

- [Diabetes Prevention](#)
- [Prevention of Type 2 Diabetes \(PDM\) Guideline \(2014\)](#)

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](#)

- [Diabetes Prevention](#)
- [Prevention of Type 2 Diabetes \(PDM\) Guideline \(2014\)](#)

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
- Screening will identify more individuals that need medical nutrition therapy (MNT)
- The cost of appropriate actions, including MNT and ongoing support.

- [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 25kg/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, they will 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](#)

American Diabetes Association. Standards of medical care in diabetes: 2014. *Diabetes Care*. 2014; 37 Suppl 1: S14-S80.

Lindström J, Neumann A, Sheppard KE, Gillis-Januszewska A, Greaves CJ, Handke U, Pajunen P, Puhl S, Pölönen A, Rissanen A, Roden M, Stemper T, Telle-Hjellset V, Tuomilehto J, Velickiene D, Schwarz PE, Acosta T, Adler M, AlKenwi A, Barengo N, Barengo R, Boavida JM, Charlesworth K, Christov V, Claussen B, Cos X, Cosson E, Deceukelier S, Dimitrijevic-Sreckovic V, Djordjevic P, Evans P, Felton AM, Fischer M, Gabriel-Sanchez R, Gillis-Januszewska A, Goldfracht M, Gomez JL, Greaves CJ, Hall M, Handke U, Hauner H, Herbst J, Hermanns N, Herrebrugh L, Huber C, Hühmer U, Huttunen J, Jotic A, Kamenov Z, Karadeniz S, Katsilambros N, Khalangot M, Kissimova-Skarbek K, Köhler D, Kopp V, Kronsbein P, Kulzer B, Kyne-Grzebalski D, Lalic K, Lalic N, Landgraf R, Lee-Barkey YH, Liatis S, Lindström J, Makriakakis K, McIntosh C, McKee M, Mesquita AC, Misina D, Muylle F, Neumann A, Paiva AC, Pajunen P, Paulweber B, Peltonen M, Perrenoud L, Pfeiffer A, Pölönen A, Puhl S, Raposo F, Reinehr T, Rissanen A, Robinson C, Roden M, Rothe U,

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Pajunen P, Landgraf R, Muylle F, Neumann A, Lindström J, Schwarz PE, Peltonen M, Acosta T, Adler M, Alkerwi A, Barengo N, Barengo R, Boavida JM, Charlesworth K, Christov V, Claussen B, Cos X, Cosson E, Deceukelier S, Dimitrijevic-Sreckovic V, Djordjevic P, Evans P, Felton AM, Fischer M, Gabriel-Sanchez R, Gilis-Januszewska A, Goldfracht M, Gomez JL, Greaves CJ, Hall M, Handke U, Hauner H, Herbst J, Hermanns N, Herbergh L, Huber C, Hühmer U, Huttunen J, Jotic A, Kamenov Z, Karadeniz S, Katsilambros N, Khalangot M, Kissimova-Skarbek K, Köhler D, Kopp V, Kronsbein P, Kulzer B, Kyne-Grzebalski D, Lalic K, Lalic N, Landgraf R, Lee-Barkey YH, Liatis S, Lindström J, Makrilakis K, McIntosh C, McKee M, Mesquita AC, Misina D, Muylle F, Neumann A, Paiva AC, Pajunen P, Paulweber B, Peltonen M, Perrenoud L, Pfeiffer A, Pölonen A, Puhl S, Raposo F, Reinehr T, Rissanen A, Robinson C, Roden M, Rothe U, Saaristo T, Scholl J, Schwarz PE, Sheppard KE, Spiers S, Stemper T, Stratmann B, Szendroedi J, Szybinski Z, Tankova T, Telle-Hjelset V, Terry G, Tolks D, Toti F, Tuomilehto J, Undeutsch A, Valadas C, Valensi P, Velickiene D, Vermunt P, Weiss R, Wens J, Yilmaz T. Quality indicators for the prevention of type 2 diabetes in Europe: IMAGE. *Horm Metab Res.* 2010 Apr; 42 Suppl 1: S56-S63.

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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](#))
 - [CVD](#) risk factors (lipid profile and [blood pressure](#))
 - [Physical activity](#)
 - Medications and supplements
 - Dietary factors
 - History of depression
 - Obesigenic/diabetogenic environment
 - Socio-economic status ([SES](#)).
- These factors allow the RDN to determine the appropriate interventions to prevent type 2 diabetes.

Rating: Consensus

Imperative

- [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 35kg/m², 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 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, i-IGT or i-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 glycemic load and high glycemic 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).
- 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)
- Obesigenic/diabetogenic 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 and poverty has 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
- 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](#)

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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

- o In adults with metabolic syndrome, research regarding a weight loss achieved via lifestyle modification over at least a three-month period ranging from 1.1 kg to 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.
- o 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 5.9cm
 - Decreased systolic blood pressure 3.5mm Hg to 6mm Hg and diastolic blood pressure by 5mm Hg.
- o 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 1.9mg per dL (0.05mmol per L)
 - Decreased systolic blood pressure by 6mm Hg.

Rating: Strong

Conditional

- o 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.
- o 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>;
 - Vegetarian Nutrition Evidence-Based Nutrition Practice Guideline: <http://andevidencelibrary.com/topic.cfm?cat=4021>.
- o Potential Costs Associated with Application

The costs of medical nutrition therapy (MNT).
- o Recommendation Narrative

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

- Twelve positive-quality randomized controlled trials (RCT) (Lee et al, 2009; Al-Sarraj et al, 2010; Klemsdal et al, 2010; Straznicki et al, 2010; Busnelo et al, 2011; Christian et al, 2011; Gagnon et al, 2011; Lu et al, 2011; Munakata et al, 2011; Sakane et al, 2011; Straznicki et al, 2011; Straznicki et al, 2012)
- Nine neutral-quality randomized controlled trials (RCT) (Chan et al, 2008; Burtscher et al, 2009; Ng et al, 2009; Yassine et al, 2009; Mujica et al, 2010; Oh et al, 2010; Parikh et al, 2010; Katula et al, 2011; Seligman et al, 2011)
- Two positive-quality cohort studies (Caiazzo et al, 2010; de la Cruz-Munoz et al, 2011)
- Two neutral-quality cohort studies (Allen et al, 2008; Bihan et al, 2009)
- One neutral-quality case-control study (Aizawa 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 (Orozco 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: Chan et al, 2008; Aizawa et al, 2009; Bihan et al, 2009; Cicero et al, 2009; Kim et al, 2009; Lee et al, 2009; Ng et al, 2009; Yassine et al, 2009; Evangelou et al, 2010; Mujica et al, 2010; Oh et al, 2010; Straznicki et al, 2010; Busnelo et al, 2011; Christian et al, 2011; Munakata et al, 2011; Straznicki et al, 2011; Straznicki et al, 2012.
- Lipid outcomes (TG, HDL):
 - The majority of research reported that a weight loss ranging from 1.1 kg 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
 - Evidence is based on the following: Chan et al, 2008; Aizawa et al, 2009; Bihan et al, 2009; Cicero et al, 2009; Kim et al, 2009; Lee et al, 2009; Ng et al, 2009; Yassine et al, 2009; Al Sarraj et al, 2010; Evangelou et al, 2010; Mujica et al, 2010; Oh et al, 2010; Straznicki et al, 2010; Busnelo et al, 2011; Christian et al, 2011; Munakata et al, 2011; Straznicki et al, 2011; Straznicki et al, 2012.
- Anthropometric outcomes (WC, WHR):
 - Research reports that a weight loss ranging from 1.1 kg to 13kg significantly reduced waist circumference by 1.5cm to 11cm in adults with metabolic syndrome
 - However, most studies reported no significant impact of weight loss on waist-to-hip ratio in adults with metabolic syndrome
 - Evidence is based on the following: Chan et al, 2008; Aizawa et al, 2009; Bihan et al, 2009; Kim et al, 2009; Lee et al, 2009; Ng et al, 2009; Yassine et al, 2009; Evangelou et al, 2010; Klemsdal et al, 2010; Mujica et al, 2010; Oh et al, 2010; Straznicki et al, 2010; Busnelo et al, 2011; Christian et al, 2011; Munakata et al, 2011; Seligman et al, 2011; Straznicki et al, 2011; Straznicki et al, 2012.
- 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
 - Evidence is based on the following: Chan et al, 2008; Aizawa et al, 2009; Bihan et al, 2009; Kim et al, 2009; Yassine et al, 2009; Evangelou et al, 2010; Mujica et al, 2010; Oh et al, 2010; Straznicki et al, 2010; Christian et al, 2011; Munakata et al, 2011; Straznicki et al, 2011; Straznicki et al, 2012.
- 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 urinary albumin excretion rate or albumin:creatinine ratio
 - Evidence is based on the following: Seligman et al, 2011; Straznicki 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

- Of those studies reporting a weight loss ranging from 2.6kg to 7.1kg, there was a significant reduction in fasting blood glucose levels by 2.2mg to 9.2mg per dL (0.12mmol to 0.5mmol per L)
 - In bariatric surgery intervention studies, a weight loss of up to 47kg or 41% of excess **BMI** over a period of three to five years significantly reduced fasting glucose levels by 16.2mg to 20.9mg per dL (0.9mmol to 1.16mmol per L), two-hour glucose levels by 16mg per dL (0.9mmol per L) and A1C by 0.5%
 - 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
 - Evidence is based on the following: Allen et al, 2008; Orozco et al, 2008; Burtcher et al, 2009; Caiazzo et al, 2010; Parikh et al, 2010; de la Cruz-Munoz et al, 2011; Gagnon et al, 2011; Katula et al, 2011; Lu et al, 2011, Sakane et al, 2011.
 - 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
 - Evidence is based on the following: Allen et al, 2008; Orozco et al, 2008; Burtcher et al, 2009; Caiazzo et al, 2010; Gagnon et al, 2011; Lu et al, 2011, Sakane et al, 2011.
 - 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
 - Evidence is based on the following: Allen et al, 2008; Orozco et al, 2008; Parikh et al, 2010; Gagnon et al, 2011; Katula et al, 2011; Lu et al, 2011, Sakane et al, 2011.
 - 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
 - Evidence is based on the following: Allen et al, 2008; Orozco et al, 2008; Burtcher et al, 2009; Caiazzo et al, 2010; Parikh et al, 2010; Gagnon et al, 2011; Lu et al, 2011, Sakane et al, 2011.

o [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).

o [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 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?](#)

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- [Diabetes Prevention](#)
- [Prevention of Type 2 Diabetes \(PDM\) Guideline \(2014\)](#)

Quick Links

Recommendations Summary

PDM: 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.

- [Recommendation\(s\)](#)

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
Imperative

- [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; Muzio et al, 2007; Paniagua et al, 2011; and Tierney et al, 2011)
- Two neutral quality RCTs (Sarkkinen et al, 1996; Wolever and Mehling, 2003)
- One positive quality cluster randomized trial (Zhang et al, 2011)
- Three neutral quality randomized crossover trials (Melton et al, 2009; Khoury et al, 2010; Konig et al, 2012)
- One 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 insulinemia
 - 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
 - Evidence is based on the following: Azadbakht et al, 2005; Khoury et al, 2010; Konig et al, 2012; Lee et al, 2009; Muzio et al, 2007; Paniagua et al, 2011; Tierney et al, 2011; Zhang et al, 2011.
- 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
 - Evidence is based on the following: Azadbakht et al, 2005; Camhi et al, 2010; Khoury et al, 2010; Kolovou et al, 2006; Lee et al, 2009; Muzio et al, 2007; Paniagua et al 2011; Tierney et al, 2011; Zhang et al, 2011.
- 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; Muzio et al, 2007; Paniagua et al, 2011; Tierney 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; 48% 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; Muzio et al, 2007; Paniagua et al, 2011; Tierney 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; McLaughlin et al, 2006; Melton et al, 2009; Sarkkinen et al, 1996; Wolever and Mehling, 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: McLaughlin et al, 2006; Melton et al, 2009; Sarkkinen et al, 1996; Wolever and Mehling, 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: McLaughlin 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 outcomes ([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](#))
 - Lipid ([TG](#), [HDL](#)).
- Grade III evidence is available for the conclusion statements regarding the impact macronutrient distribution, 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 linked).

[In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on glycemic-related outcomes \(such as fasting blood glucose, random blood glucose, 2-hour postprandial blood glucose, A1C\)?](#)

[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 blood pressure?](#)

[In adults with metabolic syndrome, what is the impact of macronutrient distribution, independent of weight loss, on renal outcomes?](#)

[In individuals with prediabetes, 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 individuals with prediabetes, what is the impact of macronutrient distribution, independent of weight loss, on lipid outcomes \(TG, HDL\)?](#)

[In individuals with prediabetes, what is the impact of macronutrient distribution, independent of weight loss, on anthropometric outcomes \(WC, WHR\)?](#)

[In individuals with prediabetes, what is the impact of macronutrient distribution, independent of weight loss, on blood pressure?](#)

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- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

Dietary Reference Intakes. Available at the Institutes of Medicine [website](#) at <http://www.iom.edu/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx>.

- [Diabetes Prevention](#)
- [Prevention of Type 2 Diabetes \(PDM\) Guideline \(2014\)](#)

Quick Links

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.

- [Recommendation\(s\)](#)

PDM: Fiber 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 **fiber** at the level recommended by the USDA Dietary Guidelines (14g per 1,000kcal). Limited research regarding fiber intake, independent of weight loss, reported no significant impact on outcomes in **adults** with **metabolic syndrome** or individuals with **prediabetes**. However, a high-fiber diet can help reduce body weight and therefore reduce the risk of type 2 diabetes.

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 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) (Wien 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 post-prandial 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 the 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
 - 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 post-prandial 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
 - 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 an 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):
 - Limited research reports no significant impact of total fiber intake, independent of weight loss, on fasting blood glucose, two-hour post-prandial blood glucose or A1C in individuals with [prediabetes](#)
 - Additional intervention studies are needed to ascertain the effect of total fiber intake on glycemic-related outcomes in individuals with prediabetes
 - Evidence is based on the following: Wien et al, 2010; Lankinen et al, 2011.
 - 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.
 - 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.
 - 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.
 - 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.

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 B) .

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).

o [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](#)).
 - Grade V evidence is available for the conclusion statements regarding the impact of total fiber intake, independent of weight loss, on the following outcomes:
 - Anthropometric measures ([WC](#), [WHR](#))
 - [Blood pressure](#)
 - Renal measures.
 - 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:
 - Anthropometric measures ([WC](#), [WHR](#))
 - Blood pressure
 - Renal measures.

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](#))
 - Anthropometric 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](#))
 - Anthropometric measures ([WC](#), [WHR](#))
 - Blood pressure.

From Primary Prevention 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 grade B.

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 B 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).

[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 individuals with prediabetes, 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 total fiber intake, independent of weight loss, on anthropometric outcomes \(WC\)?](#)

[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 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 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 anthropometric outcomes \(WC\)?](#)

[In individuals with prediabetes, 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 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 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 anthropometric outcomes \(WC\)?](#)

[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 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 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 anthropometric outcomes \(WC\)?](#)

[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 renal outcomes?](#)

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Januszewska A, Lalic K, Jotic A, Djordjevic P, Dimitrijevic-Sreckovic V, Hühmer U, Kulzer B, Puhl S, Lee-Barkey YH, AlKerwi A, Abraham C, Hardeman W, on behalf of the IMAGE Study Group: Acosta T, Adler M, AlKerwi A, Barengo N, Barengo R, Boavida JM, Charlesworth K, Christov V, Claussen B, Cos X, Cosson E, Deceukelier S, Dimitrijevic-Sreckovic V, Djordjevic P, Evans P, Felton AM, Fischer M, Gabriel-Sanchez R, Gillis-Januszewska A, Goldfracht M, Gomez JL, Greaves CJ, Hall M, Handke U, Hauner H, Herbst J, Hermanns N, Herrebrough L, Huber C, Hühmer U, Huttunen J, Jotic A, Kamenov Z, Karadeniz S, Katsilambros N, Khalangot M, Kissimova-Skarbek K, Köhler D, Kopp V, Kronsbein P, Kulzer B, Kyne-Grzebalski D, Lalic K, Lalic N, Landgraf R, Lee-Barkey YH, Liatis S, Lindström J, Makrilakis K, McIntosh C, McKee M, Mesquita AC, Misina D, Muylle F, Neumann A, Paiva AC, Pajunen P, Paulweber B, Peltonen B, Perrenoud L, Pfeiffer A, Pölonen A, Puhl S, Raposo F, Reinehr T, Rissanen A, Robinson C, Roden M, Rothe U, Saaristo T, Scholl J, Schwarz PE, Sheppard KE, Spiers S, Stemper T, Stratmann B, Szendroedi J, Szybinski Z, Tankova T, Telle-Hjellset V, Terry G, Tolks D, Toti F, Tuomilehto J, Undeutsch A, Valadas C, Valensi P, Velickiene D, Vermunt P, Weiss R, Wens J, Yilmaz T. A European evidence-based guideline for the prevention of type 2 diabetes. *Horm Metab Res.* 2010 Apr; 42 Suppl 1: S3-S36.

- [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 (RD_N) 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
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 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 [triglyceride](#) 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 the 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 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.

- Anthropometric outcomes (WC, WHR):
 - There were no studies identified to evaluate the impact of whole or refined grains, independent of weight loss, on anthropometric outcomes in individuals with prediabetes
 - Intervention studies are needed to ascertain the effect of whole or refined grains on anthropometric outcomes in individuals with prediabetes.
- Blood pressure outcomes:
 - There were no studies identified to evaluate the impact of whole or refined grains, independent of weight loss, on blood pressure in individuals with prediabetes
 - Intervention studies are needed to ascertain the effect of whole or refined grains on blood pressure in individuals with prediabetes.

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 B).

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, particularly 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).

o [Recommendation Strength Rationale](#)

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.

From Primary Prevention 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 grade B.

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 B and C.

o [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 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 individuals with prediabetes, 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 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 lipid outcomes \(TG, HDL\)?](#)

[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?](#)

o [References](#)

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- [Diabetes Prevention](#)
- [Prevention of Type 2 Diabetes \(PDM\) Guideline \(2014\)](#)

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](#)
 - Intervention studies are needed to ascertain the effects 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
 - Intervention studies are needed to ascertain the effects of vegetable-based protein versus 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 an 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 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 vegetable-based protein vs. animal-based protein on glycemic-related outcomes in individuals with [prediabetes](#)
 - Intervention studies are needed to ascertain the effects of vegetable-based protein vs. animal-based protein on glycemic outcomes in individuals with prediabetes.
- 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 individuals with prediabetes
 - Intervention studies are needed to ascertain the effects of vegetable-based protein vs. animal-based protein on lipid outcomes in individuals with prediabetes.
- 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 individuals with prediabetes
 - Intervention studies are needed to ascertain the effects of vegetable-based protein vs. animal-based protein on anthropometric outcomes in individuals with prediabetes.
- [Blood pressure](#) outcomes:
 - There were no studies identified to evaluate the impact of vegetable-based protein vs. animal-based protein on blood pressure in individuals with prediabetes
 - Intervention studies are needed to ascertain the effects of vegetable-based protein vs. animal-based protein on blood pressure in individuals with prediabetes.

- [Recommendation Strength Rationale](#)

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.

- [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 vegetable-based protein vs. animal-based protein, 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 vegetable-based protein vs. animal-based protein, independent of weight loss, on lipid outcomes \(TG, HDL\)?](#)

[In adults with metabolic syndrome, what is the impact of vegetable-based protein vs. animal-based protein, independent of weight loss, on anthropometric outcomes \(WC, WHR\)?](#)

[In adults with metabolic syndrome, what is the impact of vegetable-based protein vs. animal-based protein, independent of weight loss, on blood pressure?](#)

[In adults with metabolic syndrome, what is the impact of vegetable-based protein vs. animal-based protein, independent of weight loss, on renal outcomes?](#)

[In individuals with prediabetes, what is the impact of vegetable-based protein vs. animal-based protein, 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 vegetable-based protein vs. animal-based protein, independent of weight loss, on lipid outcomes \(TG, HDL\)?](#)

[In individuals with prediabetes, what is the impact of vegetable-based protein vs. animal-based protein, independent of weight loss, on anthropometric outcomes \(WC, WHR\)?](#)

[In individuals with prediabetes, what is the impact of vegetable-based protein vs. animal-based protein, independent of weight loss, on blood pressure?](#)

- [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 positive-quality randomized controlled trials (RCT) (Lindstrom et al, 2006; Muzio et al, 2007; Gulseth et al, 2010; Hartwich et al, 2010; Paniagua et al, 2011; Tierney et al, 2011)
- Four neutral-quality randomized controlled trials (RCT) (Sarkkinen et al, 1996; Louheranta et al, 2002; Mukuddem-Petersen et al, 2007; Wien et al, 2010).

In Adults with Metabolic Syndrome

- Glycemic-related outcomes (FBG, random BG, two-hour post-prandial BG, A1C):
 - Most studies reported no significant impact of the type of fat intake, independent of weight loss, on fasting glucose levels in adults with metabolic syndrome
 - Additional longer-term intervention studies are needed to ascertain an effect of type of fat 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: Mukuddem-Petersen et al, 2007; Muzio et al, 2007; Paniagua et al, 2011; Tierney et al, 2011.
- Lipid outcomes (TG, HDL):
 - Most studies report no significant impact of the type of fat intake, independent of weight loss, on triglyceride 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
 - Evidence is based on the following: Mukuddem-Petersen et al, 2007; Muzio et al, 2007; Hartwich et al, 2010; Paniagua et al, 2011; Tierney et al, 2011.
- Anthropometric outcomes (WC, WHR):
 - Research reports no significant impact of the type of fat intake, independent of weight loss, on waist circumference in adults with metabolic syndrome
 - 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
 - Evidence is based on the following: Mukuddem-Petersen et al, 2007; Muzio et al, 2007; Paniagua et al, 2011; Tierney et al, 2011.
- 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
 - Evidence is based on the following: Mukuddem-Petersen et al, 2007; Muzio et al, 2007; Gulseth et al, 2010; Paniagua et al, 2011; Tierney et al, 2011.
- 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
 - 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
 - Evidence is based on the following: Sarkkinen et al, 1996; Louheranta et al, 2002; Wien et al, 2010.
- Lipid outcomes (TG, HDL):
 - Limited research reports no significant impact of 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
 - Evidence is based on the following: Sarkkinen et al, 1996; Wien et al, 2010.
- 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
 - Evidence is based on the following: Lindstrom et al, 2006; Wien et al, 2010.
- 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: Wien et al, 2010.

- [Recommendation Strength Rationale](#)

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 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 type of fat intake, independent of weight loss, on lipid outcomes \(TG, HDL\)?](#)

[In individuals with prediabetes, what is the impact of type of fat intake, independent of weight loss, on anthropometric outcomes \(WC, WHR\)?](#)

[In individuals with prediabetes, what is the impact of type of fat intake, independent of weight loss, on blood pressure?](#)

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- [Diabetes Prevention](#)
- [Prevention of Type 2 Diabetes \(PDM\) Guideline \(2014\)](#)

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 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 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 the 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 the effects of fruits and vegetables intake on blood pressure in individuals with prediabetes.

- [Recommendation Strength Rationale](#)

For Adults with Metabolic Syndrome

- Grade V evidence is available for the conclusion statements regarding the impact of fruits and vegetables, 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, 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 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 individuals with prediabetes, 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 anthropometric outcomes \(WC, WHR\)?](#)

[In individuals with prediabetes, 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 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?](#)

- [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 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 renal outcomes?](#)

- [References](#)
- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

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US Departments of Agriculture and Health and Human Services. Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010. <http://www.cnpp.usda.gov/dgas2010-dgacreport.htm> and <http://www.nutritionevidencelibrary.com/category.cfm?cid=21>.

- [Diabetes Prevention](#)
- [Prevention of Type 2 Diabetes \(PDM\) Guideline \(2014\)](#)

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.

- [Recommendation\(s\)](#)

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.

o [Potential Costs Associated with Application](#)

The costs of medical nutrition therapy ([MNT](#)).

o [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)
- Three neutral-quality randomized crossover feeding trials (Perala et al, 2011; Konig, Muser et al, 2012; Konig, Theis et al, 2012).

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.

o [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.

o [Minority Opinions](#)

Consensus reached.

o [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 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 individuals with prediabetes, what is the impact of glycemic index/load, independent of weight loss, on anthropometric outcomes \(WC, WHR\)?](#)

[In individuals with prediabetes, 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 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 renal outcomes?](#)

- [References](#)

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- [Diabetes Prevention](#)

- [Prevention of Type 2 Diabetes \(PDM\) Guideline \(2014\)](#)

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.

- [Recommendation\(s\)](#)

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 [triglycerides](#) by 33mg per dL (0.37mmol per L)
 - Decreased [waist circumference](#) by 3cm
 - Decreased [systolic blood pressure](#) by 6mm Hg
 - Decreased [diastolic blood pressure](#) by 3mm Hg.

Rating: Weak

Imperative

- [Risks/Harms 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:

- Five positive-quality randomized controlled trials (RCT) (Cohen et al, 2008; Pescatello et al, 2008; Yates et al, 2009; Camhi et al, 2010; Desch et al, 2010; Yates et al, 2011)
- 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

- no significant impact of intensity on post-prandial glucose levels
- Additional longer-term intervention studies are needed to ascertain an effect of physical activity 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: Zhang et al, 2006; Cohen et al, 2008; Mestek et al, 2008; Pescatello et al, 2008.
- Lipid outcomes (TG, HDL):
 - While limited research reports that low intensity or short duration physical activity, independent of weight loss and dietary change, has no significant impact on triglyceride levels in adults with metabolic syndrome, limited research reports that moderate-intensity physical activity, at a level of 135 minutes per week, significantly reduces plasma triglycerides by 33mg per dL (0.37mmol per L)
 - The majority of research reported no significant impact of physical activity on HDL cholesterol levels, regardless of duration or intensity
 - Additional longer-term intervention studies are needed to ascertain an effect of physical activity 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: Zhang et al, 2006; Cohen et al, 2008; Mestek et al, 2008; Camhi et al, 2010; Casella-Filho et al, 2011.
- Anthropometric outcomes (WC, WHR):
 - While limited research reports that low intensity physical activity, independent of weight loss and dietary change, has no significant impact on waist circumference in adults with metabolic syndrome, limited research on moderate-intensity physical activity, at a level of 135 to 180 minutes per week, significantly reduces waist circumference by 3cm
 - Additional longer-term intervention studies are needed to ascertain an effect of physical activity 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: Cohen et al, 2008; Camhi et al, 2010; Casella-Filho et al, 2011.
- Blood pressure outcomes:
 - While limited research reports that low intensity or short duration physical activity, independent of weight loss and dietary change, has no significant impact on blood pressure in adults with metabolic syndrome, limited research on moderate intensity physical activity, at a level of 135 minutes per week, significantly reduces systolic blood pressure by 6mm Hg and diastolic blood pressure by 3mm 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
 - Evidence is based on the following: Cohen et al, 2008; Pescatello et al, 2008; Casella-Filho et al, 2011.
- Renal outcomes:
 - There were no studies identified to evaluate the impact of physical activity, independent of weight loss and dietary change, on renal outcomes in adults with metabolic syndrome
 - Intervention studies are needed to ascertain an effect of physical activity 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):
 - 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
 - Of two intervention studies reporting A1C values, both reported no significant effect of moderate intensity physical activity
 - Additional longer-term intervention studies are needed to ascertain an effect of physical activity on glycemic-related outcomes in individuals with prediabetes
 - Evidence is based on the following: Sixt et al, 2008; Melton et al, 2009; Yates et al, 2009; Black et al, 2010; Desch et al, 2010; Yates et al, 2011; van Dijk et al, 2012.
- 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: Sixt et al, 2008; Melton et al, 2009; Yates 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 individuals with prediabetes
 - 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; Yates et al, 2011.
- Blood pressure outcomes:
 - Limited research reports that moderate-intensity physical activity, independent of weight loss and dietary change, has no significant impact on systolic or diastolic blood pressure in individuals with prediabetes
 - Additional longer-term intervention studies are needed to ascertain an effect of physical activity on blood pressure in individuals with prediabetes
 - Evidence is based on the following: Yates et al, 2009; Desch et al, 2010.

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 dietary 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 dietary 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 individuals with prediabetes, 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 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 renal outcomes?](#)

- [References](#)

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- [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 glipizide 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](#)

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- [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 (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 Counseling

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

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

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

Rating: Strong

Imperative

- [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.

- [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 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 (Boutelle et al, 1999; Tate et al, 2003) and compliance with renal diets (Milas 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-Ebhohimhen 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 (Perrin 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; Barrera et al, 2006; Toobert 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 (Clark 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 as part of 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
 - Evidence in support of the recommendation was grades A, B and C.
- From 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
 - Conclusion Statements in support of these recommendations received Grades I, II and III.

- [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/food behavior change in adults counseled in an outpatient/clinic setting?](#)

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

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

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

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

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

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

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

Rating: Strong
Imperative

- [Risks/Harms of Implementing This Recommendation](#)

None.

- [Conditions of Application](#)

A multi-disciplinary 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, dietician and nutritionists, exercise specialists and lay people, often working within a multi-disciplinary 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)
- Work with participants 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).

- [Recommendation Strength Rationale](#)

- 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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- [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, use 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**)
 - **CVD** risk factors (lipid profile and **blood pressure**)
 - **Physical activity**
 - Medications and supplements
 - Dietary factors.
- These factors allow the RDN to evaluate the effectiveness of medical nutrition therapy (**MNT**) for the prevention of type 2 diabetes in high-risk groups.

Rating: Consensus

Imperative

- [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 **35kg/m²**, 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 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) 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, i-IGT or i-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 glycemic load and high glycemic 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 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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