



FACT SHEET: Type 2 Diabetes Mellitus & Diet

How to prevent and treat type 2 diabetes with nutrition

Key Points

Diabetes currently affects approximately 536 million people worldwide, which is projected to rise to 783 million people by 2045—that is 12.2% of the world's population (1).

Type 2 diabetes mellitus (T2DM) accounts for up to 90% of all diabetes cases (1).

An unfavourable dietary composition and increased visceral adipose tissue are reversible and among the key risk factors for T2DM (1).

T2DM itself increases the risk of atherosclerosis, neuropathy, and diabetic foot syndrome, as well as nephropathy and retinopathy, a leading cause of visual impairment blindness (1).

Insulin resistance (IR) may occur decades before T2DM becomes diagnostically apparent, so early preventive dietary strategies are of paramount importance.

**In 2019
an estimated
4.2 million
deaths were
attributable
to diabetes
and its
complications (1).**

Pathomechanisms Influenced by Diet

Adipose Tissue Dysfunction Over nutrition

Diets high in fat, simple sugars, and processed foods are calorically dense and facilitate energy surplus and adipose tissue (AT) dysfunction resulting in:

- down-regulated secretion of insulin-sensitizing adiponectin (2).
- chronic tissue inflammation due to macrophage infiltration (3).
- release of pro-inflammatory cytokines causing impaired insulin signaling and lipolysis (2-4).
- up-regulated lipolysis leading to release of free fatty acids (FFAs) (3).

Lipotoxicity

Dietary Fat

Dietary saturated fat contributes to oversupply of saturated FFAs (5).

- saturated FFAs cause IR through mitochondrial dysfunction, increased oxidative stress, and pro-inflammatory signaling (6).

Conversely, monounsaturated and omega-3 polyunsaturated fatty acids increase insulin sensitivity (5, 7).

Ectopic Fat

FFAs from adipocytes and dietary saturated fat are redirected to and accumulated at multiple anatomic sites as ectopic fat (EF) (3).

EF causes lipotoxicity, (5) which contributes to organ dysfunction and IR, resulting in impaired insulin secretion and increased insulin needs (2, 3).

Liver

- upregulated gluconeogenesis and glycogenolysis (2).

Skeletal muscle

- build-up of intramyocellular lipids, which interferes with GLUT4 translocation (3).
- decreased uptake of blood glucose and glycogen synthesis (2, 3).

Pancreas

- increased oxidative stress and lipopoptosis of β -cells (2, 5).



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Pathomechanisms Influenced by Diet

Glucotoxicity

Rapidly Absorbable Carbohydrates such as simple sugars

- cause increased insulin needs (increasingly difficult to meet in lipotoxic state)
- can induce **de novo lipogenesis**, leading to increased accumulation of AT
- contribute to chronically elevated blood glucose levels resulting in glucotoxicity (4)
- production of advanced glycation end products (AGEs), which cause glomerulosclerosis and thus contribute to diabetic nephropathy
- increased oxidative stress and apoptosis of pancreatic β -cells

Glucolipotoxicity

Lipotoxic and glucotoxic effects cause progressive pancreatic β -cell dysfunction and death, which leads to the inability to compensate for increased insulin needs resulting in the hallmark of T2DM: hyperglycemia.

The Scientific Evidence

Epidemiological Evidence

- Significant association between abdominal obesity and incidence of T2DM (8, 9).
- 74% reduced risk of developing diabetes by long-term adherence to a vegetarian diet vs. meat-containing diet (10).
- Significant inverse association between higher adherence to a plant-based dietary pattern and risk of T2DM (11).

Evidence from RCTs and Meta-Analyses

- Significant decrease in HbA1c when following a low-carbohydrate diet, low glycaemic index (GI) diet or Mediterranean diet compared to control diets (12).
- 0.4% reduction in HbA1c levels on low GI-diets compared to high-GI diets (13).
- Vegan, vegetarian, and Mediterranean diets show greater reduction in bodyweight and HbA1c levels, delayed requirement for diabetes medication, and improved glycemic control compared to other diets (14).

General Recommendations

Eat predominantly or entirely from a wide variety of whole plant foods:

Maximize the intake of high-quality plant foods such as vegetables, whole grains, legumes, fruits, nuts, seeds, herbs, and spices; your health will benefit from every step towards more whole plant foods.

Eliminate or limit all processed foods, refined carbohydrates, and sugar-sweetened foods and beverages.

Eliminate red and processed meat products such as burgers, sausages, bacon, ham, salami, dried meat, canned meat, and pastrami (15).

Eliminate or limit other animal products such as poultry, fish, eggs, cheese, and dairy.

Make sure to **cover potentially critical nutrients** with a wide variety of plant foods, enriched foods/drinks, or supplements (especially vitamin B12 and vitamin D).

Disease Specific Recommendations

Eliminate chronic excessive calorie intake. This is best achieved by choosing plant foods with low calorie density such as green vegetables, starchy root vegetables, legumes, and fruit with lower sugar content such as berries and citrus fruits.

Aim for optimal body weight, which is best achieved by consuming predominately whole plant foods—losing weight helps keeping blood sugar levels under control.

When eating carbohydrates, **choose low glycaemic food** options such as fruits, vegetables, legumes, minimally processed whole grains, and nuts. Those will help control blood sugar levels and also promote weight loss.



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Disease Specific Recommendations

Limit saturated fats, from both animal and plant sources as much as possible, (16, 17) and replace them with monounsaturated and omega-3 polyunsaturated fats from nuts and seeds or high-quality carbohydrates such as whole grains, as this has been shown to ameliorate IR (16).

Make it a habit to eat beans, chickpeas, lentils, and split peas, as pulses help keep blood sugar levels stable (18).

Regularly include inulin-rich foods such as chicory root and Jerusalem artichoke. Inulin is an indigestible kind of fibre, which may help maintain steady blood sugar levels, (19) ameliorate IR, and reduce LDL cholesterol (20).

Regularly season your food with the spice turmeric (1/4–2 tsp per day), as one of its active compounds **curcumin** has been shown to improve glycaemic control (21). Consult your physician if pregnant or lactating (22).

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