Vegetarian Nutrition

VN: Major Recommendations (2011)

Vegetarian Nutrition (VN) Evidence-Based Nutrition Practice Guideline: Major Recommendations

Below, you will find a list of Vegetarian Nutrition recommendations. Click on each link to view the recommendation. You can also print the guideline material in PDF format.

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Intervention

Children and Adolescents

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Adults, Children and Adolescents

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  - VN: Diet Diversity of Vegetarian Diets for Children, Adolescents and Adults
- VN: Macronutrient Intake of Adult, Child and Adolescent Vegetarians
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  - VN: Essential Fatty Acid Intake of Adult, Child and Adolescent Vegetarians

Adults

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  - VN: Micronutrient Intake of Adult Vegetarians
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  - VN: Nutrition Counseling to Support Therapeutic Vegetarian Diets for Adults

Pregnant Adolescents and Adults

- VN: Macronutrient Intake in Adolescent and Adult Vegetarians During Pregnancy
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- VN: Micronutrient Intake in Adolescent and Adult Vegetarians During Pregnancy
  - VN: Micronutrient Intake in Pregnant Adolescent and Adult Vegetarians
  - VN: Vitamin B-12 Intake in Pregnant Adolescent and Adult Vegetarians

Treating Disease with a Vegetarian Diet

Children and Adolescents

- None.

Adults, Children and Adolescents

- None.

Adults

Hypercholesterolemia

- VN: Hyperlipidemia Treatment with a Vegetarian Diet for Adults
    - VN: Treating Hyperlipidemia with a Vegetarian Diet for Adults

Obesity

- VN: Overweight and Obesity Treatment with a Vegetarian Diet for Adults
    - VN: Treating Overweight and Obesity with a Vegetarian Diet for Adults

Diabetes

- VN: Type 2 Diabetes Treatment with a Vegetarian Diet for Adults
    - VN: Treating Type 2 Diabetes with a Vegetarian Diet for Adults

Pregnant Adults and Adolescents

- None

Monitoring and Evaluation

Children and Adolescents

- None

Adults, Children and Adolescents

- None

Adults

- VN: Monitoring Adherence to Vegetarian Diet Prescriptions for Adults
    - VN: Adherence to a Vegetarian Therapeutic Diet for Adults
    - VN: Adherence to Vegetarian Diets for Treatment of Overweight or Obesity for Adults

Pregnant Adults and Adolescents

- None.

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Assessing Food and Nutrient Intake of Child and Adolescent Vegetarians 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

VN: Assessing Micronutrient Intake of Adolescent Vegetarians

For adolescent vegetarians, the Registered Dietitian (RD) should assess micronutrient intake, particularly iron, zinc, vitamin C and vitamin B-12. Research from a limited number of Western countries indicates that adolescent vegetarians or semi-vegetarians (11 to 19 years) may have lower intake than national standards for micronutrients such as iron, zinc and vitamin C. In addition, two studies measuring methylmalonic acid (MMA) levels showed that lacto-ovo vegetarian/lacto-vegetarian (LOV/LV) or omnivorous adolescents (9 to 15 years) who had followed a very restrictive vegetarian diet (macrobiotic) early in life, may be at risk for vitamin B-12 deficiency (41% of adolescents had MMA >290nmol/L and 21% had MMA >410nmol/L).

Rating: Strong
Imperative

VN: Assessing Dietary Intake of Adolescent Vegetarians

For adolescent vegetarians, the Registered Dietitian (RD) should assess intake of foods rich in calcium (e.g., dairy products, kale, broccoli, fortified soy milk, etc.). Research indicates that although dietary patterns differ among countries, adolescent vegetarians (11 to 19 years) tended to consume fewer dairy products.

Rating: Strong
Imperative

VN: Assessing Micronutrient Intake of Vegetarian Children

For vegetarian children, the Registered Dietitian (RD) should assess micronutrient intake, particularly vitamin B-12. Research studies measuring methylmalonic acid (MMA) levels, indicate that small children (10 months to 11.7 years) of parents who follow a macrobiotic diet, had a high prevalence of vitamin B-12 deficiency (55 to 85%).

Rating: Weak
Imperative

VN: Assessing Macronutrient Intake of Child and Adolescent Vegetarians

For child and adolescent vegetarians, the Registered Dietitian (RD) should assess intake of protein and essential fatty acids (EFA). While meeting protein requirements is typically not an issue with vegetarian diets, the RD can recommend that children and adolescents include complementary mixtures of plant proteins. This can be achieved by consuming a varied diet throughout the day. In addition, some research suggests that blood and tissue eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) levels may be sub-optimal among patients who follow a vegetarian dietary pattern.

Rating: Consensus

Imperative

- Risks/Harms of Implementing This Recommendation

  There are no potential risks or harms associated with the application of this recommendation.

- Conditions of Application

  - Patient or client is a child (0 to 12 years) or adolescent (13 to 18 years) and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - Nutritional assessment may be limited by under- or over-reporting of dietary intake
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may be even less costly.

- Recommendation Narrative

  A total of 11 studies were included in the evidence analysis for this recommendation:

  - Five positive quality cross-sectional studies (Perry et al, 2002; Schneede et al, 1994; van Dusseldorp et al, 1999; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998)
  - Six neutral quality cross-sectional studies (Dhonukshe-Rutten et al, 2005; Donovan and Gibson, 1996; Greene-Finestone et al, 2005; Larsson et al, 2001; Miller et al, 1991; and Neumark-Sztainer et al, 1997).

  Food and Nutrient Intake of Adolescent Vegetarians

  - Seven studies from a limited number of Western countries provide evidence for the following:
    - Adolescent vegetarians or semi-vegetarians may be more likely than adolescent omnivores to meet general national standards for some nutrients. However, they may also have lower intake than national standards for micronutrients such as iron, zinc and vitamin C. Because of the limited nature of the studies available, other nutrients, such as vitamin B-12, may also be of concern.
    - Research on the dietary intake of adolescent vegetarians from several countries indicated that although the patterns differ somewhat among countries, adolescent vegetarians tended to consume fewer dairy products, snack foods and sweets than omnivorous adolescents. They tended to consume more vegetables than their omnivorous peers. Outside the US and Canada, adolescents who considered themselves vegetarian tended to eat more chicken or fish than their omnivorous counterparts.
  - Evidence is based on the following studies: Donovan and Gibson, 1996; Greene-Finestone et al, 2005; Larsson et al, 2001; Neumark-Sztainer et al, 1997; Perry et al, 2002; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998
  - The studies were carried out on Swedish, Norwegian, US, Canadian and Australian populations.

  Markers of Vitamin B-12 Status

  - There is no universally accepted measure for determining vitamin B-12 deficiency. Because research indicates that serum B-12 may not be a reliable marker for B-12 deficiency, other measures, such as HoloTC or methylmalonic acid (MMA) either separately or in combination, may provide better measures of vitamin B-12 status. MMA is a biomarker for cellular or tissue (B-12 status) because it is an intermediate in a vitamin B-12 dependent metabolic pathway. Compared to measurement of serum B-12 levels alone, MMA and homocysteine have been shown to be more sensitive in diagnosing early vitamin B-12 deficiency (Oh and Brown, 2003). While homocysteine levels increase in both folate and vitamin B-12 deficiency, increased MMA is specific to a vitamin B-12 deficiency. Thus, research was included in this evidence analysis only if MMA level was used to identify vitamin B-12 deficiency.
  - Estimating the proportion of vegetarian subjects who were vitamin B-12 deficient based on MMA levels depended on the way that the reference levels of MMA were determined. Authors differed regarding the methods they used to determine vitamin B-12 deficiency.

  Vitamin B-12 Status of Infants and Children

  - Two studies provide limited, but consistent evidence that small children of parents who follow very restrictive vegetarian diets are likely to be deficient in vitamin B-12 as measured by MMA. The proportion of these children who were vitamin B-12 deficient ranged from 55 to 85%.
  - Evidence is based on the following studies: Miller et al, 1991; and Schneede et al, 1994
  - Neither study appeared to assess whether vitamin supplements were taken nor do they control for supplementation.

  Vitamin B-12 Status of Adolescents

  - Two studies of the same group of subjects provide evidence that adolescent vegetarians who followed restrictive diets in childhood may be at risk for vitamin B-12 deficiency. Vegetarian (LOV/LV) or omnivorous adolescents who had followed a very restrictive (macrobiotic) vegetarian diet early in life were likely to be vitamin B-12 deficient. Forty-one percent of adolescents had MMA >290nmol/L and 21% had MMA >410nmol/L.
  - Evidence is based on the following studies: Dhonukshe-Rutten et al, 2005; and van Dusseldorp et al, 1999
  - Neither study reported on whether subjects consumed colbalamin supplements.

  Protein

  - Protein quality is determined primarily by digestibility and the amino acid composition of the protein. The quality of the protein source is based on the nitrogen and amino acids provided for growth, maintenance, and repair. Different protein sources vary in chemical composition and nutritional value. In food, it is the contribution of all of the amino acids to the total nitrogen content that must be considered in assessing the overall protein quality of the diet (IOM, 2005).
  - Vegetarian diets that include complementary mixtures of plant proteins can provide the same quality of protein as that from animal proteins. While plant proteins are generally less digestible than animal proteins, the digestibility can be altered through processing and preparation. Vegetarians can have an adequate intake of protein by consuming a varied diet (IOM, 2005).

  Essential Fatty Acids

  - Several studies have reported that there is potential for vegetarians to be deficient in EFA such as EPA and DHA. Limited research suggests that DHA levels are lower in pregnant vegetarian women (Mangels et al, 2011)
  - Vegetarians (and particularly vegans) tend to have lower blood levels of EPA and DHA, compared to non-vegetarians (Craig, 2010)
  - While one study found that vegan children had high intakes of linoleic acid compared to linolenic acid, it may be prudent for patients to consume diets that enhance conversion of linolenic acid to DHA (Messina, 2001).

- Recommendation Strength Rationale

  - Grade II evidence is available for the conclusion statement regarding food intake of adolescent vegetarians compared to adolescent omnivores
  - Grade III evidence is available for the following conclusion statements regarding:
    - Nutrient intakes of adolescent vegetarians compared to omnivores and nutritional standards
    - Vitamin B-12 status of children of vegetarians and among adolescent vegetarians, as measured by MMA
  - Consensus Statements
    - Consensus: Specific questions about assessing protein and EFA intake were not analyzed as part of the evidence analysis process, thus, the macronutrient recommendation is based on consensus publications.

- Minority Opinions

None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  What is the vitamin B-12 status of children of vegetarians, as measured by methylmalonic acid (MMA)?

  What is the vitamin B-12 status among adolescent vegetarians, as measured by methylmalonic acid (MMA)?

  What are the nutrient intakes of adolescent vegetarians compared to omnivores and nutritional standards?

  How does food intake of adolescent vegetarians compare to adolescent omnivores?

  - References

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  - References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

    A Report of the Panel on Micronutrients, Subcommittees on Upper Reference Levels of Nutrients and of Interpretation and Uses of Dietary Reference Intakes, and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. Food and Nutrition Board. Institute of Medicine. Washington, DC, *The National Academies Press;* 2001. Accessed online: http://www.nap.edu/openbook.php?record_id=10026&page=R1.

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    Subcommittees on Upper Reference Levels of Nutrients and Interpretation and Uses of Dietary Reference Intakes, and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty acids, Cholesterol, Protein and Amino Acids. Food and Nutrition Board. Institute of Medicine. Washington DC, *The National Academies Press*; 2005. Accessed online August 01, 2011: http://books.nap.edu/openbook.php?record_id=10490.

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Assessing Knowledge, Beliefs and Motivations of Adult, Child and Adolescent Vegetarians 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Assessing Knowledge and Beliefs of Adult, Child and Adolescent Vegetarians

  For adult, child and adolescent vegetarians, the Registered Dietitian (RD) should assess knowledge and beliefs about a vegetarian diet. Research indicates that vegetarian dietary patterns vary and fluctuate over time. Even within types of vegetarian diets, individuals may not always include a variety of healthful foods in their diet. Vegetarians who are on highly restrictive diets resulting from unhealthful food choices, may be at nutritional risk. Specific nutrient considerations may need to be addressed in some vegetarian dietary patterns for optimal nutrition.

Rating: Strong
Imperative

VN: Assessing Motivations that Influence Vegetarian Dietary Lifestyle for Adults and Children

For adult, child and adolescent vegetarians, the Registered Dietitian (RD) should assess reasons for following a vegetarian lifestyle. Research indicates that the motivations for being vegetarian (e.g., health, ethical, environmental, cultural or religious, etc.) influence dietary practices which may impact nutrient intake. Dietary patterns based on health beliefs may be more flexible than dietary patterns based on religious or moral convictions.

Rating: Strong
Imperative

- Risks/Harms of Implementing This Recommendation

  There are no potential risks or harms associated with the application of this recommendation.

- Conditions of Application

  - Patient or client self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - Vegetarian diet has been recommended to the patient by a health care professional for therapeutic reasons
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and enriched products purchased in bulk may even be less expensive.

- Recommendation Narrative

  A total of 34 studies were included in the evidence analysis for this recommendation:

  - Twelve positive quality cross-sectional studies (Aarnio and Lindeman, 2004; Dagnelie et al, 1994; Draper et al, 1993; Fessler et al, 2003; Gale et al, 2007; Greene-Finestone et al, 2008; Greenwood et al, 2000; Lea and Worsley, 2002; Lea and Worsley, 2003; Melby et al, 1994, Perry et al, 2002; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998)
  - One positive quality narrative review (Sabate, 2003)
  - Ten neutral quality cross-sectional studies (Bas et al, 2005; Donovan and Gibson, 1996; Dwyer, 1999; Greene-Finestone et al 2005; Larsson et al, 2001; Martins et al, 1999; Nardoto et al, 2006; Neumark-Sztainer et al, 1997; Padmadas et al, 2006; and Perry et al, 2001)
  - Two neutral quality descriptive studies (Barr and Chapman, 2002; Hobbs, 2005; Jabs et al, 1998; and Larsson et al, 2003)
  - One neutral quality ethnograpic study (Beardsworth and Keil, 1992)
  - One neutral quality longitudinal study (Kim et al, 1999)
  - One neutral panel design study (Spencer et al, 2007)
  - One negative quality narrative review (Jacobs and Dwyer, 1988)
  - Two negative quality cross-sectional studies (Santos and Booth, 1996; and Kenyon and Barker, 1998).

  Research on different types of vegetarian diets and the eating patterns of people self-identifying as vegetarian demonstrates that, empirically, vegetarianism encompasses a very broad range of dietary practices and patterns--not all of which are healthful.

  Additionally, research examining actual vegetarian intake frequently finds that a substantial proportion of those who consider themselves vegetarians eat fish (and sometimes poultry) occasionally to regularly. Patients or clients who are trying to follow a completely animal product-free diet (a vegan diet) may not be aware of animal products added to some processed foods.

  Diet Diversity
  - Twenty-one studies provide evidence that the two most common ways of defining vegetarian diets in the research are:
    - Vegan diets: Diets devoid of all flesh foods,
    - Vegetarian Diets: Diets devoid of all flesh foods, but also include egg (ovo) and/or dairy (lacto) products
  - However, these very broad categories mask important variations within vegetarian diets and dietary practices. These variations within vegetarian diets make absolute categorization of vegetarian dietary practices difficult and may be one of the sources of unclear relationships between vegetarian diets and other factors.
  - Evidence is based on the following studies: Barr and Chapman, 2002; Beardsworth and Keil, 1992; Dagnelie et al, 1994; Donovan et al, 1996; Draper et al, 1993; Dwyer, 1999; Fessler et al, 2003; Greene-Finestone et al 2005; Greenwood et al, 2000; Hobbs, 2005; Jacobs and Dwyer, 1988; Larsson et al, 2001; Lea and Worsley, 2003; Melby et al, 1994; Nardoto et al, 2006; Padmadas et al, 2006; Perry et al, 2002; Perry et al, 2001; Sabate, 2003; Worsley and Skrzypiec, 1998; and Worsley and Skrzypiec, 1997.

  Dietary Patterns/Social Definitions

  - Eight studies provide evidence that vegetarianism is a fluid concept. Research shows that it is common for individuals who consider themselves vegetarian to change dietary patterns over time, sometimes becoming more restrictive, sometimes less so. Additionally, societal perspectives on vegetarianism change over time. It is more common now for individuals to be vegetarian for ethical or environmental reasons vs. 30 years ago. Likewise, it is more common for research to focus on the health benefits of vegetarianism and plant-based diets than in decades past when the focus tended to be on potential nutrient deficiencies associated with vegetarian diets.
  - Evidence is based on the following studies: Barr and Chapman, 2002; Beardsworth and Keil, 1992; Dagnelie et al, 1994; Draper et al, 1993; Jabs et al, 1998; Kim et al, 1999; Larsson et al, 2003; and Sabate, 2003.

  Motivations for Vegetarianism in Adults and Children

  - Twenty studies provide evidence that although motivations for following a vegetarian lifestyle are complex, research on Western populations identifies common reasons for being vegetarian, including: Ethical and environmental concerns, religious concerns, health reasons and gustatory reasons. Some individuals with eating disorders may adopt a vegetarian diet as a means of weight control. Research also indicates that dietary patterns vary depending on the motivation behind a vegetarian lifestyle.
  - Evidence is based on the following studies: Aarnio and Lindeman, 2004; Barr and Chapman, 2002; Bas et al, 2005; Beardsworth and Keil, 1992; Dagnelie et al, 1994; Fessler et al, 2003; Greene-Finestone et al, 2008; Greene-Finestone et al, 2005; Jabs et al, 1998; Kenyon and Barker, 1998; Kim et al, 1999; Larsson et al, 2003; Lea and Worsley, 2002; Lea and Worsley, 2003; Martins et al, 1999; Neumark-Sztainer et al, 1997; Perry et al, 2001; Santos and Booth, 1996; Spencer et al, 2007; and Worsley and Skrzypiec, 1997.

  Motivations for Vegetarianism in Adolescents
  - Twenty-two studies provide consistent evidence that animal rights and welfare and environmental concerns are most often listed as primary motivations behind adolescent vegetarianism in Western societies. Although health concerns are also cited as motivations for vegetarianism, they are less important in this population.
  - Evidence is based on the following studies: Aarnio and Lindeman, 2004; Bas et al, 2005; Donovan and Gibson, 1996*; Fessler et al, 2003; Gale et al, 2007; Greene-Finestone et al, 2008*; Greene-Finestone et al, 2005*; Jabs et al, 1998; Kenyon et al, 1998*; Kim et al, 1999; Larsson et al, 2003*; Larsson et al, 2001*; Lea and Worsley, 2002; Lea and Worsley, 2003; Martins et al, 1999; Neumark-Sztainer et al, 1997*; Perry et al, 2002*; Perry et al, 2001*; Santos and Booth, 1996; Spencer et al, 2007; Worsley and Skrzypiec, 1997*; and Worsley and Skrzypiec, 1998*.
    - Note: *Studies with an asterisk (*) indicate studies that focused specifically on adolescents.*

- Recommendation Strength Rationale

  - The diversity within vegetarian diets is well-documented. The links between types of vegetarian diets and health is less clear
  - Research from a number of studies (including large, high quality studies) examining vegetarian dietary patterns in different parts of the world agree that there is no unitary "vegetarian diet"

- Qualitative research (smaller studies) indicate that motivations and beliefs influence the choice of foods and that, in some cases, this may lead to unhealthy diet practices
- Grade I evidence is available for the conclusion statement regarding motivations behind adolescent vegetarianism
- Grade II evidence is available for the following conclusion statements regarding:
  - Types of vegetarian diets examined in the research
  - Common motivations for being vegetarian and how these motivations affect dietary practices in adults and children
  - How individual dietary patterns and social definitions of vegetarianism change over time in adult and child vegetarians.

- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  What types of vegetarian diets for adults and children are examined in the research?

  What are common motivations for being vegetarian and how do these motivations affect dietary practices in adults and children?

  How do the individual dietary patterns and social definitions of vegetarianism change over time in adult and child vegetarians?

  What are the motivations behind adolescent vegetarianism?

  - References

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- References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

  None.

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Assessing for Signs of Disordered Eating Behaviors Among Adolescent and Young Adult Vegetarians 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Assessing for Signs of Disordered Eating Behaviors Among Adolescent and Young Adult Vegetarians

  In adolescent (13-18) and young adult (19 to 30 years) vegetarians, the Registered Dietitian (RD) should assess for problem behaviors such as dieting. Research finds that 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.

  Rating: Fair
  Imperative

  - Risks/Harms of Implementing This Recommendation

    There are no potential risks or harms associated with the application of this recommendation.

  - Conditions of Application

    - Patient or client is an adolescent (13 to 18 years) or young adult (19 to 30 years) and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
    - RD knowledgeable or experienced in vegetarian diet counseling is preferred
    - RD knowledgeable or experienced in assessment and treatment of disordered eating is preferred
    - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

  - Potential Costs Associated with Application

    No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and enriched products purchased in bulk may even be less expensive.

  - Recommendation Narrative

    A total of twenty-two studies were included in the evidence analysis for this recommendation:

    - Nine positive quality cross-sectional studies (Aarnio and Lindeman, 2004; Fessler et al, 2003; Gale et al, 2007; Greene-Finestone et al, 2008*; Lea and Worsley, 2002; Lea and Worsley, 2003; Perry et al, 2002*; Worsley and Skrzypiec, 1997*; and Worsley and Skrzypiec, 1998*)
    - Seven neutral quality cross-sectional studies (Bas et al, 2005; Donovan and Gibson, 1996*; Greene-Finestone et al, 2005*; Larsson et al, 2001*; Martins et al, 1999; Neumark-Sztainer et al, 1997*; and Perry et al, 2001*)
    - Two neutral quality descriptive studies (Jabs et al, 1998; and Larsson et al, 2003*)
    - One neutral quality longitudinal study (Kim et al, 1999)
    - One neutral quality panel-design study (Spencer et al, 2007)
    - Two negative quality cross-sectional studies (Kenyon et al, 1998*; and Santos and Booth, 1996).
      - *Studies with an asterisk (*) indicate studies that focused specifically on adolescents.*

    Disordered Eating Among Adolescent and Young Adult Vegetarians

    - Twenty-two studies provide evidence that disordered eating is common among self-defined adolescent and young adult vegetarians. However, the two studies that differentiate among types of vegetarians indicate that this is not true of all adolescent and young adult vegetarians.
    - Evidence is based on the following studies: Aarnio and Lindeman, 2004; Bas et al, 2005; Donovan and Gibson, 1996; Fessler et al, 2003; Gale et al, 2007; Greene-Finestone et al, 2005; Greene-Finestone et al, 2008; Kenyon et al, 1998; Kim et al, 1999; Jabs et al, 1998; Larsson et al, 2001; Larsson et al, 2003; Lea and Worsley, 2002; Lea and Worsley, 2003; Martins et al, 1999; Neumark-Sztainer et al, 1997; Perry et al, 2001; Perry et al, 2002; Santos and Booth, 1996; Spencer et al, 2007; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998.

    Screening Tools for Eating Disorders

    The Vegetarian Nutrition Workgroup did not conduct evidence analysis on eating disorder assessment tools. The RD should use clinical judgement to identify validated tools for assessment and consult with other health care professionals.

  - Recommendation Strength Rationale

    Grade II evidence is available for the conclusion statement regarding disordered eating among adolescent vegetarians.

  - Minority Opinions

    None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

Is disordered eating common among adolescent and young adult vegetarians?

- References

Aarnio K, Lindeman M. Magical food and health beliefs: a portrait of believers and functions of the beliefs. *Appetite.* 2004 Aug; 43 (1): 65-74.

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- References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

  None.

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Assessing Biochemical Data of Adult, Child and Adolescent Vegetarians 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

VN: Assessing Biochemical Data of Adult, Child and Adolescent Vegetarians

For adult, child and adolescent vegetarians for whom dietary assessment reveals inadequate intake, the Registered Dietitian (RD) should assess the biochemical data, medical tests and procedures including, but not limited to complete blood count (CBC), serum iron, ferritin, transferrin, vitamin B-12, zinc, vitamin D and essential fatty acids (EFA). Research suggests that intake and/or bioavailability of these nutrients may be of special concern for vegetarian or vegan adults, adolescents and children. Assessment of these factors is needed to effectively determine nutrition diagnoses and plan the nutrition interventions. Inability to achieve optimal nutrient intake may contribute to poor outcomes.

Rating: Consensus
Imperative

VN: Assessing Vitamin B12 Status of Adult, Child and Adolescent Vegetarians

For adult, child and adolescent vegetarians, the Registered Dietitian (RD) should assess for dietary adequacy of vitamin B-12 intake. If dietary intake of vitamin B-12 is inadequate, then the RD may recommend using methylmalonic acid (MMA) if available, as a functional indicator of deficiency. Two research studies measuring MMA levels showed that lacto-ovo vegetarian and lacto-vegetarian (LOV/LV) or omnivorous adolescents (9 to 15 years) who had followed a very restrictive vegetarian diet (macrobiotic) early in life, may be at risk for vitamin B-12 deficiency (41% of adolescents had MMA >290nmol/L and 21% had MMA >410nmol/L). In addition, research studies showed that the prevalence of vitamin B-12 deficiency among healthy, non-pregnant adult vegetarians ranged from 30% to 86%. When vegans and LOV/LV vegetarians were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43% to 88%). Among children (10 months to 11.7 years) and older adults (>55 years), the prevalence of vitamin B-12 deficiency was 55 to 85% and 46.9% to 68%, respectively.

Rating: Fair

Imperative

- Risks/Harms of Implementing This Recommendation

  There are no potential risks or harms associated with the application of this recommendation.

- Conditions of Application

  - Patient or client is an adult, child (0 to 12 years) or adolescent (13 to 18 years) who self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
  - Use urinary or blood MMA to assess vitamin B-12 status, if available.
  - RD knowledgeable or experienced in vegetarian diet diet counseling is preferred

  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  Accessibility and costs of biochemical parameter testing should be considered.

- Recommendation Narrative

  A total of 24 studies were included in the evidence analysis for this recommendation:

  - Eight positive quality cross-sectional studies (Gibson et al, 2008; Hermann et al, 2001; Hermann, Schorr et al 2003; Perry et al, 2002; Schneede et al, 1994; van Dusseldorp et al, 1999; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998)
  - Ten neutral quality cross-sectional studies (Dhonukshe-Rutten et al, 2005; Donovan and Gibson, 1996; Geisel et al, 2005; Greene-Finestone et al, 2005; Hermann et al, 2009; Kwok et al, 2002; Larsson et al, 2001; Miller et al, 1991; Neumark-Sztainer et al, 1997; and Obeid et al, 2002)
  - One positive quality case-control study (Refsum et al, 2002)
  - One neutral quality randomized controlled trial (RCT) (Donaldson, 2000)
  - One neutral quality prospective cohort study (Geisel et al, 2003)
  - One neutral quality non-randomized controlled trial (Morkbak et al, 2006)
  - Two neutral quality diagnostic, validity or reliability study (Hermann, Obeid et al, 2003; and Kwok et al, 2004).

  Food and Nutrient Intake of Adolescent Vegetarians

  - Seven studies from a limited number of Western countries provide evidence for the following:
    - Adolescent vegetarians or semi-vegetarians may be more likely than adolescent omnivores to meet general national standards for some nutrients. However, they may also have lower intake than national standards for micronutrients such as iron, zinc and vitamin C. Because of the limited nature of the studies available, other nutrients, such as vitamin B-12, may also be of concern.
    - Research on the dietary intake of adolescent vegetarians from several countries indicated that although the patterns differ somewhat among countries, adolescent vegetarians tended to consume fewer dairy products, snack foods and sweets than omnivorous adolescents. They tended to consume more vegetables than their omnivorous peers. Outside the US and Canada, adolescents who considered themselves vegetarian tended to eat more chicken or fish than their omnivorous counterparts.
  - Evidence is based on the following studies: Donovan and Gibson, 1996; Greene-Finestone et al, 2005; Larsson et al, 2001; Neumark-Sztainer et al, 1997; Perry et al, 2002; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998
  - The studies were carried out on Swedish, Norwegian, US, Canadian and Australian populations.

  Markers of Vitamin B-12 Status

  - There is no universally accepted measure for determining vitamin B-12 deficiency. Because research indicates that serum B-12 may not be a reliable marker for B-12 deficiency, other measures, such as HoloTC or methylmalonic acid (MMA) either separately or in combination, may provide better measures of vitamin B-12 status. MMA is a biomarker for cellular or tissue (B-12 status) because it is an intermediate in a vitamin B-12 dependent metabolic pathway. Compared to measurement of serum B-12 levels alone, MMA and homocysteine have been shown to be more sensitive in diagnosing early vitamin B-12 deficiency (Oh and Brown, 2003). While homocysteine levels increase in both folate and vitamin B-12 deficiency, increased MMA is specific to a vitamin B-12 deficiency. Thus, research was included in this evidence analysis only if MMA level was used to identify vitamin B-12 deficiency.
  - Estimating the proportion of vegetarian subjects who were vitamin B-12 deficient based on MMA levels depended on the way that the reference levels of MMA were determined. Authors differed regarding the methods they used to determine vitamin B-12 deficiency.

  Vitamin B-12 Status of Infants and Children

  - Two studies provide limited, but consistent evidence that small children of parents who follow very restrictive vegetarian diets are likely to be deficient in vitamin B-12 as measured by MMA. The proportion of these children who were vitamin B-12 deficient ranged from 55 to 85%.
  - Evidence is based on the following studies: Miller et al, 1991; and Schneede et al, 1994
  - Neither study appeared to assess whether vitamin supplements were taken nor do they control for supplementation.

  Vitamin B-12 Status of Adolescents

  - Two studies of the same group of subjects provide evidence that adolescent vegetarians who followed restrictive diets in childhood may be at risk for vitamin B-12 deficiency. Vegetarian (LOV/LV) or omnivorous adolescents who had followed a very restrictive (macrobiotic) vegetarian diet early in life were likely to be vitamin B-12 deficient. Forty-one percent of adolescents had MMA >290nmol/L and 21% had MMA >410nmol/L.
  - Evidence is based on the following studies: Dhonukshe-Rutten et al, 2005; and van Dusseldorp et al, 1999
  - Neither study reported on whether subjects consumed colbalamin supplements.

  Vitamin B-12 Status in Adults

  - Twelve studies provide evidence that among healthy, non-pregnant adults, vegetarians consistently had a significantly higher prevalence of vitamin B-12 deficiency (as measured by elevated MMA levels) than omnivores. Depending on the criteria used to define B-12 deficiency and sample differences, prevalence of B-12 deficiency among adult vegetarians ranged from 30% to 86%. When vegans and LOV/LV were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43% to 88%).
  - Evidence is based on the following studies: Donaldson, 2000; Geisel et al, 2003; Geisel et al, 2005; Gibson et al, 2008; Hermann et al, 2009; Hermann et al, 2001; Hermann, Obeid et al, 2003; Hermann, Schorr et al, 2003; Miller et al, 1991; Morkbak et al, 2006; Obeid et al, 2002; and Refsum et al, 2002.

  Vitamin B-12 Status in Older Adults

  - Two studies of Chinese women provide limited evidence that the proportion of senior vegetarians (older than 55 years) who are vitamin B-12 deficient ranges from 46.9% to 68%
  - Evidence is based on the following studies: Kwok et al, 2004; and Kwok et al, 2002
  - While a third study (Geisel et al, 2003) was identified, it did not provide data specifically on senior vegetarians.

  Essential Fatty Acids

  - Several studies have reported that there is potential for vegetarians to be deficient in EFA such as EPA and DHA. Limited research suggests that DHA levels are lower in pregnant vegetarian women (Mangels et al, 2011)
  - Vegetarians (and particularly vegans) tend to have lower blood levels of EPA and DHA, compared to non-vegetarians (Craig, 2010)
  - While one study found that vegan children had high intakes of linoleic acid compared to linolenic acid, it may be prudent for patients to consume diets that enhance conversion of linolenic acid to DHA (Messina and Mangels, 2001).

Vitamin D

Adults:

- While Vitamin D is rare in vegetarian diets, lacto-ovo vegetarians or vegans do not appear to be more likely to be deficient than omnivores since humans can synthesize it (Li, 2011). However, if at least 15 minutes of sun exposure during peak hours cannot be achieved, food sources of vitamin D or vitamin D supplement may be needed, especially in heavy sunscreen users, the elderly or those who live at more northern latitudes, especially in the winter (Li, 2011, Craig, 2010).
- In some vegan groups who did not take vitamin D supplements or ingest vitamin D-fortified foods, low vitamin D intakes, low serum 25-hydroxy vitamin D levels, and reduced bone mass have been reported (Craig, 2010).

Children

- If sun exposure is inadequate, parents of vegan children should be counseled to select vitamin D-fortified products (Messina and Mangels, 2001).

Iron

Adults

- The incidence of iron-deficiency anemia is common among both vegetarians and non-vegetarians alike and is the most common mineral deficiency globally (Li, 2011; Craig, 2010)
- The iron content of vegetarian diets is similar to or slightly better than that of non-vegetarian diets, but the bioavailability of the [non-heme] iron is lower (Craig, 2010; Key et al, 2006)
- Low iron status is moderately common among premenopausal women throughout the world, and young female vegetarians need to ensure that their diet includes good sources of iron with vitamin C to help absorption or supplements, if needed (Key et al, 2006)
- Studies reported that vegetarians have a significantly lower serum ferritin concentration than omnivores (Li, 2011).

Children

- Although vegan children typically have iron intakes above recommended levels, nonheme iron has lower absorbability (Messina and Mangels, 2001)
- Based on very limited research, no significant difference in iron status indicators (hemoglobin, serum iron, and ferritin) were seen in vegetarian and vegan children, compared to non-vegetarian children and no anemia was identified. However, because iron deficiency anemia is a common nutrition deficiency among all population groups, parents should encourage consumption of foods high in iron or supplement with iron, if needed (Messina and Mangels, 2001).
- If the child's diet is low in iron, laboratory evaluation of iron status is appropriate (Messina and Mangels, 2001).

Zinc

Adults

- Because of low zinc bioavailability in vegetarian diets, vegetarians have lower status compared with omnivores (Li, 2011) and intakes may be marginal or fall below recommendations (Craig, 2010). However, overt zinc deficiency has not been seen in vegetarians in Western countries (Craig, 2010). In addition, no significant difference has been seen between vegetarians and omnivores on serum or plasma zinc concentrations. It is important to note that there is no agreement on the best method to assess zinc status, as all methods have shortcomings in assessing zinc pools. (Li, 2011; and Messina and Mangels, 2001).

Children

- The average consumption of zinc in the diets in vegan and non-vegan children are similar. However, the bioavailability of zinc from plant foods is reduced by phytates. While some evidence in adults, shows that zinc excretion decreases when dietary zinc is low, it is unknown if this compensation occurs in children (Messina and Mangels, 2001).

- Recommendation Strength Rationale

  - Only nine of 24 studies were of positive quality
  - Studies frequently relied on convenience samples, it was often unclear that study groups were comparable, and intake of vitamin supplements was not reported or controlled for in many studies
  - Over half of the studies identified were on subjects from Northern European nations. Two studies each were of US and Chinese populations. The rest were from other countries (including India, Ethiopia, England and the Middle East). Because dietary patterns and food fortification policies can differ dramatically by country and region, readers should be careful when generalizing.
  - Grade I evidence is available for the conclusion statement regarding vitamin B-12 status among adult vegetarians, as measured by MMA
  - Grade III evidence is available for the following conclusion statements regarding:
    - Nutrient intakes of adolescent vegetarians compared to omnivores and nutritional standards
    - Vitamin B-12 status of children of vegetarians, adolescent vegetarians and seniors (>55 years), as measured by MMA
  - Consensus Statement
    - Consensus: Specific questions about assessment of biochemical data, medical tests and procedures were not analyzed as part of the evidence analysis process, thus, the assessing biochemical data recommendation is based on consensus publications.

- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  What is the vitamin B-12 status of children of vegetarians, as measured by methylmalonic acid (MMA)?

  What is the vitamin B-12 status among adolescent vegetarians, as measured by methylmalonic acid (MMA)?

  What is the vitamin B12 status among adult vegetarians, as measured by methylmalonic acid (MMA)?

  What is the vitamin B-12 status among vegetarian older adults (>55 years) as measured by methylmalonic acid (MMA)?

  What are the nutrient intakes of adolescent vegetarians compared to omnivores and nutritional standards?

  - References

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- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Assessing Food and Nutrient Intake of Adult Vegetarians 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

VN: Assessing Micronutrient Intake of Adult Vegetarians

For adult vegetarians, the Registered Dietitian (RD) should assess micronutrient intake, particularly vitamin B-12. Research studies measuring methylmalonic acid (MMA) levels, showed that the prevalence of vitamin B-12 deficiency among healthy, non-pregnant adult vegetarians ranged from 30% to 86%. When vegans, lacto-ovo vegetarians/lacto-vegetarians (LOV/LV) were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43% to 88%). Among older adults (>55 years), the prevalence of vitamin B-12 deficiency was 46.9% to 68%.

Rating: Fair
Imperative

VN: Assessing Protein Intake of Adult Vegetarians

For adult vegetarians, the Registered Dietitian (RD) should assess intake of protein. While meeting protein requirements is typically not an issue with vegetarian diets, the RD can recommend that adults include complementary mixtures of plant proteins. This can be achieved by consuming a varied diet throughout the day.

Rating: Consensus
Imperative

VN: Assessing Essential Fatty Acid Intake of Adult Vegetarians

For adult vegetarians, the Registered Dietitian (RD) should assess dietary intake of essential fatty acids (EFA). Some research suggests that blood and tissue eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) levels may be sub-optimal among patients who follow a vegetarian dietary pattern.

Rating: Consensus
Imperative

- Risks/Harms of Implementing This Recommendation

  There are no potential risks or harms associated with the application of this recommendation.

- Conditions of Application

  - Patient or client is an adult and self-reports to be vegetarian or is interested in following a vegetarian dietary lifestyle
  - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
  - Nutritional assessment may be limited by under- or over-reporting of dietary intake
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred

  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may even be less expensive.

- Recommendation Narrative

  A total of 14 studies were included in the evidence analysis for this recommendation:

  - Five neutral quality cross-sectional studies (Geisel et al, 2005; Hermann et al, 2009; Kwok et al, 2002; Obeid et al, 2002; and Miller et al, 1991)
  - Three positive quality cross-sectional studies (Gibson et al, 2008; Hermann et al, 2001; and Hermann, Schorr et al 2003)
  - One positive quality case-control study (Refsum et al, 2002)
  - Two neutral quality diagnostic, validity or reliability studies (Hermann, Obeid et al, 2003; and Kwok et al, 2004)
  - One neutral quality randomized controlled trial (RCT) (Donaldson, 2000)
  - One neutral quality prospective cohort study (Geisel et al, 2003)
  - One neutral quality non-randomized controlled trial (Morkbak et al, 2006).

  Markers of Vitamin B-12 Status

  - There is no universally accepted measure for determining vitamin B-12 deficiency. Because research indicates that serum B-12 may not be a reliable marker for B-12 deficiency, other measures, such as HoloTC or methylmalonic acid (MMA) either separately or in combination, may provide better measures of vitamin B-12 status. MMA is a biomarker for cellular or tissue (B-12 status) because it is an intermediate in a vitamin B-12 dependent metabolic pathway. Compared to measurement of serum B-12 levels alone, MMA and homocysteine have been shown to be more sensitive in diagnosing early vitamin B-12 deficiency (Oh and Brown, 2003). While homocysteine levels increase in both folate and vitamin B-12 deficiency, increased MMA is specific to a vitamin B-12 deficiency. Thus, research was included in this evidence analysis only if MMA level was used to identify vitamin B-12 deficiency.
  - Estimating the proportion of vegetarian subjects who were vitamin B-12 deficient based on MMA levels depended on the way that the reference levels of MMA were determined. Authors differed regarding the methods they used to determine vitamin B-12 deficiency.

  Vitamin B-12 Status in Adults

  - Twelve studies provide evidence that among healthy, non-pregnant adults, vegetarians consistently had a significantly higher prevalence of vitamin B-12 deficiency (as measured by elevated MMA levels) than omnivores. Depending on the criteria used to define B-12 deficiency and sample differences, prevalence of B-12 deficiency among adult vegetarians ranged from 30% to 86%. When vegans and lacto-ovo vegetarians/lacto-vegetarians (LOV/LV) were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43%-88%).
  - Evidence is based on the following studies: Donaldson, 2000; Geisel et al, 2003; Geisel et al, 2005; Gibson et al, 2008; Hermann et al, 2009; Hermann et al, 2001; Hermann, Obeid et al, 2003; Hermann, Schorr et al, 2003; Miller et al, 1991; Morkbak et al, 2006; Obeid et al, 2002; and Refsum et al, 2002.

  Vitamin B-12 Status in Older Adults

  - Two studies of Chinese women provide limited evidence that the proportion of senior vegetarians (older than 55 years) who are vitamin B-12 deficient ranges from 46.9% to 68%
  - Evidence is based on the following studies: Kwok et al, 2004; and Kwok et al, 2002
  - While a third study (Geisel et al, 2003) was identified, it did not provide data specifically on senior vegetarians.

  Protein

  - Protein quality is determined primarily by digestibility and the amino acid composition of the protein. The quality of the protein source is based on the nitrogen and amino acids provided for growth, maintenance, and repair. Different protein sources vary in chemical composition and nutritional value. In food, it is the contribution of all of the amino acids to the total nitrogen content that must be considered in assessing the overall protein quality of the diet (IOM, 2005).
  - Vegetarian diets that include complementary mixtures of plant proteins can provide the same quality of protein as that from animal proteins. While plant proteins are generally less digestible than animal proteins, the digestibility can be altered through processing and preparation. Vegetarians can have an adequate intake of protein by consuming a varied diet (IOM, 2005).

  Essential Fatty Acids

  - Several studies have reported that there is potential for vegetarians to be deficient in EFA such as EPA and DHA. Limited research suggests that DHA levels are lower in pregnant vegetarian women (Mangels et al, 2011)
  - Vegetarians (and particularly vegans) tend to have lower blood levels of EPA and DHA, compared to non-vegetarians (Craig, 2010).

- Recommendation Strength Rationale

  - Only three of 14 studies were of positive quality
  - Studies frequently relied on convenience samples
  - It was often unclear that study groups were comparable, and intake of vitamin supplements was not reported or controlled for in many studies
  - Eight of the 14 studies identified were on subjects from Northern European nations. Two studies each were of US and Chinese populations. The rest were from other countries (including India, Ethiopia, England and the Middle East). Because dietary patterns and food fortification policies can differ dramatically by country and region, readers should be careful when generalizing.
  - Grade I evidence is available for the conclusion statement regarding vitamin B-12 status among adult vegetarians, as measured by MMA
  - Grade III evidence is available for the conclusion statement regarding vitamin B-12 status among vegetarian seniors (>55 years), as measured by MMA

- Consensus Statement
  - Consensus: Specific questions about assessing protein and EFA intake were not analyzed as part of the evidence analysis process, thus, the protein and EFA recommendations are based on consensus publications.

- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  What is the vitamin B12 status among adult vegetarians, as measured by methylmalonic acid (MMA)?

  What is the vitamin B-12 status among vegetarian older adults (>55 years) as measured by methylmalonic acid (MMA)?

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- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Assessing Food and Nutrient Intake During Pregnancy for Adolescent and Adult Vegetarians 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

VN: Assessing Micronutrient Needs in Pregnant Adolescent and Adult Vegetarians

For pregnant adolescent and adult vegetarians, the Registered Dietitian (RD) should assess the patient's/client's intake of all micronutrients, particularly folate, vitamin B-12, iron, and zinc to ensure the Dietary Reference Intakes (DRI) are met. Research indicates that pregnant vegetarians did not meet dietary requirements for at least one of these micronutrients. Two high quality studies report that pregnant vegetarians had significantly lower serum B-12 concentrations than pregnant non-vegetarians. In addition, research studies measuring methylmalonic acid (MMA) levels, showed that the prevalence of vitamin B-12 deficiency among healthy, non-pregnant adult vegetarians ranged from 30% to 86%. When vegans and lacto-ovo vegetarians/lacto-vegetarians (LOV/LV) were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43% to 88%).

Rating: Strong
Conditional

VN: Assessing Macronutrient Needs in Pregnant Adolescent and Adult Vegetarians

For pregnant adolescent and adult vegetarians and vegans, the Registered Dietitian (RD) should assess for adequate protein from a variety of complementary mixtures of plant proteins consumed throughout the day, compared to the Dietary Reference Intakes (DRI) in pregnancy. While research indicates that pregnant vegetarians typically had lower protein intake than pregnant omnivores, they met or exceeded the national standards for protein intake for pregnant women in the populations studied.

Rating: Strong
Imperative

VN: Assessing Essential Fatty Acid Intake of Pregnant Adolescent and Adult Vegetarians

For pregnant adolescent and adult vegetarians, the Registered Dietitian (RD) should assess dietary intake of essential fatty acids (EFA). Some research suggests that blood and tissue eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) levels may be sub-optimal among patients who follow a vegetarian dietary pattern.

Rating: Consensus
Imperative

- Risks/Harms of Implementing This Recommendation

  There are no potential risks or harms associated with the application of this recommendation.

- Conditions of Application

  - Patient or client is a pregnant adult or adolescent (13 to18 years) and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
  - Nutritional assessment may be limited by under- or over-reporting of dietary intake
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - While adequate EFA intake is critical for all vegetarians, EPA and DHA levels are particularly critical in pregnancy (Niinivirta et al, 2011; Craig, 2010)
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may even be less expensive.

- Recommendation Narrative

  A total of 29 studies were included in the evidence analysis for this recommendation:

  - Six positive quality prospective cohort studies (Campbell-Brown et al, 1985; Cheng et al, 2004; Ganpule et al, 2006; Koebnick et al, 2001; Koebnick et al, 2004; and Koebnick et al, 2005)
  - Six positive quality cross-sectional studies (Gibson et al, 2008; Hermann et al, 2001; Hermann, Schorr et al 2003; Schneede et al, 1994; van Dusseldorp et al, 1999; and Ward et al, 1988)
  - One positive quality case-control study (Refsum et al, 2002)
  - One positive quality panel design study (Drake et al, 1998)
  - Seven neutral quality cross-sectional studies (Dhonukshe-Rutten et al, 2005; Geisel et al, 2005; Hermann et al, 2009; King et al, 1981; Kwok et al, 2002; Obeid et al, 2002; and Miller et al, 1991)
  - Two neutral quality diagnostic, validity or reliability studies (Hermann, Obeid et al, 2003; and Kwok et al, 2004)
  - Two neutral quality prospective cohort studies (Geisel et al, 2003; and North and Golding, 2000)
  - One neutral quality randomized controlled trial (RCT) (Donaldson, 2000)
  - One neutral quality report of two cross-sectional studies (Reddy et al, 1994)
  - One neutral quality non-randomized controlled trial (Morkbak et al, 2006)
  - One neutral quality panel design study (Ellis et al, 1987).

  Macronutrient and Energy Intake in Pregnant Vegetarians

  - Four studies on non-US populations provide limited evidence that the macronutrient intake of pregnant vegetarians is similar to that of non-vegetarians with the following exceptions (as percentages of energy intake):
    - Pregnant vegetarians receive statistically lower levels of protein than pregnant non-vegetarians
    - Pregnant vegetarians receive statistically higher levels of carbohydrates than pregnant non-vegetarians
  - It is important to note, however, that none of the studies report a protein deficiency in pregnant vegetarians
  - No research was identified that focused on macronutrient intakes among pregnant vegans
  - Evidence is based on the following studies: Drake et al, 1998; Campbell-Brown et al, 1985; Ganpule et al, 2006; and Reddy et al, 1994
  - The Dietary Reference Intakes (DRI) should be met as a minimum in all pregnant women (regardless of whether they are vegetarian or not).

  Birth Outcomes

  - Four studies of non-US populations provide limited evidence that there are no significant health differences in babies born to non-vegan vegetarian mothers vs. non-vegetarians
  - No research was identified that focused on the birth outcomes of vegan vs. omnivorous mothers
  - Evidence is based on the following studies: Drake et al, 1998; Ganpule et al, 2006, North and Golding, 2000; and Reddy et al, 1994.

  Micronutrient Intake in Pregnant Women

  - Ten studies, two of which were conducted in the US, provide evidence for the following:
    - Only the following micronutrients had lower intake among vegetarians than non-vegetarians:

        - Vitamin B-12
        - Vitamin C
        - Calcium
        - Zinc
    - Vegetarians did not meet dietary standard (in at least one country) for:
        - Vitamin B-12 (in UK)
        - Iron (in US, for both vegetarians and omnivores)
        - Folate (in Germany, though lower rate of deficiency than among omnivores)
        - Zinc (in UK)
- Evidence is based on the following studies: Campbell-Brown et al, 1985; Cheng et al, 2004; Drake et al, 1998; Ellis et al, 1987; Ganpule et al, 2006; King et al, 1981; Koebnick et al, 2001; Koebnick et al, 2004; Koebnick et al, 2005; and Ward et al, 1988
- Six studies (five non-US, one with combined US and non-US samples) provide evidence for the following:
    - Of the micronutrients examined in the research, only serum B-12 levels were significantly lower in non-vegan vegetarians than non-vegetarians. Additionally, one study reported that lower B-12 levels are more likely to be associated with high serum tHCY in lacto-ovo vegetarians than low meat eaters or omnivores.
    - While zinc levels were not significantly different between non-vegan vegetarians and non-vegetarians, vegetarians who have a high intake of calcium may be at risk for zinc deficiency (because of the interaction between phytate, calcium and zinc).
    - Based on limited evidence, plasma folate levels may actually be higher among some vegetarian groups than non-vegetarians
- Evidence is based on the following studies: Campbell-Brown et al, 1985; Cheng et al, 2004; Ellis et al, 1987; Koebnick et al, 2001; Koebnick et al, 2004; and Ward et al, 1988.

Vitamin B-12 Status in Adults

- Twelve studies provide evidence that among healthy, non-pregnant adults, vegetarians consistently had a significantly higher prevalence of vitamin B-12 deficiency (as measured by elevated MMA levels) than omnivores. Depending on the criteria used to define B-12 deficiency and sample differences, prevalence of B-12 deficiency among adult vegetarians ranged from 30% to 86%. When vegans and lacto-ovo vegetarians/lacto-vegetarians (LOV/LV) were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43%-88%).
- Evidence is based on the following studies: Donaldson, 2000; Geisel et al, 2003; Geisel et al, 2005; Gibson et al, 2008; Hermann et al, 2009; Hermann et al, 2001; Hermann, Obeid et al, 2003; Hermann, Schorr et al, 2003; Miller et al, 1991; Morkbak et al, 2006; Obeid et al, 2002; and Refsum et al, 2002
- **Markers of Vitamin B-12 Status:**
    - There is no universally accepted measure for determining vitamin B-12 deficiency. Because research indicates that serum B-12 may not be a reliable marker for B-12 deficiency, other measures, such as HoloTC or methylmalonic acid (MMA) either separately or in combination, may provide better measures of vitamin B-12 status. MMA is a biomarker for cellular or tissue (B-12 status) because it is an intermediate in a vitamin B-12 dependent metabolic pathway. Compared to measurement of serum B-12 levels alone, MMA and homocysteine have been shown to be more sensitive in diagnosing early vitamin B-12 deficiency (Oh and Brown, 2003). While homocysteine levels increase in both folate and vitamin B-12 deficiency, increased MMA is specific to a vitamin B-12 deficiency. Thus, research was included in this evidence analysis only if MMA level was used to identify vitamin B-12 deficiency.
    - Estimating the proportion of vegetarian subjects who were vitamin B-12 deficient based on MMA levels depended on the way that the reference levels of MMA were determined. Authors differed regarding the methods they used to determine vitamin B-12 deficiency.

Protein

- Protein quality is determined primarily by digestibility and the amino acid composition of the protein. The quality of the protein source is based on the nitrogen and amino acids provided for growth, maintenance, and repair. Different protein sources vary in chemical composition and nutritional value. In food, it is the contribution of all of the amino acids to the total nitrogen content that must be considered in assessing the overall protein quality of the diet (IOM, 2005).
- Vegetarian diets that include complementary mixtures of plant proteins can provide the same quality of protein as that from animal proteins. While plant proteins are generally less digestible than animal proteins, the digestibility can be altered through processing and preparation. Vegetarians can have an adequate intake of protein by consuming a varied diet. (IOM, 2005).

Essential Fatty Acids

- Several studies have reported that there is potential for vegetarians to be deficient in EFA such as EPA and DHA. Limited research suggests that DHA levels are lower in pregnant vegetarian women (Mangels et al, 2011)
- Vegetarians (and particularly vegans) tend to have lower blood levels of EPA and DHA, compared to non-vegetarians (Craig, 2010).

- Recommendation Strength Rationale

    - The research suffered from a number of design limitations:
        - All but one study (Ellis et al, 1987) relied on self reported intake
        - One (Ganpule et al, 2006) had no comparison group and appeared to combine vegetarian and non-vegetarian data
        - The number of vegetarian subjects in comparison studies was relatively small: from N=98 (Cheng et al, 2004) to N=12 (King et al, 1981)
        - Research on all micronutrients except zinc was limited to two or fewer studies
        - Two studies focused on particular ethnic groups (Ganpule et al, 2006; Ward et al, 1988) which limits the generalizability of the findings
        - The majority of studies examining micrunutrient intake were done on non-US populations, making generalizability to the US population suspect
    - However, because there was no risk for this assessment, and because the DRI should be met as a minimum in all pregnant women (regardless of whether they are vegetarian or not), the strength of the recommendation was rated as strong
    - Grade I evidence is available for the conclusion statement regarding vitamin B-12 status among adult vegetarians, as measured MMA
    - Grade III evidence is available for the following conclusion statements regarding:
        - Difference in macronutrient and energy intake in pregnant vegetarians vs. pregnant omnivores
        - Difference in birth outcomes for mothers who maintain a vegetarian vs. omnivorous diet during pregnancy
        - Patterns of micronutrient intake among pregnant vegetarians
        - Bioavailability of different micronutrients in pregnant vegetarians
    - Consensus Statement
        - Consensus: Specific questions about EFA intake were not analyzed as part of the evidence analysis process, thus, the assessing EFA intake recommendation is based on consensus publications.

- Minority Opinions

    None.

- Supporting Evidence

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

What are patterns of micronutrient intake among pregnant vegetarians?

What is the bioavailability of different micronutrients in pregnant vegetarians?

How do macronutrient and energy intake in pregnant vegetarians differ from intakes in pregnant omnivores?

Are birth outcomes different for mothers who maintain a vegetarian versus an omnivorous diet during pregnancy?

How do macronutrient and energy intake in pregnant vegans differ from intakes in pregnant omnivores?

Are birth outcomes different for mothers who maintain a vegan versus an omnivorous diet during pregnancy?

What is the vitamin B12 status among adult vegetarians, as measured by methylmalonic acid (MMA)?

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- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Dietary and Micronutrient Intake of Vegetarian Children and Adolescents 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

VN: Micronutrient Intake of Adolescent Vegetarians

For adolescent vegetarians, the Registered Dietitian (RD) should specifically plan foods rich in micronutrients, such as iron, zinc, vitamin C and vitamin B-12 into the diet to meet the Dietary Reference Intakes (DRI). When appropriate, vitamin and/or mineral supplements may be indicated to prevent or resolve nutrient deficiency. Research from a limited number of Western countries showed that adolescent vegetarians or semi-vegetarians (11 to 19 years) may have lower intake than national standards for micronutrients such as iron, zinc and vitamin C. In addition, two studies measuring methylmalonic acid (MMA) levels showed that lacto-ovo vegetarian and lacto-vegetarian (LOV/LV) or omnivorous adolescents (9 to 15 years) who had followed a very restrictive vegetarian diet (macrobiotic) early in life, may be at risk for vitamin B-12 deficiency (41% of adolescents had MMA >290nmol/L and 21% had MMA >410nmol/L).

Rating: Fair
Imperative

VN: Dietary Intake of Adolescent Vegetarians

For adolescent vegetarians, the Registered Dietitian (RD) should recommend a meal plan that incorporates foods rich in calcium (e.g., dairy products, kale, broccoli, fortified soy milk, etc.) or if appropriate, calcium supplements. Research indicates that although dietary patterns differ, adolescent vegetarians (11 to 19 years) tended to consume fewer dairy products.

Rating: Strong
Imperative

VN: Micronutrient Intake of Vegetarian Children

For vegetarian children, the Registered Dietitian (RD) should design a nutrition prescription to ensure the Dietary Reference Intakes (DRI) for all micronutrients, particularly vitamin B-12 are met. If appropriate, vitamin and/or mineral supplements may be needed to prevent or resolve nutrient deficiency. Research studies measuring methylmalonic acid (MMA) levels, indicates that small children (10 months to 11.7 years) of parents who follow a macrobiotic diet, had a high prevalence of vitamin B-12 deficiency (55 to 85%).

Rating: Weak
Imperative

- Risks/Harms of Implementing This Recommendation

  Some individuals who take calcium supplements, particularly calcium carbonate, might experience gastrointestinal side effects including gas, bloating, and/or constipation. To alleviate these symptoms, consideration for another form of calcium may be warranted, as well as spreading out the calcium dose throughout the day and/or taking the supplement with meals (Office of Dietary Supplements).

- Conditions of Application

  - Patient or client is a child (0 to 12 years) or adolescent (13 to 18 years) and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  - No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may even be less expensive
  - In some cases, there may be increased cost associated with the selective use of vitamin and/or mineral supplements.

- Recommendation Narrative

  A total of 11 studies were included in the evidence analysis for this recommendation:

  - Five positive quality cross-sectional studies Perry et al, 2002; Schneede et al, 1994; van Dusseldorp et al, 1999; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998
  - Six neutral quality cross-sectional studies (Dhonukshe-Rutten et al, 2005; Donovan and Gibson, 1996; Greene-Finestone et al, 2005; Larsson et al, 2001; Miller et al, 1991; and Neumark-Sztainer et al, 1997).

  Food and Nutrient Intake of Adolescent Vegetarians

  - Seven studies from a limited number of Western countries provide evidence for the following:
    - Adolescent vegetarians or semi-vegetarians may be more likely than adolescent omnivores to meet general national standards for some nutrients. However, they may also have lower intake than national standards for micronutrients such as iron, zinc and vitamin C. Because of the limited nature of the studies available, other nutrients, such as vitamin B-12, may also be of concern.
    - Research on the dietary intake of adolescent vegetarians from several countries indicated that although the patterns differ somewhat among countries, adolescent vegetarians tended to consume fewer dairy products, snack foods and sweets than omnivorous adolescents. They tended to consume more

vegetables than their omnivorous peers. Outside the US and Canada, adolescents who considered themselves vegetarian tended to eat more chicken or fish than their omnivorous counterparts.

- Evidence is based on the following studies: Donovan and Gibson, 1996; Greene-Finestone et al, 2005; Larsson et al, 2001; Neumark-Sztainer et al, 1997; Perry et al, 2002; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998
- The studies were carried out on Swedish, Norwegian, US, Canadian and Australian populations.

Markers of Vitamin B-12 Status

- There is no universally accepted measure for determining vitamin B-12 deficiency. Because research indicates that serum B-12 may not be a reliable marker for B-12 deficiency, other measures, such as HoloTC or methylmalonic acid (MMA) either separately or in combination, may provide better measures of vitamin B-12 status. MMA is a biomarker for cellular or tissue (B-12 status) because it is an intermediate in a vitamin B-12 dependent metabolic pathway. Compared to measurement of serum B-12 levels alone, MMA and homocysteine have been shown to be more sensitive in diagnosing early vitamin B-12 deficiency (Oh and Brown, 2003). While homocysteine levels increase in both folate and vitamin B-12 deficiency, increased MMA is specific to a vitamin B-12 deficiency. Thus, research was included in this evidence analysis only if MMA level was used to identify vitamin B-12 deficiency.
- Estimating the proportion of vegetarian subjects who were vitamin B-12 deficient based on MMA levels depended on the way that the reference levels of MMA were determined. Authors differed regarding the methods they used to determine vitamin B-12 deficiency.

Vitamin B-12 Status of Infants and Children

- Two studies provide limited, but consistent evidence that small children of parents who follow very restrictive vegetarian diets are likely to be deficient in vitamin B-12 as measured by MMA. The proportion of these children who were vitamin B-12 deficient ranged from 55 to 85%.
- Evidence is based on the following studies: Miller et al, 1991; and Schneede et al, 1994
- Neither study appeared to assess whether vitamin supplements were taken nor do they control for supplementation.

Vitamin B-12 Status of Adolescents

- Two studies of the same group of subjects provide evidence that adolescent vegetarians who followed restrictive diets in childhood may be at risk for vitamin B-12 deficiency. Vegetarian (LOV/LV) or omnivorous adolescents who had followed a very restrictive (macrobiotic) vegetarian diet early in life were likely to be vitamin B-12 deficient. Forty-one percent of adolescents had MMA >290nmol/L and 21% had MMA >410nmol/L.
- Evidence is based on the following studies: Dhonukshe-Rutten et al, 2005; and van Dusseldorp et al, 1999
- Neither study reported on whether subjects consumed colbalamin supplements.

- Recommendation Strength Rationale

  - Grade II evidence is available for the conclusion statement regarding food intake of adolescent vegetarians compared to adolescent omnivores
  - Grade III evidence is available for the following conclusion statements regarding:
    - Nutrient intakes of adolescent vegetarians compared to adolescent omnivores and nutritional standards
    - Vitamin B-12 status of children of vegetarians and adolescent vegetarians, as measured by MMA.

- Minority Opinions

  None.

- Supporting Evidence

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

What are the nutrient intakes of adolescent vegetarians compared to omnivores and nutritional standards?

How does food intake of adolescent vegetarians compare to adolescent omnivores?

What is the vitamin B-12 status among adolescent vegetarians, as measured by methylmalonic acid (MMA)?

What is the vitamin B-12 status of children of vegetarians, as measured by methylmalonic acid (MMA)?

- References

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- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Diet Diversity and Vegetarian Diets for Children, Adolescents and Adults 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

VN: Diet Diversity of Vegetarian Diets for Children, Adolescents and Adults

If the adult, child or adolescent patient or client is on a highly restrictive vegetarian diet with a narrow range of food choices, then the Registered Dietitian (RD) should educate them on the importance of including a variety of foods within their diet to meet their nutritional needs. When appropriate, vitamin and/or mineral supplements may be indicated. Research shows that vegetarian dietary patterns vary and fluctuate over time. Even within types of vegetarian diets, individuals vary in the extent to which they include a variety of plant-based foods. Vegetarians who are on highly restrictive diets resulting from unhealthful food choices, may be at nutritional risk.

Rating: Strong
Conditional

- Risks/Harms of Implementing This Recommendation

  There are no potential risks or harms associated with the application of this recommendation.

- Conditions of Application

  - Patient or client is an adult, child (0 to 12 years) or adolescent (13 to 18 years) self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  - No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may even be less expensive
  - In some cases, there may be increased cost associated with the selective use of vitamin and/or mineral supplements.

- Recommendation Narrative

  A total of 34 studies were included in the evidence analysis for this recommendation:

  - Thirteen positive quality cross-sectional studies (Aarnio and Lindeman, 2004; Dagnelie et al, 1994; Draper et al, 1993; Fessler et al, 2003; Gale et al, 2007; Greene-Finestone et al, 2008; Greenwood et al, 2000; Lea and Worsley, 2002; Lea and Worsley, 2003; Melby et al, 1994, Perry et al, 2002; Worsley and Skrzypiec, 1997; and Worsley and Skrzypiec, 1998)
  - One positive quality narrative review (Sabate, 2003)
  - Ten neutral quality cross-sectional studies (Bas et al, 2005; Donovan and Gibson, 1996; Dwyer, 1999; Greene-Finestone et al 2005; Larsson et al, 2001; Martins et al, 1999; Nardoto et al, 2006; Neumark-Sztainer et al, 1997; Padmadas et al, 2006; and Perry et al, 2001)
  - Four neutral quality descriptive studies (Barr and Chapman, 2002; Hobbs, 2005; Jabs et al, 1998; and Larsson et al, 2003)
  - One neutral quality ethnograpic study (Beardsworth and Keil, 1992)
  - One neutral quality longitudinal study (Kim et al, 1999)
  - One neutral panel design study (Spencer et al, 2007)
  - One negative quality narrative review (Jacobs and Dwyer, 1988)
  - Two negative quality cross-sectional studies (Santos and Booth, 1996; and Kenyon and Barker, 1998).

  Research on different types of vegetarian diets and the eating patterns of people self-identifying as vegetarian demonstrates that, empirically, vegetarianism encompasses a very broad range of dietary practices and patterns--not all of which are healthful.

  Additionally, research examining actual vegetarian intake frequently finds that a substantial proportion of those who consider themselves vegetarians eat fish (and sometimes poultry) occasionally to regularly. Patients or clients who are trying to follow a completely animal product-free diet (a vegan diet) may not be aware of animal products added to some processed foods.

  Diet Diversity

  - Twenty-one studies provide evidence that the two most common ways of defining vegetarian diets in the research are:
    - Vegan diets: Diets devoid of all flesh foods,
    - Vegetarian Diets: Diets devoid of all flesh foods, but also include egg (ovo) and/or dairy (lacto) products
  - However, these very broad categories mask important variations within vegetarian diets and dietary practices. These variations within vegetarian diets make absolute categorization of vegetarian dietary practices difficult and may be one of the sources of unclear relationships between vegetarian diets and other factors.
  - Evidence is based on the following studies: Barr and Chapman, 2002; Beardsworth and Keil, 1992; Dagnelie et al, 1994; Donovan et al, 1996; Draper et al, 1993; Dwyer, 1999; Fessler et al, 2003; Greene-Finestone et al 2005; Greenwood et al, 2000; Hobbs, 2005; Jacobs and Dwyer, 1988; Larsson et al, 2001; Lea and Worsley, 2003; Melby et al, 1994, Nardoto et al, 2006; Padmadas et al, 2006; Perry et al, 2002; Perry et al, 2001; Sabate, 2003; Worsley and Skrzypiec, 1998; and Worsley and Skrzypiec, 1997.

  Dietary Patterns/Social Definitions

  - Eight studies provide evidence that vegetarianism is a fluid concept. Research shows that it is common for individuals who consider themselves vegetarian to change dietary patterns over time, sometimes becoming more restrictive, sometimes less so. Additionally, societal perspectives on vegetarianism change over time. It is more

common now for individuals to be vegetarian for ethical or environmental reasons vs. 30 years ago. Likewise, it is more common for research to focus on the health benefits of vegetarianism and plant-based diets than in decades past when the focus tended to be on potential nutrient deficiencies associated with vegetarian diets.
- Evidence is based on the following studies: Barr and Chapman, 2002; Beardsworth and Keil, 1992; Dagnelie et al, 1994; Draper et al, 1993; Jabs et al, 1998; Kim et al, 1999; Larsson et al, 2003; and Sabate, 2003.

Motivations for Vegetarianism in Adults and Children

- Twenty studies provide evidence that although motivations for following a vegetarian lifestyle are complex, research on Western populations identifies common reasons for being vegetarian, including: Ethical and environmental concerns, religious concerns, health reasons and gustatory reasons. Some individuals with eating disorders may adopt a vegetarian diet as a means of weight control. Research also indicates that dietary patterns vary depending on the motivation behind a vegetarian lifestyle.
- Evidence is based on the following studies: Aarnio and Lindeman, 2004; Barr and Chapman, 2002; Bas et al, 2005; Beardsworth and Keil, 1992; Dagnelie et al, 1994; Fessler et al, 2003; Greene-Finestone et al, 2008; Greene-Finestone et al, 2005; Jabs et al, 1998; Kenyon and Barker, 1998; Kim et al, 1999; Larsson et al, 2003; Lea and Worsley, 2002; Lea and Worsley, 2003; Martins et al, 1999; Neumark-Sztainer et al, 1997; Perry et al, 2001; Santos and Booth, 1996; Spencer et al, 2007; and Worsley and Skrzypiec, 1997.

Motivations for Vegetarianism in Adolescents

- Twenty-two studies provide consistent evidence that animal rights and welfare and environmental concerns are most often listed as primary motivations behind adolescent vegetarianism in Western societies. Although health concerns are also cited as motivations for vegetarianism, they are less important in this population.
- Evidence is based on the following studies: Aarnio and Lindeman, 2004; Bas et al, 2005; Donovan and Gibson, 1996*; Fessler et al, 2003; Gale et al, 2007; Greene-Finestone et al, 2008*; Greene-Finestone et al, 2005*; Jabs et al, 1998; Kenyon et al, 1998*; Kim et al, 1999; Larsson et al, 2003*; Larsson et al, 2001*; Lea and Worsley, 2002; Lea and Worsley, 2003; Martins et al, 1999; Neumark-Sztainer et al, 1997*; Perry et al, 2002*; Perry et al, 2001*; Santos and Booth, 1996; Spencer et al, 2007; Worsley and Skrzypiec, 1997*; and Worsley and Skrzypiec, 1998*.
  - Note: Studies with an asterisk (*) indicate studies that focused specifically on adolescents.

- Recommendation Strength Rationale

  - The diversity within vegetarian diets is well-documented. The links between types of vegetarian diets and health is less clear
  - Research from a number of studies (including large, high quality studies) examining vegetarian dietary patterns in different parts of the world agree that there is no unitary "vegetarian diet"
  - Qualitative research (smaller studies) indicate that motivations and beliefs influence the choice of foods and that, in some cases, this may lead to unhealthy diet practices
  - Grade I evidence is available for the conclusion statement regarding motivations behind adolescent vegetarianism
  - Grade II evidence is available for the following conclusion statements regarding:
    - Types of vegetarian diets examined in the research
    - Common motivations for being vegetarian and how these motivations affect dietary practices in adults and children
    - How individual dietary patterns and social definitions of vegetarianism change over time in adult and child vegetarians.

- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  What types of vegetarian diets for adults and children are examined in the research?

  How do the individual dietary patterns and social definitions of vegetarianism change over time in adult and child vegetarians?

  What are common motivations for being vegetarian and how do these motivations affect dietary practices in adults and children?

  What are the motivations behind adolescent vegetarianism?

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- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Recommendations Summary

VN: Macronutrient Intake of Adult, Child and Adolescent Vegetarians 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  NV: Vegetarian Nutrition Protein Intake of Adult, Child and Adolescent Vegetarians

  For adult, child and adolescent vegetarians, the Registered Dietitian (RD) should develop a nutrition prescription providing adequate protein, and offer comprehensive nutrition education and skill development on planning a diet which provides a variety of protein foods. While meeting protein requirements is typically not an issue with vegetarian diets, the RD can recommend including complementary mixtures of plant proteins. This can be achieved by consuming a varied diet throughout the day.

  Rating: Consensus
  Imperative

  VN: Essential Fatty Acid Intake of Adult, Child and Adolescent Vegetarians

  In the adult, child or adolescent vegetarian, if nutrition assessment of intake or blood levels of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) reveals a potential deficiency or lower than optimal levels, the Registered Dietitian (RD) should counsel the patient or client to increase EPA and DHA levels by any of the following methods (as appropriate based on RD clinical judgement):

  - Increasing intake of foods rich in EPA and DHA
  - EPA and DHA supplementation
  - Increase endogenous synthesis of essential fatty acids (EFA) by decreasing intake of omega-6 fatty acid as well as reducing the amount of saturated fat and trans fat in the diet.

  Rating: Consensus
  Conditional

  - Risks/Harms of Implementing This Recommendation

    Since the optimal ratio of EPA and DHA are not known for vegetarians, very high levels of EPA and DHA may be contraindicated, and thus, over-supplementation should be avoided. The US Food and Drug Administration advises that consumption of more than three grams of omega-3 fatty acids per day may cause gastrointestinal symptoms.

- Conditions of Application
  - Patient or client is an adult, child (0 to12 years) or adolescent (13 to 18 years) and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.
- Potential Costs Associated with Application
  - If supplementation of EPA and DHA is warranted, additional costs may be incurred
  - No other obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may even be less expensive.
- Recommendation Narrative

  Protein

  - Protein quality is determined primarily by digestibility and the amino acid composition of the protein. The quality of the protein source is based on the nitrogen and amino acids provided for growth, maintenance, and repair. Different protein sources vary in chemical composition and nutritional value. In food, it is the contribution of all of the amino acids to the total nitrogen content that must be considered in assessing the overall protein quality of the diet (IOM, 2005).
  - Vegetarian diets that include complementary mixtures of plant proteins can provide the same quality of protein as that from animal proteins. While plant proteins are generally less digestible than animal proteins, the digestibility can be altered through processing and preparation. Vegetarians can have an adequate intake of protein by consuming a varied diet (IOM, 2005).

  Essential Fatty Acids

  - Several studies have reported that there is potential for vegetarians to be deficient in EFA such as EPA and DHA. Limited research suggests that DHA levels are lower in pregnant vegetarian women (Mangels et al, 2011)
  - Vegetarians (and particularly vegans) tend to have lower blood levels of EPA and DHA, compared to non-vegetarians (Craig, 2010)
  - While one study found that vegan children had high intakes of linoleic acid compared to linolenic acid, it may be prudent for patients to consume diets that enhance conversion of linolenic acid to DHA (Messina, 2001).
- Recommendation Strength Rationale

  Consensus Statement
  - Consensus: Specific questions about protein and EFA intake were not analyzed as part of the evidence analysis process. Thus, the protein intake and EFA intake recommendations are based on consensus publications.
- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  - References
  - References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

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- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Micronutrient Intake of Adult Vegetarians 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Micronutrient Intake of Adult Vegetarians

  For adult vegetarian patients or clients, the Registered Dietitian (RD) should design a nutrition prescription to ensure the Dietary Reference Intakes (DRI) for all micronutrients, particularly vitamin B-12 are met. When appropriate, vitamin and/or mineral supplements may be indicated to prevent or resolve nutrient deficiency. Research studies measuring methylmalonic acid (MMA) levels showed that the prevalence of B-12 deficiency among healthy, non-pregnant adult vegetarians ranged from 30% to 86%. When vegans and lacto-ovo vegetarians/lacto-vegetarians (LOV/LV) were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43% to 88%). Among older adults (>55 years), the prevalence of vitamin B-12 deficiency was 46.9% to 68%.

  Rating: Fair
  Imperative

- Risks/Harms of Implementing This Recommendation

  There are no potential risks or harms associated with the application of this recommendation.

- Conditions of Application

  - Patient or client is an adult and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  - No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may even be less expensive
  - In some cases, there may be increased cost associated with the selective use of vitamin and/or mineral supplements.

- Recommendation Narrative

  A total of 14 studies were included in the evidence analysis for this recommendation:

  - Five neutral quality cross-sectional studies (Geisel et al, 2005; Hermann et al, 2009; Kwok et al, 2002; Obeid et al, 2002; and Miller et al, 1991)
  - Three positive quality cross-sectional studies (Gibson et al, 2008; Hermann et al, 2001; and Hermann, Schorr et al 2003)
  - One positive quality case-control study (Refsum et al, 2002)
  - Two neutral quality diagnostic, validity or reliability studies (Hermann, Obeid et al, 2003; and Kwok et al, 2004)
  - One neutral quality randomized controlled trial (RCT) (Donaldson, 2000)
  - One neutral quality prospective cohort study (Geisel et al, 2003)
  - One neutral quality non-randomized controlled trial (Morkbak et al, 2006).

  Markers of Vitamin B-12 Status

  - There is no universally accepted measure for determining vitamin B-12 deficiency. Because research indicates that serum B-12 may not be a reliable marker for B-12 deficiency, other measures, such as HoloTC or methylmalonic acid (MMA) either separately or in combination, may provide better measures of vitamin B-12 status. MMA is a biomarker for cellular or tissue (B-12 status) because it is an intermediate in a vitamin B-12 dependent metabolic pathway. Compared to measurement of serum B-12 levels alone, MMA and homocysteine have been shown to be more sensitive in diagnosing early vitamin B-12 deficiency (Oh and Brown, 2003). While homocysteine levels increase in both folate and vitamin B-12 deficiency, increased MMA is specific to a vitamin B-12 deficiency. Thus, research was included in this evidence analysis only if MMA level was used to identify vitamin B-12 deficiency.
  - Estimating the proportion of vegetarian subjects who were vitamin B-12 deficient based on MMA levels depended on the way that the reference levels of MMA were determined. Authors differed regarding the methods they used to determine vitamin B-12 deficiency.

  Vitamin B-12 Status in Adults

  - Twelve studies provide evidence that among healthy, non-pregnant adults, vegetarians consistently had a significantly higher prevalence of vitamin B-12 deficiency (as measured by elevated MMA levels) than omnivores. Depending on the criteria used to define B-12 deficiency and sample differences, prevalence of B-12 deficiency among adult vegetarians ranged from 30% to 86%. When vegans and lacto-ovo vegetarians/lacto-vegetarians (LOV/LV) were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43%-88%).
  - Evidence is based on the following studies: Donaldson, 2000; Geisel et al, 2003; Geisel et al, 2005; Gibson et al, 2008; Hermann et al, 2009; Hermann et al, 2001; Hermann, Obeid et al, 2003; Hermann, Schorr et al, 2003; Miller et al, 1991; Morkbak et al, 2006; Obeid et al, 2002; and Refsum et al, 2002.

  Vitamin B-12 Status in Older Adults

  - Two studies of Chinese women provide limited evidence that the proportion of senior vegetarians (older than 55 years) who are vitamin B-12 deficient ranges from 46.9% to 68%
  - Evidence is based on the following studies: Kwok et al, 2004; and Kwok et al, 2002
  - While a third study (Geisel et al, 2003) was identified, it did not provide data specifically on senior vegetarians.

- Recommendation Strength Rationale

  - Only three of 14 studies were of positive quality
  - Studies frequently relied on convenience samples
  - It was often unclear that study groups were comparable, and intake of vitamin supplements was not reported or controlled for in many studies
  - Eight of the 14 studies identified were on subjects from Northern European nations. Two studies each were of US and Chinese populations. The rest were from other countries (including India, Ethiopia, England and the Middle East). Because dietary patterns and food fortification policies can differ dramatically by country and region, readers should be careful when generalizing.
  - Grade I evidence is available for the conclusion statement regarding vitamin B-12 status among adult vegetarians, as measured by MMA
  - Grade III evidence is available for the conclusion statement regarding vitamin B-12 status among vegetarian seniors (>55 years), as measured by MMA.

- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  What is the vitamin B12 status among adult vegetarians, as measured by methylmalonic acid (MMA)?

  What is the vitamin B-12 status among vegetarian older adults (>55 years) as measured by methylmalonic acid (MMA)?

  - References

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- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Nutrition Counseling to Support a Therapeutic Vegetarian Diet for Adults 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Nutrition Counseling to Support Therapeutic Vegetarian Diets for Adults

  If a vegetarian diet is proposed as a therapeutic diet according to stage in the life cycle and disease state for adults, the Registered Dietitian (RD) should employ a a variety of counseling approaches and strategies to promote adherence to the diet. Research shows that intensive support (e.g., frequent encounters, cooking demonstration, incentives, etc.) can improve nutrition-related outcomes when using a vegetarian diet therapeutically; and nutrition counseling strategies such as motivational interviewing, can improve adherence to recommendations and diet-related outcomes.

  Rating: Strong
  Conditional

  - Risks/Harms of Implementing This Recommendation

    There are no potential risks or harms associated with the application of this recommendation.

  - Conditions of Application

    - Patient or client is an adult and seeks treatment with a therapeutic vegetarian diet, self-reports to be vegetarian or is interested in following a vegetarian dietary lifestyle
    - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
    - RD knowledgeable or experienced in vegetarian diet counseling is preferred
    - A Dietetic Technician Registered (DTR), under the supervision of the RD, may serve as a facilitator in the implementation of this recommendation
    - The studies reviewed in this evidence analysis included adults following vegetarian diets to treat overweight, fibromyalgia symptoms, or to manage cholesterol and Type 2 diabetes risk factors
    - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

  - Potential Costs Associated with Application

    Although costs of Medical Nutrition Therapy (MNT) sessions and reimbursement vary, MNT is essential for improved outcomes.

  - Recommendation Narrative

    A total of 54 studies were included in the evidence analysis for the recommendation:

    - Thirty-three positive quality randomized controlled trials (RCTs) (Ashley et al, 2001; Barnard et al, 2000; Barnard et al, 2006; Barrera et al, 2002; Barrera et al, 2006; Berry et al, 1989; Boutelle et al, 1999; Bowen et al, 2002; Brug et al, 2007; Burke et al, 2007; Burke et al, 2006; Clark et al, 2004; Dansinger et al, 2005; de Mello et al, 2006; Ditschuneit et al, 1999; Geppert et al, 2006; Glasgow et al, 2004; Hakala and Karvetti, 1989; Jeffery and Wing, 1995; Jenkins et al, 2003 (JAMA); Jenkins et al, 2003 (*Metabolism*); Karlsson et al, 1994; Mahon et al, 2007; Metz et al, 1997; Perry et al, 2001; Resincow et al, 2001; Smith et al, 1997; Tate et al, 2003; Toobert et al, 2007; Turner-McGrievy et al, 2007; West et al, 2007; Wing et al, 1991; and Wing et al, 1996)
    - One positive quality review article (Shilts et al, 2004)

- One positive quality meta-analysis of seven RCTs (Paul-Ebhohimhen et al, 2007)
- One positive quality cohort study (Wing et al, 1999)
- Seven neutral quality RCTs (De Lucia et al, 1990; Ditschuneit et al, 2001; Flechtner-Mors et al, 2000; Fuller et al, 1998; Kestin, et al, 1989; Mhurchu et al, 1998; and Milas et al, 1998)
- Two neutral quality cross-sectional studies (Baker and Kirschenbaum, 1998; and Mattfeldt-Beman et al, 1999)
- Two neutral quality non-randomized trials (Daubenmier et al, 2007; Delgado et al, 1996)
- One neutral quality time-series study (Streit et al, 1991)
- One neutral quality observational study (Estabrook et al, 2005)
- One neutral quality non-randomized crossover trial (Hunt et al, 1998)
- One neutral quality randomized crossover trial (Stephenson et al, 2005)
- Two negative quality RCTs (Agren et al, 2001; and Shankar et al, 2002)
- One negative quality nonrandomized controlled trial (Kaartinen et al, 2000).

Therapeutic Vegetarian Diets and Attrition Rate in Adults

- Thirteen studies provide evidence for the following:
  - Results are mixed comparing attrition rates for therapeutic vegetarian and therapeutic omnivorous diets in adults. Therapeutic vegetarian diets appear to perform as well and possibly better than omnivorous diets in terms of attrition rate, provided that patients receive appropriate dietary support.
  - Of the study characteristics examined, disease or condition treated, restrictiveness of the vegetarian diet and level of subject/patient support appeared to be associated with study attrition rates. Attrition rates for obesity treatment with vegetarian diets were higher than that for other diseases. Attrition rates were lower for vegan compared to other types of vegetarian diets.
  - Subject/patient support (e.g., weekly meetings, incentives, cooking demonstrations, etc.) contributed to greater patient/subject retention
- In these studies, vegetarian diets were used to treat overweight or fibromyalgia symptoms, or to manage cholesterol or Type 2 diabetes risk factors
- Evidence was based on the following studies: Agren et al, 2001; Barnard et al, 2006; Barnard et al, 2000; Burke et al, 2007; Burke et al, 2006; Dansinger et al, 2005; Daubenmier et al, 2007; Delgado et al, 1996; de Mello et al, 2006; Geppert et al, 2006; Hakala and Karvetti, 1989; Hunt et al, 1998; Jenkins et al, 2003 (JAMA); Jenkins et al, 2003 (Metabolism); Kaartinen et al, 2000; Karlsson et al, 1994; Kestin, et al, 1989; Mahon et al, 2007; Shankar et al, 2002; Stephenson et al, 2005; and Turner-McGrievy et al, 2007.

Behavior Change Strategies

Self-monitoring as a Component of a Behavioral Program

- Six studies provide evidence that self-monitoring of food intake improves nutrition-related outcomes related to weight loss and compliance with renal diets. Three neutral quality observational studies revealed that clients enrolled in cognitive behavioral weight-loss programs that were successful in losing weight were significantly more consistent with self-monitoring.
- Evidence was based on the following studies: Baker and Kirschenbaum, 1998; Boutelle et al, 1999; Mattfeldt-Beman et al, 1999; Milas et al, 1998; Streit et al, 1991; Tate et al, 2003.

Meal Replacements or Structured Meal Plans, Used as a Component of a Behavioral Program

- Six studies assessed the efficacy of various types of meal replacement or structured meal plan strategies, as compared to self-selected diets in middle-aged adults and provide evidence that the use of various types of meal replacements or structured meal plans helpful in achieving health and food behavior change
- Additional research is needed to determine if benefits derived from temporary use of these behavioral strategies can be sustained over time
- Evidence was based on the following studies: Ashley et al, 2001; Ditschuneit et al, 1999; Ditschuneit et al, 2001; Flechtner-Mors et al, 2000; Metz et al, 1997; and Wing et al, 1996.

Reward and Reinforcement (Contingency Management), as a Component of a Behavioral Intervention

- Two studies provide evidence that monetary rewards or reinforcement had no treatment effect
- Evidence was based on the following studies: Fuller et al, 1998; Jeffery and Wing, 1995; and Paul-Ebhohimhen et al, 2007.

Problem-solving

- Two studies, one in overweight and obese women and the other in post-menopausal women with diabetes, utilized interventions that incorporated problem-solving strategies. In both studies, use of problem-solving strategies resulted in improvements in key outcome measures, including maintenance of weight loss and in subjects with diabetes, was linked to improvements in fat consumption, self-efficacy and physical activity.
- Evidence was based on the following studies: Perry et al, 2001; and Glasgow et al, 2004.

Social Support

- Five studies provide evidence for the following:
  - One highly-intense lifestyle change study found social support was helpful and four traditional lifestyle change programs did not find it helpful
  - The definition of social support has evolved to include multiple dimensions of social support measured pre- and post-treatment
  - One RCT and one cohort study manipulated social support and found no significant (NS) treatment effect
  - In one RCT, multiple dimensions of social support were measured pre- and post-treatment and use of social resources was shown to mediate intervention effects on physical activity, fat consumption and hemoglobin A1c change
- Additional studies are needed to measure impact of social support interventions on outcomes
- Evidence was based on the following studies: Barrera et al, 2002; Barrera et al, 2006; Toobert et al, 2007; Wing et al, 1991; and Wing et al, 1999.

Goal-setting

- Five studies provide evidence for the following:
  - One positive quality RCT found a 30-minute motivational interviewing session, based on self-selected diabetic self-management goals, followed by three 10-minute phone calls at one, three and seven weeks, was significantly more effective than usual care in reducing dietary fat intake and increasing physical activity at one year in 100 adults with Type 2 diabetes
  - A positive quality RCT showed similar results regarding the value of clients' self-selected behavior change goals and demonstrated the effectiveness of goal-attainment training in realizing dietary improvements
  - One neutral quality observational study found 422 clients with diabetes who used computer technology to self-select a behavior-change goal in an area of diet or exercise and received brief (eight to 10 minutes) counseling related to the goal, were successful in reducing fat intake two months later. Clients' active participation in selecting and setting goals led to the selection of a goal from the area that could use the most improvement and the goal that was most personally appropriate.
- Evidence was based on the following studies: Berry et al, 1989; Clark et al, 2004; Estabrook et al, 2005; and Shilts et al, 2004.

Cognitive Restructuring

- One study assessed the additive effect of a cognitive restructuring component to a 10-week strictly behavioral weight-loss program in 63 middle-aged overweight subjects and found NS difference between the treatment group and control group in any physiological, behavioral or cognitive measures at baseline, post-treatment and at three-month follow-up
- Additional research is needed on the isolated effect of cognitive restructuring as part of a behavioral intervention on nutrition-related outcomes
- Evidence was based on the following studies: De Lucia et al, 1990.

Motivational Interviewing

- Six studies provide evidence for the following:
  - Two studies assessed motivational interviewing employed by dietitians as a sole form of intervention (without cognitive behavioral therapy) and results were NS different from usual care, with the exception of a decreased reported intake of saturated fat in newly-diagnosed patients with diabetes
  - Further research is warranted with larger sample sizes, longer follow-up periods and measurement of readiness to change diet behaviors
  - Four studies examined patient outcomes of nutrition interventions provided by dietitians (three) or licensed clinical psychologists (one) trained in motivational

interviewing techniques. Three of these studies employed motivational interviewing as an adjunct to cognitive-behavioral therapy and one employed motivational interviewing as an adjunct therapy to a self-help program. In all cases, the motivational interviewing group achieved significantly better outcomes. Positive patient outcomes included significantly larger improvements, compared to usual care, in dietary fat intake, in adherence to a behavioral weight reduction program and improved glucose control, reduction in body weight, increased fruit and vegetable intake and improved low-fat vegetable preparation practices.

- Evidence was based on the following studies: Bowen et al, 2002; Brug et al, 2007; Mhurchu et al, 1998; Resincow et al, 2001; Smith et al, 1997; and West et al, 2007).

- Recommendation Strength Rationale

  - Grade I evidence is available for the following conclusion statements regarding:
    - Comparison of therapeutic vegetarian diets to other types of therapeutic diets in terms of attrition rate in adults
    - Factors associated with attrition rates in studies of adults using vegetarian diets for nutrition therapy
    - Behavioral strategy of self-monitoring, meal replacements or structured meal plans, and reward and reinforcement (contingency management) used as a component of a behavioral program and health or food behavior change in adults counseled in an outpatient or clinic setting
    - Motivational interviewing, used as an adjunct to a cognitive-behavioral program, and health and food behavior change in adults counseled in an outpatient or clinic setting
  - Grade II evidence is available for the conclusion statements regarding behavioral strategy of social support, goal-setting, and problem-solving and health or food behavior change in adults counseled in an outpatient or clinic setting
  - Grade III evidence is available for the following conclusion statements:
    - Behavioral strategy of cognitive restructuring and health or food behavior change in adults counseled in an outpatient or clinic setting
    - Nutrition counseling based on the motivational Interviewing alone and health and food behavior change in adults counseled in an outpatient or clinic setting

- Minority Opinions

  None.

- Supporting Evidence

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

How do therapeutic vegetarian diets compare to other types of therapeutic diets in terms of attrition rate in adults?

What are some factors associated with attrition rates in studies of adults using vegetarian diets for nutrition therapy?

What is the evidence that the behavioral strategy of self-monitoring, used as a component of a behavioral program, will result in health or food behavior change in adults counseled in an outpatient or clinic setting?

What is the evidence that the behavioral strategy of meal replacements or structured meal plans, used as a component of a behavioral program, will result in health or food behavior change in adults counseled in an outpatient or clinic setting?

What is the evidence that the behavioral strategy of reward and reinforcement (contingency management), used as a component of a behavioral intervention, will result in health/food behavior change in adults counseled in an outpatient/clinic setting?

What is the evidence that the behavioral strategy of problem-solving will result in health or food behavior change in adults counseled in an outpatient or clinic setting?

What is the evidence that the behavioral strategy of social support will result in health/food behavior change in adults counseled in an outpatient/clinic setting?

What is the evidence that the behavioral strategy of goal-setting will result in health or food behavior change in adults counseled in an outpatient or clinic setting?

What is the evidence that the behavioral strategy of cognitive restructuring will result in health or food behavior change in adults counseled in an outpatient or clinic setting?

What is the evidence that nutrition counseling based on the Motivational Interviewing alone results in health/food behavior change in adults counseled in an outpatient/clinic setting?

What is the evidence that Motivational Interviewing, used as an adjunct to a cognitive-behavioral program, results in health/food behavior change in adults counseled in an outpatient/clinic setting?

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- References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

  None.

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Macronutrient Intake of Adolescent and Adult Vegetarians During Pregnancy 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Protein Intake of Pregnant Adolescent and Adult Vegetarians

  For pregnant adult and adolescent vegetarians and vegans, the Registered Dietitian (RD) should develop a nutrition prescription and offer comprehensive nutrition education and skill development on planning a diet which provides adequate protein from a variety of complementary mixtures of plant proteins consumed throughout the day. While research indicates that pregnant vegetarians typically had lower protein intake than pregnant omnivores, they met or exceeded the national standards for protein intake for pregnant women in the populations studied.

  Rating: Weak
  Imperative

  VN: Essential Fatty Acid Intake of Pregnant Adolescent and Adult Vegetarians

  For the pregnant adolescent or adult vegetarian, if nutrition assessment of intake or blood levels of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) reveals a potential deficiency or lower than optimal levels, the Registered Dietitian (RD) should counsel the patient or client to increase EPA and DHA levels by any of the following methods (as appropriate based on RD clinical judgment):

  - Increasing intake of foods rich in EPA and DHA
  - EPA and DHA supplementation
  - Increase endogenous synthesis of essential fatty acids (EFA) by decreasing intake of omega-6 fatty acid as well as reducing the amount of saturated fat and trans fat in the diet.

  Rating: Consensus
  Conditional

  - Risks/Harms of Implementing This Recommendation

    Since the optimal ratio of EPA and DHA are not known for vegetarians, very high levels of EPA and DHA may be contraindicated, and thus, over-supplementation should be avoided. The US Food and Drug Administration advises that consumption of more than three grams of omega-3 fatty acids per day may cause gastrointestinal symptoms.

  - Conditions of Application

    - Patient or client is a pregnant adult or adolescent (13 to 18 years) and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
    - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
    - RD knowledgeable or experienced in vegetarian diet counseling is preferred
    - While counseling for EFA intake is critical for all vegetarians, EPA and DHA levels are particularly critical in pregnancy (Niinivirta et al, 2011; Craig, 2010)
    - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

  - Potential Costs Associated with Application

    - If supplementation of EPA and DHA is warranted, additional costs may be incurred
    - No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may even be less expensive.

  - Recommendation Narrative

    A total of four studies were included in the evidence analysis for this recommendation:

    - Two positive quality prospective cohort studies (Campbell-Brown et al, 1985; and Ganpule et al, 2006)
    - One positive quality panel design study (Drake et al, 1998)
    - One neutral quality report of two cross-sectional studies (Reddy et al, 1994).

    Macronutrient and Energy Intake in Pregnant Vegetarians

    - Four studies on non-US populations provide limited evidence that the macronutrient intake of pregnant vegetarians is similar to that of non-vegetarians with the following exceptions (as percentages of energy intake):
      - Pregnant vegetarians receive statistically lower levels of protein than pregnant non-vegetarians
      - Pregnant vegetarians receive statistically higher levels of carbohydrates than pregnant non-vegetarians
    - It is important to note, however, that none of the studies report a protein deficiency in pregnant vegetarians
    - No research was identified that focused on macronutrient intakes among pregnant vegans
    - The Dietary Reference Intakes (DRI) should be met as a minimum in all pregnant women (regardless of whether they are vegetarian or not)

- Evidence is based on the following studies: Drake et al, 1998; Campbell-Brown et al, 1985; Ganpule et al, 2006; and Reddy et al, 1994.

Protein

- Protein quality is determined primarily by digestibility and the amino acid composition of the protein. The quality of the protein source is based on the nitrogen and amino acids provided for growth, maintenance, and repair. Different protein sources vary in chemical composition and nutritional value. In food, it is the contribution of all of the amino acids to the total nitrogen content that must be considered in assessing the overall protein quality of the diet (IOM, 2005).
- Vegetarian diets that include complementary mixtures of plant proteins can provide the same quality of protein as that from animal proteins. While plant proteins are generally less digestible than animal proteins, the digestibility can be altered through processing and preparation. Vegetarians can have an adequate intake of protein by consuming a varied diet. (IOM, 2005).

Essential Fatty Acids

- Several studies have reported that there is potential for vegetarians to be deficient in EFA such as EPA and DHA. Limited research suggests that DHA levels are lower in pregnant vegetarian women (Mangels et al, 2011).
- Vegetarians (and particularly vegans) tend to have lower blood levels of EPA and DHA, compared to non-vegetarians. (Craig, 2010).

- Recommendation Strength Rationale
  - The research suffered from a number of design limitations:
    - Research was limited and restricted to non-US populations.
    - One study (Ganpule et al, 2006) had no comparison group and appeared to combine vegetarian and non-vegetarian data.
    - One study focused on particular ethnic groups (Ganpule et al, 2006) which limits the generalizability of the findings.
    - Additionally, the content of vegetarian diets was not well-defined. Since individuals who are considered vegetarian may have quite different diets the lack of definition of vegetarian diets confounds studies of nutritional intake. In short, it is rarely clear what "vegetarian" means in the different studies.
  - Grade III evidence is available for the conclusion statement on the differences in macronutrient and energy intake in pregnant vegetarians vs. pregnant omnivores
  - Consensus Statement
    - Consensus: Specific questions about EFA intake were not analyzed as part of the evidence analysis process, thus, the EFA intake recommendation is based on consensus publications.

- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  How do macronutrient and energy intake in pregnant vegetarians differ from intakes in pregnant omnivores?

  How do macronutrient and energy intake in pregnant vegans differ from intakes in pregnant omnivores?

  - References

    Campbell-Brown M, Ward RJ, Haines AP, North WR, Abraham R, McFadyen IR, Turnlund JR, King JC. Zinc and copper in Asian pregnancies--is there evidence for a nutritional deficiency? *Br J Obstet Gynaecol.* 1985 Sep; 92 (9): 875-85.

    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.

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  - References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

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    Subcommittees on Upper Reference Levels of Nutrients and Interpretation and Uses of Dietary Reference Intakes, and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty acids, Cholesterol, Protein and Amino Acids. Food and Nutrition Board. Institute of Medicine. Washington DC, *The National Academies Press*; 2005. Accessed online August 01, 2011: http://books.nap.edu/openbook.php?record_id=10490.

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Micronutrient Intake in Adolescent and Adult Vegetarians During Pregnancy 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Micronutrient Intake in Pregnant Adolescent and Adult Vegetarians

For pregnant adolescent and adult vegetarians, the Registered Dietitian (RD) should design a nutrition prescription to ensure the Dietary Reference Intakes (DRI) for all micronutrients are met. If unable to meet the DRI for recommended levels of micronutrients, particularly iron, folate and zinc, the RD should recommend supplementation to ensure adequate intake. Research indicates that pregnant vegetarians did not meet dietary requirements for at least one of these micronutrients.

Rating: Fair
Conditional

VN: Vitamin B12 Intake in Pregnant Adolescent and Adult Vegetarians

For pregnant adolescent and adult vegetarian or vegan patients or clients, the Registered Dietitian (RD) should design a nutrition prescription to ensure vitamin B-12 requirements are met by diet and/or supplementation, including prenatal supplements. Two high quality studies report that lacto-ovo vegetarian pregnant women are less likely than non-vegetarian pregnant women to meet dietary requirements for vitamin B-12 intake, and two high quality studies report that pregnant vegetarians had significantly lower serum B-12 concentrations than pregnant non-vegetarians. In addition, twelve studies measuring methylmalonic acid (MMA) levels, showed that the prevalence of vitamin B-12 deficiency among healthy, non-pregnant adult vegetarians ranged from 30% to 86%. When vegans and lacto-ovo vegetarians/lacto-vegetarians (LOV/LV) were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43% to 88%).

Rating: Fair
Imperative

- Risks/Harms of Implementing This Recommendation

  Care should be taken that patient/client intake from all sources is not above the tolerable upper intake level (UL).

- Conditions of Application

  - Supplementation is only encouraged after assessment of dietary intake and supplementation intake
  - Patient or client is a pregnant adult or adolescent (13 to 18 years) and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
  - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

  - No obvious costs are associated with the application of this recommendation, since purchase of fruits, vegetables, whole grains, fortified and/or enriched products purchased in bulk may even be less expensive.
  - In some cases, there may be increased cost associated with the selective use of vitamin and/or mineral supplements.

- Recommendation Narrative

  A total of 22 studies were included in the evidence analysis for this recommendation:

  - Six positive quality prospective cohort studies (Campbell-Brown et al, 1985; Cheng et al, 2004; Ganpule et al, 2006; Koebnick et al, 2001; Koebnick et al, 2004; and Koebnick et al, 2005)
  - Four positive quality cross-sectional studies (Gibson et al, 2008; Hermann et al, 2001; Hermann, Schorr et al 2003; and Ward et al, 1988)
  - One positive quality case-control study (Refsum et al, 2002)
  - One positive quality panel design study (Drake et al, 1998)
  - Five neutral quality cross-sectional studies (Geisel et al, 2005; Hermann et al, 2009; King et al, 1981; Obeid et al, 2002; and Miller et al, 1991)
  - One neutral quality randomized controlled trial (RCT) (Donaldson, 2000)
  - One neutral quality prospective cohort study (Geisel et al, 2003)
  - One neutral quality non-randomized controlled trial (Morkbak et al, 2006)
  - One neutral quality diagnostic, validity or reliability study (Hermann, Obeid et al, 2003)
  - One neutral quality panel design study (Ellis et al, 1987).

  Birth Outcomes

  - Four studies of non-US populations provide limited evidence that there are no significant health differences in babies born to non-vegan vegetarian mothers vs. non-vegetarians
  - No research was identified that focused on the birth outcomes of vegan vs. omnivorous mothers
  - Evidence is based on the following studies: Drake et al, 1998; Ganpule et al, 2006, North and Golding, 2000; and Reddy et al, 1994.

  Micronutrient Intake in Pregnant Women

  - Ten studies, two of which were conducted in the US, provide evidence for the following:
    - Only the following micronutrients had lower intake among vegetarians than non-vegetarians:
      - Vitamin B-12
      - Vitamin C
      - Calcium
      - Zinc
    - Vegetarians did not meet dietary standard (in at least one country) for:
      - Vitamin B-12 (in UK)
      - Iron (in US, for both vegetarians and omnivores)
      - Folate (in Germany, though lower rate of deficiency than among omnivores)
      - Zinc (in UK)
  - Evidence is based on the following studies: Campbell-Brown et al, 1985; Cheng et al, 2004; Drake et al, 1998; Ellis et al, 1987; Ganpule et al, 2006; King et al, 1981; Koebnick et al, 2001; Koebnick et al, 2004; Koebnick et al, 2005; and Ward et al, 1988
  - Six studies (five non-US, one with combined US and non-US samples) provide evidence for the following:
    - Of the micronutrients examined in the research, only serum B-12 levels were significantly lower in non-vegan vegetarians than non-vegetarians. Additionally, one study reported that lower B-12 levels are more likely to be associated with high serum tHCY in ovo-lacto vegetarians than low meat eaters or omnivores.
    - While zinc levels were not significantly different between non-vegan vegetarians and non-vegetarians, vegetarians who have a high intake of calcium may be at risk for zinc deficiency (because of the interaction between phytate, calcium and zinc).
    - Based on limited evidence, plasma folate levels may actually be higher among some vegetarian groups than non-vegetarians
  - Evidence is based on the following studies: Campbell-Brown et al, 1985; Cheng et al, 2004; Ellis et al, 1987; Koebnick et al, 2001; Koebnick et al, 2004; and Ward et al, 1988.

  Vitamin B-12 Status in Adults

  - Twelve studies provide evidence that among healthy, non-pregnant adults, vegetarians consistently had a significantly higher prevalence of vitamin B-12 deficiency (as measured by elevated MMA levels) than omnivores. Depending on the criteria used to define B-12 deficiency and sample differences, prevalence of B-12 deficiency among adult vegetarians ranged from 30% to 86%. When vegans and lacto-ovo vegetarians/lacto-vegetarians (LOV/LV) were analyzed separately, vegans had even higher proportions of vitamin B-12 deficiency (43%-88%).
  - Evidence is based on the following studies: Donaldson, 2000; Geisel et al, 2003; Geisel et al, 2005; Gibson et al, 2008; Hermann et al, 2009; Hermann et al, 2001; Hermann, Obeid et al, 2003; Hermann, Schorr et al, 2003; Miller et al, 1991; Morkbak et al, 2006; Obeid et al, 2002; and Refsum et al, 2002
  - No studies included pregnant vegetarians. However, studies of adult vegetarians may be used to establish baseline vitamin B-12 status prior to conception.
  - **Markers of Vitamin B-12 Status:**
    - There is no universally accepted measure for determining vitamin B-12 deficiency. Because research indicates that serum B-12 may not be a reliable marker for B-12 deficiency, other measures, such as HoloTC or methylmalonic acid (MMA) either separately or in combination, may provide better measures of vitamin B-12

status. MMA is a biomarker for cellular or tissue (B-12 status) because it is an intermediate in a vitamin B-12 dependent metabolic pathway. Compared to measurement of serum B-12 levels alone, MMA and homocysteine have been shown to be more sensitive in diagnosing early vitamin B-12 deficiency (Oh and Brown, 2003). While homocysteine levels increase in both folate and vitamin B-12 deficiency, increased MMA is specific to a vitamin B-12 deficiency. Thus, research was included in this evidence analysis only if MMA level was used to identify vitamin B-12 deficiency.
    - Estimating the proportion of vegetarian subjects who were vitamin B-12 deficient based on MMA levels depended on the way that the reference levels of MMA were determined. Authors differed regarding the methods they used to determine vitamin B-12 deficiency.

- Recommendation Strength Rationale

    - Evidence in this area is limited by several factors including:
        - A limited number of studies
        - Most were carried out on non-US populations.
    - The DRI should be met as a minimum in all pregnant women (regardless of whether they are vegetarian or not)
    - Grade I evidence is available for the conclusion statement regarding vitamin B-12 status among adult vegetarians, as measured by MMA
    - Grade III evidence is available for the conclusion statements regarding:
        - Patterns of micronutrient intake among pregnant vegetarians
        - Bioavailability of different micronutrients in pregnant vegetarians.

- Minority Opinions

    None.

- Supporting Evidence

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

What are patterns of micronutrient intake among pregnant vegetarians?

What is the bioavailability of different micronutrients in pregnant vegetarians?

What is the vitamin B12 status among adult vegetarians, as measured by methylmalonic acid (MMA)?

- References

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- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Hyperlipidemia Treatment with a Vegetarian Diet for Adults 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

VN: Treating Hyperlipidemia with a Vegetarian Diet for Adults

If consistent with patient or client preference, the Registered Dietitian (RD) may recommend and educate on the benefits of a vegetarian diet for adults seeking treatment to lower total cholesterol (TC) and low-density lipoprotein-cholesterol (LDL-C) levels, or if appropriate, to reduce weight. Research shows that various types of vegetarian diets (e.g., vegetarian Ornish, Portfolio diet, ovo-lacto vegetarian and vegan) lower TC from 7.2% to 26.6% and lower LDL-C from 8.7% to 35% (with five of the eight studies that provided comparison data showing a decrease between 10% and 20% for both TC and LDL-C). Vegan diets lower both TC and LDL-C more than other types of vegetarian diets.

Rating: Strong
Conditional

- Risks/Harms of Implementing This Recommendation

There are no potential risks or harms associated with the application of this recommendation.

- Conditions of Application

  - Patient or client is an adult with hyperlipidemia who is interested in following a vegetarian dietary lifestyle or who self-reports to be vegetarian
  - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
  - RD knowledgeable or experienced in vegetarian diet counseling is preferred
  - A Dietetic Technician Registered (DTR), under the supervision of the RD, may serve as a facilitator in the implementation of this recommendation
  - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

- Potential Costs Associated with Application

Although costs of Medical Nutrition Therapy (MNT) sessions and reimbursement vary, MNT is essential for improved outcomes.

- Recommendation Narrative

A total of 14 studies were included in the evidence analysis for this recommendation:

  - Eight positive quality randomized controlled trials (RCTs) (Barnard et al, 2000; Barnard et al, 2006; Burke et al, 2006; Burke et al, 2007; Dansinger et al, 2005; de Mello and Zelmanovitz, 2006; Jenkins et al, 2003 (*VN*); and Mahon et al 2007)
  - Two neutral quality RCTs (Jenkins et al, 2003 (*Metabolism*); and Stephenson et al, 2005)
  - Two neutral quality non-randomized trials (Daubenmier and Weidner, 2007; and Hunt et al, 1998)
  - One negative quality RCT (Agren and Tvrzicka, 2001)
  - One negative quality non-randomized trial (Kaartinen et al, 2000).

Total Cholesterol (TC)

  - Thirteen studies provide evidence that the therapeutic use of a vegetarian diet is effective for decreasing TC among subjects being treated for obesity, Type 2 diabetes, or cholesterol management. Additionally, the therapeutic use of a vegetarian diet is at least as effective as therapeutic omnivorous diets for lowering TC and may perform better than omnivorous diets for lowering TC in adults.
  - Evidence is based on the following studies: Agren and Tvrzicka, 2001; Barnard et al, 2006; Burke et al, 2006; Burke et al, 2007; Dansinger et al, 2005; Daubenmier and Weidner, 2007; de Mello and Zelmanovitz, 2006; Hunt et al, 1998; Jenkins et al, 2003 (*Metabolism*); Jenkins et al, 2003 (*VN*); Kaartinen et al, 2000; Mahon et al 2007; and Stephenson et al, 2005.

Low-density Lipoprotein Cholesterol (LDL-C)

- Thirteen studies provide strong evidence that the therapeutic use of a vegetarian diet is effective for decreasing LDL-C among subjects being treated for obesity, Type 2 diabetes or cholesterol management. Additionally, the therapeutic use of a vegetarian diet is equally or more effective for lowering LDL-C compared to omnivorous diets among subjects being treated for obesity, Type 2 diabetes or cholesterol management.
- Evidence is based on the following studies: Agren and Tvrzicka, 2001; Barnard et al, 2000; Barnard et al, 2006; Burke et al, 2006; Burke et al, 2007; Dansinger et al, 2005; Daubenmier and Weidner, 2007; de Mello and Zelmanovitz, 2006; Hunt et al, 1998; Jenkins et al, 2003 (*Metabolism*); Jenkins et al, 2003 (*VN*); Mahon et al 2007; and Stephenson et al, 2005.

For additional information, see related ADA Evidence-Based Guideline: Disorders of Lipid Metabolism Guideline.

- Recommendation Strength Rationale

  Grade I evidence is available for the following conclusion statements regarding:

  - Effectiveness of the therapeutic use of a vegetarian diet for bringing about improvements in TC levels and LDL-C levels
  - Therapeutic use of a vegetarian diet compared to omnivorous diets for improving TC levels and LDL-C levels.

- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  Is the therapeutic use of a vegetarian diet effective for bringing about improvements in total cholesterol levels in adults?

  How does the therapeutic use of a vegetarian diet compare to omnivorous diets for improving total cholesterol levels in adults?

  Is the therapeutic use of a vegetarian diet effective for bringing about improvements in LDL cholesterol levels in adults?

  How does the therapeutic use of a vegetarian diet compare to omnivorous diets for improving LDL cholesterol levels in adults?

  - References

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    Jenkins DJ, Kendall CW, Marchie A, Faulkner DA, Wong JM, de Souza R, Emam A, Parker TL, Vidgen E, Lapsley KG, Trautwein EA, Josse RG, Leiter LA, Connelly PW. Effects of a dietary portfolio of cholesterol-lowering foods vs. lovastatin on serum lipids and C-reactive protein. *JAMA.* 2003 Jul 23; 290 (4): 502-510.

    Jenkins DJ, Kendall CW, Marchie A, Faulkner D, Vidgen E, Lapsley KG, Trautwein EA, Parker TL, Josse RG, Leiter LA, Connelly PW. The effect of combining plant sterols, soy protein, viscous fibers, and almonds in treating hypercholesterolemia. *Metabolism.* 2003 Nov; 52(11): 1478-83

    Kaartinen K, Lammi K, Hypen M, Nenonen M, Hanninen O, Rauma AL. Vegan diet alleviates fibromyalgia symptoms. *Scand J Rheumatol.* 2000; 29 (5): 308-313.

    Mahon AK, Flynn MG, Stewart LK, McFarlin BK, Iglay HB, Mattes RD, Lyle RM, Considine RV, Campbell WW. Protein intake during energy restriction: effects on body composition and markers of metabolic and cardiovascular health in postmenopausal women. *J Am Coll Nutr.* 2007 Apr; 26 (2): 182-189.

    Stephenson TJ, Setchell KDR, Kendall CWC, Jenkins DJA, Anderson JW, Fanti P. Effect of soy protein-rich diet on renal function in young adults with insulin-dependent diabetes mellitus. *Clin Nephrol.* 2005; 64: 1-11.

    Barnard ND, Cohen J, Jenkins DJ, Turner-McGrievy G, Gloede L, Jaster B, Seidl K, Green AA, Talpers S. A low-fat vegan diet improves glycemic control and cardiovascular risk factors in a randomized clinical trial in individuals with type 2 diabetes. *Diabetes Care.* 2006 Aug;29(8):1777-83.

  - References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

    ATP III Full Report and Executive Summary. National Cholesterol Education Program. *Third Report of the Expert Panel on Detection, Evaluation and Treatment of High Blood Choleterol in Adults (Adult Treatment Panel III).* 2004. Accessed August 01, 2011: http://www.nhlbi.nih.gov/guidelines/cholesterol/ (pending the expected release of ATP IV in Fall 2011).

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Overweight and Obesity Treatment with a Vegetarian Diet for Adults 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Treating Overweight and Obesity with a Vegetarian Diet for Adults

  If consistent with patient or client preference, the Registered Dietitian (RD) may recommend and educate on the benefits of the therapeutic use of a vegetarian diet for adults seeking treatment for overweight or obesity. Research indicates that the therapeutic use of a vegetarian diet is effective for treating overweight and obesity in both the short term (less than one year) and longer term (greater than one year), and may perform better than alternative omnivorous diets for the same purpose. Percent weight loss ranged from 3.2% to 9.3% at 12 months across studies.

  Rating: Strong
  Conditional

  - Risks/Harms of Implementing This Recommendation

    There are no potential risks or harms associated with the application of this recommendation.

  - Conditions of Application

    - Patient or client is an adult seeking treatment for weight loss or weight loss maintenance and is interested in following a vegetarian diet, or who self-reports to be a vegetarian
    - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
    - RD knowledgeable or experienced in vegetarian diet counseling is preferred
    - A Dietetic Technician Registered (DTR), under the supervision of the RD, may serve as a facilitator in the implementation of this recommendation
    - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

  - Potential Costs Associated with Application

    Although costs of Medical Nutrition Therapy (MNT) sessions and reimbursement vary, MNT is essential for improved outcomes.

  - Recommendation Narrative

    A total of 17 studies were included in the evidence analysis for this recommendation:

    - Twelve positive quality randomized controlled trials (RCTs) [Barnard et al, 2006; Barnard et al, 2000; Burke et al, 2007; Burke et al, 2006; Dansinger et al, 2005; de Mello et al, 2006; Hakala and Karvetti, 1989; Jenkins et al, 2003 (*Metabolism*); Jenkins et al, 2003 *(VN)*; Kestin et al, 1989; Mahon et al, 2007; and Turner-McGrievy et al, 2007)
    - Two neutral quality RCTs (Karlsson et al, 1994; and Marniemi et al, 1990)
    - One neutral quality non-randomized trial (Daubenmier and Weidner, 2007)
    - One negative quality before-after study (Bhumisawasdi et al, 2006)
    - One negative quality non-randomized trial (Kaartinen et al, 2000).

    Short-Term Improvements in Weight Status (Less than One Year)

    - Sixteen studies provide evidence that the therapeutic use of a vegetarian diet is an effective way to bring about short-term improvements in weight status in adults, as part of a multi-component weight management program
    - Evidence is based on the following studies: Barnard et al, 2006; Barnard et al, 2000; Bhumisawasdi et al, 2006; Burke et al, 2007; Burke et al, 2006; Dansinger et al, 2005; Daubenmier and Weidner, 2007; de Mello and Zelmanovitz, 2006; Hakala and Karvetti, 1989; Jenkins et al, 2003 (*Metabolism*)); Kaartinen et al, 2000; Karlsson et al, 1994; Kestin et al, 1989; Mahon et al, 2007; Marniemi et al, 1990; and Turner-McGrievy et al, 2007.

    Longer-Term Improvements in Weight Status (More than One Year)

    - Five studies provide evidence that the therapeutic use of a vegetarian diet as part of a multi-component weight-management program is an effective way to bring about longer-term (more than one year) improvements in weight status among adults who are compliant
    - Evidence is based on the following studies: Burke et al, 2007; Dansinger et al, 2005; Hakala and Karvetti, 1989; Marniemi et al, 1990; and Turner-McGrievy et al, 2007
    - All of the studies included the vegetarian diet as part of a multi-component support program which included educational support, group meetings and exercise recommendations
    - The ADA Adult Weight Management Guideline recommends that weight management programs include diet, exercise and behavioral therapy components since combination therapy is more successful than using any one intervention alone. See Adult Weight Management (AWM) Comprehensive Weight Management Program.

    Comparison of Vegetarian Diets and Other Diets

    - Eleven studies provide evidence that compared to omnivorous diets that could be used to treat obesity, findings are mixed as to whether therapeutic vegetarian diets are more or less effective for improving weight status in adults
    - Evidence is based on the following studies: Barnard et al, 2006; Burke et al, 2007; Burke et al, 2006; Dansinger et al, 2005; de Mello and Zelmanovitz, 2006; Hakala and Karvetti, 1989; Karlsson et al, 1994; Kestin et al, 1989; Mahon et al, 2007; Marniemi et al, 1990; and Turner-McGrievy et al, 2007.

    For additional information, see related ADA Evidence-Based Guideline: Adult Weight Management Guideline.

  - Recommendation Strength Rationale

    - Evidence was consistently strong for the relationship between improved weight status and the therapeutic use of a vegetarian diet both in the short term and longer term
    - In terms of how vegetarian diets performed relative to therapeutic omnivorous diets for improving weight status, there was no clear difference in effectiveness
    - Grade I evidence is available for the conclusion statements regarding the effectiveness of the therapeutic use of a vegetarian diet for bringing about short-term (less than one year) and longer-term (more than one year) improvements in weight status in obese and overweight adults
    - Grade III evidence is available for the conclusion statement regarding how vegetarian diets compare to other therapeutic diets for treating overweight or obese adults.

  - Minority Opinions

    None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  Is the therapeutic use of a vegetarian diet effective for bringing about short-term (less than one year) improvements in weight status in obese and overweight adults?

  Is the therapeutic use of a vegetarian dietary pattern effective for bringing about longer-term (more than one year) improvements in weight status in obese and overweight adults?

  How do vegetarian diets compare to other therapeutic diets for treating overweight or obese adults?

  - References

    Barnard, ND, Scialli, AR et al. Effectiveness of a low-fat vegetarian diet in altering serum lipids in healthy premenopausal women. *Am J of Cardiology.* 2000 (Apr); 85: 969-972.

    Bhumisawasdi J, Vanna O, Surinpang N. The self-reliant system for alternative care of diabetes mellitus patients--experience macrobiotic management in Trad Province. *J Med Assoc Thai.* 2006 Dec; 89 (12): 2,104-2,115.

Burke LE, Hudson AG, Warziski MT, Styn MA, Music E, Elci OU, Sereika SM. Effects of a vegetarian diet and treatment preference on biochemical and dietary variables in overweight and obese adults: a randomized clinical trial. *Am J Clin Nutr.* 2007 Sep; 86 (3): 588-596.

Burke LE, Styn MA, Steenkiste AR, Music E, Warziski M, Choo J. A randomized clinical trial testing treatment preference and two dietary options in behavioral weight management: preliminary results of the impact of diet at six months: PREFER study. *Obesity* (Silver Spring). 2006 Nov; 14 (11): 2,007-2,017.

Dansinger ML, Gleason JA, Griffith JL, Selker HP, Schaefer EJ. Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction. *JAMA* 2005; 293: 43-53.

Daubenmier JJ, Weidner G, Sumner MD, Mendell N, Merritt-Worden T, Studley J, Ornish D. The contribution of changes in diet, exercise, and stress management to changes in coronary risk in women and men in the multisite cardiac lifestyle intervention program. *Ann Behav Med.* 2007 Feb; 33 (1): 57-68.

de Mello VD, Zelmanovitz T, Perassolo MS, Azevedo MJ, Gross JL. Withdrawal of red meat from the usual diet reduces albuminuria and improves serum fatty acid profile in type 2 diabetes patients with macroalbuminuria. *Am J Clin Nutr.* 2006 May; 83 (5): 1,032-1,038.

Hakala P, Karvetti R. Weight reduction on lactovegetarian and mixed diets. *Eur J Clin Nutr.* 1989; 43: 421-430.

Jenkins DJ, Kendall CW, Marchie A, Faulkner DA, Wong JM, de Souza R, Emam A, Parker TL, Vidgen E, Lapsley KG, Trautwein EA, Josse RG, Leiter LA, Connelly PW. Effects of a dietary portfolio of cholesterol-lowering foods vs. lovastatin on serum lipids and C-reactive protein. *JAMA.* 2003 Jul 23; 290 (4): 502-510.

Jenkins DJ, Kendall CW, Marchie A, Faulkner D, Vidgen E, Lapsley KG, Trautwein EA, Parker TL, Josse RG, Leiter LA, Connelly PW. The effect of combining plant sterols, soy protein, viscous fibers, and almonds in treating hypercholesterolemia. *Metabolism.* 2003 Nov; 52(11): 1478-83

Kaartinen K, Lammi K, Hypen M, Nenonen M, Hanninen O, Rauma AL. Vegan diet alleviates fibromyalgia symptoms. *Scand J Rheumatol.* 2000; 29 (5): 308-313.

Karlsson J, Hallgren P, Kral J, Lindroos A, Sjostrom L, Sullivan M. Predictors and effects of long-term dieting on mental well being and weight loss in obese women. *Appetite.* 1994; 23: 15-26.

Kestin, M, Rouse, IL, Correll, RA, Nestel, PJ. Cardiovascular disease risk factors in free-living men: Comparison of two prudent diets, one based on lactoovovegetarianism and the other allowing lean meat. *Am J Clin Nutr.* 1989; 50: 280-287.

Mahon AK, Flynn MG, Stewart LK, McFarlin BK, Iglay HB, Mattes RD, Lyle RM, Considine RV, Campbell WW. Protein intake during energy restriction: effects on body composition and markers of metabolic and cardiovascular health in postmenopausal women. *J Am Coll Nutr.* 2007 Apr; 26 (2): 182-189.

Marniemi J, Seppänen A, Hakala P. Long-term effects on lipid metabolism of weight reduction on lactovegetarian and mixed diet. *Int J Obes.* 1990 Feb; 14 (2): 113-125.

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* (Silver Spring). 2007 Sep; 15 (9): 2,276-2,281.

- References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

  National Heart, Lung, and Blood Institute in cooperation with the National Institute of Diabetes and Digestive and Kidney Diseases. *The Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report,* NIH Publication No. 98-4083, September 1998. Accessed August 01, 2011 at: http://www.nhlbi.nih.gov/guidelines/obesity/e_txtbk/txgd/40.htm

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Type 2 Diabetes Treatment with a Vegetarian Diet for Adults 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Treating Type 2 Diabetes with a Vegetarian Diet for Adults

  If consistent with patient or client preference, the Registered Dietitian (RD) may recommend and educate on the benefits of the therapeutic use of a vegetarian diet for adults seeking treatment for Type 2 diabetes. Research indicates that a vegetarian diet may decrease or maintain blood glucose levels; a vegan diet may decrease hemoglobin A1c (A1c), as well as, or better than an omnivorous diet. Additionally, a vegetarian diet may reduce diabetes-related co-morbidities (e.g., cardiovascular disease, obesity, and hypertension).

  Rating: Fair
  Conditional

  - Risks/Harms of Implementing This Recommendation

    There are no potential risks or harms associated with the application of this recommendation.

  - Conditions of Application

    - Patient or client is an adult who has been diagnosed with impaired glucose tolerance or diabetes, and is interested in following a vegetarian diet or who self-reports to be vegetarian
    - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
    - RD knowledgeable or experienced in vegetarian diet counseling is preferred
    - A Dietetic Technician Registered (DTR), under the supervision of the RD, may serve as a facilitator in the implementation of this recommendation
    - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

  - Potential Costs Associated with Application

    Although costs of Medical Nutrition Therapy (MNT) sessions and reimbursement vary, MNT is essential for improved outcomes.

  - Recommendation Narrative

    A total of eight studies were included in the evidence analysis for this recommendation:

    - Six positive quality randomized controlled trials (RCTs) (Barnard et al, 2006; Burke et al, 2006; Burke et al, 2007; Dansinger et al, 2005; Mahon et al, 2007; and de Mello et al, 2006)
    - One neutral quality randomized crossover trial (Stephenson et al, 2005)

- One negative quality before-after study (Bhumisawasdi et al, 2006).

The evidence analysis examined the relationship between the following set of symptoms associated with Type 2 diabetes and the therapeutic use of a vegetarian diet.

Blood Glucose Level

- Seven studies provide evidence that a vegetarian diet does not increase blood glucose levels, however the findings are mixed regarding the effectiveness of a vegetarian diet in decreasing blood glucose levels. The therapeutic use of a vegetarian diet may be effective in decreasing blood glucose among persons with Type 2 diabetes.
- Evidence is based on the following studies: Barnard et al, 2006; Bhumisawasdi et al, 2006; Burke et al, 2006; Dansinger et al, 2005; de Mello et al, 2006; Mahon et al, 2007; and Stephenson et al, 2005.

A1c Values

- One study provides very limited evidence that the therapeutic use of a low-fat vegan diet may be more effective than omnivorous therapeutic diets for decreasing A1c levels in adults, in part because of decreases in weight associated with a low-fat vegan diet
- Evidence is based on the following study: Barnard et al, 2006.

Insulin Levels and Homeostasis Model Assessment of Insulin Resistance (HOMA-IR)

- Three studies provide limited evidence that the therapeutic use of a vegetarian diet may be effective for decreasing insulin levels in adults. However, none of the studies identified for analysis focused specifically on diabetes patients.
- Evidence is based on the following studies: Burke et al, 2006; Dansinger et al, 2005; and Mahon et al, 2007.

For additional information, see related ADA Evidence-Based Guideline: Diabetes Mellitus Guideline.

- Recommendation Strength Rationale
  - While several studies reported on various diabetes symptoms, the findings were mixed or were otherwise limited for blood glucose levels and A1c levels
  - Grade II evidence is available for the conclusion statement regarding how the therapeutic use of a vegetarian diet compares to omnivorous therapeutic diets for lowering blood glucose levels among patients with diabetes
  - Grade III evidence is available for the following conclusion statements regarding:
    - Effectiveness of the therapeutic use of a vegetarian diet for reducing blood glucose levels, reducing A1c levels and improving insulin levels among patients with diabetes
    - Comparison of the therapeutic use of a vegetarian diet vs. omnivorous therapeutic diets for lowering A1c levels among patients with diabetes.
- Minority Opinions

  None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  Is the therapeutic use of a vegetarian diet effective for reducing blood glucose levels among adults with diabetes?

  How does the therapeutic use of a vegetarian diet compare to omnivorous therapeutic diets for lowering blood glucose levels among adults with diabetes?

  Is the therapeutic use of a vegetarian diet effective for reducing A1c levels in adults with diabetes?

  How does the therapeutic use of a vegetarian diet compare to omnivorous therapeutic diets for lowering A1c levels among adults with diabetes?

  Is the therapeutic use of a vegetarian diet effective for improving insulin levels in adults with diabetes?

  - References

    Barnard ND, Cohen J, Jenkins DJ, Turner-McGrievy G, Gloede L, Jaster B, Seidl K, Green AA, Talpers S. A low-fat vegan diet improves glycemic control and cardiovascular risk factors in a randomized clinical trial in individuals with type 2 diabetes. *Diabetes Care.* 2006 Aug;29(8):1777-83.

    Bhumisawasdi J, Vanna O, Surinpang N. The self-reliant system for alternative care of diabetes mellitus patients--experience macrobiotic management in Trad Province. *J Med Assoc Thai.* 2006 Dec; 89 (12): 2,104-2,115.

    Burke LE, Hudson AG, Warziski MT, Styn MA, Music E, Elci OU, Sereika SM. Effects of a vegetarian diet and treatment preference on biochemical and dietary variables in overweight and obese adults: a randomized clinical trial. *Am J Clin Nutr.* 2007 Sep; 86 (3): 588-596.

    Burke LE, Styn MA, Steenkiste AR, Music E, Warziski M, Choo J. A randomized clinical trial testing treatment preference and two dietary options in behavioral weight management: preliminary results of the impact of diet at six months: PREFER study. *Obesity* (Silver Spring). 2006 Nov; 14 (11): 2,007-2,017.

    Dansinger ML, Gleason JA, Griffith JL, Selker HP, Schaefer EJ. Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction. *JAMA* 2005; 293: 43-53.

    de Mello VD, Zelmanovitz T, Perassolo MS, Azevedo MJ, Gross JL. Withdrawal of red meat from the usual diet reduces albuminuria and improves serum fatty acid profile in type 2 diabetes patients with macroalbuminuria. *Am J Clin Nutr.* 2006 May; 83 (5): 1,032-1,038.

    Mahon AK, Flynn MG, Stewart LK, McFarlin BK, Iglay HB, Mattes RD, Lyle RM, Considine RV, Campbell WW. Protein intake during energy restriction: effects on body composition and markers of metabolic and cardiovascular health in postmenopausal women. *J Am Coll Nutr.* 2007 Apr; 26 (2): 182-189.

    Stephenson TJ, Setchell KDR, Kendall CWC, Jenkins DJA, Anderson JW, Fanti P. Effect of soy protein-rich diet on renal function in young adults with insulin-dependent diabetes mellitus. *Clin Nephrol.* 2005; 64: 1-11.

  - References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process

    Numbers at a Glance 2011: For Non-pregnant Adults. National Diabetes Education Program (NDEP). Accessed online August 01, 2011: http://ndep.nih.gov/media/numatglance_eng.pdf.

    American Diabetes Association. Nutrition recommendations and interventions for diabetes: a position statement of the American Diabetes Association. *Diabetes Care.* 2008; 31, Suppl 1: S61-S78.

    National Diabetes Information Clearinghouse (NDIC). National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). *National Institutes of Health (NIH).* Accessed online August 01, 2011: http://diabetes.niddk.nih.gov/.

- Vegetarian Nutrition
- Vegetarian Nutrition (VN) Guideline (2011)

Quick Links

Recommendations Summary

VN: Monitoring Adherence to Vegetarian Diet Prescriptions for Adults 2011

Click here to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

- Recommendation(s)

  VN: Adherence to a Vegetarian Therapeutic Diet for Adults

  For adult patients or clients, the Registered Dietitian (RD) should monitor and evaluate adherence to a therapeutic vegetarian diet. Research indicates that these diets appear to perform as well and possibly better than omnivorous diets in terms of attrition rate, provided that patients receive nutrition education and appropriate dietary support. Many factors may influence the adherence to a diet, such as disease state, length of intervention, restrictiveness, and patient support.

  Rating: Strong
  Imperative

  VN: Adherence to Vegetarian Diets for Treatment of Obesity and Overweight for Adults

  For adult patients or clients seeking treatment for overweight or obesity with a vegetarian diet, the Registered Dietitian (RD) should monitor and evaluate adherence and provide continued nutrition education support. Research shows lower compliance rates for weight loss patients vs. patients treated for other disease states.

  Rating: Strong
  Imperative

  - Risks/Harms of Implementing This Recommendation

    There are no potential risks or harms associated with the application of this recommendation.

  - Conditions of Application

    - Patient or client is an adult seeking treatment with a therapeutic vegetarian diet, and self-reports to be a vegetarian or is interested in following a vegetarian dietary lifestyle
    - Vegetarian diet has been recommended to the patient or client by a health care professional for therapeutic reasons
    - The studies reviewed in this evidence analysis included adults following vegetarian diets to treat overweight, fibromyalgia symptoms, or to manage cholesterol and type 2 diabetes risk factors
    - RD knowledgeable or experienced in vegetarian diet counseling is preferred
    - A Dietetic Technician Registered (DTR), under the supervision of the RD, may serve as a facilitator in the implementation of this recommendation
    - A vegetarian dietary pattern encompasses wide variations in foods eaten and complexity regarding dietary practices, beliefs and motivations. The RD should maintain flexiblity and acceptance to support the lifestyle choices in working with this population. See the Guideline Overview for a more detailed explanation of the complexity of vegetarian dietary patterns.

  - Potential Costs Associated with Application

    Although costs of Medical Nutrition Therapy (MNT) sessions and reimbursement vary, MNT is essential for improved outcomes.

  - Recommendation Narrative

    A total of 21 studies were included in the evidence analysis for this recommendation:

    - Thirteen positive quality randomized controlled trials (RCTs) (Barnard et al, 2006; Barnard et al, 2000; Burke et al, 2007; Burke et al, 2006; Dansinger et al, 2005; de Mello et al, 2006; Geppert et al, 2006; Hakala and Karvetti, 1989; Jenkins et al, 2003 (*JAMA*); Jenkins et al, 2003 (*Metabolism*); Karlsson et al, 1994; Mahon et al, 2007; and Turner-McGrievy et al, 2007)
    - One neutral quality RCT (Kestin, et al, 1989)
    - Two neutral quality nonrandomized trials (Daubenmier et al, 2007; and Delgado et al, 1996)
    - One neutral quality nonrandomized crossover trial (Hunt et al, 1998)
    - One neutral quality randomized crossover trial (Stephenson et al, 2005)
    - Two negative quality RCTs (Agren et al, 2001; and Shankar et al, 2002)
    - One negative quality nonrandomized controlled trial (Kaartinen et al, 2000).

    Therapeutic Vegetarian Diets and Attrition Rate in Adults

    - Thirteen studies provide evidence for the following:
      - Results are mixed comparing attrition rates for therapeutic vegetarian and therapeutic omnivorous diets in adults. Therapeutic vegetarian diets appear to perform as well and possibly better than omnivorous diets in terms of attrition rate, provided that patients receive appropriate dietary support.
      - Of the study characteristics examined, disease or condition treated, restrictiveness of the vegetarian diet and level of subject/patient support appeared to be associated with study attrition rates. Attrition rates for obesity treatment with vegetarian diets were higher than that for other diseases. Attrition rates were lower for vegan compared to other types of vegetarian diets.
      - Subject/patient support (e.g., weekly meetings, incentives, cooking demonstrations, etc.) contributed to greater patient/subject retention
    - In these studies, vegetarian diets were used to treat overweight or fibromyalgia symptoms, or to manage cholesterol or Type 2 diabetes risk factors
    - Evidence was based on the following studies: Agren et al, 2001; Barnard et al, 2006; Barnard et al, 2000; Burke et al, 2007; Burke et al, 2006; Dansinger et al, 2005; Daubenmier et al, 2007; Delgado et al, 1996; de Mello et al, 2006; Geppert et al, 2006; Hakala and Karvetti, 1989; Hunt et al, 1998; Jenkins et al, 2003 (*JAMA*); Jenkins et al, 2003 (*Metabolism*); Kaartinen et al, 2000; Karlsson et al, 1994; Kestin, et al, 1989; Mahon et al, 2007; Shankar et al, 2002; Stephenson et al, 2005; and Turner-McGrievy et al, 2007.

  - Recommendation Strength Rationale

    Grade I evidence is available for the following conclusion statements regarding:

    - How therapeutic vegetarian diets compare to other types of therapeutic diets in terms of attrition rate
    - Factors associated with attrition rates in studies of adults using vegetarian diets for nutrition therapy.

  - Minority Opinions

    None.

- Supporting Evidence

  The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

  How do therapeutic vegetarian diets compare to other types of therapeutic diets in terms of attrition rate in adults?

  What are some factors associated with attrition rates in studies of adults using vegetarian diets for nutrition therapy?

  - References

Agren JJ, Tvrzicka E, Nenonen MT, Helve T, Hänninen O. Divergent changes in serum sterols during a strict uncooked vegan diet in patients with rheumatoid arthritis. *Br J Nutr.* 2001 Feb; 85 (2): 137-139.

Barnard ND, Cohen J, Jenkins DJ, Turner-McGrievy G, Gloede L, Jaster B, Seidl K, Green AA, Talpers S. A low-fat vegan diet improves glycemic control and cardiovascular risk factors in a randomized clinical trial in individuals with type 2 diabetes. *Diabetes Care.* 2006 Aug;29(8):1777-83.

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Geppert J, Kraft V, Demmelmair H, Koletzko B. Microalgal docosahexaenoic acid decreases plasma triacylglycerol in normolipidaemic vegetarians: a randomised trial. *Br J Nutr.* 2006 Apr; 95 (4): 779-786.

Hakala P, Karvetti R. Weight reduction on lactovegetarian and mixed diets. *Eur J Clin Nutr.* 1989; 43: 421-430.

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  None.