How to Monitor and Advise Vegans to Ensure Adequate Nutrient Intake

Heather Fields, MD; Barbara Ruddy, MD; Mark R. Wallace, MD; Amit Shah, MD; Denise Millstine, MD; and Lisa Marks, MLS

According to a 2012 report, 2% of the US population follows a vegan diet, which is a strict plant-based diet that excludes all animal-derived foods. Increasingly, people are choosing to follow this diet for ethical, environmental, religious, and health concerns. The increase in patients following a vegan diet can lead to requests for provider advice about the safety of this dietary pattern. Several studies have demonstrated health benefits of plant-based diets, including improvements in ischemic heart disease mortality, as well as decreases in hypertension, hyperlipidemia, obesity, type 2 diabetes mellitus, and cancer incidence. Despite these benefits, could vegans be at risk for deficiency of essential nutrients? The present article concisely summarizes the recent literature examining potential negative consequences of a vegan diet and assists clinicians in their conversations with patients.

The Evidence

In December 2014, we performed an independent literature review of the PubMed, EMBASE, and Medline databases from 2004 to the present. The following search terms were used: vegan, risk, safety, vitamin B₁₂, protein, amino acids, iron, calcium, omega-3 fatty acids, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). We included all prospective cohort, cross-sectional, and review articles on the proposed risks associated with vegan diets. Non-English studies and studies regarding the health benefits of a vegan diet and effects in pregnancy and breastfeeding were excluded. We identified 167 titles and abstracts and reviewed relevant full texts and pertinent references. The Table identifies nutrients of concern and sources of those nutrients for vegans, and the Figure provides suggested actions for primary care physicians.

Clinical Question: Do nutritional risks exist for vegans?

Evidence: Vegans may be at increased risk for deficiencies in vitamin B₁₂, iron, calcium, vitamin D, omega-3 fatty acids, and protein; however, implications are not always clear.

Recommendation: Physicians should encourage vegan patients to vary their sources of nutrients. Periodic monitoring of serum nutrient levels is also recommended.

Vitamin B₁₂

Plant foods contain a negligible amount of vitamin B₁₂; thus, vegans have difficulty meeting the recommended daily allowance (2.4 μg) and maintaining adequate serum concentrations of B₁₂. In a cross-sectional study of 689 men, 121 of 232 vegans (52%) were B₁₂ deficient (<118 pmol/L), whereas only 1 of 226 omnivores (0%) was B₁₂ deficient. A prospective study of 20 omnivores who adopted a vegan diet over 5 years showed that B₁₂ levels were only maintained in the patients who consumed B₁₂-fortified products. Vitamin B₁₂ deficiency can cause cognitive disorders, neuropathies, weakness, and macrocytic anemia, which can result in fatigue and low energy. Deficiency also affects digestion and absorption of nutrients and metabolism of serotonin and melatonin. Vegetarians have a lower risk of death from ischemic heart disease; however, low B₁₂ levels have been associated with worsening of some cardiovascular markers. A cross-sectional study of 154 vegans revealed an elevated homocysteine level in 66% of participants, of whom 93% also had low B₁₂ levels (<250 pmol/L). A 2014 review identified elevated homocysteine level, impaired brachial flow-mediated endothelial dilation, and increased carotid intimal medial thickness in patients with low B₁₂ levels. These effects were improved with B₁₂ supplementation.
Considering the frequency of B₁₂ deficiency in vegans, providers should advise vegans to take supplemental B₁₂ or eat B₁₂-fortified foods. To ensure adequate intake, periodic monitoring of B₁₂ levels should be considered.

**Iron**

Iron deficiency is one of the most common nutritional deficiencies worldwide.²⁰ Although the overall iron intake in vegans is surprisingly greater than that in omnivores, levels of ferritin, which stores iron, are often lower in vegans.¹⁴,²¹,²² Absorption and storage is affected by the bioavailability of nonheme iron (plant sources) being less than that of heme iron (animal sources).¹⁴,²⁰ The vegan diet contains nutrients that both enhance and inhibit iron absorption, such as organic acids and phytates, respectively, leading to variable iron levels.⁴,²⁰ Iron deficiency is more prevalent in young vegan women compared with older vegan women²⁰ and men and women following omnivore diets.²¹

Periodic assessments of anemia and iron status should be considered for all vegans but especially for vegan children and women of childbearing age. Health care professionals should encourage patients with documented low ferritin levels to take a bioavailable supplement with absorption-enhancing foods.

**Calcium and Vitamin D**

Multiple studies have documented lower intake of calcium and vitamin D in vegans,²⁰²³ yet the implications of a vegan diet in bone health, particularly bone mineral density (BMD), have been varied. Several investigations have demonstrated lower BMD in vegans compared with nonvegans,²³⁻²⁶ whereas 1 study showed no difference.²⁷ Data on fracture incidence are also mixed. In 1 study, fracture incidence was 30% higher in vegans than in nonvegans, though participants with a minimum daily calcium intake of 525 mg had no increase in fractures.²⁸ A prospective longitudinal study of Asian women found no statistically significant difference in fracture incidence between vegans and nonvegans.²⁹

Gastrointestinal calcium absorption increases when dietary calcium intake is low, and lower animal protein intake decreases renal calcium excretion. Thus, the skeletal effects of a vegan diet might be attenuated. The higher intake of vitamin K and phytoestrogens and increased alkalinity of vegan diets are also thought to improve BMD.

Many factors affect bone health. Osteoporosis, fracture risk, and vitamin D deficiency are not unique to the vegan diet; nevertheless, health care professionals should advise vegans to consume at least 525 mg of calcium and 15 μg of vitamin D per day. Periodic monitoring of BMD could be considered, but recent evidence is not conclusive.

**Omega-3 Fatty Acids (EPA and DHA)**

Two essential fatty acids must be acquired in the diet because the human body cannot make them: linoleic acid (LA) and α-linolenic acid (ALA). Linoleic acid is the main component of most vegetable-based oils; consequently, the vegan diet need only include vegetable fat to avoid deficiency. α-Linolenic acid is found in many vegan foods: soy, soybean oil, canola (rapeseed) oil, walnuts, and flaxseeds. Two additional fatty acids, EPA and DHA, are deficient in the vegan diet. Vegans do not ingest EPA or DHA unless they consume large amounts of seaweed, so they are dependent on synthesis of these fatty acids from ALA. The health effects of lower levels of EPA and DHA remain

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Vegan Sources</th>
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<tbody>
<tr>
<td>Vitamin B₁₂</td>
<td>Cereal, fortified soy and rice milk, meat analogs, nutritional yeast, supplements</td>
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<tr>
<td>Calcium</td>
<td>Blackstrap molasses, collard greens, fortified plant milks and juices</td>
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<tr>
<td>Vitamin D</td>
<td>Fortified plant milk; ultraviolet B–exposed mushrooms</td>
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<tr>
<td>Omega-3 fatty acids (EPA, DHA)</td>
<td>Algae (EPA and DHA), chia, flaxseed, walnuts</td>
</tr>
<tr>
<td>Iron</td>
<td>Spinach, collard greens, lentils, soybeans, tofu</td>
</tr>
<tr>
<td>Essential amino acids</td>
<td>Soy, quinoa, buckwheat, hempseed, chia, legumes</td>
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Abbreviations: DHA, docosahexaenoic acid; EPA, eicosapentaenoic acid.
vegans, the total reported protein intake was lower compared with the national average for men (65 vs 87 g/d) and women (47 vs 66 g/d) but still met the Institute of Medicine’s recommendations. A prospective trial of omnivores placed on a vegan diet for 18 weeks showed a decline of only 1.1% in total protein calories.

Despite these reports, protein intake remains a concern. Essential amino acids must be ingested because the body is incapable of manufacturing them independently. Plant sources are commonly believed to be incomplete sources of protein and to lack at least 1 essential amino acid. A specific food source may have low levels of a specific amino acid, but none is completely absent. No evidence has shown that vegans become deficient in specific amino acids.

To ensure appropriate protein levels, providers should advise vegans that they will achieve adequate essential amino acid and protein intake by varying the plant sources that comprise their diet.

Conclusion
A vegan diet has many health benefits but is not without risk of dietary deficiencies. Health care professionals should ask patients about their dietary practices and assess for possible nutrient deficiencies through physical examination, periodic serum monitoring (including complete blood cell count, vitamin B12, iron, calcium, and vitamin D), and perhaps BMD monitoring. (doi:10.7556/jaoa.2016.022)

References


