The age groups were separated into 18-24 years and 25-39 years in SPSS to satisfy the requirements for the use of Chi-Square. There were not enough participants to make meaningful interpretations of body composition and levels of meat intake by age.

Big 5 Personality Results and Its Relationship to Dietary Habits and BMI

The Big 5 Personality Survey was used to analyze possible differences between vegetarian and non-vegetarian. Vegetarians (n=43) had the highest mean (M=26.6, SD=18.5) in the 'Agreeableness' category followed closely by the 'Intellect/Imagination' category (M=26.1, SD=17.2). No significant differences were found between vegetarian and non-vegetarian women.

Comparison of Waist to Hip Ratio Between Vegetarian and Non-vegetarian Women

The non-vegetarian women who consumed low to very-low intakes of meat, poultry, seafood, and fish had a mean of 0.800 ± 0.0631 WHR, while vegetarians had the mean of 0.818 ± 0.0575 . We found non-significant differences between these two groups.

Implications of Results

This study did not support the assumption that eating less meat will lead to lower BMI, lower body fat, lower waist to hip ratio, and lower weight. Mississippi is tied with West Virginia in having the highest adult obesity rate of 39.5% (Adult Obesity, 2018). Multiple factors could contribute to this statistic such as more people with a lack of access to adequate health care, cultural emphasis on fried and fast foods, lack of knowledge on how to prepare healthy meals, and insufficient income to buy a steady supply of fresh foods. Previous studies focused on populations/communities who had a cultural emphasis on plant-based diets as only one facet of living a healthy lifestyle that is lacking in Mississippi.

Limitations

There were several limitations regarding the non-vegetarian sample pool, which could have interfered with the results of the study. Firstly, the sample size was not evenly distributed among the three categories of meat intakes. There were also many fewer vegetarians than non-vegetarians making it more difficult to compare. Participants did not complete every aspect of the survey. The hip-to-waist ratio variable was not added to the retrospective data until later on during the data collection, therefore there was a much smaller sample size for that variable. The time span of when data were collected for the retrospective data and vegetarian data varied by a few years. Another limitation was that vegetarian data collection was disrupted by the COVID-19 pandemic. Participants were no longer allowed to meet for body composition measurements, thus requiring self-reported data. There was a decrease in vegetarian participants once COVID-19 started. The vegetarian sample size (n=32) was much smaller than the non-vegetarian sample size (n=704).

Future Research

Previous studies focused on populations/communities that put emphasis on eating mostly plant-based diets. The southern states in the U.S. have a very small percent (2.3% respectively) of those who identify as a vegetarian (Staff, V.R.G, 2016); therefore there may not be as many resources that cater to that lifestyle. The states that were considered southern states are AL, AR, FL, GA, KY, LA, MS, NC, OK, SC, TN, TX, and VA (Staff, V.R.G, 2016). Previous studies also focused on populations that put emphasis on other lifestyle factors such as exercise, community/relationships, and limiting alcohol intake. Mississippi has an adult obesity rate of 39.5% as of 2018²⁹, indicating that there is not a strong cultural emphasis and/or adequate resources for healthy eating and exercise.

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APPENDIX A
QUESTIONNAIRE PARTICIPANTS USED OF THE SURVEY

The following questions are part of the DHQ III (Diet History Questionnaire)

Meal replacement or high-protein beverages (such as Ensure, Boost, Muscle Milk, Slimfast,

Instant Breakfast, or others; NOT including any added protein

You drank meal replacement or high-protein beverages in the past 12 months.

Over the past 12 months, how often did you drink meal replacement or high- protein beverages

(such as Ensure, Boost, Muscle Milk, Slimfast, Instant Breakfast, or others; NOT including any

added protein powder)?

time per month or less

2-3 times per month

1-2 times per week

3-4 times per week

5-6 times per week

time per day

2-3 times per day

4-5 times per day

6 or more times per day

GROUND chicken or turkey

You ate GROUND chicken or turkey in the past 12 months

Over the past 12 months, how often did you eat GROUND chicken or turkey?

1-6 times per year

7-11 times per year

1 time per month

2-3 times per month

1 time per week

2 times per week

3-4 times per week

5-6 times per week

1 time per day

2 or more times per day

Baked, broiled, roasted, stewed, grilled, pan-fried, or fried chicken (including chicken nuggets;

NOT including chicken in mixtures)

You ate baked, broiled, roasted, stewed, grilled, pan-fried, or fried chicken in the past 12 months.

Over the past 12 months, how often did you eat baked, broiled, roasted, stewed, grilled, pan-fried, or fried chicken (including chicken nuggets; NOT including chicken in mixtures)?

1-6 times per year

7-11 times per year

time per month

2-3 times per month

time per week

times per week

3-4 times per week

5-6 times per week

1 time per day

2 or more times per day

Big 5 Personality Survey

Instructions in the table below, for each statement 1-50 mark how much you agree with on the scale 1-5, where 1=Very Inaccurate 2=Moderately Inaccurate, 3=neutral, 4=Moderately Accurate and 5=Very Accurate, in the box to the left of it.

	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
1. Am the life of the party.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Feel little concern for others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Am always prepared.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Get stressed out easily.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Have a rich vocabulary.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Don't talk a lot.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Am interested in people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. Leave my

belongings

around.

9. Am

relaxed most

of the time.

10. Have

difficulty

understandin

g abstract

ideas.

11. Feel

comfortable

around

people.

12. Insult

people.

13. Pay

attention to

details.

14. Worry

about things.

15. Have a

vivid

imagination.

16. Keep in

the

background.

17.

Sympathize

with others'

feelings

18. Make a

mess of

things.

19. Seldom

feel blue.

20. Am not

interested in

abstract

ideas.

21. Start

conversations

.