Plant-Based Diets on Overall Health and Type II Diabetes

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Abstract

Plant-based diets have been up and coming and have a questionable nutrient quality from the nutritionist perspective. The younger population has heavily endorsed the vegan diet because of ethical or health reasons. Possible deficiencies are present in individuals who strictly follow a plant-based diet. Although for individuals suffering from type II diabetes, a low-fat vegan diet would be beneficial to their health.

The vegan and vegetarian diet has gradually been gaining the attention of the health care field. Health professionals have been studying diets to figure out if plant-based diets can fulfill the nutritional needs of the human body. Nutritionists have been skeptical over the ability to obtain all of the needed nutrients when some of the nutrients are only found in animal products. Vitamin B12 is a specific concern for those following a plant-based diet, and they need to research deficiencies that are possible without supplementation for vegans. The low-fat vegan or vegetarian diet can be the right choice for individuals suffering from pre-diabetes or type II diabetes. Animal products can promote risk factors that are associated with heart disease, which is the leading cause of death in those suffering from type II diabetes. A plant-based diet will reduce the prevalence and risk of type 2 diabetes, as well as reduce the risks associated with those already diagnosed with type 2 diabetes.

Every individual chooses some sort of “diet” whether the diet has a specific name or they just eat whatever they want. A diet can be a healthy diet or just a diet. So what makes a person decide to eat a certain way or not? This question is especially interesting when discussing a vegan or vegetarian diet. A vegan diet, also known as a plant-based diet, has been the new “fad” diet for several years now. Why is there a sudden change in people’s behavior? Cutting out any

type of animal product can be a difficult task, so for one to cut out that much of their diet, there must be a really important reason.

In the past 15 years, the vegan lifestyle has become more and more popular. In 1997, 300,000 to 500,000 Americans identified as vegan. In 2012, 2.5 to 6 million Americans identified as vegan. Although this number represents only 1-2% of the United States population. The two major reasons for practicing a vegan diet are ethical and health reasons. Several studies have shown vegans to have positive health benefits when compared to their meat eating counterparts. A cross-sectional study found vegans to have a smaller average body mass index than non-vegans. The vegan participant's average BMI was 23.6, while the non-vegans average BMI was 28.8. Several risk factors for disease are lower in those practicing a vegan lifestyle. Vegan's cholesterol levels as well as blood pressure levels are lower than non-vegans. The risk of cardiovascular disease and diabetes is also reduced with a plant-based diet. The Adventists Health Study 2 studied vegetarian and vegan diets and their effect on health. The overall vegan death rate was decreased by 15%, this did not reach statistical significance, but it was close. Other smaller studies have shown no mortality difference between vegan and non-vegan diets. Although the vegan diet has exhibited positive health benefits for the individual (Beezhold, DiMatteo, Radnitz, 2015).

A vegan or a plant-based diet is a diet that is void of any sort of animal product, this means no poultry, meat, eggs, fish, and dairy products. A plant-based diet is high in legumes, whole grains, vegetables, fruits, healthy fats, seeds and nuts. The definition of a vegan diet sounds very healthy, which it can be, but sugar, salt and unhealthy fats are also vegan food groups. Individuals who are on vegan diets do show positive health changes, but the question can be made, "Are they more aware of consuming healthy foods and engaging in health promoting

behaviors?" or is it really the absence of meat that is behind the health promoting effects of the diet (Beezhold, et. al., 2015).

The vegan or vegetarian diet is chosen for several reasons, which the reasoning behind the decision will affect their additional lifestyle choices. The top reasons for choosing a vegan diet are ethics or animal rights, health, concern for the environment, peer pressure, and sensory disgust. The top two reasons for selecting a vegan diet are ethics and concern for their health. The definition of vegetarian varies between individuals. Some individuals will identify themselves as vegetarians, but they will still consume some meat products. Others will call themselves vegetarians but still consume seafood. The varying definitions of vegetarianism makes it hard to pinpoint exact personality traits of "vegetarians." Men are less likely to be vegan or vegetarian than women are (Egloff & Pfeiler, 2017). Male strength and meat have often been positively associated with one another, hence why more women are vegetarian compared to the male population. Weakness and showing feminist qualities has been compared to eating vegetables, grains, and fruits. Comparing meat eaters to non-meat eaters, non-meat eaters tend to be in the younger generation and have completed a higher level of education. A study found that income and vegetarianism were positively associated with one another. A higher socioeconomic class tended to eat fewer amounts of fatty meats. Culture can play a role in some communities. When looking at China, less meat consumption is generally associated with a lower socioeconomic status (Egloff & Pfeiler, 2017).

The majority of individuals who choose to follow a vegetarian diet do so gradually, although some made abrupt choices to cut out animal products. A non-representative sample of 23 vegetarians were asked about their experience in converting to a vegetarian diet. Two of the vegetarians that had stated they converted suddenly, stated that they then thought of meat as

disgusting, and it even distressed them. Again the majority of motivating factors are ethics and health. Some of the individuals who chose the vegetarian lifestyle because of health concerns were undergoing a physical disease or observed a loved one suffering from a disease. Having high cholesterol and heart disease were common health diseases that encouraged the individual to choose a vegetarian lifestyle. Vegetarians who chose to eat as a vegetarian because of health concerns, also could have made the connection that what you eat positively or negatively changes your health. These vegetarians focused on prevention of future disease, that they had possibly seen in a friend or family member. Health vegetarians also stated that they gradually learned about animal welfare, and decided to cut more animal products out because of ethical reasons (Devine, Jabs, & Sobal, 1998).

Ethical concerns were the choice of 11 of the participants. The ethical vegetarians made the link that animal products in the store or on their plates came from the raising and/or killing of animals, and thus decided to cut out animal products. Children sometimes made this decision when the realization occurred for the first time. Adults focused more on animal welfare when deciding to cut out animal products. Some of the ethical vegans factored in health concerns, although some did not see the importance. The ethical vegetarians were more likely to make the next step and become vegan than the health vegetarians. The process of cutting out animal products generally began by not eating red meat, followed by not eating chicken, fish, eggs and dairy products. Individuals going through this would describe their choice as a journey (Devine, Jabs, & Sobal, 1998).

Personality has also been studied to compare meat eaters and vegan or vegetarian diets. Big Five personality tests have been shown to correlate with what one consumes. For example, unhealthy eating habits have been compared to having the trait of conscientiousness. Healthy

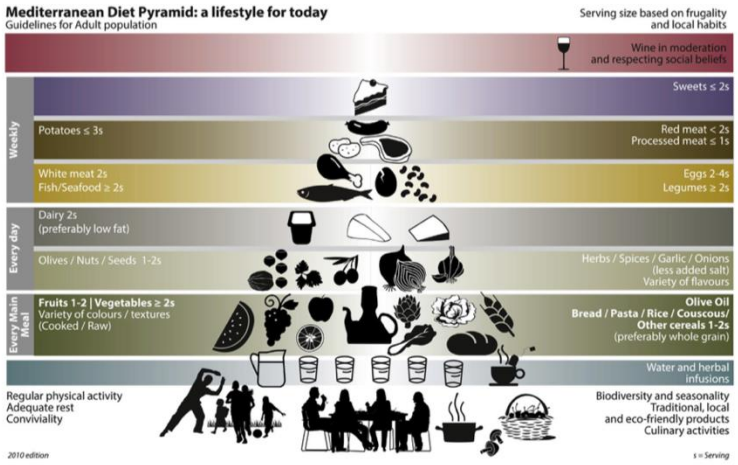
eating has been shown more in those who show openness and extroversion. Openness has been shown to correlate with being willing to try new, different foods, as well as vegetable and fruit consumption. Openness was also shown to be associated with non-meat eaters, as were conscientiousness and agreeableness. Another study also found that avoiding meat was shown in those who exhibited agreeableness, openness, and conscientiousness. An online survey found that practicing vegetarians were not extroverted, but portrayed agreeableness, conscientiousness, and openness. Although results on personality traits and the vegetarian or vegan diet have been mixed, many found that openness, agreeableness, and conscientiousness were positively associated with a non-meat eater. Political values have also been studied to determine their role in food choices. Those who consume meat are generally more conservative. The Western culture also views meat consumption as tradition and a social norm. Right-wing ideologies have been shown to have negative association with the vegetarian diet (Egloff & Pfeiler, 2017).

The four main differences that were discovered between meat eaters and vegetarians were politics, sociodemographic variables, personality, or health reasons. Of the sociodemographic outcomes, non-meat eaters were mostly females, of the younger generation, and of higher education. Income was also higher in those who did not consume meat. Personality traits have shown varied results. Openness has continuously been positively associated with not eating meat. Again, because of the social norm of meat consumption in the Western culture, being open to new foods such as vegan options, is often avoided. While those individuals such as vegetarians and vegans did decide to try new foods, so they expressed openness. When considering politics, it is expected that meat eaters would be more conservative because of the Western culture. The political interest of vegetarians often stems from their motivations of not eating meat because of their concern of the farming and slaughtering of animals. Therefore, they are often more

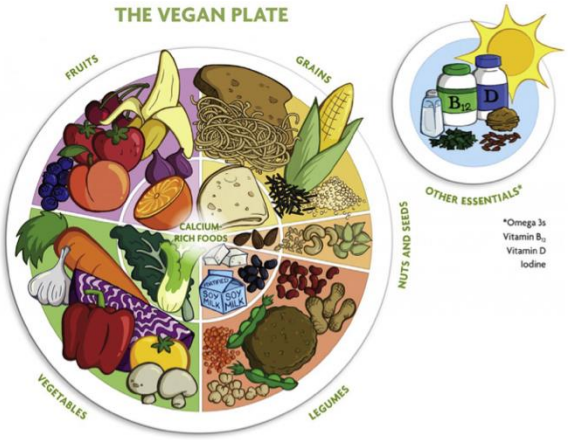
interested in issues of politics for protection of the environment, sustainability and animal rights. Vegetarians generally view themselves as healthier than their meat eating counterparts. When sociodemographic variables are taken away from differences between vegetarians and meat eaters, health status and optimism of personality do not hold (Egloff & Pfeiler, 2017).

The Mediterranean diet is considered a healthy diet for the Western world. The Mediterranean diet focuses on vegetables, fish, nuts, and fruits, which are generally health promoting foods. A decreased risk of type II diabetes has been connected to a Mediterranean lifestyle. Neurodegenerative diseases, as well as cancers, have also been shown to have a decreased risk from practicing a Mediterranean diet. The vegan diet has similar health benefits to the Mediterranean diet. Vegans have been shown to have lower blood pressure and plasma levels with low cholesterol, both of which contribute to a reduced risk of heart disease. The vegan diet also comes with some deficiencies and possible health problems. When someone completely cuts out all animal products, some micronutrients will be deficient. Micronutrients such as vitamin B_{12}, calcium, or long-chain fatty acids. If the intakes of B_{12} are extremely low, it can adversely affect a vegan's health. If the B_{12} intake is less than 0.3 mg/day, this will cause a risk of heart disease, nerve damage, and anemia (Anton & Castane, 2017).

To compare a Mediterranean diet and a vegan diet, their weekly diets were assessed using nutrient rich food index, NRF9.3. The NRF9.3 chooses foods to avoid and foods to consume more. The nutrients to avoid would be those



high in saturated fat, sodium, and those with added sugars. Nutrients that are promoted are those foods high in fiber, minerals, protein, vitamins A, C, and E, potassium, iron, and magnesium. The NRF9.3 calculated health food scores for the foods that are promoted by multiplying 100 times the amount of nutrient consumed per day divided by recommended daily value times the kilocalorie amount consumed per food divided by serving size of each day. The health food score for the nutrients that are to be avoided is calculated by the amount of nutrient consumed per day divided by the maximum recommended daily value times the kilocalorie amount consumed per food divided by the serving size of each day. Both of the calculations used 100 kilocalorie units (Anton & Castane, 2017).



Promoted nutrients were generally higher on average for those practicing the vegan diet than those practicing the Mediterranean diet. Exceptions to this would be protein, Vitamin C, and calcium. Low promotion of protein and calcium in the vegan diet would be from the deletion of dairy products and no meat consumption in the vegan diet. The higher levels of vitamin D in the Mediterranean diet would be due to high intake of cow's milk and seafood. The vegan diet had a lower consumption of the foods that were said to avoid, such as those high in saturated fats, sodium and added sugars. Again this is due to the lack of animal meats, which are high in those nutrients (Anton & Castane, 2017). A menu was planned for each diet to fulfill all nutrient needs. Cereals and tofu were the top sources of calcium and protein in the vegan diet. Protein daily needs were always met, but calcium daily needs were not always reached. Vegans are suggested to eat calcium-fortified foods. Examples of calcium fortified foods are calcium set

tofu or soya milk. Supplements are not recommended because of the possible increased risk of cancer. The final NRF9.3 score for the Mediterranean diet was 90.6, and the final score for the vegan diet was 103. The vegan diet received a nutritional quality score that was higher than the Mediterranean diet because of the lower intake of nutrients that were supposed to be avoided, and a higher intake of nutrients that were promoted (Anton & Castane, 2017).

The Western diet is generally considered an omnivorous diet, which emphasizes meat as a main nutrient source, as opposed to the vegan diet. Abbate, Casini, Dinu, Gensini, & Sofi (2016), studied the different health results of an omnivorous and vegan or vegetarian diet. The objective of their study was to explain the difference between the risk factors that are associated with the vegan and vegetarian diet and an omnivorous diet. The risk factors studied were those of cardio-cerebrovascular diseases, cancer, the risk of mortality, and chronic diseases. They conducted a systematic review to compare the diets. The meta-analysis was able to include 108 articles in the study. The specific risk factors studied were body mass index, LDL-cholesterol, HDL-cholesterol and total cholesterol, triglycerides and blood glucose. The meta-analysis showed that the vegan diet and vegetarian diet had a substantially lower level of the risk factors that contribute most to chronic disease. Vegetarians and vegans had lower levels of lipid variables, body mass index, and fasting glucose when compared to omnivores. All of the studies were prone to biases. The vegetarian diet studied in cohort prospective studies, showed a decrease in risk of the prevalence of ischemic heart disease by 25% and an 8% decrease in the prevalence of total cancer. A 15% decrease of risk of total cancer prevalence was associated with the vegan diet. When cardiovascular risk factors and the prevalence in the vegan and vegetarian population are studied, it is difficult to compare to the general public. Those following a vegetarian or vegan diet are usually void of bad habits such as smoking and they generally have

a low body mass index and do not have hypertension, so it is harder to compare their results to the general public (Abbate et al., 2016).

When comparing vegetarians to non-vegetarians, those who participate in a vegan or vegetarian diet have lower body mass index's, LDL-cholesterol, total cholesterol, blood glucose, and triglycerides. The analysis also found that total cholesterol, body mass index, and LDL-cholesterol was lower in vegans than those not following a vegan diet. The study also found several different reasons behind their lower risk factors. A lower body mass is also associated with the plant-based eating population, which is expected because of their lower energy intake. The vegan and vegetarian generally consumed lower amounts of saturated fats. Foods that are encouraged and highly consumed in a plant-based lifestyle also decrease risk factors of disease, such as legumes, soybeans, vegetable oils and nuts. Ischemic heart disease mortality and prevalence was found to have a reduction by 25% in vegetarians, cerebrovascular and total cardiovascular diseases were not found to have a reduction in total mortality or prevalence. Mortality from total cancer was not reduced in vegetarians, but prevalence from cancer was reduced by 8% in vegetarians. Mortality from cancer and prevalence from cancer are defined differently, which explains the difference in the findings. Treatment is very involved in the mortality of cancer and cardiovascular diseases (Abbate et al., 2016).

To broaden the research of the vegan diet, other restrictive diets have also been studied. Including vegan and vegetarian, others are semi-vegetarians, pesco-vegetarians, and omnivores. Normal weight of these groups of 1475 individuals were assessed. For vegans, 78.8% had a normal weight, while the of 155 omnivores, 67.7% had a normal body weight. Around 8.7% of vegans, vegetarians, and pesco-vegetarians were underweight. Omnivores held the highest percentages for being overweight and obese, while vegans having the lowest scores. The vegans

in the sample had the lowest energy intake. When compared to the omnivores, vegetarians also had a low energy intake. Although the energy intake between vegetarians, semi- and pesco-vegetarians did not vary significantly (Clarys et al., 2014).

The average amount of saturated fat consumed by omnivores was 54 grams, while the average for the vegan group was 21 grams. Vegans consumed more dietary fiber, poly-unsaturated fatty acids, and iron than omnivores did. The other non-meat eating diets were comparable to the vegan group. Sugar and carbohydrate intake was not different between the groups. It is known that fruits are often high in sugars and carbohydrates, which are consumed frequently in non-meat eating diets. Other sources of sugars and carbohydrates, such as candy, cookies, cakes, and brownies, often contain animal products, removing these items form the vegan diet. The vegan group consumed the lowest amounts of calcium, while the pesco- and semi-vegetarian groups consumed the highest amount of calcium per day. The vegan calcium consumption was half that of the vegetarian group's calcium consumption. Calcium in the Western culture is most often obtained from dairy products. Vegans have been shown to be at a higher risk for fractures when compared to diets who consume dairy, such as omnivores, and vegetarian diets. Although in the United Kingdom, vegans who consumed more than 525 mg/day did not have this same risk of fracture. The current study had calculated the vegan's calcium intake as 456 mg/day. The vegan's intake of sodium was half of that compared to the omnivore group. (Clarys et al., 2014).

Less restricted diets than total vegan diets have also been questioned as to whether or not they are adequate to supply the body all the nutritional needs. Diets such as vegetarian or semi-vegetarian diets are also a new fad. To assess the nutrient quality of diets, a new approach has been used. The new approach looks at the whole dietary pattern. The idea behind this is that

foods and nutrients are not eaten alone, food and nutrients are complex in their interactions with one another, therefore this needs to be considered (Clarys et al., 2014).

The Healthy Eating Index (HEI) and the Mediterranean Diet Score (MDS) are two of these approaches. The HEI assesses the degree that the diet pattern adheres to the United States Department of Agriculture Food Guide Pyramid official guidelines, with a score of 10-12. The MDS assesses if the dietary pattern adheres to the Mediterranean diet by using 7 desirable components, 2 undesirable components, and 1 component of moderation, being alcohol. The undesirable components are dairy and meat. HEI scores for the vegan diet were the highest among the diets studied. The omnivore group scored the lowest HEI score among the groups. The scores of vegetarian, semi- and pesco-vegetarian had HEI scores that were similar. Because the vegetarian and vegan diet promotes high amounts of vegetables, fruits, minimal sodium and fat content, the scores were higher. The omnivore group consumed more foods high in sodium and fat, and fewer fruits and vegetables. The vegan group did not get any points in the dairy portion of the HEI. The seafood and plant protein portion of the HEI was not differentiated between for the vegans and pesco-vegetarians. Vegans received the highest score for empty calories, and lowest for omnivores. When considering the MDS, the vegan group also scored the highest average, while the omnivores received the lowest average score. The vegetarian group had a significantly lower score than the semi- and pesco-vegetarians. The omnivore group had a low percentage of participants who scored above the medium when looking at vegetable, fruit, legumes, cereals, and nut intake (Clarys et al., 2014).

Diabetes has become a worldwide concern as those individuals effected with diabetes has increased every year. Worldwide, there are around 422 million cases. Cases of type 2 diabetes in countries of low to the middle class are growing even more quickly. The United States suffers

from diabetes. As of 2011-2012, 12-14% of the adult population in the United States suffered from type 2 diabetes. The same year, 38% of the adult population in the United States were diagnosed with prediabetes. Individuals who are over the age of 65 are even more at risk for prediabetes. The prevalence of prediabetes in the age group over 65 is fifty percent. Diabetes is also a huge cost for the United States. The annual per capita cost of individuals with diabetes in the United States is $7900. The annual per capita cost of individuals without diabetes is 2.3 times less than those with diabetes. Type 2 diabetes in the United States was the 7th leading cause of death in 2015 (McMacken & Shah, 2017).

As previously mentioned, type 2 diabetes is especially at risk for those who are over the age of 65. Older individuals who are diagnosed with diabetes are especially at risk for institutionalization, mortality, and impaired functional status. Complications also increase with age in association with diabetes. Micro- and macro-vascular issues such as myocardial infarction, end stage renal disease, major lower extremity amputations, as well as possible visual problems are all at the highest risk for older patients with diabetes. Hypoglycemia is also a medical issue that increases with age, the elder population visit the emergency room twice as much as the adult population with diabetes (McMacken & Shah, 2017).

Insulin resistance is highly affected by the lifestyle and diet choices of an individual, which can cause an increase in type 2 diabetes worldwide. Dietary choices such as sugar-sweetened drinks, fast foods, animal fats and meats, and highly refined grains play a large part in the increase of type 2 diabetes. Modifications in lifestyle, and especially diet, can aid in the prevention and management of type 2 diabetes. A plant-based diet that is primarily legumes, fruits, vegetables, whole grains, seeds and nuts has been shown to aid in the prevention of type 2

diabetes. A plant based diet also has been shown to give patients lower rates of cancer, hypertension, hyperlipidemia, obesity, and cardiovascular mortality (McMacken & Shah, 2017).

Type II diabetes worsens from insulin resistance. Insulin resistance causes higher intramyocellular levels. This is caused because of the extended release of non-esterified fatty acids from the myocytes. A study was done on individuals who had been vegan for three years or more and a control group of omnivores. The participant's beta-cell function and insulin sensitivity was tested by a homeostatic model assessment method. Insulin sensitivity did not vary between groups. Beta-cell function was increased in the vegan group, which has been linked to a lower risk of type II diabetes (Bell, Dornhorst, Frost, Goff, & So, 2005).

Diabetes comes with several health risk factors, and diet can be highly effective in managing these risk factors. A diet that is vegan or a low-fat vegetarian diet could be effective for individuals with type II diabetes. These two diets have been known to reduce body weight, reduce the risk of cardiovascular issues, and positively improve insulin sensitivity. A decrease in intramyocellular lipids has been seen in those practicing a vegan diet. Intramyocellular lipids have a strong connection to insulin sensitivity. Intramyocellular levels of 21 vegans and 25 meat eaters were compared from the median soleus muscle. The vegan's intramyocellular levels were 31% lower than the meat eater's levels. Because of cardiovascular disease being a cause of premature death for individuals with type II diabetes, these diets could be especially beneficial (Barnard et al., 2009).

A study was conducted on people with type II diabetes, they were either given a low-fat vegan diet or a diet that was made from the 2003 American Diabetes Association guidelines. The trial lasted 74 weeks. The low-fat vegan diet was to have 10% of daily energy from fat, 75% from carbohydrates, and 15% from protein sources. The main sources of nutrients would be from

fruits, grains, vegetables, and legumes. The vegan group was told to eat no meat, dairy products or eggs. The group was also told to eat fewer amounts of fatty foods. Fatty foods consisted of fried foods, nuts, seeds, avocados, and added oils. They were told to eat plenty of foods with a low glycemic index. Examples of low-glycemic foods are green vegetables and beans. The vegan diet therefore, reduces the intake of total and unsaturated fat, animal protein, and cholesterol. Complex carbohydrates and dietary fiber are increased in the vegan diet (Barnard et al., 2009).

The diet associated with the American Diabetes Association guidelines was given in the conventional group. The diet of the conventional group was to be 15-20% from protein sources, 60-70% carbohydrate and monounsaturated fats, <7% from saturated fat, and no more than 200 mg/d of cholesterol. The conventional diet was customized based on the participant's plasma lipid concentrations and body weight. If a participant had a body mass index over 25, they were given 500-100- kilocalorie energy intake deficit (Barnard et al., 2009).

Both groups were not given free meals, but because of the vegans needing adequate intake of B_{12}, both groups were given supplements. The groups were given one hour with a registered dietician to discuss a meal plan. They had 3-day dietary recalls at weeks 0, 11, 22, and 74. For the most part, the medications given to individuals did not change throughout the study. Laboratory measures were also conducted in order to compare how two diets affected each diabetic individual. The participants were asked to fast for 12 hours, their plasma glucose, HbA1c, and plasma lipids were then measured. The tests were done at weeks 0, 11, 22, 35, 48, 61, and 74 (Barnard et al., 2009).

The study concluded that the conventional and vegan group was successful in reducing energy intake. The reduction of energy intake was considerably greater in the vegan group. Total energy intake including reduction in cholesterol consumption, and total, saturated and *trans* fat,

were all reduced greatly in the vegan group. The conventional group had only slight carbohydrate and fiber intake increases, while these were greatly increased in the vegan diet group. Although the vegan group had a greater decrease in consumption of micronutrients such as zinc, calcium, and vitamin D compared to the conventional diet group. The conventional diet group had a lower intake of micronutrients such as folate, magnesium, vitamin C, and iron than the vegan diet group. Because of the meal plan for the vegan group, they had a more significant increase of fruits and vegetables than the conventional group. The body weight of the vegan and conventional diet groups were reduced. The vegan group obtained a -4.4-kilogram average reduction of weight, and the conventional group obtained a -3.0-kilogram average reduction of weight. This resulted in no significant difference of weight loss between conventional and vegan diets (Barnard et al., 2009).

Hemoglobin A1c is an important measurement for those with type II diabetes, thus measuring each participant's levels can be very informative. Hemoglobin A1c is directly related to blood glucose levels. A hexose molecule will attach to the N-terminal amino acid of the hemoglobin molecule without use of enzymes, resulting in HbA1c. The erythrocyte will experience this attachment throughout its lifespan. The erythrocyte is reliant on the concentration of blood glucose and how long it is exposed. Hemoglobin A1c shows the average glucose concentration over the last 8-12 weeks. Hemoglobin A1c, therefore can show long-term glycemic levels. Diabetic individual's HbA1c values are generally 2 to 3 times higher than normal HbA1c levels (Mayo Medical Laboratories, N/A). The vegan group showed a -0.34 change in HbA1c values, compared to a -0.14 change in the conventional group, these results did not concern adjusted medications. The difference of HbA1c values were not statistically significant. Although when medication adjustments were removed, the vegan group HbA1c

values were -0.40, and the conventional group of 0.01, these values were statistically significant. Fourteen vegan participants and 21 conventional participants had no medication changes, the vegan average HbA1c changes were -0.82, and the conventional average HbA1c changes were -0.21. Change in body weight was shown to be positively correlated to change in HbA1c values, although the vegan and conventional diet was not significantly correlated to HbA1c values when baseline HbA1c, the diet group and weight change were used to predict a change in HbA1c values (Barnard et al., 2009).

At the end of the 74-week trial, weight loss was seen in the conventional and the vegan diet group. When medication was not regarded, HbA1c values were reduced. The vegan group had a marginally greater average change of HbA1c values compared to the conventional group. Although when the medication was accounted for, the vegan group had a significantly greater decrease in LDL-cholesterol and HbA1c values. Weight loss seemed to be the main promoter of change on glycemic index values. The two diets both changed the participant's energy intake, although the vegan and conventional diets accomplished this in different ways. The conventional diet gave their overweight participant's an energy deficit, while the vegan diet by definition decreased dietary fat while consuming more dietary fiber. The conventional group's positive changes were mostly due to reduced portion sizes and restricted calorie intake, which led to weight loss. The conventional group did not change their macronutrient balance (Barnard et al., 2009). Lipid control is best controlled by practicing vegetarian and vegan diets. For individuals with diabetes, this is important to consider because heart diseases are the leading cause of mortality. The current study saw a decrease in triglycerides on the vegan diet. The reasoning behind this would be the recommended low-glycemic and high-fiber foods on this study's vegan menu. The vegan and vegetarian diet seemed to be accepted for those who needed a therapeutic

diet for those with cardiovascular diseases. Adequate planning is necessary for those who would take on a vegan or vegetarian diet. Sources of vitamin D and B_{12} and calcium must be planned or supplemented to reach adequate levels of each (Barnard et al., 2009).

Compared to a Western diet, the conventional Korean diet is more highly based on plant-based food groups such as rice, fruits, and beans. A randomized clinical trial was done to compare a vegan diet and a conventional Korean diet to see the effects of the vegan diet. The study was done on individuals who suffer from type II diabetes. The participants had to have been on medication for more than 6 months and their HbA1c levels had to have been 6.0-11.0 percent. The vegan diet was to be restricted to brown rice, minimal white rice, no processed wheat or rice flour, no animal products, eat high amounts of green vegetables, seaweed, and legumes. Energy intake, portion sizes, and the occurrence of meals per day were not limited (Joen et al., 2016). The control group consumed a conventional diet. The conventional diet consisted of a daily restricted energy intake that was made based on the participant's weight, their physical activity, and agreement to participate. The conventional diet had to have a total of 50-60% of total kilocalorie intake from carbohydrates, 12-15% from proteins, and less than 25% from fats. The diet was also to have less than 7% from saturated fats, small amounts of trans-fat, and less than 200 mg/day of cholesterol. The conventional diet could choose from six food groups to get their daily energy needs, the six groups are: meat, vegetables, oils, grains, milk, fruit, and fats. They were allowed snacks between three meals a day (Joen et al., 2016).

The vegan group and conventional group were not given a menu for each week, just the guidelines as discussed above. The participants were given a consultation with a registered dietician to make a diet plan. They were also given weekly phone calls to make sure they were following the given diet. Physical activity was kept at their usual level, and their medication was

not changed unless the physician decreased the dosage. Their glucose levels were measured three times throughout the trial. The participant was called by their dietician twelve times to do a 24-hour food recall. The food recall was analyzed via country-specific food and nutrient database. The participants also had their weight, height, blood pressure, and waist circumference measured three times. The participants were to take daily records of their food consumption, the registered dietician would take one point from the vegan groups total score if they consumed meat, dairy, fish, poultry, or eggs. The conventional group had points taken away if their diet did not follow the given food and energy plan. The conventional Korean diet group had an average higher score than the vegan group, the conventional group's score was 9.2+-1.6 and the vegan group's score was 8.2 + -1.5. The average energy intake of the vegan group was 1,496 kcal/day and the average energy intake of the conventional group was 1,559 kcal/day (Joen et al., 2016). The vegan group consumed a significantly higher amount of vegetable fat, beta-carotene, phosphorus, potassium, vitamins E, K, C, B6, and folate. The conventional Korean diet consumed a significantly higher amount of saturated fatty acids, mono-unsaturated fatty acids, vitamins D, B12, iron, protein, cholesterol, animal fat, and total fatty acids. The HbA1c decreased in both groups, although the vegan group had a greater average decrease. When compliance to the diets were added the vegan group decreased HbA1c by -0.9% and the conventional group decreased by -0.3% by the end. Waist circumference and body mass index only decreased a significant amount in the vegan group (Joen et al., 2016).

The vegan diet was once again proved to be more successful in managing type II diabetes, even in a culture that bases a lot of their meal from plant-based sources. Glycemic control is important in individuals with type II diabetes, which the vegan diet is successful in reducing the weight of those following the diet, which is very effective in successful glycemic

control. The vegan's higher intake of fiber is also beneficial in controlling glycemic index. Fiber will slow the absorption of glucose. Fiber also increases bile excretion and increases the creation of short-chain fatty acids from the bacterial fermentation of the ingested fiber (Joen et al., 2016).

Micronutrients have been of concern for individuals who are on a strict plant-based diet. Plant foods provide plenty of copper and manganese. Iron and zinc are more bioavailable in animal products. The lack of iron in plant sources causes the RDA for vegan and vegetarians to be double that of the RDA for those consuming animal products. The iron that is not present in plant food sources is the heme-iron, which is found in fish, meat, and poultry. Bioavailability is the next concern for micronutrients. Phytic acid will significantly reduce the bioavailability of zinc and of iron (Hunt, 2003). The total intake of iron may not be effected when converting to a plant-based diet, although this does not consider the bioavailability of iron and zinc. Of the iron that is present in fish, poultry and meat, less than 40% is the heme-iron. Iron in the heme form is absorbed 15-40%, while non-heme iron is only absorbed 1-15% as efficiently. When an individual's diet contains red meat, about half of their absorbed iron is heme-iron. If an individual has low iron stores, then the non-heme iron absorption will be up regulated, so the iron absorbed will be mostly non-heme iron rather than heme-iron. The type and amount of stored iron depends on what kind is consumed in larger amounts. If an individual has high iron stores, such as a meat eater, their non-heme iron stores will be smaller and more limited. Although an individual with lower iron stores will be able to absorb non-heme iron more efficiently than those with high iron stores (Hunt, 2003).

Non-heme iron absorption can be effected by all consumed foods. Eating large amounts of fruits and vegetables, not eating meat, more whole grains, and legumes will affect the absorption of non-heme iron. Non-heme iron absorption is negatively affected by phytic acid.

Phytic acid is present in legumes, lentils, whole grains, tea, coffee, nuts, cereals, red wine, vegetables, eggs, soy, and spices. A study was done over an eight-week period over vegetarian and non-vegetarian iron status. Iron status showed no difference. Although in Western countries, women who are on a vegetarian diet seem to be more prone to iron deficiency anemia than women not on a vegetarian diet. Recommendations for vegetarians who are women and of fertile age should possibly add iron supplementation, although long-term studies need to be done before the recommendation is confirmed (Hunt, 2003). A long-term supplementation could lower iron absorption, as well as create oxidative stress coming from the lower bowel where the un-absorbed iron is left, which could increase the risk of cancers. Individuals who are on a lacto-vegetarian diet compared to a red meat diet, had lower levels of serum ferritin and hemoglobin, although they were still in the normal range. Function is only negatively affected when hemoglobin concentrations are very low, which has not been shown for vegetarians (Hunt, 2003).

A deficiency or insufficiency of B12 has also been a concern for individuals who follow a vegan or vegetarian diet. The role of B12 in the body is for energy creation carbohydrate metabolism as well as aiding in neurological functions. Cobalt is contained in vitamin B12, and is needed in trace amounts in the body. Cobalt is heavily utilized in the making of B12, so if the body is not getting enough cobalt from foods, a deficiency of B12 is possible. Our body obtains the needed B12 from absorption in the small intestine. If the body is to properly absorb B12, binding proteins must be sufficient and present in the body. Intrinsic Factor will be secreted by the stomach, which aids in the binding of B12. The B12 is then moved to the cells on the intestinal wall. Another protein, Trans cobalamin II is vital in the body's use of B12, the proteins job is to circulate B12 throughout the bloodstream. An individual who is practicing a vegan diet,

may not be consuming enough protein to complete the cycle of B12. If they consume trace amounts of protein, then their body is not making enough essential amino acids. The essential amino acids are necessary to make proteins. B12 is found in foods that can contain B vitamin complex. Plant-based foods have some B vitamin complex, but it is not enough to supply the body's needs. A B12 deficiency can cause multiple long-term problems if not treated effectively. Neurological damage or vascular injury are possible health issues with a deficiency in B12. Some fruits and vegetables could have trace amounts of B12 from the soil that they are grown in, if left unwashed. Therefore, it is advised for those who are on a plant-based diet to have their B12 levels tested, and possibly be given a supplement of B12 (Bennet, NA).

The American diet gets around half of its zinc from animal foods, one-fourth of this from beef. Obviously vegetarians are not consuming beef, so they must plan their diet to consume large amounts of legumes, whole grains, seeds, and nuts to contribute to zinc stores. The bioavailability of zinc is also negatively affected in vegetarian diets because of phytic acid. A study was done on the individuals beginning a vegetarian's diet and the plasma zinc and urinary zinc was measured. The zinc was lowered after three months, but after 6 months there was no change, which could be from a new equilibrium being created. Supplements again need to be studied more because supplementation could cause a reduction in absorption of minerals such as copper. Copper and manganese are high in plant foods, so vegetarians are not at risk of low copper or manganese. Selenium also increases in individuals who change to a vegetarian diet.

The vegetarian or vegan lifestyle will continue to be a point of interest for many individuals, and they may even try out the lifestyle. For vegans especially, careful planning must take place in order for the individual to obtain all of the essential nutrients. And even then, supplementation may be in needed, such as B12. Although a low-fat vegetarian or vegan diet has

shown positive results when compared to other diets recommended for those with type II diabetes. If the patient is willing, a vegetarian diet may be beneficial to their health in management of their disease.

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