Agency for Healthcare Research and Quality
Advancing Excellence in Health Care

NATIONAL GUIDELINE CLEARINGHOUSE

General

Guideline Title

Prevention of type 2 diabetes evidence-based nutrition practice guideline.

Bibliographic Source(s)

Academy of Nutrition and Dietetics. Prevention of type 2 diabetes evidence-based nutrition practice guideline. Chicago (IL): Academy of Nutrition and Dietetics; 2014. Various p.

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Recommendations

Major Recommendations

Ratings for the strength of the recommendations (Strong, Fair, Weak, Consensus, Insufficient Evidence), conclusion grades (I-V), and statement labels (Conditional versus Imperative) are defined at the end of the "Major Recommendations" field.

Prevention of Type 2 Diabetes (PDM): Screen for Type 2 Diabetes Risk

PDM: Screen for Type 2 Diabetes Risk

The registered dietitian nutritionist (RDN) should ensure that all individuals are screened for risk of type 2 diabetes, using a recognized screening tool (such as the American Diabetes Association Type 2 Diabetes Risk Test, http://www.diabetes.org/diabetes-basics/prevention/diabetes-risk-test/). The prevalence and socioeconomic burden of type 2 diabetes and associated co-morbidities are rising worldwide, and individuals who are at high risk for type 2 diabetes should be prioritized for intensive intervention to delay the onset of disease.

Consensus, Imperative

PDM: Determine Appropriate Action Based on Screening

The RDN should collaborate with other healthcare providers to determine the appropriate actions to be taken, based on the results of the screening:

- Re-screening three years later if tests are normal
- General advice about risk factors and development of diabetes
- Referral to healthcare provider for laboratory work and other medical tests

- Referral for weight reduction, including medical nutrition therapy (MNT) for adult weight management
- Referral for type 2 diabetes prevention program, including MNT for prevention of type 2 diabetes in high-risk groups
- Referral for diabetes therapy, including MNT for diabetes

The prevalence and socioeconomic burden of type 2 diabetes and associated co-morbidities are rising worldwide, and individuals who are at high risk for type 2 diabetes should be prioritized for intensive intervention to delay the onset of disease.

Consensus, Imperative

PDM: MNT for Prevention of Type 2 Diabetes in High Risk Groups

PDM: MNT for Prevention of Type 2 Diabetes in High Risk Groups

The RDN should provide MNT encounters for individuals who are at high risk for type 2 diabetes and increase the frequency of encounters to optimize outcomes.

In adults with metabolic syndrome, research regarding the impact of MNT reported significant improvements:

- Decreased fasting blood glucose by 2.5 mg to 9 mg per dL (0.1 mmol to 0.5 mmol per L)
- Decreased glycosylated hemoglobin (A1C) by 0.12% to 0.23%
- Decreased triglycerides by 21 mg to 35 mg per dL (0.2 mmol to 0.4 mmol per L)
- Increased high-density lipoprotein (HDL) cholesterol by 2.4 mg per dL (0.06 mmol per L)
- Decreased body weight by 2.5 kg to 4.1 kg
- Decreased waist circumference by 1.9 cm to 4.8 cm
- Decreased systolic blood pressure by 4.9 mm Hg

In individuals with prediabetes, research regarding the impact of MNT reported significant improvements:

- Decreased fasting blood glucose by 2 mg to 9 mg per dL (0.1 mmol to 0.5 mmol per L)
- Decreased two-hour post-prandial blood glucose by 9 mg to 16.2 mg per dL (0.5 mmol to 0.9 mmol per L).
- Decreased waist circumference by 3.8 to 5.9 cm

In addition, studies reported that increased frequency of visits resulted in greater improvements in certain metabolic and anthropometric outcomes.

Strong, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grades I, II, III, and V.

PDM: Assessment in High-risk Groups

PDM: Assessment in High-risk Groups

The RDN should assess the following, but not limited to, for individuals who are at high risk for type 2 diabetes:

- Glycemia (fasting blood glucose, two-hour post-prandial blood glucose and A1C)
- Anthropometrics (weight, body mass index [BMI], waist circumference, waist-to-hip ratio)
- Cardiovascular disease (CVD) risk factors (lipid profile and blood pressure)
- Physical activity
- Medications and supplements
- Dietary factors
- History of depression
- Obesigenic/diabetogenic environment
- Socio-economic status (SES)

These factors allow the RDN to determine the appropriate interventions to prevent type 2 diabetes.

Consensus, Imperative

PDM: Weight Loss and Prevention of Type 2 Diabetes

PDM: Weight Loss and Prevention of Type 2 Diabetes

- For individuals who are at high risk for type 2 diabetes who are overweight or obese, the RDN should prescribe a weight-reducing diet and support weight loss using evidence-based nutrition practice guidelines.
- In adults with metabolic syndrome, research regarding a weight loss achieved via lifestyle modification over at least a three-month period ranging from 1.1 kg to 13 kg reported significant improvements:
  - Decreased A1C by 0.12% to 0.3%
  - Decreased triglycerides by 20 mg to 132 mg per dL (0.23 mmol to 1.5 mmol per L)
  - Decreased waist circumference by 1.5 cm to 11 cm
  - Decreased systolic blood pressure by 4.9 mm Hg to 10 mm Hg
- In individuals with prediabetes, research regarding a weight loss achieved via lifestyle modification over at least a three-month period ranging from 2.6 kg to 7.1 kg reported significant improvements:
  - Decreased fasting glucose levels by 2.2 mg to 9.2 mg per dL (0.12 mmol to 0.5 mmol per L)
  - Decreased triglyceride levels by 30.9 mg per dL (0.35 mmol per L)
  - Decreased waist circumference by 1.3 cm to 5.9 cm
  - Decreased systolic blood pressure 3.5 mm Hg to 6 mm Hg and diastolic blood pressure by 5 mm Hg
- In individuals with prediabetes, research regarding a weight loss achieved via bariatric surgery of up to 47 kg or 41% of excess BMI over a period of three to five years reported significant improvements:
  - Decreased fasting glucose levels by 16.2 mg to 20.9 mg per dL (0.9 mmol to 1.16 mmol per L)
  - Decreased two-hour post-prandial glucose levels by 16 mg per dL (0.9 mmol per L)
  - Decreased A1C by 0.5%
  - Decreased triglyceride levels by 70.6 mg per dL (0.8 mmol per L)
  - Increased HDL cholesterol levels by 1.9 mg per dL (0.05 mmol per L)
  - Decreased systolic blood pressure by 6 mm Hg

Strong, Conditional

Recommendation Strength Rationale

- Conclusion statements are Grades I, II, and III.

PDM: Nutrition Prescription for Macronutrients

PDM: Nutrition Prescription for Macronutrients

The RDN should individualize the nutrition prescription for macronutrients based on the Dietary Reference Intakes (DRI), which are 10% to 35% protein, 20% to 35% fat, and 45% to 65% carbohydrate, for individuals who are at high risk for type 2 diabetes. Research is inconclusive regarding the effect of macronutrient distribution as a percentage of energy, independent of weight loss, on outcomes in both adults with metabolic syndrome and individuals with prediabetes, related to the varying macronutrient distributions in study diets.

Fair, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grades II, III, and Vâ€‹.

PDM: Fiber and Prevention of Type 2 Diabetes

PDM: Fiber and Prevention of Type 2 Diabetes

The RDN should encourage individuals who are at high risk for type 2 diabetes to consume fiber at the level recommended by the United States Department of Agriculture (USDA) Dietary Guidelines (14 g per 1,000 kcal). Limited research regarding fiber intake, independent of weight loss, reported no significant impact on outcomes in adults with metabolic syndrome or individuals with prediabetes. However, a high-fiber diet can help reduce body weight and therefore reduce the risk of type 2 diabetes.

Fair, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grades III and V.

PDM: Whole Grains and Prevention of Type 2 Diabetes

PDM: Whole Grains and Prevention of Type 2 Diabetes

The RDN should encourage individuals who are at high risk for type 2 diabetes to consume whole grains at the level recommended by the USDA Dietary Guidelines (one-half of grain intake). Limited research regarding whole grain intake, independent of weight loss, reported no significant impact on outcomes in adults with metabolic syndrome or individuals with prediabetes. However, a high-fiber diet can help reduce body weight and therefore reduce the risk of type 2 diabetes.

Weak, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grades III and V.

PDM: Vegetable-Based Protein and Prevention of Type 2 Diabetes

PDM: Vegetable-Based Protein and Prevention of Type 2 Diabetes

If the consumption of vegetable-based protein is proposed for the prevention of type 2 diabetes, the RDN should advise individuals who are at high risk for type 2 diabetes that the source of dietary protein alone, without weight loss, may or may not be beneficial. There were no studies identified to evaluate the impact of vegetable-based protein intake vs. animal-based protein intake, independent of weight loss, on outcomes in adults with metabolic syndrome or individuals with prediabetes.

Insufficient Evidence, Conditional

Recommendation Strength Rationale

- Conclusion statements are Grade V.

PDM: Type of Fat and Prevention of Type 2 Diabetes

PDM: Type of Fat and Prevention of Type 2 Diabetes

The RDN should educate individuals who are at high risk for type 2 diabetes that the type of fat consumption alone, without weight loss, may not prevent type 2 diabetes. Most studies regarding the type of fat intake, independent of weight loss, reported no significant impact on outcomes in adults with metabolic syndrome or individuals with prediabetes.

Fair, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grades I, II, and III.

PDM: Fruits and Vegetables and Prevention of Type 2 Diabetes

PDM: Fruits and Vegetables and Prevention of Type 2 Diabetes

If modifying the consumption of fruits and vegetables is proposed for the prevention of type 2 diabetes, the RDN should advise individuals who are at high risk for type 2 diabetes that fruit and vegetable consumption alone, without weight loss, may or may not be beneficial. There were no studies identified to evaluate the impact of fruit and vegetable intake, independent of weight loss, on outcomes in adults with metabolic syndrome or individuals with prediabetes.

Insufficient Evidence, Conditional

Recommendation Strength Rationale

- Conclusion statements are Grade V.

PDM: Sugar and Prevention of Type 2 Diabetes

PDM: Sugar and Prevention of Type 2 Diabetes

If avoiding the consumption of sugar is proposed for the prevention of type 2 diabetes, the RDN should advise individuals who are at high risk for

type 2 diabetes that limiting sugar consumption, without weight loss, may or may not be beneficial. There were no studies identified to evaluate the impact of sugar intake, independent of weight loss, on outcomes in adults with metabolic syndrome or individuals with prediabetes. However, higher intake of added sugars may contribute to higher energy intake and increased body weight, and therefore increase the risk of type 2 diabetes.

Insufficient Evidence, Conditional

Recommendation Strength Rationale

- Conclusion statements are Grade V.

PDM: Glycemic Index/Glycemic Load and Prevention of Type 2 Diabetes

PDM: Glycemic Index/Glycemic Load and Prevention of Type 2 Diabetes

If the use of glycemic index/glycemic load is proposed for the prevention of type 2 diabetes, the RDN should advise individuals who are at high risk for type 2 diabetes that a reduction in glycemic index/glycemic load alone, without weight loss, may or may not be beneficial. Limited research in both adults with metabolic syndrome and individuals with prediabetes reported that a reduction in glycemic index/load results in improvements in postprandial blood glucose values, independent of weight loss.

Weak, Conditional

Recommendation Strength Rationale

- Conclusion statements are Grades III and V.

PDM: Physical Activity and Prevention of Type 2 Diabetes

PDM: Physical Activity and Prevention of Type 2 Diabetes

- The RDN should educate individuals who are at high risk for type 2 diabetes that physical activity alone, without weight loss and dietary change, has limited impact on the prevention of type 2 diabetes.
- However, in adults with metabolic syndrome, research regarding moderate intensity physical activity, at a level of 135 to 180 minutes per week, independent of weight loss and dietary change, reported significant improvements:
    - Decreased triglycerides by 33 mg per dL (0.37 mmol per L)
    - Decreased waist circumference by 3 cm
    - Decreased systolic blood pressure by 6 mm Hg
    - Decreased diastolic blood pressure by 3 mm Hg

Weak, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grades II, III and V.

PDM: Nutrition-Related Effects of Medications

PDM: Nutrition-Related Effects of Medications

For individuals at high risk for type 2 diabetes who have been prescribed medications, the RDN should educate on potential food and drug interactions and nutrition-related adverse effects. Pharmacotherapy may be prescribed to treat various aspects related to the prevention of diabetes; however, these medications may be poorly tolerated and have contraindications.

Strong, Conditional

PDM: Nutrition Counseling

PDM: Nutrition Counseling

The RDN should counsel individuals who are at high risk for type 2 diabetes based on established, well-defined behavior change strategies, such as (but not limited to) the following:

- Goal setting

- Motivational interviewing
- Practice of new behavior
- Relapse prevention
- Self-monitoring
- Self-talk
- Social support
- Time management

These strategies are associated with initiation and maintenance of behavior change.

Strong, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grades I, II, and III.

PDM: Coordination of Care

PDM: Coordination of Care

For individuals who are at high risk for type 2 diabetes, the RDN should implement MNT and coordinate care with a multi-disciplinary team and important others (e.g., family, friends and colleagues) in a wide variety of settings. This approach is necessary to effectively integrate MNT into overall management for individuals who are at high risk for type 2 diabetes.

Strong, Imperative

PDM: Monitoring and Evaluation in High-Risk Groups

PDM: Monitoring and Evaluation in High-Risk Groups

The RDN should monitor and evaluate the following, but not limited to, for individuals who are at high risk for type 2 diabetes:

- Glycemia (fasting blood glucose, two-hour post-prandial blood glucose and A1C)
- Anthropometrics (weight, BMI, waist circumference, waist-to-hip ratio)
- CVD risk factors (lipid profile and blood pressure)
- Physical activity
- Medications and supplements
- Dietary factors

These factors allow the RDN to evaluate the effectiveness of MNT for the prevention of type 2 diabetes in high-risk groups.

Consensus, Imperative

Definitions:

Conditional vs Imperative Recommendations

Recommendations are categorized in terms of either *conditional* or *imperative* statements. While conditional statements clearly define a specific situation, imperative statements are broadly applicable to the target population and do not impose restraints on their application.

Conditional recommendations are presented in an if/then format, such that:

If CONDITION then ACTION(S) because REASON(S)

Fulfillment of the condition triggers one or more guideline-specified actions. In contrast, imperative recommendations include terms such as "require," "must," and "should," and do not contain conditional text that would limit their applicability to specified circumstances.

Conclusion Grading Table

Strength of Evidence Elements	Grades				
	I Good/Strong	II Fair	III Limited	IV Expert Opinion Only	V Grade Not Assignable
Quality • Scientific rigor/validity • Considers design and execution	Studies of strong design for question Free from design flaws, bias and execution problems	Studies of strong design for question with minor methodological concerns OR Only studies of weaker study design for question	Studies of weak design for answering the question OR Inconclusive findings due to design flaws, bias or execution problems	No studies available Conclusion based on usual practice, expert consensus, clinical experience, opinion, or extrapolation from basic research	No evidence that pertains to question being addressed
Consistency Of findings across studies	Findings generally consistent in direction and size of effect or degree of association, and statistical significance with minor exceptions at most	Inconsistency among results of studies with strong design OR Consistency with minor exceptions across studies of weaker designs	Unexplained inconsistency among results from different studies OR Single study unconfirmed by other studies	Conclusion supported solely by statements of informed nutrition or medical commentators	NA
Quantity • Number of studies • Number of subjects in studies	One to several good quality studies Large number of subjects studied Studies with negative results having sufficiently large sample size for adequate statistical power	Several studies by independent investigators Doubts about adequacy of sample size to avoid Type I and Type II error	Limited number of studies Low number of subjects studied and/or inadequate sample size within studies	Unsubstantiated by published studies	Relevant studies have not been done
Clinical Impact • Importance of studied outcomes • Magnitude of effect	Studied outcome relates directly to the question Size of effect is clinically meaningful Significant (statistical) difference is large	Some doubt about the statistical or clinical significance of effect	Studied outcome is an intermediate outcome or surrogate for the true outcome of interest OR Size of effect is small or lacks statistical and/or clinical significance	Objective data unavailable	Indicates area for future research
Generalizability To population of interest	Studied population, intervention and outcomes are free from serious doubts about generalizability	Minor doubts about generalizability	Serious doubts about generalizability due to narrow or different study population, intervention or outcomes studied	Generalizability limited to scope of experience	NA

This grading system was based on the grading system from Greer, Mosser, Logan, & Wagstrom Halaas. A practical approach to evidence grading. Jt Comm J Qual Improv. 2000;26:700-712. In September 2004, The ADA Research Committee modified the grading system to this current version.

Criteria for Recommendation Rating

Statement Rating	Definition	Implication for Practice
Strong	A Strong recommendation means that the workgroup believes that the benefits of the recommended approach clearly exceed the harms (or that the harms clearly exceed the benefits in the case of a strong negative recommendation), and that the quality of the supporting evidence is excellent/good (grade I or II).* In some clearly identified circumstances, strong recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Practitioners should follow a Strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Fair	A Fair recommendation means that the workgroup believes that the benefits exceed the harms (or that the harms clearly exceed the benefits in the case of a negative recommendation), but the quality of evidence is not as strong (grade II or III).* In some clearly identified circumstances, recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits outweigh the harms.	Practitioners should generally follow a Fair recommendation but remain alert to new information and be sensitive to patient preferences.
Weak	A Weak recommendation means that the quality of evidence that exists is suspect or that well-done studies (grade I, II, or III)* show little clear advantage to one approach versus another.	Practitioners should be cautious in deciding whether to follow a recommendation classified as Weak, and should exercise judgment and be alert to emerging publications that report evidence. Patient preference should have a substantial influencing role.
Consensus	A Consensus recommendation means that Expert opinion (grade IV)* supports the guideline recommendation even though the available scientific evidence did not present consistent results, or controlled trials were lacking.	Practitioners should be flexible in deciding whether to follow a recommendation classified as Consensus, although they may set boundaries on alternatives. Patient preference should have a substantial influencing role.
Insufficient Evidence	An Insufficient Evidence recommendation means that there is both a lack of pertinent evidence (grade V)* and/or an unclear balance between benefits and harms.	Practitioners should feel little constraint in deciding whether to follow a recommendation labeled as Insufficient Evidence and should exercise judgment and be alert to emerging publications that report evidence that clarifies the balance of benefit versus harm. Patient preference should have a substantial influencing role.

*Conclusion statements are assigned a grade based on the strength of the evidence. Grade I is good; grade II, fair; grade III, limited; grade IV signifies expert opinion only and grade V indicates that a grade is not assignable because there is no evidence to support or refute the conclusion. The evidence and these grades are considered when assigning a rating (Strong, Fair, Weak, Consensus, Insufficient Evidence - see chart above) to a recommendation.

Adapted by the Academy of Nutrition and Dietetics (AND) from the American Academy of Pediatrics, Classifying Recommendations for Clinical Practice Guideline, Pediatrics. 2004;114;874-877. Revised by the AND Evidence-Based Practice Committee, Feb 2006.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

- Type 2 diabetes
- Prediabetes

- Metabolic syndrome

Guideline Category

Counseling

Diagnosis

Evaluation

Management

Prevention

Risk Assessment

Screening

Clinical Specialty

Cardiology

Endocrinology

Family Practice

Geriatrics

Internal Medicine

Nursing

Nutrition

Ophthalmology

Pediatrics

Preventive Medicine

Intended Users

Advanced Practice Nurses

Allied Health Personnel

Dietitians

Health Care Providers

Hospitals

Managed Care Organizations

Nurses

Pharmacists

Physician Assistants

Physicians

Public Health Departments

Social Workers

Guideline Objective(s)

Overall Objective

To provide evidence-based recommendations on medical nutrition therapy (MNT) for individuals who are at high risk for type 2 diabetes

Specific Objectives

- To define evidence-based nutrition recommendations for registered dietitian nutritionists (RDNs) that are carried out in collaboration with other healthcare providers
- To guide practice decisions that integrate medical, nutritional and behavioral strategies
- To reduce variations in practice among RDNs
- To provide the RDN with data to make recommendations to adjust MNT or recommend other therapies to achieve desired outcomes
- To develop guidelines for interventions that have measurable clinical outcomes
- To define the highest quality of care within cost constraints of the current healthcare environment

Target Population

Adolescent (13 to 18 years) and adult (19 and older) individuals who are at high risk for type 2 diabetes, such as individuals with prediabetes and adults with metabolic syndrome

Interventions and Practices Considered

1. Screening and referral
    - Screening for type 2 diabetes using a recognized screening tool
    - Determining appropriate action based on screening results
    - Provision of medical nutrition therapy (MNT) encounters for high-risk individuals
2. Assessment of the following for individuals at high risk of type 2 diabetes
    - Glycemia (fasting blood glucose, two-hour post-prandial blood glucose and glycosylated hemoglobin [A1C])
    - Anthropometrics (weight, body mass index [BMI], waist circumference, waist-to-hip ratio)
    - Cardiovascular disease (CVD) risk factors (lipid profile and blood pressure)
    - Physical activity
    - Medications and supplements
    - Dietary factors
    - History of depression
    - Obesigenic/diabetogenic environment
    - Socio-economic status (SES)
3. Nutrition intervention
    - Prescription of weight-reducing diet and supporting weight loss
    - Individualized prescription for macronutrients based on the Dietary Reference Intakes (DRI)
    - Providing education and advice on consumption the following diet components in type 2 diabetes prevention:
        - Macronutrients
        - Fiber
        - Whole grain
        - Vegetable-based protein
        - Type of fat
        - Fruits and vegetables
        - Sugars
    - Providing education and advice on glycemic index/glycemic load in type 2 diabetes prevention
    - Providing education and advice on physical activity

    - Providing education and advice on nutrition-related effects of medications
    - Nutrition counseling based on established, well-defined behavior change strategies
    - Coordination of care
4. Monitoring and evaluation of the following in high-risk groups
    - Glycemia (fasting blood glucose, two-hour post-prandial blood glucose and A1C)
    - Anthropometrics (weight, BMI, waist circumference, waist-to-hip ratio)
    - CVD risk factors (lipid profile and blood pressure)
    - Physical activity
    - Medications and supplements
    - Dietary factors

Major Outcomes Considered

- Glycemic-related outcomes (fasting blood glucose, glycosylated hemoglobin [A1C])
- Lipid outcomes (triglycerides, high-density protein)
- Anthropometric outcomes (waist circumference, waist-to-hip ratio)
- Blood pressure outcomes (systolic and diastolic blood pressure)
- Renal outcomes (urinary albumin excretion rate and albumin:creatinine ratio)

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

General Methods for Collecting/Selecting the Evidence

The following list provides an overview of the steps which the Academy evidence analysis team goes through to identify research through database searches.

1. Plan the search strategy to identify the current best evidence relevant to the question. The plan for identification and inclusion of articles and reports should be systematic and reproducible, not haphazard. Write out the original search strategy and document adjustments to the strategy if they occur. Allow for several iterations of searches.
    - List inclusion and exclusion criteria. The work group will define the inclusion and exclusion criteria. These criteria will be used in defining the search strategy and for filtering the identified research reports. The Academy uses only peer-reviewed research; that is, articles accepted for evidence analysis must be peer-reviewed and published in a juried publication. Additionally, the Academy only uses human subjects in its research and does not include animal studies in its evidence analysis.
    - Identify search words. During the process of considering outcomes, interventions, nutrition diagnoses, and assessments, the work group may have identified a number of specific terms or factors that were important, but were not included in the actual question. These terms can be used as additional search terms to help identify relevant pieces of research. Both text word search and keyword search using Medical Subject Headings (MeSH) definitions may be used.
    - Identify databases to search. PubMed, Medline, CINAHL, EMBASE, Cochrane, Agricola, DARE, TRIP, AHRQ and ERIC are some common databases for clinical nutritional research. Note that search terms can vary depending on the database.
2. Conduct the search. Depending on the number and type of sources found in the initial search, adjustments might have to be made in the search strategy and to inclusion/exclusion criteria, and additional searches run. Changes to the search plan should be recorded for future reference. Document the number of sources identified in each search.
3. Review titles and abstracts. At this point, a filtering procedure is used to determine whether a research article matches the inclusion criteria

and is relevant to the work group's questions. Typically, the lead analyst, along with a member of the expert workgroup, first reviews the citations and abstracts to filter out reports that are not applicable to the question. If a determination cannot be made based on the citation and abstract, then the full text of the article is obtained for review.

4. Gather all remaining articles and reports. Obtain paper or electronic copies of research articles that remain on the list following the citation and abstract review. If there are less than six citations, it could mean that the search was too specific to identify relevant research or that research has not been done on this topic. A broadened search should be tried. When there is a long list of citations, ascertain whether it includes articles that are tangential to the question or address the question in only a general way. In this case a more focused search strategy may be necessary.

Specific Methods for This Guideline

The recommendations in the guideline were based on a systematic review of the literature. Searches of PubMed were performed on the following topics in relation to type 2 diabetes prevention in individuals with prediabetes or metabolic syndrome:

- Medical nutrition therapy
- Weight loss
- Macronutrient distribution
- Fiber
- Whole and refined grains
- Protein type
- Fat type
- Fruits and vegetables
- Sugar
- Glycemic index/glycemic load
- Physical activity

Each evidence analysis topic has a link to supporting evidence, where the Search Plan and Results can be found. Here, the reader can view when the search plan was performed, inclusion and exclusion criteria, search terms, databases that were searched and the excluded articles.

Number of Source Documents

The total number of supporting documents for all of the reviewed topics is below:

- Recommendations: 17
- Conclusion Statements: 108
- Evidence Summaries: 108
- Article Worksheets: 300

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Conclusion Grading Table

Strength of Evidence Elements	**Grades**				
	I Good/Strong	**II Fair**	**III Limited**	**IV Expert Opinion Only**	**V Grade Not Assignable**
Quality • Scientific rigor/validity	Studies of strong design for question Free from design flaws, bias	Studies of strong design for question with minor	Studies of weak design for answering the question	No studies available Conclusion based on usual practice, expert	No evidence that pertains to question

Strength of Evidence Elements	I Good/Strong	II Fair	III Limited	IV Expert Opinion Only	V Grade Not Assignable
• Considers design and execution	and execution problems	methodological concerns OR Only studies of weaker study design for question	OR Inconclusive findings due to design flaws, bias or execution problems	consensus, clinical experience, opinion, or extrapolation from basic research	being addressed
Consistency Of findings across studies	Findings generally consistent in direction and size of effect or degree of association, and statistical significance with minor exceptions at most	Inconsistency among results of studies with strong design OR Consistency with minor exceptions across studies of weaker designs	Unexplained inconsistency among results from different studies OR Single study unconfirmed by other studies	Conclusion supported solely by statements of informed nutrition or medical commentators	NA
Quantity • Number of studies • Number of subjects in studies	One to several good quality studies Large number of subjects studied Studies with negative results having sufficiently large sample size for adequate statistical power	Several studies by independent investigators Doubts about adequacy of sample size to avoid Type I and Type II error	Limited number of studies Low number of subjects studied and/or inadequate sample size within studies	Unsubstantiated by published studies	Relevant studies have not been done
Clinical Impact • Importance of studied outcomes • Magnitude of effect	Studied outcome relates directly to the question Size of effect is clinically meaningful Significant (statistical) difference is large	Some doubt about the statistical or clinical significance of effect	Studied outcome is an intermediate outcome or surrogate for the true outcome of interest OR Size of effect is small or lacks statistical and/or clinical significance	Objective data unavailable	Indicates area for future research
Generalizability To population of interest	Studied population, intervention and outcomes are free from serious doubts about generalizability	Minor doubts about generalizability	Serious doubts about generalizability due to narrow or different study population, intervention or outcomes studied	Generalizability limited to scope of experience	NA

This grading system was based on the grading system from Greer, Mosser, Logan, & Wagstrom Halaas. A practical approach to evidence grading. Jt Comm J Qual Improv. 2000;26:700-712. In September 2004, The ADA Research Committee modified the grading system to this current version.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

General Methods

Step 1: Formulate Evidence Analysis Question

Specify a question in a defined area of practice or state a tentative conclusion or recommendation that is being considered. Include the patient type and special needs of the target population involved, the alternatives under consideration, and the outcomes of interest (PICO format).

Step 2: Gather and Classify Evidence

Conduct a systematic search of the literature to find evidence related to the question, gather studies and reports, and classify them by type of evidence. Classes differentiate primary reports of new data according to study design, and distinguish them from secondary reports that include systematic and/or narrative review.

Step 3: Critically Appraise Each Article

Review each article for relevance to the question and use the checklist of questions to evaluate the research design and implementation. Abstract key information from the report.

Step 4: Summarize Evidence

Synthesize the reports into an overview table and summarize the research relevant to the question.

Step 5: Write and Grade the Conclusion Statement

Develop a concise conclusion statement (the answer to the question). Assign a grade to indicate the overall strength or weakness of evidence informing the conclusion statement (see the "Rating Scheme for the Strength of the Evidence" field).

Guideline-Specific Methods

The following major outcomes were considered in the analysis:

- Glycemic outcomes (specifically fasting blood glucose, 2 hour post prandial blood glucose, and glycosylated hemoglobin [A1C])
- Lipid outcomes (specifically triglycerides and high-density lipoprotein [HDL] cholesterol levels)
- Anthropometric outcomes (specifically waist circumference and waist-to-hip ratio)
- Blood pressure outcomes (specifically systolic and diastolic blood pressure)
- Renal outcomes (specifically urinary albumin excretion rate and albumin:creatinine ratio).

These outcomes are the diagnostic markers of prediabetes (as defined by the American Diabetes Association) and/or metabolic syndrome (as defined by the Third Adult Treatment Panel [ATP III] or the World Health Organization [WHO]). In addition, based on the Position of the Academy of Nutrition and Dietetics: The Role of Nutrition in Health Promotion and Chronic Disease Prevention, obesity and family history are the main predictors of type 2 diabetes, and hypertension, low HDL cholesterol levels and high triglyceride levels are also predictive of type 2 diabetes risk.

The focus of this analysis was to separate out the impact of each intervention, on specified outcomes, without the influence of weight loss. The evidence analysis, on the impact of specific interventions, was based on randomized controlled trials (class A), cohort trials (class B) and nonrandomized clinical studies (class C) that control for the impact of significant weight loss, meaning that one of the following existed in each study included:

- No statistically significant ($P<0.05$) weight loss occurred between or within groups during the course of the study.
- Statistically significant weight loss occurred between or within groups, but it was controlled for in the statistical analysis.
- Statistically significant weight loss was similar between and within groups, but the interventions studied were different.

In taking this approach, any studies resulting in weight loss (such as the landmark studies on prevention of type 2 diabetes) only appear in the evidence analysis for weight loss (and possibly medical nutrition therapy if the intervention was provided by a registered dietitian nutritionist). For the evidence analysis on weight loss, a Cochrane review published in 2008 which included the landmark studies on prevention of type 2 diabetes (such as the Diabetes Prevention Program, Finnish DPS, Indian DPP, Da Qing IGT and Diabetes Study, etc.) was included to represent these historical findings, and more recently published research was added to the evidence analysis.

Methods Used to Formulate the Recommendations

Description of Methods Used to Formulate the Recommendations

Development of Evidence-Based Nutrition Practice Guidelines

The expert work group, which includes practitioners and researchers with a depth of experience in the specific field of interest, develops the disease-specific guideline. The guideline development involves the following steps:

1. Review the Conclusion Statements: The work group meets to review the materials resulting from the evidence analysis, which may include conclusion statements, evidence summaries, and evidence worksheets.
2. Formulate Recommendations for the Guideline Integrating Conclusions from Evidence Analysis: The work group uses an expert consensus method to formulate the guideline recommendations and complete the various sections on the recommendation page. These include:
    - Recommendation(s): This is a course of action for the practitioner. The recommendation is written using two brief and separate statements. The first statement is "what" the dietitian should do or not do. The second statement describes the "why" of the recommendation. More than one recommendation may be formulated depending on a particular topic and the supporting conclusion statements.
    - Rating: The rating for the recommendation is based on the strength of the supporting evidence. The grade of the supporting conclusion statement(s) will help determine this rating (see the "Rating Scheme for the Strength of the Recommendations" field).
    - Label of Conditional or Imperative: Each recommendation will have a label of "conditional" or "imperative." Conditional statements clearly define a specific situation, while imperative statements are broadly applicable to the target population without restraints on their pertinence.
    - Risks and Harms of Implementing the Recommendations: Includes any potential risks, anticipated harms or adverse consequences associated with applying the recommendation(s) to the target population.
    - Conditions of Application: Includes any organizational barriers or changes that would need to be made within an organization to apply the recommendation in daily practice. Also includes any conditions which may limit the application of the recommendation(s). For instance, application may be limited to only people in an inpatient setting, or not applicable for pregnant women. Facilitators for the application of the guideline may also be listed here. Conditional recommendations will always have conditions specified. Imperative recommendations may have some general conditions for application.
    - Potential Costs Associated with Application: Includes any costs that may be associated with the application of this recommendation such as specialized staff, new equipment or treatments.
    - Recommendation Narrative: Provides a brief description of the evidence that supports this recommendation.
    - Recommendation Strength Rationale: Provides a brief list of the evidence strength and methodological issues that determined the recommendation strength.
    - Minority Opinions: If the expert work group cannot reach consensus on the recommendation, the minority opinions may be listed here.
    - Supporting Evidence: Provides links to the conclusions statements, evidence summaries and worksheets related to the formulation of this recommendation(s).
3. References Not Graded in the Academy's Evidence Analysis Process: Recommendations are based on the summarized evidence from the analysis. Sources that are not analyzed during the evidence analysis process may be used to support and formulate the recommendation or to support information under other categories on the recommendation page, if the workgroup deems necessary. References must be credible resources (e.g., consensus reports, other guidelines, position papers, standards of practice, articles from peer-reviewed journals, nationally recognized documents or websites). If recommendations are based solely on these types of references, they will be rated as "consensus." Occasionally recommendations will include references that were not reviewed during the evidence analysis process but are relevant to the recommendation, risks and harms of implementing the recommendation, conditions of application, or potential costs associated with application. These references will be listed on the recommendation page under "References Not Graded in the Academy's Evidence Analysis Process."
4. Develop a Clinical Algorithm for The Guideline: The workgroup develops a clinical algorithm based on Academy's Nutrition Care Process, to display how each recommendation can be used within the treatment process and how they relate to the Nutrition Assessment, Diagnosis, Intervention and Monitoring and Evaluation.
5. Complete the Writing of the Guideline: Each disease-specific guideline has a similar format which incorporates the Introduction (includes: Scope of the Guideline, Statement of Intent, Guideline Methods, Implementation, Benefits and Risks/Harms of Implementation), Background Information and any necessary Appendices. The work group develops these features.
6. Criteria Used in Guideline Development: The criteria used in determining the format and process for development of Academy's guidelines

are based on the following tools and criteria for evidence-based guidelines:

- Guideline Elements Model (GEM) which has been incorporated by the American Society for Testing and Materials (ASTM) as a Standard Specification for clinical practice guidelines.
- Appraisal for Guidelines Research and Evaluation (AGREE) Instrument
- National Guideline Clearinghouse www.guideline.gov .

Rating Scheme for the Strength of the Recommendations

Criteria for Recommendation Rating

Statement Rating	Definition	Implication for Practice
Strong	A Strong recommendation means that the workgroup believes that the benefits of the recommended approach clearly exceed the harms (or that the harms clearly exceed the benefits in the case of a strong negative recommendation), and that the quality of the supporting evidence is excellent/good (grade I or II).* In some clearly identified circumstances, strong recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Practitioners should follow a Strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Fair	A Fair recommendation means that the workgroup believes that the benefits exceed the harms (or that the harms clearly exceed the benefits in the case of a negative recommendation), but the quality of evidence is not as strong (grade II or III).* In some clearly identified circumstances, recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits outweigh the harms.	Practitioners should generally follow a Fair recommendation but remain alert to new information and be sensitive to patient preferences.
Weak	A Weak recommendation means that the quality of evidence that exists is suspect or that well-done studies (grade I, II, or III)* show little clear advantage to one approach versus another.	Practitioners should be cautious in deciding whether to follow a recommendation classified as Weak, and should exercise judgment and be alert to emerging publications that report evidence. Patient preference should have a substantial influencing role.
Consensus	A Consensus recommendation means that Expert opinion (grade IV)* supports the guideline recommendation even though the available scientific evidence did not present consistent results, or controlled trials were lacking.	Practitioners should be flexible in deciding whether to follow a recommendation classified as Consensus, although they may set boundaries on alternatives. Patient preference should have a substantial influencing role.
Insufficient Evidence	An Insufficient Evidence recommendation means that there is both a lack of pertinent evidence (grade V)* and/or an unclear balance between benefits and harms.	Practitioners should feel little constraint in deciding whether to follow a recommendation labeled as Insufficient Evidence and should exercise judgment and be alert to emerging publications that report evidence that clarifies the balance of benefit versus harm. Patient preference should have a substantial influencing role.

*Conclusion statements are assigned a grade based on the strength of the evidence. Grade I is good; grade II, fair; grade III, limited; grade IV signifies expert opinion only and grade V indicates that a grade is not assignable because there is no evidence to support or refute the conclusion. The evidence and these grades are considered when assigning a rating (Strong, Fair, Weak, Consensus, Insufficient Evidence - see chart above) to a recommendation.

Adapted by the Academy of Nutrition and Dietetics (AND) from the American Academy of Pediatrics, Classifying Recommendations for Clinical Practice Guideline, Pediatrics. 2004;114;874-877. Revised by the AND Evidence-Based Practice Committee, Feb 2006.

Cost Analysis

The guideline developers reviewed a published cost analysis.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

Each guideline is reviewed internally and externally using the Appraisal for Guidelines Research and Evaluation (AGREE) Instrument as the evaluation tool. The external reviewers consist of an interdisciplinary group of individuals (may include dietitians, doctors, psychologists, nurses, etc.). The guideline is adjusted by consensus of the expert panel and approved by Academy's Evidence-Based Practice Committee prior to publication on the Evidence Analysis Library (EAL).

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

The guideline contains conclusion statements that are supported by evidence summaries and evidence worksheets. These resources summarize the important studies (randomized controlled trials [RCTs], clinical studies, observational studies, cohort and case-control studies) pertaining to the conclusion statement and provide the study details.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

- A primary goal of implementing these recommendations includes improving a person's ability to achieve optimal nutrition through healthful food choices and a physically-active lifestyle.
- Although costs of medical nutrition therapy (MNT) sessions and reimbursement vary, MNT is essential for improved outcomes.
- MNT education can be considered cost-effective when considering the benefits of nutrition interventions on the onset and progression of comorbidities versus the cost of the intervention.

Potential Harms

Overall Risk/Harm Considerations

When using these recommendations, consider the following general risks and harms:

- Patient's age, socio-economic status (SES), cultural issues, psychosocial and mental health status, health history and other individual and health conditions
- Use clinical judgment in applying the guidelines

Recommendation-Specific Risks/Harms

Screening for Type 2 Diabetes Risk

There is a potential for negative psychological effect from screening for diabetes risk (for example, emotional distress and denial).

Weight Loss

- Reduction of caloric intake may result in nutritional inadequacies; therefore, special attention should be paid to maintaining adequate intake of vitamins and minerals.

- Adverse risks may be associated with pharmacotherapy and bariatric surgery.

Glycemic Index/Glycemic Load

The registered dietitian nutritionist (RDN) should be aware that the relationship between consumption of low-glycemic index foods and plasma glucose concentration is complex and is altered by the protein and fat composition of a meal, preparation and processing of the food items, prior food intake, fasting or preprandial plasma glucose levels and degree of insulin resistance.

Physical Activity

Intense physical activity in some overweight and obese individuals may contribute to disability or death; thus, consultation with a physician prior to beginning an exercise program should be recommended.

Qualifying Statements

Qualifying Statements

- This nutrition practice guideline is meant to serve as a general framework for handling clients with particular health problems. The independent skill and judgment of the health care provider must always dictate treatment decisions.
- This guideline is intended for use by registered dietitian nutritionists (RDNs) involved in providing medical nutrition therapy (MNT) for individuals who are at high risk for type 2 diabetes. The application of the guideline must be individualized to assist the RDN to successfully integrate MNT into the overall medical management of persons at high risk for type 2 diabetes.
- While the evidence-based nutrition practice guidelines represent a statement of promising practice based on the latest available evidence at the time of publication, the guideline is not intended to overrule professional judgment. Rather, it may be viewed as a relative constraint on individual clinician discretion in a particular clinical circumstance. These nutrition practice guidelines are provided with the express understanding that they do not establish or specify particular standards of care, whether legal, medical or other.
- This guideline recognizes the role of patient and family preferences for possible outcomes of care, when the appropriateness of a clinical intervention involves a substantial element of personal choice or values. With regard to types of evidence that are associated with particular outcomes, two major classes have been described. Patient-oriented evidence that matters (POEM) deals with outcomes of importance to patients, such as changes in morbidity, mortality or quality of life. Disease-oriented evidence (DOE) deals with surrogate end-points, such as changes in laboratory values or other measures of response. Although the results of DOE sometimes parallel the results of POEM, they do not always correspond. When possible, the Academy of Nutrition and Dietetics recommends using POEM-type evidence rather than DOE. When DOE is the only guidance available, the guideline indicates that key clinical recommendations lack the support of outcomes evidence.

Implementation of the Guideline

Description of Implementation Strategy

The publication of this guideline is an integral part of the plans for getting the Academy Medical Nutrition Therapy (MNT) evidence-based recommendations on prevention of type 2 diabetes to all dietetics practitioners engaged in, teaching about or researching the topic. National implementation workshops at various sites around the country and during the Academy Food Nutrition Conference & Expo (FNCE) are planned. Additionally, there are recommended dissemination and adoption strategies for local use of the Academy of Nutrition and Dietetics (AND) Prevention of Type 2 Diabetes Evidence-Based Nutrition Practice Guideline.

The guideline development team recommended multi-faceted strategies to disseminate the guideline and encourage its implementation. Management support and learning through social influence are likely to be effective in implementing guidelines in dietetic practice. However, additional interventions may be needed to achieve real change in practice routines.

Implementation of the guideline will be achieved by announcement at professional events, presentations and training. Some strategies include:

- National and local events: State dietetic association meetings and media coverage will help launch the guideline.
- Local feedback adaptation: Presentation by members of the work group at peer review meetings and opportunities for continuing education units (CEUs) for courses completed.

- Education initiatives: The guideline and supplementary resources will be freely available for use in the education and training of dietetic interns and students in approved Commission on Accreditation of Dietetics Education (CADE) programs.
- Champions: Local champions will be identified and expert members of the recommendation team will prepare articles for publications. Resources will be provided that include PowerPoint presentations, full guidelines and pre-prepared case studies.
- Practical tools: Some of the tools that will be developed to help implement the guideline include specially designed resources such as clinical algorithms, slide presentations, training and toolkits.

Specific distribution strategies include:

Publication in full: The guideline is available electronically at the Academy Evidence Analysis Library Web site and announced to all Academy Dietetic Practice Groups. The Academy's Evidence Analysis Library will also provide downloadable supporting information and links to relevant position papers.

Implementation Tools

Quick Reference Guides/Physician Guides

Slide Presentation

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Staying Healthy

IOM Domain

Effectiveness

Patient-centeredness

Identifying Information and Availability

Bibliographic Source(s)

Academy of Nutrition and Dietetics. Prevention of type 2 diabetes evidence-based nutrition practice guideline. Chicago (IL): Academy of Nutrition and Dietetics; 2014. Various p.

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2014

Guideline Developer(s)

Academy of Nutrition and Dietetics - Professional Association

Source(s) of Funding

Academy of Nutrition and Dietetics

Guideline Committee

Prevention of Type 2 Diabetes Evidence-Based Nutrition Practice Guideline Workgroup

Composition of Group That Authored the Guideline

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Financial Disclosures/Conflicts of Interest

In the interest of full disclosure, the Academy has adopted the policy of revealing relationships workgroup members have with companies that sell products or services that are relevant to this topic. Workgroup members are required to disclose potential conflicts of interest by completing the Academy Conflict of Interest Form. It should not be assumed that these financial interests will have an adverse impact on the content, but they are noted here to fully inform readers.

None of the workgroup members listed above disclosed potential conflicts.

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Electronic copies: Available to members from the Academy of Nutrition and Dietetics Web site .

Availability of Companion Documents

The following are available:

- Prevention of type 2 diabetes evidence-based nutrition practice guideline. Executive summary of recommendations. Chicago (IL): Academy of Nutrition and Dietetics; 2014. Electronic copies: Available from the Academy of Nutrition and Dietetics (AND) Web site .
- Prevention of type 2 diabetes evidence-based nutrition practice guideline. PowerPoint presentation. Chicago (IL): Academy of Nutrition and Dietetics; 2014. 43 p. Electronic copies: Available for purchase from the AND Web site .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on January 15, 2015.

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