

Nutrition in Type 2 Diabetes and the Metabolic Syndrome

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KEYWORDS

- Insulin resistance • Type 2 diabetes prevention • Dietary patterns
- Mediterranean diet • New Nordic Diet

KEY POINTS

- For individuals at risk for type 2 diabetes mellitus (T2D) or the metabolic syndrome (MetS), adherence to an idealized dietary pattern can drastically alter the risk and course of these chronic conditions.
- Target levels of carbohydrate intake should approximate 30% of consumed calories.
- Healthy food choices should include copious fruits, vegetables, and nuts while minimizing foods with high glycemic indices, especially processed foods.

INTRODUCTION

Insulin resistance manifesting as T2D, the MetS, polycystic ovary syndrome, or hypertriglyceridemia, is a major public health problem. Approximately 10% of the United States population is diagnosed with T2D, and the prevalence of MetS is approximately 22% to 30%, depending on the defining criteria used.¹ Modern lifestyles have long been suspected as the major influence of this trend, with the implication that modification of daily routines can prevent or substantially alter the course of these conditions. Prior to the therapeutic use of insulin, lifestyle intervention was the only effective option for the treatment of insulin resistance syndromes. Resistance to insulin is present for years prior to the development of T2D and drives the multiple components of MetS, including increased abdominal girth (waist circumference >102 cm in men and >88 cm in women), hypertension (systolic blood pressure >130 mm Hg and diastolic blood pressure >85 mm Hg), elevated circulating triglycerides (>150 mg/dL), reduced circulating high-density lipoprotein (HDL) levels (<40 mg/dL in men and <50 mg/dL in

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women), and elevations in serum glucose concentrations (fasting serum glucose >100 mg/dL). Individuals with at least 3 of these 5 components are considered to have MetS, although more precise definitions exist from multiple professional medical organizations (Table 1). Current views emphasize MetS as a progressive condition of interrelated pathophysiology, where the aggregate risk is greater than the sum of each individual risk factor.²

Several large clinical trials demonstrate the effectiveness of lifestyle modification for the treatment and prevention of T2D and MetS. Despite the wide array of medication classes presently available, lifestyle modification focused on dietary change and enhanced physical activity remains a cornerstone of disease management in T2D, MetS, and other insulin resistance syndromes.

Individuals develop insulin resistance over prolonged periods of time, secondary to alterations in multiple metabolic and energy regulatory pathways. This culminates in hyperglycemia and other metabolic abnormalities, such as hypertriglyceridemia, hypertension, and obesity as well as the emergence of MetS or T2D. Dietary strategies should minimize the pathophysiologic effects of insulin resistance (Table 2).

Obesity is the most significant factor contributing to insulin resistance and T2D, and, subsequently, weight loss through dietary caloric restriction has been shown to be the most important treatment in patients with T2D who are overweight or obese. Because obesity is addressed in another article in this issue, this article focuses specifically on other dietary constituents that are related to insulin resistance and T2D.

Altered energy homeostasis in insulin resistance

- Inappropriate glucagon-mediated hepatic glucose release
- Reduced release and activity of glucagon-like peptide-1 (GLP-1)
- Pancreatic β -cell dysfunction via degeneration or transformation to inactive cells
- Delayed and less efficient insulin release
- Inefficient protein synthesis resulting from generalized endoplasmic reticulum stress
- Low-grade systemic inflammation
- Reduced clearance of advanced glycosylated end-products

DIETARY COMPONENTS AFFECTING TYPE 2 DIABETES MELLITUS: CARBOHYDRATES

Carbohydrates, in the form of starch, glycogen, or other polysaccharides, as well as simple sugars (monosaccharides and disaccharides) comprise approximately 40%

Organization	Definition of the Metabolic Syndrome
World Health Organization and the European Group for the Study of Insulin Resistance	Insulin resistance and any 2 of the other criteria
National Cholesterol Education Program/ American Heart Association/National Heart, Lung, and Blood Institute	Any 3 of 5 criteria
American Association of Clinical Endocrinologists	Insulin resistance and any of the other criteria
International Diabetes Foundation	Increased waist circumference and any of the other 4 criteria

Criteria: (1) increased abdominal girth; (2) hypertension; (3) elevated triglycerides; (4) low HDL; and (5) elevated blood glucose levels.

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