

# Position of the Academy of Nutrition and Dietetics: Vegetarian Diets



## ABSTRACT

It is the position of the Academy of Nutrition and Dietetics that vegetarian diets can provide health benefits in the prevention and treatment of certain health conditions, including atherosclerosis, type 2 diabetes, hypertension, and obesity. Well-designed vegetarian diets that may include fortified foods or supplements meet current nutrient recommendations and are appropriate for all stages of the life cycle, including pregnancy, lactation, infancy, childhood, and adolescence. Vegetarians must use special care to ensure adequate intake of vitamin B-12. Vegetarian diets are primarily plant-based, comprised of grains, legumes, nuts, seeds, vegetables, and fruit; do not include flesh foods (beef, pork, poultry and fowl, wild game, and fish); and may or may not include some animal products, such as dairy (milk and milk products), eggs, and processed foods that contain casein or whey. Although vegetarians may have a higher deficiency risk for some nutrients (eg, vitamin B-12) compared to nonvegetarians, nutritional deficiencies are not the main causes of mortality or morbidity in Western societies. Vegetarian diets are associated with a lower risk of ischemic heart disease, hypertension, type 2 diabetes, obesity, and some types of cancer; low-fat vegetarian diets, in combination with other healthy lifestyle factors, have been shown to be effective in the treatment of these diseases. Vegetarians have lower low-density lipoprotein, better serum glucose control, and lower oxidative stress. Low intake of foods containing saturated fat and cholesterol, and high intake of vegetables, fruits, whole grains, legumes, nuts and seeds, and soy products that are rich in fiber and phytochemicals are components of a vegetarian diet that contribute to reduction of chronic disease.

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## POSITION STATEMENT

It is the position of the Academy of Nutrition and Dietetics that vegetarian diets may provide health benefits in the prevention and treatment of certain health conditions, including atherosclerosis, type 2 diabetes, hypertension, and obesity. Well-designed vegetarian diets that may include fortified foods or supplements meet current nutrient recommendations and are appropriate for all stages of the life cycle, including pregnancy, lactation, infancy, childhood, and adolescence. Vegetarians must use special care to ensure an adequate intake of vitamin B-12.

**V**EGETARIANISM, A GENERAL term given to plant-based diets, is inherently complex in eating style, food choice, and the motivation that leads one to choose a vegetarian lifestyle. Vegetarianism in the United States during the 16th through 18th centuries may have been born from social, political, and religious concerns—complete with spiritual roots, biblical prohibitions regarding eating meat, and heated philosophical, psychological, and medical debate.<sup>1</sup> Today, choosing to adopt a vegetarian diet may stem from a compassionate moral order to protect animals and our environment, enhance quality of life, prevent health complications, or promote self-management strategies to therapeutically treat disease. A well-designed,

plant-based eating pattern can be appropriate for these purposes and more as they deliver adequate nutrition to satisfy current recommendations. Yet, simply avoiding meat, dairy, or eggs does not guarantee adequate nutrition, and individuals who describe themselves as vegetarian may not be eating healthfully.

Vegetarian dietary patterns are quite diverse and variant due to food availability, region, age, gustatory reasons, and religious and cultural beliefs. They encompass a wide array of plant foods and food practices based on these factors and always begin with a plant-based foundation. Vegetarian diets are almost always comprised of plant foods, such as grains, legumes, nuts, seeds, vegetables, and fruit; animal products, such as flesh foods (beef, pork, poultry and fowl, wild game, and fish), dairy (milk and milk products) and eggs, along with processed foods that contain casein or whey, are

limited or eliminated. Interest in and commitment to a vegetarian diet may fluctuate throughout the life cycle, based on the previously mentioned factors as well as economics, moral concern for the environment, and ethical support for animal rights. Motivations for choosing a vegetarian diet are not static. In fact, vegetarian adults exhibit constant fluidity, as some have dropped their initial motivation, added new ones, and modified their beliefs over time. Of interest, vegetarian dietary patterns based on health may be more flexible than those based on religious or moral reasons.<sup>2</sup> Motivations influence dietary practices, which may impact nutrient intake. Although there is some risk for nutrient deficiencies in a vegetarian diet compared to nonvegetarian diets, there are tremendous advantages toward prevention of chronic health conditions by adhering to a vegetarian eating pattern.

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Being well informed of these issues will enhance the counsel of registered dietitian nutritionists (RDNs) and nutrition and dietetics technicians, registered (NDTRs) regardless of clients' reasons, convictions, motivation, and nutrition knowledge. RDNs and NDTRs should be aware of these considerable health advantages of a vegetarian diet to more effectively counsel and educate clients on the utility of plant-based diets for disease prevention and management. RDNs and NDTRs, along with assessing knowledge, beliefs, reasons, and motivations for choosing a vegetarian dietary pattern, should educate on the importance of including a variety of colorful fresh or frozen foods that are unrefined and minimally processed. This will promote self-management strategies that meet nutrition needs and address specific nutrient considerations to assure optimal nutrition.

What follows are some of the types of plant-based diets one may choose:

- **Vegetarian diet:** A vegetarian diet is devoid of all flesh foods, but may include egg or dairy products.
- **Ovo-vegetarian diet:** A vegetarian diet free from flesh foods and dairy foods but includes eggs.
- **Lacto-ovo-vegetarian diet:** A vegetarian diet free from flesh foods but includes eggs and dairy products.
- **Vegan diet:** A vegan dietary pattern is free from all flesh foods, eggs and dairy products, and sometimes honey.
- **Raw vegan diet:** A strictly fresh and uncooked food intake based on fruit, nuts, seeds, and vegetables.
- **Macrobiotic diet:** A strict whole-foods, plant-based diet that includes fish but no other flesh foods and includes mostly brown rice and whole grains supplemented with local vegetables and seaweed, beans, nuts, seeds, certain fruits, and miso soup.
- **Semi-vegetarian diet:** A plant-based dietary pattern with occasional beef, pork, poultry, or fish perhaps once or twice weekly.

## TRENDS, DIVERSITY, AND MOTIVATIONS THAT INFLUENCE ADULT VEGETARIANS

In 2012, approximately 5% of US adults were vegetarian, according to a

nationwide poll, which is up by 2% from a similar poll taken in 2006.<sup>3</sup> The same poll revealed 47% of Americans eat at least one vegetarian meal per week. More than half to nearly three-fourths of vegetarians and vegans polled seek healthier whole-food options and would purchase a vegan deli sandwich in a chain restaurant. Forty-four percent of younger consumers choose meatless meals once weekly.<sup>4</sup> One in four US adults claim to be meat reducers, those who continue to eat meat but for health reasons limit their intake. This is another growing field moving toward plant-based diets of which to take note.

There is a growing demand for products that are "meat-free," have a "meat-like texture," are "suitable for vegetarians," and are for "meat and veggie lovers alike."<sup>5</sup> Sales of alternative meat products, driven largely by health reasons and resemblance to meat, reached \$553 million in 2012, an 8% increase in 2 years; 31% and 36% of survey responders sought organic and vegan meat alternatives, respectively, especially in the 18- to 44-year age group.<sup>5,6</sup> This age group is more likely to follow a strict diet, be interested in current dietary fads like gluten- and lactose-free diets, and tend toward social media in a way the older population does not. Thus, the high availability of ready-to-eat, refined, gluten-free, and faux-meat foods may be enticing to this group who adopt a vegetarian lifestyle. However, a diet heavy in nonanimal, meat-like products and refined and highly processed vegetarian foods, while allowing the client to remain committed to a moral, ethical, or health obligation to eat vegetarian, may diminish or limit overall nutrition. Many of these "convenience" foods have little nutritional value and added sugars and high-fructose corn syrup, salt, and chemical additives. Noting avoidance of certain foods, like gluten or lactose, and the client's reason will enable a more thoughtful recommendation by the RDN.

Leading scientists and vegetarian experts from all over the world join together every 5 years at Loma Linda University for the International Congress on Vegetarian Nutrition. Here, presentations on the most up-to-date vegetarian health research and updates are heard. Local vegetarian

societies formed from the offshoot of the 1975 World Vegetarian Congress share the principles of and accessibility to vegetarianism with conventional audiences.

Also, the outreach of vegetarian food festivals is growing and aims to extend compassion into the community. For instance, for more than 15 years, the free-admission Boston Vegetarian Food Festival has grown from 1 to 2 days to sample foods; attend presentations; and learn about eco-friendly, sustainable vegetarian diets. This growth resulted in selling tickets for prefestival hours to shop without crowds. New York and San Francisco's veggie food fests have also added days and moved to larger venues. This speaks well to substantiate the growing percentage of Americans experimenting with meat-free eating.

A plant-based diet, which is the foundation of a vegetarian diet, is becoming mainstream, as further evidenced by many nonprofit and governmental institutions highlighting this dietary choice. The American Institute for Cancer Research encourages a plant-based diet defined as two-thirds of our dietary intake being comprised of vegetables, fruits, whole grains, and beans.<sup>7</sup> In addition, the US Department of Agriculture modified meal plans for lacto-ovo-vegetarian and vegan dietary patterns are listed as Appendices 8 and 9 of the 2010 Dietary Guidelines for Americans.<sup>8</sup> And, the National School Lunch Program, while not requiring vegetarian options per se, requires schools to increase availability of fruits, vegetables, and whole grains in current meal patterns in the school menu. These government-driven and health institutional changes reflect a considerable shift in the attitude of Americans.

Lastly, those adhering to a vegetarian lifestyle now have technological support. To date, while no online nutrition food tracker exists strictly for vegetarians, some allow clients adopting this lifestyle to select vegetarian and vegan plans. Various applications for mobile devices allow vegetarians to grasp nutritional needs, track intake, and locate restaurants and markets where vegan foods are available. The online tracking tool at [www.SuperTracker.usda.gov](http://www.SuperTracker.usda.gov) is a part of the US Department of Agriculture Choose MyPlate program.<sup>9</sup>

## NUTRITION CONSIDERATIONS FOR VEGETARIANS

### Protein

A concern that vegetarians, especially vegans and vegan athletes, may not consume an adequate amount and quality of protein is unsubstantiated. Vegetarian diets that include a variety of plant products provide the same protein quality as diets that include meat.<sup>10</sup> Protein consumed from a variety of plant foods supplies an adequate quantity of essential amino acids when caloric intake is met. Pregnant and lactating vegetarian women, including vegan women, need to follow the recommendation for protein intake for their life stage and should include an additional 25 g protein each day.<sup>10</sup> RDNs should assess quality of protein intake and recommend that children, adolescents, adults, pregnant adolescents and adults, and athletes include an adequate variety of protein foods daily. Combining two or more incomplete protein foods (those low in one or more essential amino acids, such as rice and beans, peanut butter and whole grain bread, tortillas with beans, and cooked beans with cornbread) is not required in every meal as long as variety is present.

### n-3 Fatty Acids

Vegetarians can meet the Adequate Intake of  $\alpha$ -linolenic acid from foods such as flaxseeds, chia seeds, walnuts, canola and soybean oil, and a few other plant sources.<sup>11</sup> Use of these products is effective in increasing serum/plasma  $\alpha$ -linolenic acid concentration. While studies have shown that increasing the dietary  $\alpha$ -linolenic acid-to-linoleic acid ratio can result in a substantial increase in the plasma or red blood cell concentration of the  $\alpha$ -linolenic acid, studies with vegetarians consistently showed low plasma eicosapentaenoic acid (EPA) among vegetarians, especially vegans compared to nonvegetarians.<sup>12</sup> Similarly, plasma docosahexaenoic acid (DHA) concentration among vegetarians has been shown to be very low, as consumption of plant foods rich in  $\alpha$ -linolenic acid has virtually no impact on serum/plasma DHA concentration.<sup>11</sup>

Consuming adequate amounts of EPA and DHA seems to be especially critical in pregnancy, infancy, and in elderly people.<sup>13</sup> Although foods such as some brands of soy milk have been fortified

with these essential oils, their dose is relatively small, as is their contribution to overall intake when compared to the recommendations.<sup>14</sup> RDNs should assess dietary intake of essential fatty acids for all stages of the life cycle and recommend consideration of available vegetarian-friendly supplements to ensure adequate intake and stores.

### Iron

Generally, because iron intake among vegetarian men and postmenopausal women is higher than the Institute of Medicine's recommendation, iron deficiency and depletion of iron stores are almost never noted among these vegetarians.<sup>15,16</sup> However, children, pregnant women, and premenopausal women may consume less iron than the Recommended Daily Allowance.<sup>17-19</sup> Although some studies showed adequate iron stores and low to no deficiency rates among vegetarian children, other findings documented relatively high rates of iron deficiency, ranging from about one-fifth to more than one-third of sampled vegetarian children.<sup>17,19,20</sup> Similarly, as high as 26% of vegetarian pregnant women were diagnosed with iron deficiency in one study.<sup>21</sup> Preventing iron deficiency among vegetarian children is imperative and may be strictly a matter of appropriate dietary planning.

Two types of inadequate iron status exist: iron deficiency and iron-deficiency anemia, the former being the less severe form. Vegetarians have a comparable rate of iron-deficiency anemia to nonvegetarians. However, vegetarians have a higher rate of iron deficiency.<sup>22</sup> Adverse symptoms are already seen when iron deficiency is present. In addition to low intake, this is most likely a result of low iron absorption due to the traditional iron-absorption inhibitors, such as fiber or phytic acid. RDNs and NDTRs can guide and counsel vegetarians in dietary planning regarding the best strategies to meet iron recommendations from plants in order to obtain adequate iron stores. The recommendation to focus on good sources of non-heme iron, such as iron-fortified breads and cereals, beans and lentils, raisins, and blackstrap molasses, along with good sources of vitamin C, like tomatoes and citrus fruits for optimal iron absorption, and cooking in cast iron pans, which also provides an additional

source of iron in cooked foods, may prove to be the most important factor in iron deficiency prevention.

### Zinc

Individuals in most regions of the world who habitually adhere to vegetarian diets, especially vegans, have low zinc intakes and status.<sup>23</sup> Vegans and vegetarian women from developing countries have the highest risk of low zinc intake and status. Due to the presence of zinc absorption inhibitors in plant foods, the recommendation for vegetarians, compared to non-vegetarians, is 50% greater.<sup>15</sup> This highlights the need for a higher intake of zinc among vegetarians. This may be especially important for pregnant and lactating women. Overt symptoms of zinc deficiency are not common in Western societies and it is unclear what impact the low intake and status of zinc among vegetarians may have.

### Calcium

Although it is not always the case, lacto-ovo-vegetarians show a relatively high intake of calcium, often exceeding the Institute of Medicine's recommendations.<sup>24</sup> In contrast, vegans consistently show lower-than-recommended calcium intake.<sup>25</sup> Findings from one large prospective study showed that vegans with calcium intake <525 mg/day had a 25% higher risk of bone fractures.<sup>26</sup> RDNs should assess calcium intake in both vegans and adolescent vegetarians who may need to increase their intake of dietary calcium. Calcium can be found in dairy products, legumes (including soybeans), spinach, kale, turnips, collards, broccoli, calcium-fortified soy milk, and other calcium-fortified nondairy milk alternatives and orange juice, and calcium-set tofu. If dietary intake of calcium is low, a well-absorbed calcium supplement can be recommended in divided doses.

### Vitamin D

Low serum vitamin D concentrations have recently been reported among both vegetarian children and adults.<sup>27-30</sup> There are considerable variations in vitamin D concentrations subject to the different seasons of the year, with the lowest concentrations reported in winter months.<sup>27,28</sup> Depending on the place of residence, vegetarians may

need to rely on sun exposure, food fortified with vitamin D, and/or vegan supplements to maintain adequate serum levels. However, obtaining adequate vitamin D from fortified foods is the most challenging for vegans because few plant foods are fortified with this vitamin. In such cases, vegan vitamin D supplements seem to be the most prudent way to ensure adequate vitamin D status. RDNs should assess the biochemical data for vitamin D for clients whose dietary assessment reveals inadequate intake.

### Vitamin B-12

Vegetarian diets are associated with vitamin B-12 depletion and/or deficiency. A high prevalence of deficiency, assessed by methylmalonic acid and/or holotranscobalamin II concentrations, is found among vegetarians, regardless of the type of diet they follow.<sup>31</sup> There is a high prevalence of low serum vitamin B-12 and elevated homocysteine among vegetarians.<sup>32</sup> Vitamin B-12 status is usually the most compromised among followers of vegan diets.<sup>31</sup> Prevalence of B-12 deficiency ranged from 30% to 86% among healthy, nonpregnant adult vegetarians, 46.9% to 68% in adults older than 55 years, and 43% to 88% in vegans.<sup>31</sup>

Although severe overt symptoms of vitamin B-12 deficiency may most likely be manifested only in a stage IV deficiency, mild and subtler symptoms like fatigue and weakness may be more common. Vitamin B-12 deficiency during pregnancy and lactation may lead to severe developmental problems in the developing fetus and infants.<sup>33</sup> Adult vitamin B-12 deficiency is associated with a range of health problems from mild to severe, including increased risk for dementia and Alzheimer's disease, multiple sclerosis, psychosis, mood swings, neuropathy, myelopathy, memory impairment, depression, brain atrophy, hearing loss, and occlusive vascular disease.<sup>34</sup> Ensuring adequate vitamin B-12 status seems to be most important among pregnant and lactating vegetarian women and in older vegetarians. RDNs should assess B-12 status in children, adolescents, and adults, including pregnant adolescents and adults, and recommend that vegetarians, regardless of the type of vegetarian diet they adhere to, take vitamin B-12 supplements based on their physician's guidance.

### EATING DISORDERS AND VEGETARIAN DIETS

It has previously been hypothesized that a vegetarian diet may be motivated by weight control and restrained eating.<sup>35</sup> Some findings support that adult vegetarians have a higher rate of disordered eating than nonvegetarians, while others suggest higher rates in nonvegetarians or no difference.<sup>36</sup>

There is also an association between vegetarianism and disturbed eating among adolescents.<sup>36,37</sup> Adolescent and young adult vegetarians were more likely to engage in binge eating with loss of control, and former vegetarians were more likely than those who never were vegetarian and current vegetarians to engage in extreme unhealthful weight-control behaviors.<sup>37</sup> However, it is still a matter of debate whether adopting a vegetarian diet is the cause of disordered eating or whether it is one of the manifestations of disordered eating (casual vs symptomatic relationship). The majority of women reduce meat intake after the onset of an eating disorder, so it is unlikely vegetarianism is a risk factor for developing an eating disorder.<sup>36,37</sup> Vegetarianism then may not lead to disordered eating. However, semi-vegetarians, who restrict meat intake for weight control and convert to vegetarianism after the eating disorder onset, could see vegetarianism playing a role in the maintenance of the eating disorder.<sup>38</sup>

Vegetarian children and adolescents are more likely than nonvegetarian children to have a diet consistent with the Healthy People 2010 dietary guidelines, and this is especially true of meeting recommendations for specific foods and nutrients including fruits, vegetables, and total and saturated fat.<sup>39,40</sup> However, a subset of vegetarian adolescents and young adults shows higher patterns of unhealthful dieting practices than omnivores or more health conscious vegetarians of the same age.<sup>38</sup> RDNs should assess for problem behaviors such as dieting in adolescent and young adult (19 to 30 years) vegetarians.

### THERAPEUTIC VEGETARIAN DIETS AND CHRONIC DISEASE

The terms *wellness* and *therapeutic* have been applied to clarify the treatment purpose of a vegetarian diet.<sup>41</sup>

A vegetarian diet for wellness is guided toward individuals in generally good health who are not in need of specific recommendations or alterations for health problems or disease. A therapeutic approach differs in that clients following or transitioning to a vegetarian or vegan diet do so because of a clinical need for treatment or management of a health problem or chronic disease. Disease state, length of intervention, restrictiveness, and client support are factors that may influence adherence to a diet. For adult clients, RDNs should monitor and evaluate adherence to a therapeutic vegetarian diet, as these diets appear to perform as well or better than omnivorous diets in terms of attrition rate, provided adequate nutrition education and appropriate dietary support are received. Employing a variety of counseling approaches and strategies, including motivational interviewing, frequent encounters, cooking demonstrations, and incentives, can improve nutrition-related outcomes when using a vegetarian diet therapeutically.

### Obesity

Healthier eating and food choice are a growing trend largely driven by more than two-thirds of overweight and obese Americans (69.2%) trying to effectively manage their weight.<sup>41</sup> Health promotion and improving cardiovascular function and insulin sensitivity by reducing the inflammatory response that underlies most disease processes are a myriad of reasons clients seek weight loss.

Research indicates the therapeutic use of a vegetarian diet is effective for treating overweight and obesity in both the short term (<1 year) and longer term (>1 year), and may perform better than alternative omnivorous diets for the same purpose. A vegan diet with structured group support and behavioral therapy compared to the National Cholesterol Education Program diet was associated with significantly greater weight loss at years 1 and 2.<sup>42</sup> If consistent with client preference, RDNs may recommend and educate on the therapeutic use of a nutrient-dense vegetarian diet for adults seeking treatment for overweight or obesity. As research shows lower compliance rates for weight-loss clients vs clients treated for other disease states, RDNs should monitor and

evaluate adherence and motivation and provide continued nutrition education and behavioral change support.

### Cardiovascular Disease Including Hyperlipidemia, Ischemic Heart Disease, and Hypertension

Vegetarian diets improve several diet-related modifiable heart disease risk factors, including abdominal obesity, blood pressure, serum lipid profile, and blood glucose, and can lower total cholesterol from 7.2% to 26.6% and low-density lipoprotein cholesterol from 8.7% to 35%.<sup>43-46</sup> They also decrease markers of inflammation such as C-reactive protein and reduce oxidative stress, and protect from atheriogenic plaque formation.<sup>47</sup> Consequently, vegetarians have a reduced risk of developing and dying from ischemic heart disease.<sup>48-50</sup> It was estimated that the probability of vegetarians developing cardiovascular disease at age 55 years was 6.1% compared to 17.9% among age-matched omnivorous.<sup>47</sup> Vegan diets seem to be most beneficial in improving heart disease risk factors.<sup>44,45</sup>

Vegetarians can also decrease their risk of developing circulatory health problems by ensuring a reliable source of, and adequate dose of, vitamin B-12, which is associated with improved arterial epithelial function and better blood flow.<sup>51</sup> Also, vitamin B-12 is essential in reducing homocysteine, which is an independent risk factor for heart disease.<sup>52</sup> While vegetarians tend to have a lower body mass index (BMI; calculated as kg/m<sup>2</sup>), an additional reduction in risk can be made by keeping weight within the range for healthy BMI and by regularly consuming a variety of vegetables, fruit, whole grains, and nuts, like almonds and walnuts.

Low-fat vegan and vegetarian diets, combined with other lifestyle factors, including not smoking and weight reduction, have been shown to reverse atherosclerosis.<sup>53-55</sup> Plaque thickness was reduced within just a few months of dietary and lifestyle modification, even without the use of cholesterol-lowering drugs.<sup>55</sup> As such, these diets are strongly recommended to all clients with heart disease who are willing to adopt them.

Vegetarians compared to nonvegetarians have a lower prevalence of

hypertension. Results of the EPIC (European Prospective Investigation into Cancer and Nutrition)-Oxford study showed that vegans have the lowest rate of hypertension of all diet groups (vegans, vegetarians, fish eaters, and meat eaters), including the lowest systolic and diastolic blood pressure.<sup>56</sup> Vegan members of the Seventh-day Adventist Church had a 63% lower odds ratio of developing hypertension compared to nonvegetarians, while vegetarians had a 43% lower risk.<sup>44</sup>

### Diabetes

Obesity increases the risk of type 2 diabetes. The difference in BMI between vegans and nonvegetarians indicates a substantial potential for vegetarianism to counteract environmental forces leading to obesity and increased risk of type 2 diabetes.<sup>46</sup> Vegan and lacto-ovo-vegetarian diets are associated with a nearly one-half reduction in risk of type 2 diabetes compared with nonvegetarian diets.<sup>46</sup> In addition, a vegetarian diet can decrease or maintain blood glucose levels, and a vegan diet can decrease hemoglobin A1c.<sup>45</sup> If consistent with client preference, RDNs can recommend and educate on the benefits of the therapeutic use of a vegetarian diet for adults seeking treatment for type 2 diabetes.

### Cancer

Several epidemiological studies, including large prospective studies with Seventh-day Adventist church members and with British vegetarians, documented modestly lower overall cancer risk among vegetarians compared to nonvegetarians.<sup>57,58</sup> A recent meta-analysis based on seven prospective studies showed a nonsignificant 9% lower risk of overall cancer mortality and an overall 29% statistically significant reduction in cancer incidents.<sup>48</sup>

### Osteoporosis

Vegetarian compared to nonvegetarian children 2 to 10 years of age have a 20%, 10%, and 15% reduced serum level of osteocalcin, bone alkaline phosphatase, and osteoclast activity, respectively.<sup>59</sup> Vegetarians, especially vegans, have lower bone mineral density as compared to nonvegetarians.<sup>27,30,60</sup> While fracture risk among vegetarians

in the EPIC-Oxford study was equal to the risk among nonvegetarians, vegans who consumed <525 mg calcium/day had a 30% higher risk.<sup>26</sup> Also, among participants of the Adventist Health Study 2, vegans had an 86% higher risk and vegetarians a 24% higher risk of fractures.<sup>61</sup> RDNs should counsel vegetarians, especially vegans, on fracture prevention, including making appropriate food and/or supplement selection to improve their calcium, vitamin B-12, and other relevant nutrients intake.

## VEGETARIAN DIETS THROUGHOUT THE LIFECYCLE

### Pregnant and Lactating Women

Neonates born to vegetarian, especially vegan, mothers from developed countries, have higher birth weight and lower prevalence of low-birth-weight compared to nonvegetarian mothers.<sup>21</sup> Vegetarian pregnant women have a high risk of vitamin B-12 deficiency. This is especially true of long-term vegetarians, especially vegans.<sup>33</sup> Vitamin B-12 deficiency in pregnancy can result in spontaneous abortion.<sup>62</sup> Vegetarian, especially vegan, pregnant women need to supplement their diet with vitamin B-12.<sup>31</sup> While deficiency symptoms might not always be seen among pregnant women, within a few months postpartum, infants of mothers who are vitamin B-12-deficient can experience severe anthropometric and developmental complications.<sup>33</sup> Neurologic symptoms that develop in infants and children who are vitamin B-12-deficient can have long-term complications.

Pregnant vegetarian women are at a high risk for iron deficiency, evidenced by more than one in four pregnant vegetarian women who develop an iron deficiency.<sup>21</sup> Iron deficiency during pregnancy can result in inadequate fetal weight gain; premature delivery; and a higher risk of maternal, fetal, and infant death. They are also at risk for inadequate EPA and DHA intake and status.<sup>11</sup> These essential fatty acids are important in brain and eye development of the fetus and breastfed infant. Adequate intake is associated with increased pregnancy duration. It is also associated with decreased risk of asthma and better attention span in children. In addition, pregnant vegan women should ensure they consume

<p><b>BREAKFAST</b>  <math>\frac{1}{2}</math> cup dry oats, cooked            1 cup 1% milk or soymilk  <math>\frac{1}{2}</math> cup blueberries  <math>\frac{1}{2}</math> medium banana, sliced            2 tablespoons slivered almonds            1 tablespoon maple syrup            529 calories</p> <p><b>LUNCH</b>            6-inch whole-wheat tortilla  <math>\frac{1}{2}</math> cup hummus            Tomato, lettuce, and cucumbers            Basil leaves, rolled and sliced thinly            Drizzle with dressing:  <math>\frac{1}{4}</math> cup lemon juice            3 tablespoons extra-virgin olive oil            2 teaspoons minced garlic            339 calories</p> <p><b>DINNER</b>            1 cup oven-roasted butternut squash cubes            1 cup steamed Haricot verts (thin green beans) with 1 teaspoon vegan margarine  <math>\frac{1}{2}</math> cup corn kernels            3 ounces oven-baked tofu marinated in teriyaki sauce  <math>\frac{1}{2}</math> cup cranberry almond quinoa salad            490 calories</p> <p><b>SNACK</b>            1 cup grapes            1 cup non-fat plain Greek or soy yogurt  <math>\frac{1}{2}</math> cup low-fat granola            444 calories</p> <p>Total calories: 1,815            Carbohydrate: 261 g (54%)            Protein: 86 g (18%)            Fat: 56 g (26%)            Fiber: 43 g</p>	<p><b>BREAKFAST</b>            2 scrambled eggs or scrambled tofu            2 corn tortillas            3 tablespoons salsa  <math>\frac{1}{2}</math> cup avocado, cubed            1 part-skim string cheese            510 calories</p> <p><b>LUNCH</b>            Pinto bean salad:  <math>\frac{1}{2}</math> cup canned pinto beans, drained  <math>\frac{1}{4}</math> cup red bell pepper, diced  <math>\frac{1}{4}</math> cup purple onion, finely diced  <math>\frac{1}{4}</math> cup cucumber, diced  <math>\frac{1}{4}</math> cup frozen corn, thawed            2 tablespoons fresh cilantro, chopped            2 tablespoons vinaigrette            2 cups mixed greens            1 tablespoon vinaigrette            1 naval orange            463 calories</p> <p><b>DINNER</b>            6 ounces pan-seared barbecued seitan (wheat gluten)            1 cup steamed cauliflower/broccoli with 1 teaspoon vegan margarine  <math>\frac{1}{2}</math> cup brown rice            Whole-wheat dinner roll with 1 teaspoon vegan margarine            414 calories</p> <p><b>SNACK</b>            Apple crisp            1 sliced apple  <math>\frac{1}{4}</math> cup dry oats            1 teaspoon lemon juice            2 teaspoons brown sugar, packed  <math>\frac{1}{2}</math> cup vanilla soy ice cream            376 calories</p> <p>Total calories: 1,763            Carbohydrate: 245 g (52%)            Protein: 77 g (16%)            Fat: 61 g (29%)            Fiber: 43 g</p>
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**Figure 1.** Two sample 1,800-calorie vegetarian meal plans for optimal nutrition.

an adequate amount of dietary or supplemental calcium.

For the pregnant adolescent or adult vegetarian, if assessment of iron, calcium, EPA, and DHA intake or status reveals a potential deficiency or lower

than optimal concentration, based on clinical judgment, RDNs should counsel the patient or client to increase intake of foods rich in these nutrients, adding foods that were fortified with them and/or taking supplements.

RDNs should design a dietary plan and offer comprehensive nutrition education and skill development on planning a diet for pregnant adult and adolescent vegetarians that provides adequate protein from a variety

of complementary mixtures of plant proteins consumed throughout the day. RDNs should ensure adequate Dietary Reference Intakes of protein and all micronutrients, particularly B-12, iron, folate, and zinc, and recommend supplementation as appropriate to ensure adequate intake.

### Infants, Children, and Adolescents

Regardless of assessment methods used, age, sex, or participant's ethnic background, vegan and vegetarian children attain adequate growth that is comparable with nonvegetarian children.<sup>63,64</sup> Although vegetarianism during the first 2 decades of life might be associated with a higher risk of deficiency of some nutrients, such as vitamins C and B-12, iron, zinc, and calcium, vegetarian children and teens are at lower risk of some health problems, such as obesity.<sup>18,30,59,65</sup> This might be, in part, a result of vegetarian children being more likely than nonvegetarian children to have a diet consistent with the Healthy People 2010 dietary guidelines, including meeting recommendations for specific foods and nutrients including fruits, vegetables, and total and saturated fat.<sup>39,40</sup> RDNs should assess micronutrient intake, particularly vitamins C and B-12, iron, zinc, and calcium, and macronutrient intake, especially protein and essential fatty acids, in children and adolescents ascribing to a vegetarian dietary pattern.

### Older Adults and the Elderly

Vegetarian diets might be beneficial for older adults and the elderly in prevention of chronic health conditions, such as heart disease and obesity, but not osteoporosis.<sup>66,67</sup> These individuals can also have a lower risk of iron deficiency compared to younger vegetarians, but may have a higher risk for a deficiency of vitamin B-12 due to a reduction in intrinsic factor. This is especially true of long-term vegetarians.<sup>31</sup>

### Ethical Choices for Vegetarian Diets

In comparison to omnivorous diets, vegetarian diets are environmentally friendlier. The increasing demand for meat and modern methods of meat production are associated with a

Vegetarian/Vegan Myths  
 Safety of Soyfoods  
 B-12 in Vegetarian Diets  
 Isoflavones in Vegetarian Diets  
 Health Effects of Soy  
 Zinc in Vegetarian Diets  
 Iron in Vegetarian Diets  
 Meeting Calcium Recommendations on a Vegan Diet  
 Choline in Vegetarian Diets  
 Vegetarian Diets in Pregnancy (Spanish translation available)  
 Vegetarian Diets During Lactation (Spanish translation available)  
 Vegetarian Infants  
 Vegetarian Diets for Toddlers and Preschoolers (Spanish translation available)  
 Vegetarian Nutrition for School-Aged Children (Spanish translation available)  
 Vegetarian Teens  
 Vegetarian Diets in Diabetes  
 Vegetarian Diets in Chronic Kidney Disease  
 Eat More Plant-Based Meals  
 Combining Vegetarian, Vegan, and Gluten-Free Diets  
 Sports Nutrition for Vegetarians  
 Protein in Vegetarian Diets  
 Therapeutic Use of Vegetarian Diets in Chronic Disease  
 Climate Change and Sustainability of Vegetarian Foods  
 Lactose Intolerance and Dairy Substitutions

**Figure 2.** Vegetarian Nutrition dietetic practice group ([www.vndpg.org](http://www.vndpg.org)) resources for registered dietitian nutritionists and consumers. These resources respond to questions or concerns regarding specific vegetarian or vegan dietary nutrients and protocols. Typically two to four pages in length, they are authored by registered dietitian nutritionists who are experts on the topic and members of the Vegetarian Nutrition dietetic practice group. These resources provide a wealth of evidence-based information and guide one to implement and maintain an appropriate nutrient-adequate vegetarian diet for all stages of the life cycle.

number of environmental problems from water, soil, and air pollution to global warming.<sup>68</sup> The livestock sector has been described by the Food and Agriculture Organization as “one of the top two or three most significant contributors to the most serious environmental problems at every scale from local to global.”<sup>69</sup> According to the US Environmental Protection Agency, about 70% of all water pollution in rivers and lakes in the United States is a result of pollution from animal farms.<sup>69</sup> Animal agriculture is associated with land degradation, water shortage, and loss of biodiversity.<sup>68</sup>

Among the examples of the environmental impact of meat production that the Food and Agriculture Organization report are 70% deforestation of the Amazon region, resulted from creating pastures and feedlots in areas previously covered by Amazon forest; 9% anthropogenic CO<sub>2</sub> emissions; 37%

anthropogenic methane; and 65% anthropogenic nitrous oxide.<sup>68</sup> Another area of concern related to modern meat production is the use of antibiotics in animal feed. A recent Centers for Disease Control and Prevention report listed this practice as one of the factors associated with antibiotic resistance. Antibiotic resistance is estimated to cause >2 million infections, resulting in at least 23,000 deaths.<sup>70</sup>

### ROLES AND RESPONSIBILITIES OF THE RDN AND NDTR

In order to effectively counsel the therapeutic or wellness adoption and implementation of, and adherence to, a vegetarian lifestyle, RDNs and NDTRs must have adequate knowledge and access to educational materials to facilitate lifestyle choices of health-promoting vegetarian diets. To that end, [Figure 1](#) identifies two generalized

- [www.VNDPG.org](http://www.VNDPG.org) (Vegetarian Nutrition [VN] dietetic practice group): Member benefits include professional information on vegetarian nutrition, registered dietitian nutritionist (RDN) resources, and quarterly newsletters.
- [www.vegetariannutrition.net](http://www.vegetariannutrition.net) (VN's consumer website): Provides a blog with evidence-based vegetarian nutrition plus RDN resources for consumers.
- [www.vrg.org](http://www.vrg.org): The Vegetarian Resource Group provides nutrition information, recipes, meal plans, and recommended readings for vegetarian nutrition.
- [www.PCRM.org](http://www.PCRM.org): The Physician's Committee for Responsible Medicine promotes preventive medicine through innovative programs and offers free patient educational materials.
- [www.PETA.org](http://www.PETA.org): People for the Ethical Treatment of Animals, an animal rights organization, also offers free vegetarian literature and menu plans.
- [www.veganhealth.org](http://www.veganhealth.org): This website offers evidence-based recommendations covering the myriad ways one can stay healthy eating plant-based diets.
- [www.vegweb.com](http://www.vegweb.com): Offers vegetarian recipes and community.
- [www.vegetarian-nutrition.info](http://www.vegetarian-nutrition.info): Offers articles, resources, and news on vegetarian nutrition.

**Figure 3.** Professional and consumer websites for vegetarian nutrition that provide information on vegetarian and vegan dietary nutrients and protocols as well as animal ethics and social and environmental issues. Many of these sites provide high-quality educational material that the registered dietitian nutritionist can rely on for patient or client education on individual nutrients of concern, meal plans, plant-based substitutions for meat-based dishes, and vegetarian nutrition concerns throughout the life cycle.

vegetarian meal plans that ensure adequate intake of macro- and micro-nutrients sufficient to support healthy intake. Additional food recommendations can be found in the 2010 Dietary Guidelines for Americans. [Figure 2](#) lists all evidence-based RDN consumer and professional resources available through the Vegetarian Nutrition dietetic practice group; while the RDN can refer clients to the consumer resources, only members of the Vegetarian Nutrition dietetic practice group have access to the professional resources. [Figure 3](#) contains useful websites that promote and encourage appropriate evidence-based recommendations and food choices for both the RDN and clientele. Additional recommendations can be found at the Academy's Evidence Analysis Library ([www.andeal.org](http://www.andeal.org)), a free benefit to all Academy of Nutrition and Dietetics members.

## CONCLUSIONS

Awareness in plant-based diets continues to grow in the United States with encouragement from governmental entities and the wide outreach of vegetarian organizations. Diverse interest and curiosity in vegetarian and vegan diets increases rapidly, especially given the abundant consumer choices that create greater ease in adherence to this dietary practice. When well designed and thought out,

vegetarian and vegan intakes provide adequate nutrition for all cycles of life, including both wellness and therapeutic uses for disease prevention and treatment. While vegetarians may have a higher risk of some nutrient deficiency (eg, vitamin B-12) compared to nonvegetarians, nutrient deficiencies are not the main cause of mortality and/or morbidity in Western societies. Vegetarians have a lower risk of most main causes of mortality, including heart disease and some cancers. Choosing a meat-free diet is deemed environmentally protective, a strong impetus for some in moving toward vegetarianism. Greater resources are now available, such as online tools and educational sites, as well as RDNs and NDTRs who are more up-to-date on vegetarian diets and who can assist the general public in making better-informed decisions about their health and intake through vegetarian nutrition, foods, and resources. RDNs and NDTR are the most optimal resources to vegetarian and vegan clients.

## References

1. Shapin S. Vegetable love: The history of vegetarianism. *The New Yorker*; January 22, 2007.
2. Hoffman SR, Stallings SF, Bessinger RC, Brooks GT. Differences between health and ethical vegetarians. Strength of conviction, nutrition knowledge, dietary restriction, and duration of adherence. *Appetite*. 2013;65:139-144.
3. Stahler C. How often do Americans eat vegetarian meals? And how many adults in the US are vegetarian? The Vegetarian Resource Group website. <http://www.vrg.org/journal/vj2011issue4/vj2011issue4poll.php>. Accessed October 10, 2013.
4. Nachay K. Targeting the new vegetarian foods consumer. *Inst Food Technol*. 2001; 65(11). <http://www.ift.org/food-technology/past-issues/2011/november/features/targeting-the-new-vegetarian-foods-consumer.aspx?page=viewall>. Accessed September 10, 2013.
5. Mintel International Group Limited. *Meat Alternatives. Executive Summary*. Chicago, IL: Mintel International Group Limited; June 2013.
6. Hoek AC, Luning PA, Weijzen P, Engels W, Kok FJ, de Graaf C. Replacement of meat by meat substitutes. A survey on person- and product-related factors in consumer acceptance. *Appetite*. 2011;56(3):662-673.
7. American Institute for Cancer Research. Recommendations for cancer prevention. [http://www.aicr.org/reduce-your-cancer-risk/recommendations-for-cancer-prevention/recommendations\\_04\\_plant\\_based.html?gclid=CJ6\\_07dpboCFcid4AodhkMAIA](http://www.aicr.org/reduce-your-cancer-risk/recommendations-for-cancer-prevention/recommendations_04_plant_based.html?gclid=CJ6_07dpboCFcid4AodhkMAIA). Accessed October 10, 2013.
8. US Department of Agriculture, US Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7th ed. Washington, DC: US Government Printing Office; 2010 <http://www.health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf>. Accessed October 10, 2013.
9. US Department of Agriculture. SuperTracker. <https://www.supertracker.usda.gov/default.aspx>. Accessed November 13, 2013.
10. Institute of Medicine. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. <http://www.iom.edu/Reports/2002/Dietary-Reference-Intakes-for-Energy-Carbohydrate-Fiber-Fat-Fatty-Acids-Cholesterol>

- ol-Protein-and-Amino-Acids.aspx. Accessed October 10, 2013.
11. Francois CA, Connor SL, Bolewicz LC, Connor WE. Supplementing lactating women with flaxseed oil does not increase docosahexaenoic acid in their milk. *Am J Clin Nutr.* 2003;77(1):226-233.
  12. Welch A, Shakya-Shrestha S, Lentjes M, Wareham N, Khaw K. Dietary intake and status of n-3 polyunsaturated fatty acids in a population of fish-eating and non-fish-eating meat-eaters, vegetarians, and vegans and the precursor-product ratio of  $\alpha$ -linolenic acid to long-chain n-3 polyunsaturated fatty acids: Results from the EPIC-Norfolk cohort. *Am J Clin Nutr.* 2010;92(5):1040-1051.
  13. Carlson SE, Colombo J, Gajewski BJ, et al. DHA supplementation and pregnancy outcomes. *Am J Clin Nutr.* 2013;97(4):808-815.
  14. World Health Organization. Interim summary of conclusions and dietary recommendations on total fat and fatty acids. [http://www.who.int/nutrition/topics/FFA\\_summary\\_rec\\_conclusion.pdf](http://www.who.int/nutrition/topics/FFA_summary_rec_conclusion.pdf). Accessed September 30, 2013.
  15. Institute of Medicine. Dietary Reference Intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc - <http://www.iom.edu/Reports/2001/Dietary-Reference-Intakes-for-Vitamin-A-Vitamin-K-Arsenic-Boron-Chromium-Copper-Iodine-Iron-Manganese-Molybdenum-Nickel-Silicon-Vanadium-and-Zinc.aspx#sthash.gITnT436.dpuf>. Accessed October 15, 2013.
  16. Deriemaeker P, Aerenhouts D, De Ridder D, Hebbelinc M, Clarys P. Health aspects, nutrition and physical characteristics in matched samples of institutionalized vegetarian and non-vegetarian elderly (>65yrs). *Nutr Metab.* 2011;14. 8(1):37.
  17. Deriemaeker P, Alewaeters K, Hebbelinc M, Lefevre J, Philippaerts R, Clarys P. Nutritional status of Flemish vegetarians compared with non-vegetarians: A matched samples study. *Nutrients.* 2010;2(7):770-780.
  18. Gorczyca D, Prescha A, Szeremeta K, Jankowski A. Iron status and dietary iron intake of vegetarian children from Poland. *Ann Nutr Metab.* 2013;62(4):291-297.
  19. Chelkowska M, Klemarczyk W, Ambroszkiewicz J, Gajewska J, Laskowska-Klita T. Iron status in children on vegetarian diet. *Pediatr Pol.* 2007;82(6):425-429.
  20. Wongprachum K, Sanchaisuriya K, Sanchaisuriya P, Siridamrongvattana S, Manpeun S, Schlep FP. Proxy indicators for identifying iron deficiency among anemic vegetarians in an area prevalent for thalassemia and hemoglobinopathies. *Acta Haematol.* 2012;127(4):250-255.
  21. Drake R, Reddy S, Davies J. Nutrient intake during pregnancy and pregnancy outcome of lacto-ovo-vegetarians, fish-eaters and non-vegetarians. *Veg Nutr.* 1998;2:45-52.
  22. United Nations Children's Fund, United Nations University, World Health Organization. Iron deficiency anaemia assessment, prevention, and control. A guide for programme managers. [http://www.who.int/nutrition/publications/micronutrients/anaemia\\_iron\\_deficiency/WHO\\_NHD\\_01\\_3/en/](http://www.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/WHO_NHD_01_3/en/). Accessed September 12, 2013.
  23. Foster M, Chu A, Petocz P, Samman S. Effect of vegetarian diets on zinc status: A systematic review and meta-analysis of studies in humans. *J Sci Food Agric* 2013;(15). 93:2362-2371.
  24. Institute of Medicine. Dietary Reference Intakes for calcium and vitamin D. <http://www.iom.edu/Reports/2010/Dietary-Reference-Intakes-for-calcium-and-vitamin-D.aspx>. Accessed October 17, 2013.
  25. Larsson CL, Johansson GK. Dietary intake and nutritional status of young vegans and omnivores in Sweden. *Am J Clin Nutr.* 2002;76(1):100-106.
  26. Appleby P, Roddam A, Allen N, Key T. Comparative fracture risk in vegetarians and nonvegetarians in EPIC-Oxford. *Eur J Clin Nutr.* 2007;61(12):1400-1406.
  27. Outila TA, Kärkkäinen MU, Seppänen RH, Lamberg-Allardt CJ. Dietary intake of vitamin D in premenopausal, healthy vegans was insufficient to maintain concentrations of serum 25-hydroxyvitamin D and intact parathyroid hormone within normal ranges during the winter in Finland. *J Am Diet Assoc.* 2000;100(4):434-441.
  28. Crowe FL, Steur M, Allen NE, Appleby PN, Travis RC, Key TJ. Plasma concentrations of 25-hydroxyvitamin D in meat eaters, fish eaters, vegetarians and vegans: Results from the EPIC-Oxford study. *Public Health Nutr.* 2011;14(2):340-346.
  29. Chan J, Jaceldo-Siegl K, Fraser GE. Serum 25-hydroxyvitamin D status of vegetarians, partial vegetarians, and nonvegetarians: The Adventist Health Study-2. *Am J Clin Nutr.* 2009;89(5):1686S-1692S.
  30. Ambroszkiewicz J, Klemarczyk W, Gajewska J, et al. Effect of vitamin D supplementation on serum 25-hydroxyvitamin D and bone turnover markers concentrations in vegetarian children. *Med Wieku Rozwoj.* 2009;13(1):34-39.
  31. Pawlak R, Parrott SJ, Raj S, Cullum-Dugan D, Lucus D. How prevalent is vitamin B12 deficiency among vegetarians? *Nutr Rev.* 2013;71(2):110-117.
  32. Obersby D, Chappell DC, Dunnett A, Tsiami AA. Plasma total homocysteine status of vegetarians compared with omnivores: A systematic review and meta-analysis. *Br J Nutr.* 2013;109(5):785-794.
  33. Dror DK, Allen LH. Effect of vitamin B12 deficiency on neurodevelopment in infants: current knowledge and possible mechanisms. *Nutr Rev.* 2008;66(5):250-255.
  34. Rusher DR, Pawlak R. A review of 89 published case study of vitamin B12 deficiency. *J Hum Nutr Food Sci.* 2013; 1(2):1008. <http://www.jsimedcentral.com/Nutrition/Articles/nutrition-1-1008.pdf>. Accessed October 12, 2013.
  35. Forestell CA, Spaeth AM, Kane SA. To eat or not to eat red meat. A closer look at the relationship between restrained eating and vegetarianism in college females. *Appetite.* 2012;58(1):319-325.
  36. Timko CA, Hormes JM, Chubski J. Will the real vegetarian please stand up? An investigation of dietary restraint and eating disorder symptoms in vegetarians versus non-vegetarians. *Appetite.* 2012; 58(3):982-990.
  37. Fisak B, Peterson RD, Tantleff-Dunn S, Molnar JM. Challenging previous conceptions of vegetarianism and eating disorders. *Eat Weight Disord.* 2006;11(4):195-200.
  38. Bardone-Cone AM, Fitzsimmons-Craft EE, Harney MB, et al. The inter-relationships between vegetarianism and eating disorders among females. *J Acad Nutr Diet.* 2012;112(8):1247-1252.
  39. Robinson-O'Brien R, Perry CL, Wall MM, Story M, Neumark-Sztainer D. Adolescent and young adult vegetarianism: Better dietary intake and weight outcomes but increased risk of disordered eating behaviors. *J Am Diet Assoc.* 2009;109(4):648-655.
  40. Perry CL, McGuire MT, Neumark-Sztainer D, Story M. Adolescent vegetarians: How well do their dietary patterns meet the Healthy People 2010 objectives? *Arch Pediatr Adolesc Med.* 2002;156(5):431-437.
  41. US Department of Health and Human Services, Centers for Disease Control and Prevention. Health, United States, 2012. <http://www.cdc.gov/nchs/data/healthysus/12.pdf#063>. Accessed November 15, 2013.
  42. Turner-McGrievy GM, Barnard ND, Scialli AR. A two-year randomized weight loss trial comparing a vegan diet to a more moderate low-fat diet. *Obesity.* 2007;15(9):2276-2281.
  43. Ferdowsian HR, Barnard ND. Effects of plant-based diets on plasma lipids. *Am J Cardiol.* 2009;104(7):947-956.
  44. Pettersen BJ, Anousheh R, Fan J, Jaceldo-Siegl K, Fraser GE. Vegetarian diets and blood pressure among white subjects: Results from the Adventist Health Study-2 (AHS-2). *Public Health Nutr.* 2012; 15(10):1909-1916.
  45. Barnard ND, Katcher HI, Jenkins DJ, Cohen J, Turner-McGrievy G. Vegetarian and vegan diets in type 2 diabetes management. *Nutr Rev.* 2009;67(5):255-263.
  46. Tonstad S, Butler T, Yan R, Fraser GE. Type of vegetarian diet, body weight, and prevalence of type 2 diabetes. *Diab Care.* 2009;32(5):791-796.
  47. Yang SY, Li XJ, Zhang W, et al. Chinese lacto-vegetarian diet exerts favorable effects on metabolic parameters, intima-media thickness, and cardiovascular risks in healthy men. *Nutr Clin Pract.* 2012;27(3):392-398.
  48. Huang T, Yang B, Zheng J, Li G, Wahlqvist ML, Li D. Cardiovascular disease mortality and cancer incidence in vegetarians: A meta-analysis and systematic review. *Ann Nutr Metab.* 2012; 60(4):233-240.
  49. Orlich MJ, Singh PN, Sabaté J, et al. Vegetarian dietary patterns and mortality in Adventist Health Study 2. *JAMA Intern Med.* 2013;173(13):1230-1238.
  50. Crowe FL, Appleby PN, Travis RC, Key TJ. Risk of hospitalization or death from ischemic heart disease among British vegetarians and nonvegetarians: Results from the EPIC-Oxford cohort study. *Am J Clin Nutr.* 2013;97(3):597-603.
  51. Kwok T, Chook P, Qiao M, et al. Vitamin B-12 supplementation improves arterial function in vegetarians with subnormal

- vitamin B-12 status. *J Nutr Health Aging*. 2012;16(6):569-573.
52. Elmadfa I, Singer I. Vitamin B-12 and homocysteine status among vegetarians: A global perspective. *Am J Clin Nutr*. 2009; 89(5):1693S-1698S.
  53. Ornish D. Avoiding revascularization with lifestyle changes: The Multicenter Lifestyle Demonstration Project. *Am J Cardiol*. 1998;82(10B):72T-76T.
  54. Ornish D, Brown S, Scherwitz L, et al. Can lifestyle changes reverse coronary heart disease? *Lancet*. 1990;336(8708):129-133.
  55. Esselstyn C. Updating a 12-year experience with arrest and reversal therapy for coronary heart disease (an overdue requiem for palliative cardiology). *Am J Cardiol*. 1999;84(3):339-341.
  56. Appleby PN, Davey GK, Key TJ. Hypertension and blood pressure among meat eaters, fish eaters, vegetarians and vegans in EPIC-Oxford. *Public Health Nutr*. 2002; 5(5):645-654.
  57. Tantamango-Bartley Y, Jaceldo-Siegl K, Fan J, Fraser G. Vegetarian diets and the incidence of cancer in a low-risk population. *Cancer Epidemiol Biomarkers Prev*. 2013;22(2):286-294.
  58. Key T, Appleby P, Spencer E, et al. Cancer incidence in British vegetarians. *Br J Cancer*. 2009;101(1):192-197.
  59. Ambroszkiewicz J, Klemarczyk W, Gajewska J, Chelchowska M, Laskowska-Klita T. Serum concentration of biochemical bone turnover markers in vegetarian children. *Adv Med Sci*. 2007;52:279-282.
  60. Ho-Pham LT, Nguyen ND, Nguyen TV. Effect of vegetarian diets on bone mineral density: A Bayesian meta-analysis. *Am J Clin Nutr*. 2009;90(4):943-950.
  61. Lousuebsakul-Matthews V, Thorpe DL, Knutsen R, Beeson WL, Fraser GE, Knutsen SF. Legumes and meat analogues consumption are associated with hip fracture risk independently of meat intake among Caucasian men and women: The Adventist Health Study-2. *Public Health Nutr*. 2013;17(10):2333-2343.
  62. Bennett M. Vitamin B12 deficiency, infertility and recurrent fetal loss. *J Reprod Med*. 2001;46(3):209-212.
  63. Nathan I, Hackett AF, Kirby S. The dietary intake of a group of vegetarian children aged 7-11 years compared with matched omnivores. *Br J Nutr*. 1996;75(4):533-544.
  64. Sabaté J, Lindsted KD, Harris RD, Sanchez A. Attained height of lactoovo-vegetarian children and adolescents. *Eur J Clin Nutr*. 1991;45(1):51-58.
  65. Sabaté J, Wien M. Vegetarian diets and childhood obesity prevention. *Am J Clin Nutr*. 2010;91(5):1525S-1529S.
  66. Löwik MR, Schrijver J, Odink J, van den Berg H, Wedel M. Long-term effects of a vegetarian diet on the nutritional status of elderly people (Dutch Nutrition Surveillance System). *J Am Coll Nutr*. 1990;9(6):600-609.
  67. Brants HA, Löwik MR, Westenbrink S, Hulshof KF, Kistemaker C. Adequacy of a vegetarian diet at old age (Dutch Nutrition Surveillance System). *J Am Coll Nutr*. 1990;9(4):292-302.
  68. United Nations Food and Agriculture Organization. Livestock's long shadow. Environmental issues and options. <ftp://ftp.fao.org/docrep/fao/010/a0701e/a0701e.pdf>. Accessed October 22, 2013.
  69. US Environmental Protection Agency, Office of Water. Environmental assessment of proposed revisions to the national pollutant discharge elimination system regulation and the effluent guidelines for concentrated animal farming operations. <http://water.epa.gov/scitech/wastetech/guide/cafo/proposedrule-docs.cfm>. Accessed October 30, 2013.
  70. Centers for Disease Control and Prevention. Antibiotic resistance treats in the United States, 2013. <http://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf>. Accessed November 12, 2013.

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