Diabetes Prevention

PDM: Major Recommendations (2014)

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.

Resources Available with Each Recommendation

In addition to the recommendation statement and strength rating, you will find on each recommendation page:

- A brief narrative summary of the evidence analyzed to reach the recommendation
- A statement of justification, or reason for the strength of the recommendation
- Detailed information on the evidence supporting the recommendations and background narrative (available in the Supporting Evidence section toward the bottom of each recommendation page)
- A reference list at the end of each recommendation page that includes all the sources used in the evidence analysis for the particular recommendation (each reference is hyperlinked to a summary of the article analyzed in the evidence analysis).

Below, you will find a list of the Prevention of Type 2 Diabetes Recommendations, organized according to the stage of the Nutrition Care Process and by topic. To see the Recommendation Summary, just click on the Recommendation title. You can download all of the guideline material in PDF format.

Nutrition Screening and Referral

PrevT2DM: Screen for Type 2 Diabetes Risk

Medical Nutrition Therapy

PrevT2DM: Medical Nutrition Therapy for Prevention of Type 2 Diabetes in High Risk Groups

Nutrition Assessment

PrevT2DM: Assessment in High Risk Groups

Nutrition Intervention

PrevT2DM: Weight Loss and Prevention of Type 2 Diabetes
PrevT2DM: Nutrition Prescription for Macronutrients
PrevT2DM: Fiber and Prevention of Type 2 Diabetes
PrevT2DM: Whole Grains and Prevention of Type 2 Diabetes
PrevT2DM: Vegetable-Based Protein and Prevention of Type 2 Diabetes
PrevT2DM: Type of Fat and Prevention of Type 2 Diabetes
PrevT2DM: Fruits and Vegetables and Prevention of Type 2 Diabetes
PrevT2DM: Sugar and Prevention of Type 2 Diabetes
PrevT2DM: Glycemic Index/Glycemic Load and Prevention of Type 2 Diabetes
PrevT2DM: Physical Activity and Prevention of Type 2 Diabetes
PrevT2DM: Nutrition-related Effects of Medications
PrevT2DM: Nutrition Counseling
PrevT2DM: Coordination of Care

Nutrition Monitoring and Evaluation

PrevT2DM: Monitoring and Evaluation in High Risk Groups

Recommendations Summary

PDM: Screen for Type 2 Diabetes Risk 2014

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)

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.

Rating: Consensus

Imperative

PDM: Determine Appropriate Action Based on Screening

The registered dietitian nutritionist (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.

Rating: Consensus

Imperative

Risks/Harms of Implementing This Recommendation

Potential for negative psychological effect from screening for diabetes risk (for example, emotional distress and denial).

Conditions of Application

- One barrier may be limited time and resources available for screening and implementing appropriate action, in the large and growing population of high-risk individuals
- For evidence-based practice guidelines on MNT, please refer to the following projects:
  - Adult Weight Management Evidence-Based Nutrition Practice Guideline: http://andevidencelibrary.com/topic.cfm?cat=2798
  - Diabetes Evidence-Based Nutrition Practice Guideline: http://andevidencelibrary.com/topic.cfm?cat=3251

Potential Costs Associated with Application

- Implementing the screening program
- Referral for diabetes therapy, including MNT for Diabetes.
- Referral for weight reduction, including medical nutrition therapy (MNT) for Adult Weight Management
- Referral to healthcare provider for laboratory work and other medical tests
- General advice about risk factors and development of diabetes
- Re-screening three years later if tests are normal

Recommendation Narrative

From Prevention/Delay of Type 2 Diabetes Recommendations from the American Diabetes Association Standards of Medical Care, 2014

- Testing to detect type 2 diabetes and prediabetes in asymptomatic people should be considered in adults of any age who are overweight or obese (BMI more than 25 kg/m²) and who have one or more additional risk factors for diabetes. In those without these risk factors, testing should begin at age 45 years, (B)
- If tests are normal, repeat testing at least at three-year intervals is reasonable (E)
- To test for diabetes or prediabetes, the A1C, FPG, or two-hour 75g OGTT are appropriate (B)
- In those identified with prediabetes, identify and, if appropriate, treat other CVD risk factors. (B)

From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010

- A community-based strategy should consist of using a screening test as a first step in order to estimate the risk for current diabetes or prediabetes and the risk for future diabetes. It is recommended the use of opportunistic screening by healthcare personnel, including those working in general practice, nurses and pharmacists. If after this first step a person is considered to be at increased risk for diabetes, the next step will be to proceed to PG measurements (either fasting or preferably using an OGTT) in order to determine more precisely their glycemic status (Grade A).
- In routine clinical practice, a screening strategy should be targeted to patients with at least one obvious risk factor for diabetes. It may consist of PG measurement at fasting or even better of OGTT due to its higher sensitivity. One alternative may be a stepped approach including an initial screening questionnaire (score of risk for diabetes) in the process. As examples, due to the very high number of obese subjects, OGTT is best reserved for those with higher scores, whereas the very prevalence of diabetes or prediabetes in CVD patients suggests that performing OGTT regularly in these patients is the best strategy (Grade B)
- Performance of diabetes risk scores must be assessed in the target population where they will be ultimately applied (Grade B)
- After scoring for diabetes risk, it is mandatory to inform participants about their risk and to take time to deliver explanations, in particular to lower-educated individuals. This needs to be done appropriately in order to raise the awareness and understanding of T2DM and its risk factors, while avoiding or minimizing negative effects, such as emotional distress and denial (Grade A).
- As OGTT has a higher sensitivity than FPG for detecting diabetes and is the only test to detect IGT, a definite categorization of glycemic state needs an OGTT (Grade A).

Recommendation Strength Rationale

From Prevention/Delay of Type 2 Diabetes Recommendations from the American Diabetes Association Standards of Medical Care, 2014

- The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited
- Evidence in support of the recommendation was grades B and E.

From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010

- The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited
- Evidence in support of the recommendation was grades A and B.

Minority Opinions

Consensus reached.

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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### Recommendations Summary

**PDM: Assessment in High-Risk Groups 2014**

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)

**PDM: Assessment in High-Risk Groups**

- The registered dietitian nutritionist (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, BMI, waist circumference, waist-to-hip ratio)
  - CVR 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.

**Rating:** Consensus

**Impressive**

**Risks/Harms of Implementing This Recommendation**

None.

**Conditions of Application**

Data on these factors may not be available.

**Potential Costs Associated with Application**

The costs of medical nutrition therapy (MNT).

**Recommendation Narrative**

From Prevention/Delay of Type 2 Diabetes Recommendations from the American Diabetes Association Standards of Medical Care, 2014

- Patients with IGT (A), IFG (E), or an A1C of 5.7% to 6.4% (E) should be referred to an effective ongoing support program targeting weight loss of 7% of body weight and increasing physical activity to at least 150 minutes per week of moderate activity such as walking.
- Follow-up counseling appears to be important for success (B)
- Based on the cost-effectiveness of diabetes prevention, such programs should be covered by third-party payers (B)
- Metformin therapy for prevention of type 2 diabetes may be considered in those with IGT (A), IFG (E), or an A1C of 5.7% to 6.4% (E), especially for those with BMI more than 35 kg/m^2^, aged less than 65 years and women with poor PDM (A)
- At least annual monitoring for the development of diabetes in those with prediabetes is suggested (E)
- Screening for and treatment of modifiable risk factors for CVR is suggested. (B)

From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010

- **Overweight and obesity:**
  - Reversal of obesity also decreases the risk for T2D (A) and improves glycemic control in patients with established diabetes (A)
  - A strong curvilinear relationship between BMI and the risk for T2DM was found in women in the Nurses’ Health Study (B)
  - However, studies trying to discern the relative importance of waist circumference (or waist-to-hip ratio) compared to BMI regarding risk for T2D development have not shown a major advantage of one over the other. (A)
  - Physical inactivity: The benefit of physical activity in preventing diabetes has been demonstrated in several studies (A)
  - Impaired fasting glucose (IFG) and impaired glucose tolerance (IGT):
    - The prevalence of IFG and IGT varies considerably among different ethnic groups and increases with age (B)
    - The reported estimates of diabetes development in IFG and IGT individuals vary widely, depending on the ethnicity of the population studied, with a higher incidence of T2D noted in non-Caucasian populations (B)
    - Two recent meta-analyses found no evidence of a difference in T2D risk among people with either IGT, IFG, IGT or i-IGF, but both concluded that individuals with IFG - IGT have a substantially increased risk of T2D compared to all other groups (B)
    - However, studies of shorter duration have shown that during a period of three to five years about 25% of individuals progress to diabetes, 25% return to a normal glycemia status and 50% remain in the prediabetic state. (B)
• Dietary factors, such as low fiber intake, low unsaturated saturated fat ratio and other nutrients:
  • It has been shown that a diet pattern promoting weight loss reduces the risk of T2D (A)
  • Individuals with low intake of dietary fiber, particularly of insoluble cereal fiber, have been found to be at increased risk for T2D in several epidemiologic studies (B)
  • Nevertheless, a recent meta-analysis of 37 prospective cohort studies showed, in fully adjusted models, that both high glycaemic load and high glycaemic index diets are associated with increased risk for T2D (B)
  • Shifting from a diet based on animal fat to a diet rich in vegetable fat might reduce the risk for T2D (B)
  • An increased intake of nonunsaturated fat appears to be of particular benefit (C)
  • The consumption of trans fatty acids has consistently been found to be associated with increased risk for T2D and CVD (A)
  • A less consistent but still significant body of evidence suggests that the risk for T2D is lowered by regular consumption of moderate amounts of alcohol (B), fruits and vegetables (B), nuts and coffee (B).

• Depression: Depression has been considered as a risk factor for T2D and its complications and an increased risk for developing T2D in adults with depression has been demonstrated in a meta-analysis of nine longitudinal studies (B)

• Obesogenic/obesity-related environment: The recent increase in T2D seems to be strongly linked to unfavorable changes in the environment (B)

• Low socio-economic status (SES);
  • There is also an inverse association between SES and T2D, with a higher prevalence among less-advantaged groups. This appears to be consistent across several developed countries and across different ethnic groups. (B)
  • An inverse graded association between diabetes prevalence, metabolic disorders and different measures of SES such as education, occupation, income, poverty income ratio and measures of material deprivation have been found (B).

**Recommendation Strength Rationale**

From Prevention/Delay of Type 2 Diabetes Recommendations from the American Diabetes Association Standards of Medical Care, 2014

• The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited

From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010

• The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited

Minority Opinions

Consensus reached.

**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


**Diabetes Prevention**

**Prevention of Type 2 Diabetes (PGD Guideline) (2014)**

**Quick Links**

**Recommendations Summary**

PDM: Weight Loss and Prevention of Type 2 Diabetes 2014

*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)

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 registered dietitian nutritionist (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 1.1kg to 13kg reported significant improvements:

- Decreased A1C by 0.12% to 0.3%
- Decreased triglycerides by 20mg to 132mg per dL (0.23mmol to 1.5mmol per L)
- Decreased waist circumference by 1.5cm to 11cm
- Decreased systolic blood pressure by 4.9mm Hg to 10mm Hg.

In individuals with prediabetes, research regarding a weight loss achieved via lifestyle modification over at least a three-month period ranging from 2.6kg to 7.1kg reported significant improvements:

- Decreased fasting glucose levels by 2.2mg to 9.2mg per dL (0.12mmol to 0.5mmol per L)
- Decreased triglyceride levels by 30.9mg per dL (0.35mmol per L)
- Decreased waist circumference by 1.3cm to 5.8cm
- Decreased systolic blood pressure 3.5mm Hg to 6mm Hg and diastolic blood pressure by 5mm Hg.

In individuals with prediabetes, research regarding a weight loss achieved via bariatric surgery of up to 47kg or 41% of excess BMI over a period of three to five years reported significant improvements:

- Decreased fasting glucose levels by 16.2mg to 20.9mg per dL (0.9mmol to 1.16mmol per L)
- Decreased two-hour post-prandial glucose levels by 16mg per dL (0.9mmol per L)
- Decreased A1C by 0.5%
- Decreased triglyceride levels by 70.6mg per dL (0.8mmol per L)
- Increased HDL cholesterol levels by 1.3mg per dL (0.05mmol per L)
- Decreased systolic blood pressure by 6mm Hg.

Rating: Strong Conditional

Risks/Harms of Implementing This Recommendation

- 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.

Conditions of Application

This recommendation applies to individuals who are at high risk for type 2 diabetes who are overweight or obese

For evidence-based weight loss methods, please refer to the following projects:

- Adult Weight Management Evidence-Based Nutrition Practice Guideline: http://andevidencelibrary.com/topic.cfm?cat=2798
- Pediatric Weight Management Evidence-Based Nutrition Practice Guideline: http://andevidencelibrary.com/topic.cfm?cat=2721

Potential Costs Associated with Application

The costs of medical nutrition therapy (MNT).

Recommendation Narrative

A total of 28 studies (30 publications) were included in the evidence analysis for this recommendation:

- Two positive-quality cohort studies (Caliazo et al, 2010; de la Cruz-Muron et al, 2011)
- Two neutral-quality cohort studies (Allen et al, 2009; Sihan et al, 2009)
- One neutral-quality case-control study (Alzawa et al, 2009)
- Three neutral-quality non-randomized controlled trials (Cicero et al, 2009; Kim et al, 2009; Evangelou et al, 2010)
- One positive-quality systematic review (Orozzo et al, 2008).

In Adults with Metabolic Syndrome

Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):

- Most studies reported no significant impact of weight loss on fasting glucose levels in adults with metabolic syndrome. However, of two intervention studies reporting A1C values, both demonstrated that weight loss significantly reduced A1C by 0.12% to 0.3%.
- Additional longer-term intervention studies are needed to ascertain an effect of weight loss on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose.
- Evidence is based on the following: Seligman et al, 2011; Straznicky et al, 2011; Munakata et al, 2011; Straznicky et al, 2012.

Lipid outcomes (TG, HDL):

- The majority of research reported that a weight loss ranging from 1.1kg to 13kg significantly reduced triglyceride levels by 20mg to 132mg per (0.23mmol to 1.5mmol per L) in adults with metabolic syndrome.
- Most studies reported no significant impact of weight loss on HDL cholesterol levels in adults with metabolic syndrome.
- Anthropometric outcomes (WC, WHR):
- Research reports that a weight loss ranging from 1.1kg to 13kg significantly reduced waist circumference by 1.5cm to 11cm in adults with metabolic syndrome.
- Most studies reported no significant impact of weight loss on WC, WHR in adults with metabolic syndrome.
- Blood pressure outcomes:
- Most studies reported that a weight loss ranging from 1.1kg to 8.4kg significantly reduced systolic blood pressure by 4.9mm Hg to 10mm Hg in adults with metabolic syndrome.
- However, the research regarding weight loss reports mixed results on diastolic blood pressure in adults with metabolic syndrome.
- Additional longer-term intervention studies are needed to ascertain an effect of weight loss on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.
- Renal outcomes:
- Two intervention studies regarding the impact of weight loss on renal outcomes reported inconclusive results.
- Additional longer-term intervention studies are needed to ascertain an effect of weight loss on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal albumin excretion rate.
- Evidence is based on the following: Selgman et al, 2011; Straznicky et al, 2011.

In Individuals with Prediabetes

Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):

- The majority of lifestyle modification intervention studies reported that weight loss significantly reduces fasting blood glucose in individuals with prediabetes, while most studies report no significant impact of weight loss on two-hour post-prandial blood glucose or A1C.
In individuals with prediabetes, what is the impact of weight loss (over at least a three-month period) on blood pressure?

In individuals with prediabetes, what is the impact of weight loss (over at least a three-month period) on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of weight loss (over at least a three-month period) on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on blood pressure?

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on renal outcomes?

Supporting Evidence


Additional lifestyle modification intervention studies are needed to ascertain the effects of weight loss on two-hour post-prandial blood glucose and A1C in individuals with prediabetes.


Lipid outcomes (TG, HDL):

Most lifestyle modification intervention studies reported that weight loss improves triglyceride levels, but does not have a significant impact on HDL cholesterol levels, in individuals with prediabetes.

In the study reporting a weight loss of 2.7kg, there was a significant reduction in triglyceride levels by 30.9mg per dL (0.35mmol per L).

In one bariatric surgery intervention study, a weight loss of up to 41% of excess BMI significantly decreased triglyceride levels by 70.6mg per dL (0.8mmol per L) and increased HDL cholesterol levels by 1.9mg per dL (0.05mmol per L).

Additional lifestyle modification intervention studies are needed to ascertain the effects of weight loss on lipid outcomes in individuals with prediabetes.


Anthropometric outcomes (WC, WHR):

The majority of lifestyle modification intervention studies reported that weight loss significantly reduces waist circumference, but does not have a significant impact on waist-to-hip ratio, in individuals with prediabetes.

Of those studies reporting a weight loss ranging from 2.7kg to 7.1kg, there was a significant reduction in waist circumference by 1.3cm to 5.9cm.


Blood pressure outcomes:

Most lifestyle modification intervention studies reported that weight loss significantly reduces systolic and diastolic blood pressure in individuals with prediabetes.

Of those studies reporting a weight loss ranging from 2.7kg to 4.9kg, there was a significant reduction in systolic blood pressure of 3.5mm Hg to 6mm Hg and in diastolic blood pressure of 5mm Hg.

In one bariatric surgery intervention study, a weight loss of up to 41% of excess BMI significantly reduced systolic blood pressure by 6mm Hg.


Recommendation Strength Rationale

For Adults with Metabolic Syndrome

Grade I evidence is available for the conclusion statements regarding the impact of weight loss for at least a three-month period on the following outcomes:

- Lipid (TG, HDL)
- Anthropometric measures (WC, WHR).

Grade II evidence is available for the conclusion statements regarding the impact of weight loss for at least a three-month period on the following outcomes:

- Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
- Blood pressure.

Grade III evidence is available for the conclusion statements regarding the impact of weight loss for at least a three-month period on the following outcomes:

- Renal outcomes.

For Individuals with Prediabetes

Grade I evidence is available for the conclusion statements regarding the impact of weight loss for at least a three-month period on the following outcomes:

- Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
- Anthropometric measures (WC, WHR)
- Blood pressure.

Grade II evidence is available for the conclusion statements regarding the impact of weight loss for at least a three-month period on the following outcomes:

- Lipid (TG, HDL).

Minority Opinions

Consensus reached.

References


Of those studies reporting a weight loss ranging from 2.6kg to 7.1kg, there was a significant reduction in waist circumference by 1.3cm to 5.9cm in individuals with prediabetes.


In bariatric surgery intervention studies, a weight loss of up to 41% of excess BMI significantly reduced systolic blood pressure by 6mm Hg.


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).

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on anthropometric outcomes (WC, WHR)?

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on blood pressure?

In adults with metabolic syndrome, what is the impact of weight loss (over at least a three-month period) on renal outcomes?

In individuals with prediabetes, what is the impact of weight loss (over at least a three-month period) on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In individuals with prediabetes, what is the impact of weight loss (over at least a three-month period) on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of weight loss (over at least a three-month period) on anthropometric outcomes (WC, WHR)?

In individuals with prediabetes, what is the impact of weight loss (over at least a three-month period) on blood pressure?
which the following recommendations were drawn, use the hyperlinks in the 
PDM: Nutrition Prescription for Macronutrients 2014
Recommendations Summary

Recommendation(s)

Prevention of Type 2 Diabetes (PDM Guideline (2014)

Quick Links

Recommendations Summary

PD M: Nutrition Prescription for Macronutrients 2014

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.
PDM: Nutrition Prescription for Macronutrients

The registered dietitian nutritionist (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.

Rating: Fair

Impressive

- Risks/Harms of Implementing This Recommendation
  - None.

- Conditions of Application
  - None.

- Potential Costs Associated with Application
  - The costs of medical nutrition therapy (MNT).

- Recommendation Narrative

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

- Nine positive quality randomized controlled trials (RCT) (Azadbakht et al, 2005; Lindstrom et al, 2006; McLaughlin et al, 2006; Camhi et al, 2010; Gulseth et al, 2010; Lee et al, 2009; Muzo et al, 2007; Paniagua et al, 2011; and Tiemey et al, 2011)
- Two neutral quality RCTs (Sarkkinen et al, 1996; Wolever and Mehlng, 2003)
- One positive quality cluster randomized trial (Zhang et al, 2011)
- Three neutral quality prospective cohort study (Feskens et al, 1995)
- One positive quality non-randomized controlled trial (Kolovou et al, 2006).

In Adults with Metabolic Syndrome

- Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):
  - Research is inconclusive on the effect of macronutrient distribution (as a percentage of energy), independent of weight loss, on glycemic-related outcomes in adults with metabolic syndrome, related to the varying macronutrient distributions in study diets (12% to 30% protein; 20% to 38% fat; 48% to 65% carbohydrate)
  - However, two feeding studies, also with diets of varying macronutrient distributions report inconclusive results regarding the effect of macronutrient distribution on post-prandial glycemia and insulinaemia
  - Additional longer-term intervention studies are needed to ascertain an effect of macronutrient distribution on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose

- Lipid outcomes (TG, HDL):
  - Research is inconclusive on the effect of macronutrient distribution (as a percentage of energy), independent of weight loss, on lipid outcomes in adults with metabolic syndrome, related to the varying macronutrient distributions in study diets (12% to 30% protein; 20% to 38% fat; 48% to 65% carbohydrate)
  - Additional longer-term intervention studies are needed to ascertain an effect of macronutrient distribution on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels

- Anthropometric outcomes (WC, WHR):
  - Research is inconclusive on the effect of macronutrient distribution (as a percentage of energy), independent of weight loss, on waist circumference (WC), independent of weight loss, in adults with metabolic syndrome, related to the varying macronutrient distributions in study diets (12% to 30% protein; 20% to 38% fat; 48% to 65% carbohydrate)
  - Although not significant, there was a trend that macronutrient distribution may lead to a decrease in WC, when fat content was at least 30%. However, in one study with fat less than 30%, there was a positive effect on waist-to-hip ratio after one year
  - Additional longer-term intervention studies are needed to ascertain an effect of macronutrient distribution on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures
  - Evidence is based on the following: Camhi et al, 2010; Lee et al, 2009; Muzo et al, 2007; Paniagua et al, 2011; Tiemey et al, 2011; and Zhang et al, 2011.

- Blood pressure outcomes:
  - Research is inconclusive on the effect of macronutrient distribution (as a percentage of energy), independent of weight loss, on blood pressure in adults with metabolic syndrome, related to the varying macronutrient distributions in study diets (12% to 19% protein; 22% to 38% fat; 46% to 65% carbohydrate)
  - Additional longer-term intervention studies are needed to ascertain an effect of macronutrient distribution on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure
  - Evidence is based on the following: Azadbakht et al, 2005; Gulseth et al, 2010; Muzo et al, 2007; Paniagua et al, 2011; Tiemey et al, 2011; Zhang et al, 2011.

- Renal outcomes:
  - There were no studies identified to evaluate the impact of macronutrient distribution (as a percentage of energy), independent of weight loss, on renal outcomes in adults with metabolic syndrome
  - Intervention studies are needed to ascertain an effect of macronutrient distribution on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal measures.

In Individuals with Prediabetes

- Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):
  - Research is inconclusive on the effect of macronutrient distribution (as a percentage of energy), independent of weight loss, on glycemic-related outcomes in individuals with prediabetes, related to the varying macronutrient distributions in study diets (15% protein; 25% to 45% fat; 40% to 60% carbohydrate)
  - Additional longer-term intervention studies are needed to quantify specific macronutrient intake ranges in individuals with prediabetes
  - Evidence is based on the following: Feskens et al, 1995; McKnight et al, 2006; Melton et al, 2009; Sarkkinen et al, 1996; Wolever and Mehlng, 2003.

- Lipid outcomes (TG, HDL):
  - Research is inconclusive on the effect of macronutrient distribution (as a percentage of energy), independent of weight loss, on lipid outcomes in individuals with prediabetes, related to the varying macronutrient distributions in study diets (15% protein; 30% to 40% fat; 40% to 55% carbohydrate)
  - Additional longer-term intervention studies are needed to quantify specific macronutrient intake ranges in individuals with prediabetes
  - Evidence is based on the following: McKnight et al, 2006; Melton et al, 2009; Sarkkinen et al, 1996; Wolever and Mehlng, 2003.

- Anthropometric outcomes (WC, WHR):
  - Research is inconclusive on the effect of macronutrient distribution (as a percentage of energy), independent of weight loss, on anthropometric outcomes in individuals with prediabetes, related to the varying macronutrient distributions in study diets (less than 30% of calories from fat)
  - Additional longer-term intervention studies are needed to ascertain an effect of macronutrient distribution on anthropometric outcomes in individuals with prediabetes
  - Evidence is based on the following: Lindstrom et al, 2006.

- Blood pressure outcomes:
  - Research is inconclusive on the effect of macronutrient distribution (as a percentage of energy), independent of weight loss, on blood pressure in individuals with prediabetes, related to the varying macronutrient distributions in study diets (comparing 40% carbohydrate and 45% fat vs. 60% carbohydrate and 25% fat)
  - Additional longer-term intervention studies are needed to ascertain an effect of macronutrient distribution on blood pressure in individuals with prediabetes
  - Evidence is based on the following: McKnight et al, 2006.
**Recommendation Strength Rationale**

**For Adults with Metabolic Syndrome**

- **Grade II** evidence is available for the conclusion statements regarding the impact of macronutrient distribution, independent of weight loss, on adults with metabolic syndrome on:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid outcomes (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure.

- **Grade V** (no evidence) is available to evaluate the impact of macronutrient distribution, independent of weight loss on in adults with metabolic syndrome on renal outcomes.

**For Individuals with Prediabetes**

- **Grade II** evidence is available for the conclusion statements regarding the impact of macronutrient distribution, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Anthropometric measures (WC, WHR)
  - Blood pressure.

- **Grade V** (no evidence) is available to evaluate the impact of macronutrient distribution, independent of weight loss on the following outcomes:
  - Anthropometric outcomes (WC, WHR)

**Minority Opinions**

Consensus reached.

**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):

- In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?
- In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on lipid outcomes (TG, HDL)?
- In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on anthropometric outcomes (WC, WHR)?
- In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on renal outcomes?
- In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on blood pressure?
- In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on lipid outcomes (TG, HDL)?
- In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on anthropometric outcomes (WC, WHR)?
- In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on blood pressure?

**Minority Opinions**

Consensus reached.

**References**


Camhi SM, Stefanick ML, Katsimaryk PT, Young DR. Metabolic syndrome and changes in body fat from a low-fat diet and/or exercise randomized controlled trial. *Obeesity (Silver Spring)*. 2015; 18 (3): 548-554.


Recommendations Summary

PDM: Fiber and Prevention of Type 2 Diabetes 2014

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.

Risk/Impacts of Implementing This Recommendation

None.

Conditions of Application

Research on synergistic effects of nutrients was not evaluated.

Potential Costs Associated with Application

The costs of medical nutrition therapy (MNT).

Recommendation Narrative

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

- Two positive-quality randomized controlled trials (RCT) (Lindstrom et al, 2006; Lankinen et al, 2011)
- One neutral-quality randomized controlled trial (RCT) (Wen et al, 2010)
- One neutral-quality randomized crossover trial (RCT) (Pouteau et al, 2010).

In Adults With Metabolic Syndrome

- Glycemic-related outcomes (FBG, random BG, two-hour postprandial BG, A1C):
  - Limited research reports that total fiber intake, independent of weight loss, has no significant impact on fasting blood glucose levels in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of total fiber intake on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose.
  - Evidence is based on the following: Pouteau et al, 2010.

- Lipid outcomes (TG, HDL):
  - Limited research reports that total fiber intake, independent of weight loss, has no significant impact on triglycerides or HDL cholesterol levels in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of total fiber intake on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels.
  - Evidence is based on the following: Pouteau et al, 2010.

- Anthropometric outcomes (WC, WHR):
  - There were no studies identified to evaluate the impact of total fiber intake, independent of weight loss, on anthropometric outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of total fiber intake on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures.

- Blood pressure outcomes:
  - There were no studies identified to evaluate the impact of total fiber intake, independent of weight loss, on blood pressure in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of total fiber intake on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.

- Renal outcomes:
  - There were no studies identified to evaluate the impact of total fiber intake, independent of weight loss, on renal outcomes in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of total fiber intake on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal measures.

- Glycemic-related outcomes (FBG, random BG, two-hour postprandial BG, A1C):
  - Limited research reports that type of fiber intake, independent of weight loss, has no significant impact on fasting blood glucose levels in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of type of fiber intake on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose.
  - Evidence is based on the following: Pouteau et al, 2010.

- Lipid outcomes (TG, HDL):
  - Limited research reports that type of fiber intake, independent of weight loss, has no significant impact on triglycerides or HDL cholesterol levels in adults with metabolic syndrome.
metabolic syndrome

- Additional longer-term intervention studies are needed to ascertain an effect of type of fiber intake on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels
- Evidence is based on the following: Pouteau et al, 2010.

Anthropometric outcomes (WC, WHR):
- There were no studies identified to evaluate the impact of type of fiber intake, independent of weight loss, on anthropometric outcomes in adults with metabolic syndrome
- Intervention studies are needed to ascertain the effect of type of fiber intake on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures.

Blood pressure outcomes:
- There were no studies identified to evaluate the impact of type of fiber intake, independent of weight loss, on blood pressure in adults with metabolic syndrome
- Intervention studies are needed to ascertain the effect of type of fiber intake on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.

Renal outcomes:
- There were no studies identified to evaluate the impact of type of fiber intake, independent of weight loss, on renal outcomes in adults with metabolic syndrome
- Intervention studies are needed to ascertain an effect of type of fiber intake on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal measures.

In Individuals With Prediabetes

Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):
- There were no studies identified to evaluate the impact of the type of fiber intake on glycemic-related outcomes in individuals with prediabetes
- Intervention studies are needed to ascertain the effect of type of fiber intake on glycemic-related outcomes in individuals with prediabetes
- Evidence is based on the following: Pouteau et al, 2010.

Lipid outcomes (TG, HDL):
- Limited research reports no significant impact of total fiber intake, independent of weight loss, on triglycerides or HDL cholesterol in individuals with prediabetes
- Additional intervention studies are needed to ascertain the effect of total fiber intake on lipid outcomes in individuals with prediabetes
- Evidence is based on the following: Wien et al, 2010.

Anthropometric outcomes (WC, WHR):
- Limited research reports mixed results regarding the impact of total fiber intake, independent of weight loss, on waist circumference in individuals with prediabetes
- Additional longer-term intervention studies are needed to ascertain the effect of total fiber intake on anthropometric outcomes in individuals with prediabetes
- Evidence is based on the following: Lindstrom et al, 2006; Wien et al, 2010.

Blood pressure outcomes:
- Limited research reports no significant impact of total fiber intake, independent of weight loss, on systolic or diastolic blood pressure in individuals with prediabetes
- Additional longer-term intervention studies are needed to ascertain the effect of total fiber intake on blood pressure in individuals with prediabetes
- Evidence is based on the following: Wien et al, 2010.

Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):
- There were no studies identified to evaluate the impact of the type of fiber intake on glycemic-related outcomes in individuals with prediabetes
- Intervention studies are needed to ascertain the effect of type of fiber intake on glycemic-related outcomes in individuals with prediabetes
- Evidence is based on the following: Pouteau et al, 2010.

Lipid outcomes (TG, HDL):
- There were no studies identified to evaluate the impact of the type of fiber intake on lipid outcomes in individuals with prediabetes
- Intervention studies are needed to ascertain the effect of type of fiber intake on lipid outcomes in individuals with prediabetes
- Evidence is based on the following: Pouteau et al, 2010.

Anthropometric outcomes (WC, WHR):
- There were no studies identified to evaluate the impact of the type of fiber intake on anthropometric outcomes in individuals with prediabetes
- Intervention studies are needed to ascertain the effect of type of fiber intake on anthropometric outcomes in individuals with prediabetes
- Evidence is based on the following: Pouteau et al, 2010.

Blood pressure outcomes:
- There were no studies identified to evaluate the impact of the type of fiber intake on blood pressure in individuals with prediabetes
- Intervention studies are needed to ascertain the effect of type of fiber intake on blood pressure in individuals with prediabetes
- Evidence is based on the following: Pouteau et al, 2010.

From Primary Prevention of Type 2 Diabetes Recommendations from the American Diabetes Association Standards of Medical Care, 2014

Individuals at high risk for type 2 diabetes should be encouraged to achieve the U.S. Department of Agriculture (USDA) recommendation for dietary fiber (14 g fiber per 1,000 kcal) and foods containing whole grains (one-half of grain intake) (Grade C).

From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010

- A diet with high fiber (more than 15 g per 1,000 kcal), moderate fat (less than 35% of total energy), reduced saturated and trans fat (less than 10% of total energy) can lower body weight and reduce the risk of T2D and is therefore recommended (Grade B)
- Comorbidities, particular MetS, should be monitored and taken into account when planning the diet (Grade C)
- Currently there is no evidence from long-term prevention studies that reducing total dietary carbohydrate prevents T2D. Carbohydrate sources should mainly be whole-grain cereal, fruit, vegetables and legumes (Grade C).

Recommendation Strength Rationale

For Adults with Metabolic Syndrome

- Grade III evidence is available for the conclusion statements regarding the impact of total fiber intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
- Grade III evidence is available for the conclusion statements regarding the impact of type of fiber intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropic measures (WC, WHR)
  - Blood pressure
  - Renal measures.
- Grade V evidence is available for the conclusion statements regarding the impact of total fiber intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropic measures (WC, WHR)
  - Blood pressure

For Individuals with Prediabetes

- Grade III evidence is available for the conclusion statements regarding the impact of total fiber intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropic measures (WC, WHR)
  - Blood pressure
- Grade V evidence is available for the conclusion statements regarding the impact of type of fiber intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropic measures (WC, WHR)
  - Blood pressure
In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on renal outcomes?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on anthropometric outcomes (WC)?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of type of fiber intake, independent of weight loss, on anthropometric outcomes (WC)?

In individuals with prediabetes, what is the impact of type of fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of type of fiber intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In individuals with prediabetes, what is the impact of total fiber intake, independent of weight loss, on blood pressure?

In individuals with prediabetes, what is the impact of type of fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of total fiber intake, independent of weight loss, on renal outcomes?

In individuals with prediabetes, what is the impact of total fiber intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on anthropometric outcomes (WC)?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on renal outcomes?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of total fiber intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of type of fiber intake, independent of weight loss, on lipid outcomes (TG, HDL)?

References


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


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- Diabetes Prevention
- Prevention of Type 2 Diabetes (PDM Guideline 2014)

Quick Links

Recommendations Summary

PDM: Whole Grains and Prevention of Type 2 Diabetes 2014

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)**
  - PDM: Whole Grains and Prevention of Type 2 Diabetes

The registered dietitian nutritionist (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.

**Rating: Weak**

**Impressive**

- **Risks/Barriers of Implementing This Recommendation**
  - None.

- **Conditions of Application**
  - Research on synergistic effects of nutrients was not evaluated.

- **Potential Costs Associated with Application**
  - The costs of medical nutrition therapy (MNT).

- **Recommendation Narrative**
  - A total of two studies were included in the evidence analysis for this recommendation:
    - Two positive-quality randomized controlled trials (RCT) (Katcher et al, 2008; Lankinen et al, 2011).

In Adults With Metabolic Syndrome

- **Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):**
  - Limited research reports no significant impact of whole or refined grains, independent of weight loss, on fasting blood glucose or two-hour post-prandial blood glucose levels in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of whole or refined grains on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose.
  - Evidence is based on the following: Katcher et al, 2008.

- **Lipid outcomes (TG, HDL):**
  - Limited research reports no significant impact of whole or refined grains, independent of weight loss, on total triglycerides or HDL cholesterol levels in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of whole or refined grains on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels.
  - Evidence is based on the following: Katcher et al, 2008.

- **Anthropometric outcomes (WC, WHR):**
  - Limited research reports no significant impact of whole or refined grains, independent of weight loss, on waist circumference in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of whole or refined grains on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures.
  - Evidence is based on the following: Katcher et al, 2008.

- **Blood pressure outcomes:**
  - Limited research reports no significant impact of whole or refined grains, independent of weight loss, on systolic or diastolic blood pressure in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of whole or refined grains on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.
  - Evidence is based on the following: Katcher et al, 2008.

- **Renal outcomes:**
  - There were no studies identified to evaluate the impact of whole or refined grains, independent of weight loss, on renal outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of whole or refined grains on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal measures.

In Individuals With Prediabetes

- **Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):**
  - Limited research reports no significant impact of whole or refined grains, independent of weight loss, on fasting blood glucose or two-hour post-prandial blood glucose levels in individuals with prediabetes.
  - Additional intervention studies are needed to ascertain the effect of whole or refined grains on glycemic-related outcomes in individuals with prediabetes.
  - Evidence is based on the following: Lankinen et al, 2011.

- **Lipid outcomes (TG, HDL):**
  - There were no studies identified to evaluate the impact of whole or refined grains, independent of weight loss, on lipid outcomes in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effect of whole or refined grains on lipid outcomes in individuals with prediabetes.

Supporting Evidence Section

Additional intervention studies are needed to ascertain the effect of whole or refined grains on systolic or diastolic blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure. Additional intervention studies are needed to ascertain the effect of whole or refined grains on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels. Additional intervention studies are needed to ascertain the effect of whole or refined grains on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal measures.
In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on renal outcomes?

In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In individuals with prediabetes, what is the impact of whole or refined grains, independent of weight loss, on blood pressure?

In individuals with prediabetes, what is the impact of whole or refined grains, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In individuals with prediabetes, what is the impact of whole or refined grains, independent of weight loss, on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of whole or refined grains, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

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).

For Adults with Metabolic Syndrome

Grade III evidence is available for the conclusion statements regarding the impact of whole or refined grains intake, independent of weight loss, on the following outcomes:
- Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
- Lipid (TG, HDL)
- Anthropometric measures (WC, WHR)
- Blood pressure

Grade V evidence is available for the conclusion statements regarding the impact of whole or refined grains intake, independent of weight loss, on the following outcomes:
- Renal measures.

For Individuals with Prediabetes

Grade III evidence is available for the conclusion statements regarding the impact of whole or refined grains intake, independent of weight loss, on the following outcomes:
- Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
- Grade V evidence is available for the conclusion statements regarding the impact of whole or refined grains intake, independent of weight loss, on the following outcomes:
- Lipid (TG, HDL)
- Anthropometric measures (WC, WHR)
- Blood pressure.

Recommendation Strength Rationale

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).

In individuals with prediabetes, what is the impact of whole or refined grains, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In individuals with prediabetes, what is the impact of whole or refined grains, independent of weight loss, on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of whole or refined grains, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of whole or refined grains, independent of weight loss, on renal outcomes?

References


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


From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010

A diet with high fiber (more than 15g per 1,000kcal), moderate fat (less than 35% of total energy), reduced saturated and trans fat (less than 10% of total energy) can lower body weight and reduce the risk of T2D and is therefore recommended (Grade B)

Comorbidities, particular MetS, should be monitored and taken into account when planning the diet (Grade C).

Currently there is no evidence from long-term prevention studies that reducing total dietary carbohydrate prevents T2D. Carbohydrate sources should mainly be whole-grain cereal, fruit, vegetables and legumes (Grade C).

Minority Opinions

Consensus reached.

For Individuals at high risk for type 2 diabetes should be encouraged to achieve the U.S. Department of Agriculture (USDA) recommendation for dietary fiber (14 g fiber per 1,000 kcal) and foods containing whole grains (one half of grain intake) (Grade B).


### Quick Links

#### Recommendations Summary

PDM: Vegetable-Based Protein and Prevention of Type 2 Diabetes 2014

*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):**
  - 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 registered dietitian nutritionist (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*.

  **Rating: Insufficient Evidence**
  - **Conditional**
  - **Risks/Harms of Implementing This Recommendation**
    - None.
  - **Conditions of Application**
    - This recommendation applies when the consumption of *vegetable-based protein* is proposed for the prevention of *type 2 diabetes*.
  - **Research on synergistic effects of nutrients was not evaluated.**
  - **Potential Costs Associated with Application**
    - The costs of medical nutrition therapy (MNT).
  - **Recommendation Narrative**
    - No studies were included in the evidence analysis for this recommendation.

- **In Adults with Metabolic Syndrome**
  - **Glycemic-related outcomes** *(FBG, random BG, two-hour post-prandial BG, A1C)*:
    - There were no studies identified to evaluate the impact of *vegetable-based protein* vs. *animal-based protein* on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose.
  - **Lipid outcomes** *(TG, HDL)*:
    - There were no studies identified to evaluate the impact of *vegetable-based protein* vs. *animal-based protein* on lipid outcomes in adults with metabolic syndrome.
  - **Intervention studies are needed to ascertain the effects of vegetable-based protein vs. animal-based protein on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels.**
  - **Anthropometric outcomes** *(WC, WHR)*:
    - There were no studies identified to evaluate the impact of *vegetable-based protein* vs. *animal-based protein* on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures.
  - **Blood pressure outcomes**: *There were no studies identified to evaluate the impact of vegetable-based protein vs. animal-based protein on blood pressure in adults with metabolic syndrome.***
  - **Intervention studies are needed to ascertain the effects of vegetable-based protein vs. animal-based protein on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.***
  - **Renal outcomes**: *There were no studies identified to evaluate the impact of vegetable-based protein vs. animal-based protein on renal outcomes in adults with metabolic syndrome.***
  - **Intervention studies are needed to ascertain the effect of vegetable-based protein vs. animal-based protein on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for urine albumin excretion rate or albumin/creatinine ratio.*

- **In Individuals with Prediabetes**
The following recommendations were drawn, use the hyperlinks in the Supporting Evidence Section below.

For Adults with Metabolic Syndrome

- Grade V evidence is available for the conclusion statements regarding the impact of vegetable-based protein vs. animal-based protein, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure
  - Renal outcomes.

For Individuals with Prediabetes

- Grade V evidence is available for the conclusion statements regarding the impact of vegetable-based protein vs. animal-based protein, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure.

Minority Opinions

Consensus reached.

References

Diabetes Prevention
Prevention of Type 2 Diabetes (PDM Guideline 2014)

Quick Links

Recommendations Summary

PDM: Type of Fat and Prevention of Type 2 Diabetes 2014

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)

PDM: Type of Fat and Prevention of Type 2 Diabetes

The registered dietitian nutritionist (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.

Rating: Fair

Imperative

Risks/Harms of Implementing This Recommendation
None.

- **Conditions of Application**
  
  Research on synergistic effects of nutrients was not evaluated.

- **Potential Costs Associated with Application**
  
  The costs of medical nutrition therapy (MNT).

- **Recommendation Narrative**
  
  A total of eight studies (10 publications) were included in the evidence analysis for this recommendation:

  - Four neutral-quality randomized controlled trials (RCT) (Sarkkinen et al, 1996; Louheranta et al, 2002; Mukuddem-Petersen et al, 2007; Wen et al, 2010).

### In Adults with Metabolic Syndrome

- **Glycemic-related outcomes** (FBG, random BG, two-hour post-prandial BG, A1C):
  - Additional longer-term intervention studies are needed to ascertain the effect of type of fat intake on glycemic-related outcomes in adults with metabolic syndrome.

- **Lipid outcomes** (TG, HDL):
  - Most studies report no significant impact of the type of fat intake, independent of weight loss, on triglycerides or HDL cholesterol levels in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of type of fat intake on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels.

- **Anthropometric outcomes** (WC, WHR):
  - Additional longer-term intervention studies are needed to ascertain an effect of type of fat intake on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures.

- **Blood pressure outcomes**: Research reports no significant impact of type of fat intake, independent of weight loss, on systolic or diastolic blood pressure in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of type of fat intake on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.

- **Renal outcomes**: There were no studies identified to evaluate the impact of type of fat intake, independent of weight loss, on renal outcomes in adults with metabolic syndrome.
  - Additional longer-term intervention studies are needed to ascertain an effect of type of fat intake on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal measures.

### In Individuals with Prediabetes

- **Glycemic-related outcomes**: (FBG, random BG, two-hour post-prandial BG, A1C):
  - Limited research reports mixed results regarding the impact of type of fat intake, independent of weight loss, on fasting blood glucose levels in individuals with prediabetes.
  - Limited research reports no significant impact of the type of fat intake on A1C.
  - Additional longer-term intervention studies are needed to ascertain the effect of type of fat intake on glycemic outcomes in individuals with prediabetes.

- **Lipid outcomes** (TG, HDL):
  - Limited research reports no significant impact of the type of fat intake, independent of weight loss, on triglycerides or HDL cholesterol in individuals with prediabetes.
  - Additional longer-term intervention studies are needed to ascertain the effect of type of fat intake on lipid outcomes in individuals with prediabetes.

- **Anthropometric outcomes** (WC, WHR):
  - Limited research reports no significant impact of type of fat intake, independent of weight loss, on waist circumference in individuals with prediabetes.
  - Additional longer-term intervention studies are needed to ascertain the effect of type of fat intake on anthropometric outcomes in individuals with prediabetes.

- **Blood pressure outcomes**: Limited research reports no significant impact of type of fat intake, independent of weight loss, on systolic or diastolic blood pressure in individuals with prediabetes.
  - Additional longer-term intervention studies are needed to ascertain the effect of type of fat intake on blood pressure in individuals with prediabetes.
  - Evidence is based on the following: Lindstrom et al, 2006; Wen et al, 2010.

### Recommendation Strength Rationales

**For Adults with Metabolic Syndrome**

- Grade I evidence is available for the conclusion statements regarding the impact of type of fat intake, independent of weight loss, on the following outcomes:
  - Anthropometric measures (WC, WHR)
  - Blood pressure.

- Grade II evidence is available for the conclusion statements regarding the impact of type of fat intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Grade V evidence is available for the conclusion statement regarding the impact of type of fat intake, independent of weight loss, on the following outcomes:
  - Renal measures.

**For Individuals with Prediabetes**

- Grade III evidence is available for the conclusion statements regarding the impact of type of fat intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour postprandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure.

**Minority Opinions**

Consensus reached.

**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).
In adults with metabolic syndrome, what is the impact of type of fat intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of type of fat intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of type of fat intake, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In adults with metabolic syndrome, what is the impact of type of fat intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of type of fat intake, independent of weight loss, on renal outcomes?

In individuals with prediabetes, what is the impact of type of fat intake, independent of weight loss, on outcomes in adults with 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 consumption on outcomes in adults with type 2 diabetes.

If modifying the consumption of fruits and vegetables is proposed for the prevention of diabetes, the registered nutritionist (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 consumption alone, without weight loss, on outcomes in adults with metabolic syndrome or individuals with prediabetes.

### References


### Quick Links

**Recommendations Summary**

**PDM: Fruits and Vegetables and Prevention of Type 2 Diabetes 2014**

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)**

- **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 registered nutritionist (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.

  **Rating:** Insufficient Evidence

  **Conditional**

  - **Risks/Harms of Implementing This Recommendation**

    None.

  - **Conditions of Application**

    - This recommendation applies when modifying fruit and vegetable consumption is proposed for the prevention of type 2 diabetes.

    - Research on synergetic effects of nutrients was not evaluated.

  - **Potential Costs Associated with Application**

    The costs of medical nutrition therapy (MNT).
In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of fruits and vegetables intake, independent of weight loss, on blood pressure?

In individuals with prediabetes, what is the impact of fruits and vegetables intake, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In individuals with prediabetes, what is the impact of fruits and vegetables intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on anthropometric measures (WC, WHR)?

In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

### Recommendation Narrative

No studies were included in the evidence analysis for this recommendation.

### In Adults with Metabolic Syndrome

- **Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on glycemic-related outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of fruits and vegetables intake on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose.

- **Lipid outcomes (TG, HDL):**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on lipid outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of fruits and vegetables intake on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels.

- **Anthropometric outcomes (WC, WHR):**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on anthropometric outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of fruits and vegetables intake on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures.

- **Blood pressure outcomes:**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on blood pressure in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of fruits and vegetables intake on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.

- **Renal outcomes:**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on renal outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of fruits and vegetables intake on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal measures.

### In Individuals with Prediabetes:

- **Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on glycemic-related outcomes in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of fruits and vegetables intake on glycemic outcomes in individuals with prediabetes.

- **Lipid outcomes (TG, HDL):**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on lipid outcomes in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of fruits and vegetables intake on lipid outcomes in individuals with prediabetes.

- **Anthropometric outcomes (WC, WHR):**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on anthropometric outcomes in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of fruits and vegetables intake on anthropometric outcomes in individuals with prediabetes.

- **Blood pressure outcomes:**
  - There were no studies identified to evaluate the impact of fruits and vegetables intake, independent of weight loss, on blood pressure in individuals with prediabetes.
  - Intervention studies are needed to ascertain an effect of fruits and vegetables intake on blood pressure in individuals with prediabetes.

### Recommendation Strength Rationales

**For Adults with Metabolic Syndrome**

- Grade V evidence is available for the conclusion statements regarding the impact of fruits and vegetables intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure
  - Renal outcomes.

**For Individuals with Prediabetes**

- Grade V evidence is available for the conclusion statements regarding the impact of fruits and vegetables intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure.

### Minority Opinions

Consensus reached.

### 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):

- In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?
- In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on lipid outcomes (TG, HDL)?
- In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on anthropometric outcomes (WC, WHR)?
- In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on blood pressure?
- In adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?
in adults with metabolic syndrome, what is the impact of fruits and vegetables intake, independent of weight loss, on renal outcomes?

- References
- Diabetes Prevention
- Prevention of Type 2 Diabetes (PDM Guideline 2014)

Quick Links

Recommendations Summary

PDM: Sugar and Prevention of Type 2 Diabetes 2014

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)
  PDM: Sugar and Prevention of Type 2 Diabetes

If avoiding the consumption of sugar is proposed for the prevention of type 2 diabetes, the registered dietitian nutritionist (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.

Rating: Insufficient Evidence

Conditional

- Risks/Harms of Implementing This Recommendation
  None.
- Conditions of Application
  - This recommendation applies when avoiding the consumption of sugar is proposed for the prevention of type 2 diabetes.
  - Research on synergistic effects of nutrients was not evaluated.
- Potential Costs Associated with Application
  - The costs of medical nutrition therapy (MNT).

Recommendation Narrative

No studies were included in the evidence analysis for this recommendation.

In Adults With Metabolic Syndrome

- Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on glycemic-related outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain the effects of sugars intake on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose.
- Lipid outcomes (TG, HDL):
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on lipid outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain the effects of sugars intake on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels.
- Anthropometric outcomes (WC, WHR):
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on anthropometric outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain the effects of sugars intake on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures.
- Blood pressure outcomes:
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on blood pressure in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain the effects of sugars intake on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.
- Renal outcomes:
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on renal outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of sugars intake on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for urinary albumin excretion rate or albumin:creatinine ratio.

In Individuals With Prediabetes

- Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on glycemic-related outcomes in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of sugars intake on glycemic outcomes in individuals with prediabetes.
- Lipid outcomes (TG, HDL):
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on lipid outcomes in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of sugars intake on lipid outcomes in individuals with prediabetes.
- Anthropometric outcomes (WC, WHR):
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on anthropometric outcomes in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of sugars intake on anthropometric outcomes in individuals with prediabetes.
- Blood pressure outcomes:
  - There were no studies identified to evaluate the impact of sugars intake, independent of weight loss, on blood pressure in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of sugars intake on blood pressure in individuals with prediabetes.

From the 2010 Dietary Guidelines Advisory Committee (DGAC) Nutrition Evidence Library (NEL) Evidence-Based Systematic Reviews:

- In adults, what is the association between intake of sugar-sweetened beverages and energy intake?
  - Limited evidence shows that intake of sugar-sweetened beverages is linked to higher energy intake in adults.
In adults, what is the association between intake of sugar-sweetened beverages and body weight?

- A moderate body of epidemiologic evidence suggests that greater consumption of sugar-sweetened beverages is associated with increased body weight in adults. A moderate body of evidence suggests that under isocaloric controlled conditions, added sugars, including sugar-sweetened beverages, are no more likely to cause weight gain than any other source of energy.

**Recommendation Strength Rationale**

**For Adults with Metabolic Syndrome**

- Grade V evidence is available for the conclusion statements regarding the impact of sugars intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure
  - Renal outcomes.

**For Individuals with Prediabetes**

- Grade V evidence is available for the conclusion statements regarding the impact of sugars intake, independent of weight loss, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure.

2010 Dietary Guidelines Advisory Committee (DGAC) Nutrition Evidence Library (NEL) Evidence-Based Systematic Reviews received grades of Limited and Moderate.

**Minority Opinions**

- Consensus reached.

**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).

In individuals with prediabetes, what is the impact of sugars intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In individuals with prediabetes, what is the impact of sugars intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In individuals with prediabetes, what is the impact of sugars intake, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In individuals with prediabetes, what is the impact of sugars intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of sugars intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of sugars intake, independent of weight loss, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of sugars intake, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In adults with metabolic syndrome, what is the impact of sugars intake, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of sugars intake, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

**References**

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

**Quick Links**

**Recommendations Summary**

PDM: Glycemic Index/Glycemic Load and Prevention of Type 2 Diabetes 2014

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.

**Recommendations**

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 registered dietitian nutritionist (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.

**Rating: Weak**

Conditional

- **Risks/Harms of Implementing This Recommendation**

  The 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.

- **Conditions of Application**
This recommendation applies when the use of glycemic index/glycemic load is proposed for the prevention of type 2 diabetes.

Research on synergistic effects of nutrients was not evaluated.

- **Potential Costs Associated with Application**
  The costs of medical nutrition therapy (MNT).

- **Recommendation Narrative**

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

- One neutral-quality randomized controlled trials (RCT) (Wolever and Mehling, 2003)

### In Adults with Metabolic Syndrome

- **Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C)**
  - Two feeding studies regarding the impact of glycemic index/load reported a significant decrease in post-prandial glycemic outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of glycemic index/load on glycemic-related outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for impaired glucose tolerance and impaired fasting glucose.
  - Evidence is based on the following: Konig, Muser et al, 2012; Konig, Theis et al 2012.
- **Lipid outcomes (TG, HDL):**
  - One feeding study reports no significant effect of glycemic index/load on triglyceride or HDL cholesterol levels in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of glycemic index/load on lipid outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for lipid levels.
  - Evidence is based on the following: Konig, Theis et al, 2012.
- **Anthropometric outcomes (WC, WHR):**
  - There were no studies identified to evaluate the impact of glycemic index/load on anthropometric outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of glycemic index/load on anthropometric outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for anthropometric measures.
- **Blood pressure outcomes:**
  - There were no studies identified to evaluate the impact of glycemic index/load on blood pressure in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of glycemic index/load on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.
- **Renal outcomes:**
  - There were no studies identified to evaluate the impact of glycemic index/load on renal outcomes in adults with metabolic syndrome.
  - Intervention studies are needed to ascertain an effect of glycemic index/load on renal outcomes in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for renal measures.

### In Individuals with Prediabetes

- **Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C)**
  - One intervention study and one feeding study regarding the relative reduction of glycemic index/load reported a significant decrease in post-prandial glycemic outcomes in individuals with prediabetes.
  - Additional longer-term intervention studies are needed to ascertain the effects of relative reduction as well as low glycemic index/load values on glycemic outcomes in individuals with prediabetes.
  - Evidence is based on the following: Wolever and Mehling, 2003; Perala et al, 2011.
- **Lipid outcomes (TG, HDL):**
  - One intervention study and one feeding study regarding the relative reduction of glycemic index/load reported inconclusive results regarding lipid outcomes in individuals with prediabetes.
  - Additional longer-term intervention studies are needed to ascertain the effects of relative reduction as well as low glycemic index/load values on lipid outcomes in individuals with prediabetes.
  - Evidence is based on the following: Wolever and Mehling, 2003; Perala et al, 2011.
- **Anthropometric Outcomes (WC, WHR):**
  - There were no studies identified to evaluate the relative reduction of glycemic index/load on anthropometric outcomes in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of relative reduction as well as low glycemic index/load values on anthropometric outcomes in individuals with prediabetes.
- **Blood pressure outcomes:**
  - There were no studies identified to evaluate the relative reduction of glycemic index/load on blood pressure in individuals with prediabetes.
  - Intervention studies are needed to ascertain the effects of relative reduction as well as low glycemic index/load values on blood pressure in individuals with prediabetes.

### Recommendation Strength Rationale

- **For Adults with Metabolic Syndrome**
  - Grade III evidence is available for the conclusion statements regarding the impact of glycemic index/load, independent of weight loss, on the following outcomes:
    - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C).
    - Lipid (TG, HDL).
  - Grade V evidence is available for the conclusion statements regarding the impact of glycemic index/load, independent of weight loss, on the following outcomes:
    -Anthropometric measures (WC, WHR).
    - Blood pressure.
    - Renal outcomes.

- **For Individuals with Prediabetes**
  - Grade III evidence is available for the conclusion statements regarding the impact of glycemic index/load, independent of weight loss, on the following outcomes:
    - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C).
    - Lipid (TG, HDL).
  - Grade V evidence is available for the conclusion statements regarding the impact of glycemic index/load, independent of weight loss, on the following outcomes:
    -Anthropometric measures (WC, WHR).
    - Blood pressure.

### Minority Opinions

Consensus reached.

**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 link):

- In individuals with prediabetes, what is the impact of glycemic index/load, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?
In individuals with prediabetes, what is the impact of glycemic index/load, independent of weight loss, on lipid outcomes (HDL, TG)?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on anthropometric outcomes (WC, WHR)?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, 2-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on lipid outcomes (HDL, TG)?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on renal outcomes?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on diabetes prevention?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on blood pressure?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on renal outcomes?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on cardiovascular outcomes?

In adults with metabolic syndrome, what is the impact of glycemic index/load, independent of weight loss, on metabolic syndrome prevention?

Quick Links

Recommendations Summary

PDM: Physical Activity and Prevention of Type 2 Diabetes 2014

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.

Recommendations

PDM: Physical Activity and Prevention of Type 2 Diabetes

The registered dietitian nutritionist (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 waist circumference by 35mm per dl (0.37mmol) per L
- Decreased systolic blood pressure by 6mm Hg
- Decreased diastolic blood pressure by 3mm Hg

Rating: Weak

Imperative

Risk/Name of Implementing This Recommendation

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.

Conditions of Application

- Unless medically contraindicated
- For evidence-based weight loss methods, please refer to the following projects: Adult Weight Management Evidence-Based Nutrition Practice Guideline: http://andevidencelibrary.com/topic.cfm?cat=2798

Potential Costs Associated with Application

The costs of medical nutrition therapy (MNT).

Recommendation Narrative

A total of 12 studies (13 publications) were included in the evidence analysis for this recommendation:

- One neutral-quality randomized controlled trials (RCT) (Sixt et al, 2008)
- Five neutral-quality randomized crossover trials (RCT) (Zhang et al, 2006; Mestek et al, 2008; Melton et al, 2009; Black et al, 2010; van Dijk et al, 2012)
- One neutral-quality case-control study (Casella-Filho et al, 2011)

In Adults with Metabolic Syndrome

- Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):
  - While limited research reports that low intensity physical activity, independent of weight loss and dietary change, has no significant impact on fasting glucose levels in adults with metabolic syndrome, limited research on moderate-intensity physical activity reports mixed results on fasting glucose levels.
  - In addition, while one feeding study reports that physical activity significantly decreases post-prandial glucose levels, both intervention and feeding studies report mixed results on post-prandial glucose levels.

References


Wolever TM, Mehling C. Long-term effect of varying the source or amount of dietary carbohydrate on post-prandial plasma glucose, insulin, triacylglycerol and free fatty acid concentrations in subjects with impaired glucose tolerance. Am J Clin Nutr. 2003; 77: 612-618.


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


Diabetes Prevention

Prevention of Type 2 Diabetes (PDM Guideline (2014))
In individuals with prediabetes, what is the impact of physical activity, independent of weight loss and dietary change, on lipid outcomes (TG, HDL)?

Blood pressure outcomes:
- Limited research reports no significant impact of physical activity on blood pressure levels in individuals with prediabetes.
- Additional longer-term intervention studies are needed to ascertain an effect of physical activity on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.

Lipid outcomes (TG, HDL):
- Limited research reports mixed results regarding the impact of physical activity on lipid levels in individuals with prediabetes.
- Additional longer-term intervention studies are needed to ascertain an effect of physical activity on lipid outcomes in adults with metabolic syndrome without meeting the metabolic syndrome criteria for lipid levels.

In Individuals with Prediabetes

**Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):**
- Most studies report that moderate intensity physical activity, independent of weight loss and dietary change, has no significant impact on fasting blood glucose levels in individuals with prediabetes.
- In addition, limited research reports mixed results regarding the impact of moderate-intensity physical activity on two-hour post-prandial blood glucose levels.

**Lipid outcomes (TG, HDL):**
- Limited research reports mixed results regarding the impact of moderate-intensity physical activity, independent of weight loss and dietary change, on triglyceride levels in individuals with prediabetes.
- Intervention studies reported no significant impact of moderate intensity physical activity on HDL cholesterol levels.
- Additional longer-term intervention studies are needed to ascertain an effect of physical activity on lipid outcomes in individuals with prediabetes.
- Evidence is based on the following: Yates et al, 2009; Melton et al, 2009; Desch et al, 2010.

**Anthropometric outcomes (WC, WHR):**
- Limited research reports that moderate intensity physical activity, independent of weight loss and dietary change, has no significant impact on waist circumference in adults with metabolic syndrome.
- Additional longer-term intervention studies are needed to ascertain an effect of physical activity on anthropometric outcomes in individuals with prediabetes.
- Evidence is based on the following: Yates et al, 2009; Desch et al, 2010.

**Blood pressure outcomes:**
- Limited research reports that low intensity or short duration physical activity, independent of weight loss and dietary change, has no significant impact on systolic blood pressure by 6 mm Hg and diastolic blood pressure by 3 mm Hg.
- Additional longer-term intervention studies are needed to ascertain an effect of physical activity on blood pressure in adults with metabolic syndrome with or without meeting the metabolic syndrome criteria for blood pressure.

**Recommendation Strength Rationale**

For Adults with Metabolic Syndrome

- **Grade III** evidence is available for the conclusion statements regarding the impact of physical activity, independent of weight loss and diet change, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL)
  - Anthropometric measures (WC, WHR)
  - Blood pressure.
- **Grade V** evidence is available for the conclusion statement regarding the impact of physical activity, independent of weight loss and diet change, on the following outcomes: Renal outcomes.

For Individuals with Prediabetes

- **Grade II** evidence is available for the conclusion statements regarding the impact of physical activity, independent of weight loss and diet change, on the following outcomes:
  - Glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)
  - Lipid (TG, HDL).
- **Grade III** evidence is available for the conclusion statements regarding the impact of physical activity, independent of weight loss and diet change, on the following outcomes:
  - Anthropometric measures (WC, WHR)
  - Blood pressure.

**Minority Opinions**

Consensus reached.

**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].

In individuals with prediabetes, what is the impact of physical activity, independent of weight loss and dietary change, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, 2-hour post-prandial blood glucose, A1C)?

In individuals with prediabetes, what is the impact of physical activity, independent of weight loss and dietary change, on lipid outcomes (TG, HDL)?
In individuals with prediabetes, what is the impact of physical activity, independent of weight loss and dietary change, on anthropometric outcomes (WC, WHR)?

In adults with metabolic syndrome, what is the impact of physical activity, independent of weight loss and dietary change, on blood pressure?

In adults with metabolic syndrome, what is the impact of physical activity, independent of weight loss and dietary change, on glycemic-related outcomes (such as fasting blood glucose, random blood glucose, two-hour post-prandial blood glucose, A1C)?

In adults with metabolic syndrome, what is the impact of physical activity, independent of weight loss and dietary change, on lipid outcomes (TG, HDL)?

In adults with metabolic syndrome, what is the impact of physical activity, independent of weight loss and dietary change, on renal outcomes?

In adults with metabolic syndrome, what is the impact of physical activity, independent of weight loss and dietary change, on blood pressure?

In adults with metabolic syndrome, what is the impact of physical activity, independent of weight loss and dietary change, on renal outcomes?

References


Camhi SM, Stefanick ML, Katmarzyk PT, Young DR. Metabolic syndrome and changes in body fat from a low-fat diet and/or exercise randomized controlled trial. Obesity (Silver Spring). 2010; 18(3):548-554.


Diabetes Prevention
Prevention of Type 2 Diabetes (PDM Guideline 2014)

Recommendations Summary
PDM: Nutrition-Related Effects of Medications 2014

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)

PDM: Nutrition-Related Effects of Medications

For individuals at high risk for type 2 diabetes who have been prescribed medications, the registered dietitian nutritionist (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.

Rating: Strong
Conditional

Risks/Harms of Implementing This Recommendation
None.

Conditions of Application
This recommendation applies to individuals at high risk for type 2 diabetes who have been prescribed medications.

Potential Costs Associated with Application
The costs of medical nutrition therapy (MNT).

Recommendation Narrative
From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010 (page S21)

- In persons with IGT, metformin and acarbose can be used as second line strategies for prevention of T2D, provided that the drugs are tolerated (gastrointestinal side effects) and contraindications to metformin therapy (kidney, liver diseases, hypoxic conditions) are considered. (Grade A)
- In obese people with or without IGT, carefully monitored anti-obesity treatment with orlistat, in addition to intensive lifestyle modification, can be used as a second-line...
strategy for obese patients to prevent T2D (Grade A)
- Glucose-lowering drugs such as glitazones or thiazolidinediones may reduce the risk of T2D in certain high-risk groups, but either long-term efficacy or safety are unclear so that these drugs cannot be recommended for diabetes prevention at present (Grade C).

- **Recommendation Strength Rationale**

**From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010**

- The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited
- Evidence in support of the recommendation was grades A and C.

- **Minority Opinions**

  Consensus reached.

- **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**


- **Diabetes Prevention**
- **Prevention of Type 2 Diabetes (PDM Guideline 2014)**

**Quick Links**

**Recommendations Summary**

**PDM: Nutrition Counseling 2014**

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

- **Recommendation(s)**

**PDM: Nutrition Counseling**

The registered dietitian nutritionist (PDM) 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.

**Rating:** Strong

**Impetative**

- **Risks/Harms of Implementing This Recommendation**

  None.

- **Conditions of Application**

  - The RDN should incorporate behavior change techniques that are appropriate to age, culture, setting and so forth
  - The RDN may maximize their effectiveness by gaining additional training and experience in counseling strategies to impact behavior change.
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 reward and reinforcement (contingency management), used as a component of a behavioral intervention, will result in health/food 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 consensus will not have supporting evidence linked).

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).

The costs of medical nutrition therapy (MNT).

Recommendation Narrative
From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010 (page S23)

- Individual level interventions for people at risk of T2DM should:
  - Aim to promote changes in both diet and physical activity (Grade A)
  - Use established, well-defined behavior change techniques (e.g., specific goal setting, relapse prevention, self-monitoring, motivational interviewing, prompting self-talk, prompting practice, individual tailoring, time management) (Grade A)
  - Work with participants to engage social support for the planned behavior change (i.e., engage important others such as family, friends and colleagues) (Grade A)
  - Maximize the frequency or number of contacts with participants (within the resources available) (Grade B)
  - Include a strong focus on maintenance. It is not clear how best to achieve this, but behavior change techniques designed to address maintenance include establishing self-monitoring of progress, providing feedback (e.g., on changes achieved in blood glucose and other risk factors), reviewing of goals, engaging social support, use of relapse prevention, relapse management techniques and providing follow-up prompts (Grade A)
  - Building on a coherent set of self-regulatory intervention techniques (specific goal setting; prompting self-monitoring; providing feedback on performance; review of behavioral goals) may provide a good starting point for intervention design. However, this is by no means the only approach available and it is worth noting that self-regulation techniques are not normally used in isolation (e.g., techniques designed to explore and enhance initial motivation would normally be applied prior to goal setting) (Grade C).

From the Academy of Nutrition and Dietetics Evidence Analysis Library on Nutrition Counseling, 2007:

- Three RCTs, two positive-quality and one neutral-quality, provide evidence that self-monitoring of food intake improves nutrition-related outcomes related to weight loss (Bouteille et al, 1999; Tate et al, 2003) and compliance with renal diets (Mias et al, 2002). Three observational studies of neutral quality revealed that clients enrolled in cognitive-behavioral weight-loss programs that were successful in losing weight were significantly more consistent with self-monitoring (Baker et al, 1998; Mattfeldt-Beman et al, 1999; Streit et al, 1991) (Grade I).
- Four RCTs, three positive-quality and one neutral-quality, 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 found the use of various types of meal replacements or structured meal plans helpful in achieving health and food behavior change in middle-aged adults (Wing et al, 1996; Metz et al, 1997; Ditschuneit et al, 1999; Flechter-Mors et al, 2000; Ashley et al, 2001; Ditschuneit and Flechter-Mors, 2001). Additional research is needed to determine if benefits derived from temporary use of these behavioral strategies can be sustained over time (Grade I).
- Two positive-quality (one RCT and one meta-analysis) and one neutral-quality RCT found monetary rewards or reinforcement had no treatment effect (Jeffery and Wing, 1995; Fuller et al, 1998; Paul-Ebbohoinmen and Avenell, 2007) (Grade I)
- Two positive-quality RCTs, one in overweight and obese women and the other in post-menopausal women with diabetes, utilized interventions that incorporated problem-solving strategies (Pern et al, 2001, Glasgow et al, 2004). 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 (Grade II).
- One highly intense lifestyle change study found social support was helpful and four traditional lifestyle change programs did not find it helpful (Wing et al, 1991; Wing et al, 1999; Barrera et al, 2002; Barren et al, 2006; Toolis et al, 2007). The definition of social support has evolved to include multiple dimensions of social support measured pre- and post-treatment. Two RCTs conducted in the 1990s manipulated social support and found no significant treatment effect. In an RCT published in 2006, 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 HgA1C change. Additional studies are needed to measure impact of social support interventions on outcomes (Grade II).
- 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 (Caik et al, 2004). 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 (Berry et al, 1989). 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 (Estabrook et al, 2005). 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 (Grade II).
- One neutral-quality RCT 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 no significant 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 (DeLucia and Kalodner, 1990). Additional research is needed on the isolated effect of cognitive restructuring and a behavioral intervention on nutrition-related outcomes (Grade III).
- Two studies (one positive- and one neutral-quality) employed motivational interviewing as the sole style of intervention with little added effect, compared to standard therapy. Further research is warranted with larger sample sizes, longer follow-up periods and measurement of readiness to change diet behaviors (Grade III).
- Four RCTs of positive quality assessed the effect of motivational interviewing as an added component to cognitive-behavioral programs (three studies, Smith et al, 1997; Bowen et al, 2002; West et al, 2007) or a self-help intervention (one study, Resnicow et al, 2001) and found motivational interviewing significantly enhanced adherence to program recommendations and improved targeted diet-related outcomes including glycemic control, percentage of energy intake from fat, fruit and vegetable intake and weight-loss (Grade I).

Recommendation Strength Rationale
- From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010:
  - The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited in the consensus will not have supporting evidence linked).
  - The Academy of Nutrition and Dietetics Evidence Analysis Library on Nutrition Counseling, 2007:
    - The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited in the consensus will not have supporting evidence linked).

Minority Opinions
Consensus reached.

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 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 or food behavior change in adults counseled in an outpatient or 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 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 Motivational Interviewing alone results in health/food behavior change in adults counseled in an outpatient or 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 or clinic setting?

References

- **Weight control during the holidays**: Highly consistent self-monitoring as a potentially useful coping mechanism. *Health Psychol* 1998;17(4):367-370.


- Fuller PR, Penik MG, Lemmaken EA, Guyer LK. Effects of a personalized system of skill acquisition and an educational program in the treatment of obesity. *Addict Behav* 1998; 23: 97-100.


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


- **Diabetes Prevention**
- **Prevention of Type 2 Diabetes (PDM Guideline 2014)**

**Recommendations Summary**

**PDM: Coordination of Care 2014**

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

**Recommendation(s)**

**PDM: Coordination of Care**

For individuals who are at high risk for type 2 diabetes, the registered dietitian nutritionist (RDN) should implement medical nutrition therapy (MNT) and coordinate care with a multidisciplinary 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.

**Rating:** Strong

**Impressive**

- **Risks/Harms of Implementing This Recommendation**
  - None.

- **Conditions of Application**
  - A multidisciplinary team may consist of, but not be limited to, the following:
    - Community health workers
    - Doctors
    - Exercise specialists
    - Nurses
    - Pharmacists
    - Psychiatrists
    - Psychologists
    - Social service professionals
    - Social workers.

- **Potential Costs Associated with Application**
  - The costs of medical nutrition therapy (MNT).

- **Recommendation Narrative**
  - From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010:
    - **Interventions to prevent T2DM may be delivered by a wide range of people and professions, subject to appropriate training (including the use of established behavior change techniques).** There are examples of successful physical activity and dietary interventions delivered by doctors, nurses, dietitians and nutritionists, exercise specialists and lay people, often working within a multidisciplinary team (Grade A).**
    - **Interventions to prevent T2DM may be delivered in a wide range of settings.** There are examples of successful physical activity and dietary interventions delivered in health care settings, the workplace, the home and in the community (Grade A).
    - **Participate with patients to engage social support for the planned behavior change (engage important others such as family, friends and colleagues, for example) (Grade A).**
    - **Maximize the frequency or number of contacts with participants (within the resources available) (Grade B).**
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


### Diabetes Prevention

#### Prevention of Type 2 Diabetes (PDM) Guideline (2014)

**Recommendations Summary**

**PDM: Monitoring and Evaluation in High-Risk Groups 2014**

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, see the hyperlinks in the Supporting Evidence Section below.

- **Recommendation(s)**
  - PDM: Monitoring and Evaluation in High-Risk Groups
    - The registered dietitian nutritionist (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)
      - Cardiovascular risk factors (lipid profile and blood pressure)
      - Physical activity
      - Medications and supplements
      - Dietary factors
    - These factors allow the RDN to evaluate the effectiveness of medical nutrition therapy (MNT) for the prevention of type 2 diabetes in high-risk groups.

**Rating: Consensus**

**Imperative**

- **Risks/Hazards of Implementing This Recommendation**
  - None.

- **Conditions of Application**
  - Data on these factors may not be available.

- **Potential Costs Associated with Application**
  - The costs of medical nutrition therapy (MNT).

- **Recommendation Narrative**
  - From Prevention/Delay of Type 2 Diabetes Recommendations from the American Diabetes Association Standards of Medical Care, 2014
    - Patients with IGT (A), IFG (E), or an A1C of 5.7% to 6.4% (E) should be referred for an effective ongoing support program targeting weight loss of 7% of body weight and increasing physical activity to at least 150 minutes per week of moderate activity such as walking.
    - Follow-up counseling appears to be important for success (B).
    - Based on the cost-effectiveness of diabetes prevention, such programs should be covered by third-party payers (B).
    - Metformin therapy for prevention of type 2 diabetes may be considered in those with IGT (A), IFG (E) or A1C of 5.7% to 6.4% (E), especially for those with more than 35% body fat, aged less than 60 years and women with prior GDM (A).
    - At least annual monitoring for the development of diabetes in those with prediabetes is suggested (E).
    - Screening for and treatment of modifiable risk factors for CVD is suggested (B).
From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010

- Overweight and obesity:
  - Reversal of obesity also decreases the risk for T2D (A) and improves glycemic control in patients with established diabetes (A)
  - A strong curvilinear relationship between BMI and the risk for T2D was found in women in the Nurses' Health Study (B)
  - However, studies trying to discern the relative importance of waist circumstance (or waist-to-hip ratio) compared to BMI regarding risk for T2D development have not shown a major advantage of one over the other (A)
- Physical inactivity: The benefit of physical activity in preventing diabetes has been demonstrated in several studies (A)
- Impaired fasting glucose (IFG) or impaired glucose tolerance (IGT):
  - The prevalence of IFG and IGT varies considerably among different ethnic groups and increases with age (B)
  - The reported estimates of diabetes development in IFG and IGT individuals vary widely, depending on the ethnicity of the population studied, with a higher incidence of T2D noted in non-Caucasian populations (B)
  - Two recent meta-analyses found no evidence of a difference in T2D risk among people with either IGT, IFG, IGT or IFG, but both concluded that individuals with IFG + IGT have a substantially increased risk of T2D compared to all other groups (B)
  - However, studies of shorter duration have shown that during a period of three to five years about 25% of individuals progress to diabetes, 25% return to a normal glucose tolerance status and 50% remain in the prediabetic state. (B)
- Dietary factors, such as low fiber intake, low unsaturated saturated fat ratio, and other nutrients:
  - It has been shown that a dietary pattern promoting weight loss reduces the risk of T2D (A)
  - Individuals with low intake of dietary fiber, particularly of insoluble cereal fiber, have been found to be at increased risk for T2D in several epidemiologic studies (B)
  - Nevertheless, a recent meta-analysis of 37 prospective cohort studies showed, in fully adjusted models, that both high glycomic load and high glycomic index diets are associated with increased risk for T2D (B)
  - Shifting from a diet based on animal fat to a diet rich in vegetable fat might reduce the risk for T2D (B)
  - An increased intake of monounsaturated fat appears to be of particular benefit (C)
  - The consumption of trans fatty acids has consistently been found to be associated with increased risk for T2D and CVD (A)
  - A less consistent but still significant body of evidence suggests that the risk for T2D is lowered by regular consumption of moderate amounts of alcohol (B), fruits and vegetables (B), nuts (B) and coffee (B).

**Recommendation Strength Rationale**

From Prevention/Delay of Type 2 Diabetes Recommendations from the American Diabetes Association Standards of Medical Care, 2014

- The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited
- Evidence in support of the recommendation was grades A, B and E.

From Project IMAGE European Evidence-Based Guideline for the Prevention of Type 2 Diabetes, 2010

- The Academy of Nutrition and Dietetics Prevention of Type 2 Diabetes Work Group concurs with the references cited
- Evidence in support of the recommendation was grades A, B and C.

**Minority Opinions**

Consensus reached.

**Supporting Evidence**

The recommendations were created from the evidence analyses 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 Dietscites Evidence Analysis Process


