

The Benefits and Concerns of Veganism in Women's Health

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Abstract

There are many health benefits of consuming a vegan diet. It is associated with a decreased incidence of obesity, cardiovascular disease, type two diabetes, and a variety of cancers. Despite its numerous benefits, there are several concerns for consumers of a vegan diet, including nutrient deficiency and cardiovascular risk associated with consumption of coconut oil. However, many nutrients of highest concern, such as calcium and protein, are not needed in as high amounts as is commonly believed and recommended. Moreover, it is possible for vegans to obtain adequate nutrition with proper education despite restriction of animal products. Coconut oil consumption as part of a plant-based diet is not associated with the development of cardiovascular disease despite its high saturated fatty acid content. Overall, a vegan diet is an effective mode of treatment and prevention for chronic diseases, and women across the lifespan can obtain adequate nutrition while consuming a plant-based diet.

Keywords: veganism, plant-based, vegan, diet, women, nutrient deficiency, pregnancy, coconut oil, meat, dairy, eggs, health

The Benefits and Concerns of Veganism in Women's Health

Veganism is a vegetarian diet in which the consumer avoids all animal products, including meat, eggs, and dairy. The reasons for restricting these foods vary, including allergies, lactose intolerance, and animal mistreatment. Increasing evidence of a plant-based diet's ability to prevent and treat many chronic diseases has led to the subject's growing popularity in the health and medical fields. Many wonder if a vegan diet puts women at risk for health problems since they have very specific nutrient needs during pregnancy and are at greater risk of developing osteopenia and osteoporosis than men. Others fear that coconut oil, a common ingredient in vegan foods, increases the risk of cardiovascular diseases because of its high saturated fat content. A plant-based vegan diet can have both positive and negative effects on women's health that should be carefully considered before implementing this lifestyle (American Heart Association, 2014; Craig, 2009).

Benefits

Chronic diseases make up the largest category of health burdens in western cultures (Centers for Disease Control and Prevention, 2016b). While these conditions are caused by many factors, level of physical activity and diet are two modifiable and influential contributors affecting disease promotion or prevention. Current recommendations for physical activity are consistent and easily understood, but much confusion remains about what type of diet can decrease disease risk. A plant-based vegan diet has been shown to be protective against many diseases and is promoted by the American Institute for Cancer Research, World Cancer Research Fund, American Cancer

Society, American Heart Association, Heart and Stroke Foundation of Canada, American Cancer Society, National Institutes of Health, and the American Academy of Pediatrics.

It is associated with reduced rates of many chronic diseases, including obesity, cardiovascular disease, diabetes, and cancers ("Position", 2003).

Obesity

There are many effective weight-loss programs, but few promote long-term weight loss. A plant-based vegan diet has been shown to be most effective both in helping people lose weight and in maintaining their weight-loss (Spencer, Appleby, Davey, & Key, 2003; Turner-McGrievy, Barnard, & Scialli, 2007). An 18-week trial of GEICO employees with body mass indexes (BMIs) over 25 compared body changes in a control group that made no dietary changes to a group switched to a low-fat vegan diet. The vegan group consumed "whole grains, vegetables, legumes, and fruits" and had no caloric restriction (Mishra, Xu, Agarwal, Gonzales, & Barnard, 2013, p. 719). The intervention group lost an average of 9.46 pounds, compared to the control group which lost an average of 0.176 pounds (Mishra et al., 2013).

A Belgian study showed that increased animal protein intake was associated with increased BMI in males, but there was no significant association in females. The difference in these findings may be because women consumed less animal protein than men. The daily intake for females ranged from 10.2-11.6 grams of fresh meat and 3.9-5.1 grams of processed meat, while males consumed 14.3-18.2 grams of fresh meat and 7.3-9.2 grams of processed meat. However, both groups had an inverse association between plant protein intake and BMI, indicating that plant protein intake may be protective against weight gain and obesity (Lin et al., 2011).

There are many reasons for a vegan diet's effectiveness in weight-loss and protection against obesity. First, it has been shown to decrease hunger perceptions. A common barrier to weight-loss is perceived discomfort due to hunger that then leads to overeating (Furhman, Sarter, Glaser, & Acolla, 2010). One study showed that those who sustained a diet high in nutrient-dense foods such as "colorful vegetables, beans, seeds, nuts, fruits, and whole grains,... [with] less than 10% of total calories [coming from] processed foods and animal products" for at least one month experienced decreased hunger pains, decreased discomfort from skipping meals, decreased frequency of hunger, and decreased irritability due to hunger (Furhman et al., 2010, p. 2). In general, their hunger experience became less unpleasant despite their diet being lower in calories (Furhman et al., 2010).

Secondly, vegans are often able to consume larger portions and still experience weight loss and glycemic improvement since most of the foods that fit the diet's regimen are low in energy and fat while being high in fiber. This helps consumers feel more satisfied by being able to consume more volume, while other diets leave participants hungry with unhealthy cravings that typically lead to overeating (Barnard et al., 2006; Furhman et al., 2010).

Cardiovascular Disease

Cardiovascular disease is the leading cause of death in the United States, with 22.3% of women's being deaths due to heart disease and 6% due to stroke annually (Heron, 2016). Cardiovascular disease is an umbrella term for a group of conditions characterized by narrowed or blocked blood vessels. It is most commonly due to atherosclerosis and has many damaging effects on the body's organs (Mayo Clinic Staff,

2014). Types of cardiovascular diseases include stroke, myocardial infarction, arrhythmias, heart failure, coronary artery disease, and peripheral artery disease (New York State, 2012). These conditions can be promoted by genetics, poor diet, physical inactivity, medications, among other factors. Since it is the number one killer of American women, it is vital to know how to prevent, treat, and reverse this disease (Heron, 2016). This can be done with a plant-based vegan diet (Cleveland Clinic, 2013).

A major risk factor for cardiovascular disease is high cholesterol. Elevated triglycerides and low density lipoproteins (LDLs) are strongly associated with heart disease, while a high level of high density lipoproteins (HDLs) is believed to be protective. A lifestyle that reduces non-HDL cholesterol and raises HDL cholesterol is encouraged in order to improve cardiovascular health. Ideal blood lipid measurements for women include a total cholesterol less than 200 mg/dL, triglycerides less than 150 mg/dL, LDL cholesterol less than 100 mg/dL, and HDL cholesterol between 50-60 mg/dL, with above 60 being optimal. An HDL less than 40 mg/dL and an LDL level above 130 mg/dL is associated with increased cardiovascular risk (Lewis, Dirksen, Heitkemper, & Bucher, 2014, p. 699-700).

Vegan diets have been shown to reduce LDL cholesterol and triglycerides. A study of 4,466 participants assessed fruit and vegetable consumption and measured serum LDL cholesterol in the participants. Serum LDL cholesterol was 6-7% lower in the participants who consumed the most fruits and vegetables compared to those who consumed the least. The researchers concluded that increased consumption of fruits and vegetables is associated with a decreased serum LDL cholesterol (Djoussé et al., 2004).

These effects have been credited to the low amount of saturated fat and cholesterol and the lipid-lowering effect of plant-based foods (Mishra et al., 2013).

Another study comparing serum lipids of meat eaters, fish eaters, vegetarians, and vegans showed that vegans had the lowest non-HDL serum lipids of all four groups. However, the vegan group also had the lowest HDL levels (Bradbury et al., 2014). Other studies have observed a slight reduction in HDL cholesterol as well (Gardner et al., 2005; Huang et al., 2014; Mishra et al., 2014), though the ones that included the specific measurements indicated that their HDL levels remained in the therapeutic range (Huang et al., 2014; Mishra et al., 2013). Despite HDL levels remaining above 40 mg/dL, and often higher, some researchers have concluded that a vegan diet may not be the best way to prevent cardiovascular disease (Huang et al., 2014).

Other researchers, however, have stated that HDL cholesterol may not be as strong of an indicator of cardiovascular health as is currently believed. One study showed that people with genetically high HDL cholesterol levels did not have a decreased risk of myocardial infarction, challenging the current use of HDL cholesterol as a sign for decreased cardiovascular risk (Bradbury et al., 2014). Another study showed that those with a polymorphism causing higher levels of HDL cholesterol had an increased risk of coronary heart disease (Zanoni et al., 2016).

The variety of conclusions regarding the benefit of HDL cholesterol may be because different types have different effects. Some positive effects include removing LDL cholesterol, preventing LDL cholesterol from being altered by oxygen to become more damaging, easing inflammation, increasing nitric oxide, and preventing plaque accumulation in blood vessels. However, some effects are harmful such as helping LDL

cholesterol enter body cells and allowing LDL to be altered by oxygen and become more dangerous (Harvard, 2010).

These findings suggest that HDL cholesterol's effect and accepted therapeutic levels require further research (Wein, 2016). Until HDL cholesterol's effect is better understood, its reduction associated with a plant-based vegan diet cannot be counted as negative, especially since vegans often maintain therapeutic levels (Huang et al., 2014; Mishra et al., 2013; Wein, 2016). It may, however, indicate that this type of diet requires caution and medical advisement for some people.

Diabetes

Type II diabetes mellitus is an acquired condition in which the body becomes resistant to insulin, causing blood sugar to rise above the normal limits. Over time, the body's cells become starved for energy, increasing the risk of infection and complications of the eyes, kidneys, nerves, and heart (American Diabetes Association, 2015). The American Diabetes Association (ADA) has emphasized the role of carbohydrates in diabetes and the importance of a healthy diet in diabetes management. They support a diet low in carbohydrates, but high in protein and healthy fats for diabetes management (American Diabetes Association, 2016a). For each meal, the ADA recommends filling 50% of the plate with non-starchy vegetables, keeping starchy vegetables or grains to 25%, and reserving the final 25% for proteins such as fish or chicken. In addition, they recommend adding a serving of fruit, dairy, or both (American Diabetes Association, 2016b). While they encourage the consumption of whole grains, legumes, and fruits over refined carbohydrates and simple sugars, the ADA recommends that even these sources of carbohydrates be consumed in moderation (American Diabetes Association, 2014).

Recent literature, however, shows that while the ADA diet does improve glycemic and lipid control, a vegan diet is even more effective. In 2006, a 22-week study compared the effects of a low-fat vegan diet and a diet based on ADA guidelines in individuals with type II diabetes (Barnard et al., 2006). Individuals on the vegan diet consumed “vegetables, fruits, grains, legumes...[favoring]...low glycemic index foods, such as beans and green vegetables” (Barnard et al., 2006, p. 1777-1778). Furthermore, the vegan participants were not required to restrict portions, calories, or carbohydrates. Individuals on the ADA diet were to ensure that less than 7% of their daily caloric intake came from saturated fat, only 60-70% from carbohydrates and monounsaturated fats while keeping cholesterol at or below 20 milligrams (mg) per day. Those who had a BMI greater than 25 were to reduce their daily caloric intake by 500-1,000 calories (Barnard et al., 2006).

Despite their increase in carbohydrate consumption, the vegan group had greater glycemic improvement. Their A₁C, on average, decreased by 1.2%, while the ADA group's A₁C decreased by 0.88%. In the vegan group, 43% of the participants were able to reduce their diabetes medications, while only 26% of the ADA group required a medication reduction. The weight of individuals in the vegan group decreased by an average of 5.8 kilograms (kg), and the ADA group's weight loss average was 4.3 kg. Vegan participants also experienced greater reductions in waist circumference, total cholesterol, and LDL cholesterol (Barnard et al., 2006).

Since insulin resistance develops with lipid accumulation, the researchers suggested that the lipid-lowering effects of the low-fat vegan diet help explain the greater improvements in comparison to the ADA diet. Vegan diets are low in cholesterol and

saturated fat while being high in soluble fiber and other plant components that reduce cholesterol. Additionally, it is easy for someone on the ADA diet to exceed the daily recommendation of saturated fats by eating larger portions. However, since vegan diets exclude animal products, and therefore animal fats, they are less likely to consume excess fat.

While the ADA diet is certainly effective, the researchers noted that it is often hard for people to maintain. They proposed that the restrictions of a vegan diet may be easier to understand since they are more concrete. Additionally, since many plant-based foods have fewer calories per gram, vegans can consume more bulk for fewer calories, allowing them to feel satiated without eating beyond their caloric needs (Barnard et al., 2006). In addition, animal protein has been associated with increased type II diabetes risk (Sluijs et al., 2010). These studies offer explanations for a vegan diet's effectiveness in preventing, improving, and reducing diabetes when compared with other diets.

Physicians and organizations are beginning to realize the benefits of vegan plant-based diets. According to Trapp and Levin (2012), vegan and vegetarian diets offer the best treatment for prevention and management of type 2 diabetes. The Canadian Diabetes Association Clinical Practice Guidelines now recommends the implementation of a plant-based diet to manage type II diabetes due to its ability to reduce body weight, A₁C, LDL and total cholesterol, and need for diabetes medications (Rinaldi, Campbell, Fournier, O'Connor, & Madill, 2016). Other literature also promotes the implementation of a plant-based diet for patients with diabetes (Trapp & Levin, 2012; Tuso, Ismail, Ha, & Bartolotto, 2013).

One barrier to the implementation of plant-based diets is they are not always supported by physicians. In some cases, this is due to their lack of awareness or lack of patient education resources, but other physicians believe that patients would be unlikely to be compliant and that such diets are too strict (Rinaldi et al., 2016; Tuso et al., 2013). The Canadian Diabetes Association addresses the need for initiatives to “promote the benefits and acceptability of [plant-based diets] in the management of type 2 diabetes as well as to inform clinicians about appropriate prescription of [plant-based diets]” (Rinaldi et al., 2016, Conclusions, para. 2). In addition, they recommend that diabetic patients who are uninterested in completely avoiding all animal products would at least benefit from consuming more vegetables, fruits, whole grains, legumes, and consuming less processed or red meats and animal fats (Rinaldi et al., 2016).

Cancer

The most common cancers affecting women are breast, lung, colorectal, and endometrial, all of which are affected by diet (Campbell & Campbell, 2012; Centers for Disease Control and Prevention, 2016a). It is important to note that cancer often develops as a result of a variety of factors and that diet modification alone does not ensure cancer prevention (Lewis et al., 2014).

Breast cancer. A study of Mexican women investigated the relationship between phytochemicals and breast cancer. Phytochemicals are compounds found in plants such as fruits, vegetables, grains, and legumes. Examples of phytochemicals include flavonoids, dietary lignan cursors, cinnamic acid, and coumestans. These compounds all have antioxidant, antiproliferative, and antiangiogenic, and other anticancer effects (Torres-Sanchez, Galvan-Portillo, Wolff, Lopex-Carrillo, 2009). In other words, they are

able to neutralize free radicals that are harmful to the cells and deoxyribonucleic acid (DNA), prevent the spread of malignant cells, and inhibit the spread of cancer by preventing new blood vessel development (“Angiogenesis Inhibitors”, 2011; “Antioxidants”, 2014; “Antiproliferative”, n.d.). Some of these foods also protect against breast cancer in their estrogenic effects. The study’s results showed that Mexican women who consumed more phytochemicals had lower risks of breast cancer, concluding that phytochemical consumption is protective against breast cancer (Torres-Sanchez et al., 2009). In addition, populations who consume higher amounts of fat from animal products are at an increased risk of developing breast cancer (Campbell & Campbell, 2012). Another study noted that red meat consumption was directly associated with breast cancer risk in American women (Shannon, Cook, & Stanford, 2003). These findings suggest that eating a diet rich in plant-based foods and low in animal fat, and particularly red meat, is protective against breast cancer.

Lung cancer. While the greatest lifestyle factor influencing the development of lung cancer is smoking, many studies also show that diet may have an influence on this type of cancer as well (Campbell & Campbell, 2012). A study conducted in 2003 showed that increased consumption of fruits and vegetables was associated with a 16-23% decrease in lung cancer risk, with fruit’s impact being more notable. Perhaps this is due to the anti-cancer effects of phytochemicals, but it is difficult to tell whether this reduction is truly due to the components of the diet, or because those who typically consume a plant-based vegan diet have healthier lifestyles altogether and are less likely to smoke (Gallicchio et al., 2008; Smith-Warner et al., 2003). Nonetheless, if diet has any

kind of impact on lung cancer, plant-based diets reduce the risk (Campbell & Campbell, 2012).

Colorectal cancer. Colorectal cancer is highly impacted by lifestyle choices, particularly diet. Obesity, red meat, processed meat, and animal fat consumption are all associated with colorectal cancer development, while high fiber, fruit, and vegetable intake are associated with a decreased risk (Gonzalez, 2006).

A study of patients with stage III colon cancer compared the effects of diet on cancer occurrence and mortality. The study reported that those who consumed a typical western diet consisting mainly of meat, French fries, high-fat dairy products, refined grains, and dessert were over three times more likely to experience cancer recurrence or death compared to those who consumed a diet with high intakes of vegetables, fruits, and moderate to low amounts of fish and poultry (Campbell & Campbell, 2012). Researchers are consistently concluding that a diet mainly consisting of fruits, vegetables, legumes, and fiber is protective against colorectal cancer while red meat and high fat are factors that promote this type of cancer (Lewis et al., 2014; Miller et al., 2010; Papapolychroniadis, 2004; Smolinska & Paluskiewicz, 2010).

Endometrial cancer. Diet's impact on endometrial cancer is controversial. Several studies have found insignificant associations between vegetable, fruit, fat, fish, or meat intake and this type of cancer (Arem, Gunter, Cross, & Hollenbeck, 2013; Dalvi, Canchola, & Horn-Ross, 2007; Neill et al., 2014). Others have found that high plant intake and low fat intake is associated with reduced endometrial cancer risk (Campbell & Campbell, 2012; Littman, Beresford, & White, 2001; McCann et al., 2000; Rossi et al., 2013). While a direct association may not be evident, diet affects a significant risk factor

for endometrial cancer: obesity. Obesity has been associated with up to a three-fold increased risk of endometrial cancer, with at least 40% of women with this type of cancer having a BMI over 30 (Kulie et al., 2011). Since a plant-based vegan diet has been shown to decrease the incidence of obesity, taking away this risk factor could also decrease the risk of endometrial cancer.

Dairy and cancer. A vegan diet does not allow dairy consumption, but some studies suggest that dairy may be protective against different types of cancer. Overall, however, the evidence is conflicting regarding dairy's role in cancer development.

Several studies have observed that dairy intake may reduce the risk of colorectal cancer (McCullough et al., 2003; Murphy et al., 2013; Norat & Riboli, 2003). Some have stated that dairy may be protective against breast cancer (Kesse-Guyot et al., 2007; Shannon, Cook, & Stanford, 2003), while others have found no association between dairy and breast cancer (Hjartåker, Thoresen, Engeset, & Lund, 2010). Several studies have noted a trend of increased dairy consumption and increased prostate cancer risk (Álvarez-León, Román-Viñas, & Serra-Majem, 2006; Gallus et al., 2006). The majority of the evidence states that there is no relationship between dairy and ovarian cancer (Bandera, Kushi, Moore, Gifkins, & McCullough, 2007; Gallus et al., 2006; Mommers, Schouten, Goldbohm, & van den Brandt, 2006). In summary, current research is not consistent regarding the relationship between dairy and cancer and further study is required in this area (Álvarez-León, Román-Viñas, & Serra-Majem, 2006). However, there is consistent evidence that animal fat, and specifically red meat, have a high association with various cancers, while plant-based foods are protective.

Concerns

The main concerns of a vegan diet include nutrient deficiencies, poor bone health, safety in pregnancy, and coconut oil consumption. Many women depend on animal products to get adequate amounts of the nutrients of highest concern in women's health. However, the American Dietetic Association states that a vegetarian diet can be healthfully practiced by any individual if well-planned, but requires a focus on obtaining adequate calcium, protein, iron, vitamin B12, and zinc. Some studies have also demonstrated that while all of these nutrients are important, some may not be as essential to health as science has believed.

Nutrient Deficiency

Calcium, vitamin D, and bone health. Dairy intake is highly encouraged because of its calcium and vitamin D content and perceived ability to prevent osteopenia, osteoporosis, and bone fractures. Calcium is an important mineral in bone, and vitamin D helps the body absorb and use consumed calcium. Women are more likely to develop weak bones than men (Office, 2004), so the United States Department of Agriculture (USDA) currently recommends that females age nine and older consume three cups of dairy daily (USDA, 2016).

The current recommendation for dairy intake is intended to prevent hypocalcemia. Blood levels of calcium are tightly regulated since this mineral is vital for neuromuscular functions, including muscle contraction and cardiac conduction. When there is low blood calcium, parathyroid hormone (PTH) is released from small glands in the neck to increase blood calcium in several ways. One way is by stimulating osteoclasts to break down bone, releasing calcium into the blood. This knowledge has led scientists and medical

professionals to promote a high dairy intake. They believe that dairy helps to prevent hypocalcemia and subsequent bone resorption (Lewis, Dirksen, Heitkemper, & Bucher, 2014).

There is, however, little scientific evidence to support an association between dairy, bone density, and fracture risk (Álvarez-León et al., 2006; Feskanich, Willett, & Colditz, 2003; Ho-pham et al., 2009; New, 2004; Weinsier & Krumdieck, 2000). In fact, consumption of animal protein, including dairy, can lead to weak bones. Animal protein can cause an acidic state in the body, leading to release of calcium from the bones to normalize blood pH. Therefore, sources of calcium that do not contain animal protein would be more protective of bone health (Tyree, Baker, & Weatherspoon, 2012).

One study comparing vegans with non-vegan postmenopausal women demonstrated that even though vegans had lower bone mineral densities, blood calcium levels, blood vitamin D levels, and higher blood levels of PTH, their incidence of fractures over a two-year period was the same. The researchers found that corticosteroid use and a high animal protein and lipid intake led to more bone loss than veganism (Ho-pham, Vu, Lai, Nguyen, & Nguyen, 2012).

Even though dietary recommendations for dairy intake may be higher than necessary, it remains necessary for women to obtain adequate amounts of calcium and vitamin D. There are many sources of calcium, though not all are equally absorbed. Calcium is most bioavailable from “bok choy, broccoli...Napa cabbage, collards, kale, okra, and turnip greens”, with 49-61% of consumed calcium from these sources being absorbed (“Position”, 2003, Calcium, para. 1). This is much more than other sources, with 31-32% of calcium being absorbed from “calcium-set tofu, fortified juices, and

cow's milk," and 21-24% from "fortified soymilk, sesame seeds, almonds, and red and white beans" ("Position", 2003, Calcium, para. 1). So, there are many plant-based sources of calcium, with several being even more bioavailable than the calcium in milk.

Vitamin D is obtained through sunlight and consumption of supplements or fortified foods. Vegan women living in higher latitudes are at risk for decreased bone density due to their reduced sunlight exposure and may need to obtain this nutrient through their diet. Plant-based fortified foods include soy milk, rice milk, and some breakfast cereals. In supplement form, vitamin D2 is acceptable to vegans but may be less bioavailable than D3 ("Position", 2003).

Several other factors contribute to bone health as well. Weinsier and Krumdieck (2000) stated that weak bones may be more related to calcium loss rather than inadequate intake of calcium, so to promote strong bones it may be more effective to prevent this loss rather than to consume large amounts of calcium. Exposure to heavy metals, smoking, alcohol, protein, caffeine, and excessive intake of phosphorus, sodium, and retinol all contribute to calcium loss and should be avoided to promote bone health. Other nutrients important to bone health include potassium, phosphorus, magnesium, vitamins K and C, copper, manganese, zinc, and iron. These can easily be obtained by consuming a variety of plant sources. Any activity that increases muscle mass also increases bone mass, so weight-bearing physical activity is also important to prevent bone diseases (Office, 2004).

In summary, women are at increased risk for low bone density and fractures. Calcium and vitamin D, nutrients essential to bone health, can be obtained if adhering to a plant-based diet. To promote strong bones, vegan women should consume foods high in

calcium, obtain enough sunlight, or talk to their doctors about a supplement for vitamin D, participate in weight-bearing exercises, and avoid smoking and consuming excessive amounts of alcohol, protein, caffeine, sodium, and retinol supplements.

Protein. Protein is important for immunity, its function as an enzyme in chemical reactions, transporting and storing molecules, reading genetic information in DNA, and presence in every cell of the body (“What are proteins”, 2017). Since animal products are known for their protein content, many fear that women on a vegan diet will be protein deficient. While protein is necessary to maintain homeostasis, its significance is often overemphasized and many Americans consume much more protein than they require (The Physicians Committee, n.d. b).

There are 20 amino acids, and the body is able to produce 11 of them. The remaining nine must be obtained from food. Animal products are “complete proteins,” since they contain all nine of the essential amino acids, while plant proteins are generally incomplete and lack one or more amino acids. Many believe that it is necessary to consume complete proteins or to combine incomplete proteins to make them complete, but this is a myth that has been disproved. It is now known that consumers of plant proteins will obtain all the essential amino acids if their diet is varied and sufficient in energy (Novick, 2012). It is also commonly believed that consuming a diet high in protein, low in carbohydrates, and low in fat is ideal. However, a high protein diet has been associated with several diseases, including osteoporosis, heart disease, cancer, impaired kidney function, and possibly weight gain if used in a temporary, energy restricted diet (The Physicians Committee, n.d. b). A diet consisting mainly of fiber, starch, vegetables, fruit, legumes while being low in red meat, sugar, and processed food

is able to provide adequate protein while reducing disease risk (“Position”, 2003; World Cancer, 2007).

In general, if women consuming a plant-based diet eat a variety of whole foods they will obtain adequate protein without any problems (“Position”, 2003). Vegan sources of protein include legumes, whole grains, nuts, seeds, tempeh, tofu, spinach, broccoli, and much more (The Physicians Committee, n.d. b). Athletes or other women who have greater protein needs due to pregnancy, lactation, injury, or illness may need to consult a doctor or a certified nutritionist to ensure their intake is meeting their body's needs (“Position”, 2003).

Iron. Iron is important for hemoglobin formation, cellular energy release, and for killing bacteria (Grossman & Porth, 2014). A deficiency in iron leads to anemia, which also contributes to heart failure. The heart compensates for inadequate oxygen supplies to the body by increasing its rate and stroke volume, which increases the work load of the heart. In addition, when the kidneys are poorly oxygenated they compensate by initiating the renin-angiotensin-aldosterone system to retain more fluid. This further increases the work load of the heart, and the combination of these effects can contribute to heart failure if the anemia is not reversed (Silverberg, Wexler, & Iaina, 2004).

Individuals who consume animal products generally obtain enough iron without having to be conscientious about their diet. However, vegan women require more mindfulness and intentionality to ensure they obtain enough of this nutrient (Penney & Miller, 2008). Iron is found in “soy products, tofu, beans, lentils, spinach, molasses, whole wheat breads, peas, dried apricots, prunes, and raisins” (Penney & Miller, 2008, Iron, para. 6). Inhibitors of iron absorption include phytate, caffeine, fiber, and coffee

(Penney & Miller, 2008; "Position", 2003). Individuals can increase their iron absorption by soaking and sprouting their grains, seeds, and legumes and by leavening bread to decrease phytate content. Consuming iron with vitamin C also improves iron absorption. If sufficient iron is not obtained, a supplement may be necessary ("Position", 2003).

Vitamin B12. Vitamin B12, or cobalamin, serves as a methyl donor and works with folic acid in DNA and red blood cell synthesis. A deficiency of this vitamin is associated with macrocytic anemia, neurological complications, and cognitive disabilities (Penney & Miller, 2008). As with iron deficiency anemia, cobalamin deficiency anemia also puts patients at risk for heart failure (Silverberg et al., 2004).

It is crucial for women of childbearing age to obtain enough of this vitamin. Many women do not know they are pregnant for several weeks, and deficiency of this vitamin in the first trimester puts the developing child at risk for neural tube defects. Additionally, breastfed infants of mothers with a vitamin B12 deficiency have an increased risk of developmental abnormalities, growth failure, and anemia (Penney & Miller, 2008). In addition, it is recommended that anyone over the age of 50 take a supplement or increase their intake of vitamin B12 fortified foods since with increasing age the body loses its ability to digest the form of B12 present in eggs, dairy, and animal products.

Vitamin B12 is found only in animal products or in fortified foods such as cereals, soymilk, and nutritional yeast. Vegan women, therefore, require supplementation with these foods or a pill, especially if of child-bearing age or if 50 years or older. Small, frequent amounts are better absorbed than a large dose. For example, when less than five micrograms are consumed, about 60% is absorbed. When 500 micrograms or more is consumed, less than 1% is absorbed ("Position", 2003).

Zinc. Zinc deficiency is not a consistent finding among all vegans, but some have been found to have marked low levels. Since zinc is vital for cellular metabolism, growth and development from life in the womb to adulthood, taste, and smell (Office, 2016), those who restrict consumption of animal products must plan their diet well to ensure adequate intake (Hunt, 2003).

Plant-based sources of zinc include whole grains, seeds, nuts, and legumes. As with iron, phytate decreases absorption of this mineral, so soaking, sprouting, and leavening bread all improve bioavailability by decreasing phytic acid ("Position", 2003).

Pregnancy and Lactation

Obtaining adequate nutrition is highly important during pregnancy and lactation when women have very specific nutrient needs to nurture their growing children. In addition to the above nutrients, women in this life stage also require adequate polyunsaturated fatty acids (PUFAs) and folic acid (Penney & Miller, 2008; Tyree et al., 2012).

Polyunsaturated fatty acids. PUFAs are necessary for fetal development. Two highly important nutrients are linoleic acid (LA), which converts to omega-6 fatty acids, and alpha-linolenic acid (ALA), which converts to omega-3 fatty acids. Omega-6 fatty acids are then transformed to arachidonic acid (AA), while omega-3 fatty acids are converted to docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). EPA and DHA are also found individually in fish and eggs. DHA is believed to be essential for fetal visual and neurological development and for its influence on the length of pregnancy. Since ALA and LA use the same enzymes in conversion, it is important that

these nutrients be consumed in relatively equal proportions to obtain adequate EPA and DHA (Davis & Kris-Etherton, 2003; Jensen, 2006).

Consumers of plant-based diets often obtain adequate LA since it is found in vegetable oils, nuts, grains, leafy greens and seeds (Penney & Miller, 2008; Phares, 2014). Studies of vegan mothers' breast milk have shown deficiencies in DHA and EPA ("Position", 2009), making it essential for these women to consume an adequate amount of ALA, optimize conversion of ALA, and increase consumption of direct sources of DHA and EPA.

Plant-based sources of ALA include flaxseed, greens, walnuts, soybeans, and hempseed, flaxseed, and canola oils. Flaxseed oil should not be heated as this damages the ALA content. Factors that inhibit conversion to DHA and EPA include insufficient energy or protein intake, excessive trans fatty acid consumption, alcohol, and deficiencies in biotin, calcium, copper, pyridoxine, magnesium, and zinc. In addition, consuming omega-3 and omega-6 fatty acids in balance will help ensure equal conversions to AA, EPA, and DHA.

The most reliable direct source of DHA and EPA is seafood. Eggs are a good source of DHA but less so of EPA. Since strict vegans do not consume either of these foods, they can obtain these nutrients from prenatal vitamins, microalgae, or seaweed supplements (Davis & Kris-Etherton, 2003; Penney & Miller, 2008).

In addition to the above guidelines, Davis and Kris-Etherton (2003) recommended that all vegetarians, including vegans, found their diet on a variety of plant-based foods, consume their fat from whole food sources rather than oils, limit intake of trans fats from processed, deep-fried, and fast food, and limit saturated fat and cholesterol consumption.

This will help ensure adequate intake of essential fatty acids for fetal and newborn development during pregnancy and lactation.

Folic acid. Like vitamin B12, folic acid is necessary for fetal neurological development and the synthesis of DNA and red blood cells (Penney & Miller, 2008). A deficiency in this vitamin causes anemia and can lead to heart failure as with other types of anemia (Silverberg et al., 2004). Insufficient intake of folic acid in the first trimester of pregnancy is linked to an increased risk of neural tube defects. The United States recommends that all women of childbearing age obtain at least 400 micrograms of folic acid a day, even if they do not plan to become pregnant. Neural tube defects develop in the first three to four weeks following conception when many women do not yet know that they are pregnant. Women who consume plant-based diets should have no difficulty in obtaining sufficient folic acid since dark leafy greens and legumes are the primary sources of this nutrient (Centers for Disease Control and Prevention, 2016c).

Coconut Oil

Coconut oil is a common ingredient in vegan cooking as a replacement for butter. It is praised for its high smoke point that limits the oxidative damage that comes from consuming oils damaged by high heat (Falade, Oboh, & Okoh, 2017). Despite this positive quality, the American Heart Association (AHA) does not recommend the consumption of coconut oil since the fat found in coconut oil is primarily saturated fat, and saturated fats have been associated with cardiovascular disease risk (American Heart Association, 2014; American Heart Association, 2016). However, studies of populations with high coconut consumption did not have an increased incidence of cardiovascular

disease (DiBello et al., 2009; Lipoeto, Agus, Oenzil, Wahlqvist, & Wattanapenpaiboon, 2004).

Some studies have shown that coconut oil is associated with reduced obesity risk, improved insulin sensitivity, and reduced risk of death from chronic, preventable diseases. Most of these studies suggest that coconut oil's medium-chain fatty acid content is what sets it apart from other saturated fats and thus conclude that the quality rather than the quantity of saturated fat should be the consideration when planning a diet (Assunção, Ferreira, dos Santos, Cabral, & Florêncio, 2009; Fretts et al., 2016; Han et al., 2007; Koji & Yanagita, 2010; Liao, Lee, Chen, & Rasool, 2011; Manolis, 2016; Papamandjaris, White, Raeini-Sarjaz, & Jones, 2000; St-Onge, Bosarge, Goree, & Darnell, 2008).

There are several cultures in which coconut is a staple, such as in the Samoan Islands and West Sumatra, Indonesia, where the inhabitants have a low incidence of cardiovascular and metabolic diseases (DiBello et al., 2009; Lipoeto et al., 2004). The study of the Samoan Islands noted that those who consumed a more traditional diet had a low intake of meat, refined grains, and processed foods, but a high intake of plants and seafood. Those who consumed a more modern diet consisting of processed foods, meat, and eggs had an increased risk of developing metabolic syndrome, increased waist circumference, and elevated triglycerides. The study concluded that coconut consumption, as part of a diet high in fiber, whole plant foods, and seafood can be protective against metabolic syndrome (DiBello et al., 2009). The study in West Sumatra observed that coconut consumption was not associated with cardiovascular diseases. Rather, increased consumption of animal products, high protein, and cholesterol with low intake of plant-based carbohydrates was associated with cardiovascular disease (Lipoeto

et al., 2004). These studies show that coconut incorporated as a part of a plant-based diet does not have detrimental health effects.

In many studies promoting coconut oil or medium-chain saturated fatty acid consumption, participants consumed it in moderation or as part of a weight-loss diet (Assunção et al., 2009; Han et al., 2007; Liao et al., 2011). This makes it difficult to determine whether its observed benefits are due to the components of the oil or the confounding variables of the studies. It is evident, however, that consuming coconut oil in moderation as part of whole-foods, plant-based diet does not have a negative effect on cardiovascular health. This topic requires more study before definite conclusions about its effect can be made.

Veganism Compared with Other Forms of Vegetarianism

All forms of vegetarianism restrict meat. Lacto vegetarians consume dairy, ovo vegetarians consume eggs, and lacto-ovo vegetarians consume both (The Vegetarian Society, 2016). Reviewing the benefits of a vegan diet might lead some to wonder if the benefits of this lifestyle can be achieved with less restrictive diets that could also eliminate the risk for various nutrient deficiencies.

Several studies have found that vegan diets are most effective in promoting weight loss (Spencer et al., 2003; Turner-McGrievy, Davidson, Wingard, Wilcox, & Fongillo, 2015). One six-month study assessing the effectiveness of five different plant-based diets found that a vegan diet was most effective in promoting weight loss and decreasing saturated fat when compared with vegetarian, pesco-vegetarian, semi-vegetarian, and omnivorous diets (Turner-McGrievy et al., 2015).

Some evidence states that dairy can have a poor impact on health and is unnecessary for humans. It has been associated with immune, reproductive, and central nervous system abnormalities, type 1 diabetes mellitus, and breast, prostate, and ovarian cancers (Kroenke, Kwam, Sweeney, Castillo, & Caan, 2013; Lanou, 2009; The Physicians Committee, n.d. a). Dr. Lanou (2009), senior nutrition scientist for the physician's committee and chair and a university professor of health and wellness, stated that dairy should not be recommended for vegetarian diets. According to Lanou's research, dairy promotes cancers of the prostate and ovaries, type 1 and type 2 diabetes, multiple sclerosis, obesity, and heart disease. The prevalence of lactose intolerance and dairy allergies gives evidence of its inessential role in human health. Lanou concluded that all the nutrients found in milk can be found in healthier plant-based foods and that vegetarians will have better health outcomes if they eliminate dairy.

Other sources stated that dairy does not have a poor impact on health. One literature review stated that dairy reduces the incidence and risk of obesity, type 2 diabetes, cardiovascular disease and stroke, low bone density, and colorectal, bladder, gastric, and breast cancers (Thorning et al., 2016). Since there is conflicting research on dairy's effect on health, it seems that dairy is not strongly associated with a positive or negative influence on disease risk and can be safely consumed in moderation. More research is needed to make conclusive recommendations regarding its consumption.

Egg consumption has not only been limited by vegans, but also by those looking to reduce cholesterol and ischemic heart disease risk (Nakamura et al., 2004). However, eggs seem to be a minor contributor to serum cholesterol (Gray & Griffin, 2013; Nakamura et al., 2004; Ruxton, 2010). In fact, for those without egg allergies or familial

hypertension requiring strict cholesterol restriction, eggs can be a healthy dietary component. They are a source of several nutrients essential during pregnancy, lactation, and weaning, including protein, vitamin A, B vitamins, vitamin D, folate, omega-3 fatty acids, iodine, phosphorus, and selenium (Gray & Griffin, 2013; Ruxton, 2013). Egg consumption during pregnancy and weaning reduces the child's risk of developing egg allergies and eczema. Other benefits of egg consumption include increased satiation and weight control, and decreased incidence of malnutrition and sarcopenia in older adults (Gray & Griffin, 2013). Vegetarian diets that allow egg consumption can reduce the risk of nutrient deficiencies and promote overall health (Gray & Griffin, 2013, Ruxton, 2010; Ruxton, 2013).

A Summary of Evidence-Based Dietary Recommendations

A nutritious diet centered around plant foods in their most natural form, when combined with physical activity, is associated with disease prevention and reduction (Trapp & Levin, 2012). Current evidence recommends that individuals consume a variety of fruits, vegetables, whole grains, legumes, nuts, and seeds. Limiting intake of red meats, saturated fats, and animal protein reduces disease risk (Campbell & Campbell, 2012; Tyree et al., 2012). Consumers of a plant-based diet are not required to limit carbohydrate or caloric intake to experience its benefits (Barnard et al., 2006; Mishra et al., 2013).

Those uninterested in strictly eliminating all animal products from their diet can still benefit from making plant-based foods the central, main part of their diet (Tuso et al., 2013). Eggs can be a nutritious dietary component for those looking to improve their health without eliminating all animal products (Gray & Griffin, 2013; Ruxton, 2010,

Ruxton, 2013), but the nutritional value of dairy is inconclusive and requires more research. The conflicting evidence seems to suggest that dairy consumed in moderation as part of a plant-based diet is not strongly associated with disease risk (Kroenke et al., 2013; Lanou, 2009, The Physician's Committee, n.d. a; Thorning et al., 2016).

Strict vegans need to focus on consuming foods containing vitamin B12 and iron. Women who are pregnant and lactating should talk to their physicians to ensure they are consuming adequate folic acid and polyunsaturated fatty acids as well. If women are not consuming adequate amounts of these nutrients, they may require supplementation to prevent complications occurring from nutrient deficiencies (Penney & Miller, 2008; "Position", 2009; Tyree et al., 2012).

Conclusion

There are many benefits of a plant-based vegan diet, including decreased risk and incidence of obesity, cardiovascular diseases, type II diabetes mellitus, and cancers. Iron, B12, zinc, and omega-3 fatty acid deficiencies are common in vegans and require educated diet planning or supplementation to ensure adequate levels of these nutrients. In summary, a vegan plant-based diet is a safe and effective way for women in any stage of life to improve their health and reduce their disease risk.

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