

Diabetes Protocol

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Diabetes

The consequences of uncontrolled diabetes are severe: blindness, kidney failure, increased risk of heart disease, and painful peripheral nerve damage. Today, most practitioners focus treatment on strict blood sugar control.

While diabetes is characterized by excess blood glucose (the form of sugar used by cells as energy), this simplified approach can actually hasten the progression of the most common form of diabetes and does nothing to address the damage it causes.

A new approach to diabetes recognition and treatment is needed because the conventional wisdom has failed us. America is in the midst of a diabetes epidemic. Over the past 20 years, the number of adults diagnosed with diabetes has more than doubled, and children are being diagnosed with diabetes in alarming numbers.

Diabetes has rapidly emerged as a leading culprit in the epidemic of heart disease that is sweeping the country, and it is a leading cause of amputation and blindness among adults.

It is crucial that diabetics (and those predisposed to diabetes) understand the ways in which blood glucose causes damage and take active steps to interrupt these processes. The most notorious process is glycation, the same process that causes food to brown in an oven.

Glycation (defined as sugar molecules reacting with proteins to produce nonfunctional structures in the body) is a key feature of diabetes-related complications because it compromises proteins throughout the body and is linked to nerve damage, heart attack, and blindness.

Oxidative stress is also central to the damage caused by diabetes. Diabetics suffer from high levels of free radicals that damage arteries throughout the body, from the eyes to the heart. Once again, it is important that diabetics understand their need for antioxidant therapy to help reduce oxidative stress and lower the risk of diabetic complications.



The Difference between Type 1 and Type 2 Diabetes

There are two types of diabetes: type 1 and type 2. Underlying either form of diabetes is a disorder of insulin production, use, or both. Insulin is a hormone responsible for transporting glucose into cells. When there is excess glucose in the blood, insulin is secreted from the pancreas and signals the liver and muscles to store glucose as glycogen.

Insulin also stimulates adipose tissue to store glucose as fat for long-term energy reserves. Insulin receptors are found in all cells throughout the body. In a healthy person, blood glucose levels are extremely stable (Kumar V et al 2005). Normal fasting glucose levels range between 70 and 100 mg/dL.

Type 1 diabetes. Type 1 diabetes, formerly known as insulin-dependent diabetes, is an autoimmune condition that occurs when the body attacks and destroys the cells (called beta cells) that make insulin. Type 1 diabetes accounts for about 5 to 10 percent of cases. Because type 1 diabetics can no longer make insulin, insulin replacement therapy is essential.

Type 2 diabetes. Type 2 diabetes, formerly known as non-insulin-dependent diabetes, occurs when the body is no longer able to use insulin effectively and gradually becomes resistant to its effects. It is a slowly progressing disease that goes through identifiable stages. In the early stages of diabetes, both insulin and glucose levels are elevated (conditions called hyperinsulinemia and hyperglycemia, respectively).

In the later stages, insulin levels are reduced, and blood glucose levels are very elevated. Although few people are aware of this crucial distinction, therapy for type 2 diabetes should be tailored to the stage of the disease.

Risk factors for type 2 diabetes include aging, obesity, family history, physical inactivity, ethnicity, and impaired glucose metabolism. Type 2 diabetes is also a prominent risk of metabolic syndrome, a constellation of conditions that includes insulin resistance along with hypertension, lipid disorders, and overweight.



The Diabetes Damage Cascade

Glycation and oxidative stress are central to the damage caused by diabetes. Unfortunately, neither of them figures into conventional treatment for diabetes, which is generally concerned only with blood sugar control.

Glycation occurs when glucose reacts with protein, resulting in sugar-damaged proteins called advanced glycation end products (AGEs) (Kohn RR et al 1984; Monnier VM et al 1984). One well-known AGE among diabetics is glycated hemoglobin (HbA1c). HbA1c is created when glucose molecules bind to hemoglobin in the blood.

Measuring HbA1c in the blood can help determine the overall exposure of hemoglobin to glucose, which yields a picture of long-term blood glucose levels.

Glycated proteins cause damage to cells in numerous ways, including impairing cellular function, which induces the production of inflammatory cytokines (Wright E Jr. et al 2006) and free radicals (Forbes JM et al 2003; Schmidt AM et al 2000). In animal studies, inhibiting glycation protects against damage to the kidney, nerves, and eyes (Forbes JM et al 2003; Sakurai S et al 2003).

In a large human trial, therapies that resulted in each 1 percent reduction in HbA1c correlated with a 21 percent reduction in risk for any complication of diabetes, a 21 percent reduction in deaths related to diabetes, a 14 percent reduction in heart attack, and a 37 percent reduction in microvascular complications (Stratton IM et al 2000).

High levels of blood glucose and glycation also produce free radicals that further damage cellular proteins (Vincent AM et al 2005) and reduce nitric oxide levels. Nitric oxide is a potent vasodilator that helps keep arteries relaxed and wide open. Oxidative stress in diabetes is also linked to endothelial dysfunction, the process that characterizes atherosclerotic heart disease.

According to studies, diabetes encourages white blood cells to stick to the endothelium, or the thin layer of cells that line the inside of arteries. These white blood cells cause the local release of pro-inflammatory chemicals that damage the endothelium, accelerating atherosclerosis (Lum H et al 2001). Diabetes is closely associated with severe coronary heart disease and increased risk of heart attack.

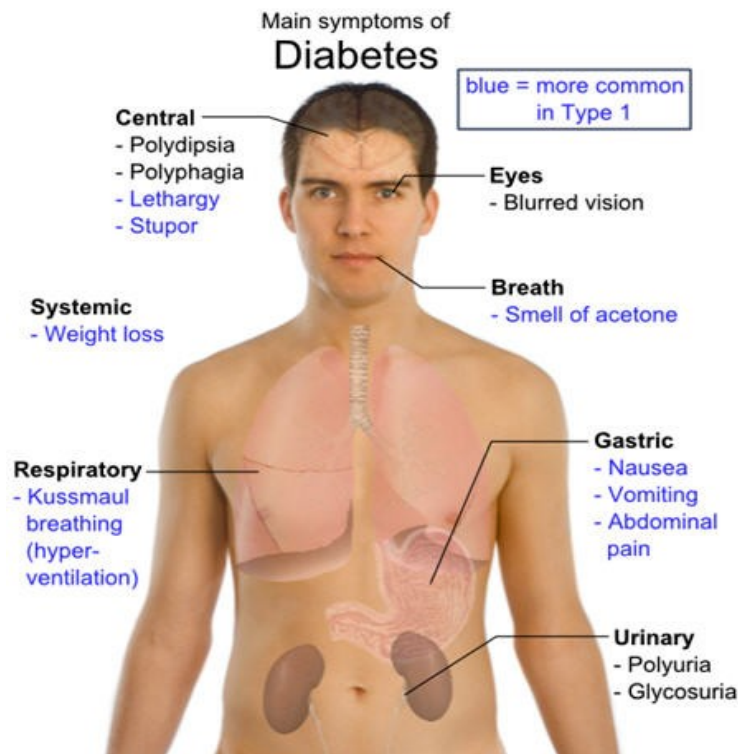
Symptoms and Diagnosis of Diabetes

Common symptoms of diabetes include increased thirst and urination, unusual weight changes, irritability, fatigue, and blurry vision. Clinical abnormalities include hyperglycemia and glucose in the urine. The breath might smell sweet because of ketones in the blood (ketosis), which are naturally sweet smelling. Dark outgrowths of skin (skin tags) may also appear.

The most common clinical tests used to diagnose diabetes are measures of blood glucose. The common fasting glucose test measures the amount of glucose in the blood after fasting. Prediabetes is diagnosed if the fasting blood glucose level is between 100 and 125 mg/dL. Diabetes is diagnosed if the fasting blood glucose level rises to 126 mg/dL or above.

The glucose tolerance test is used to measure insulin response to high glucose levels. During this test, patients are given glucose, and the rise in blood glucose levels is measured. Prediabetes is diagnosed if the glucose level rises to between 140 and 199 mg/dL. Diabetes is diagnosed if blood glucose levels rise to 200 mg/dL or higher.

The HbA1c test is also helpful in diagnosing less severe cases of diabetes. From this test clinicians can estimate the average blood glucose level during the preceding two to four months. Normally 4 to 6 percent of hemoglobin is glycosylated, which corresponds to average blood glucose between 60 and 120 mg/dL.



A Program for Early Diabetics

There are acute differences between the early stages of diabetes and the advanced stages. Thus, it doesn't make sense to treat all people with type 2 diabetes the same. In the early stages of the disease, people suffer from both hyperglycemia and hyperinsulinemia.

Rather than take drugs that further increase the level of insulin in the blood, people with type 2 diabetes would do better to pursue therapies that increase the sensitivity of insulin receptors on the cell membranes.

One of the best defenses against mild to moderate type 2 diabetes and hyperinsulinemia is improved diet and exercise. Although the disease has a genetic component, many studies have shown that diet and exercise can prevent it (Diabetes Prevention Program Research Group 2002; Diabetes Prevention Program Research Group 2003; Muniyappa R et al 2003; Diabetes Prevention Program Research Group 2000).

One study also showed that while some medications delay the development of diabetes, diet and exercise work better. Just 30 minutes a day of moderate physical activity, coupled with a 5 to 10 percent reduction in body weight, produces a 58 percent reduction in the incidence of diabetes among people at risk (Sheard NF 2003).

The American Diabetes Association recommends a diet high in fiber and unrefined carbohydrates and low in saturated fat (Sheard NF et al 2004). Foods with a low glycemic index are especially recommended because they blunt the insulin response. For more information on glycemic index, see the chapter titled Obesity.

The high-carbohydrate, high-plant-fiber (HCF) diet popularized by James Anderson, MD, has substantial support and validation in the scientific literature as the diet of choice in the treatment of diabetes (Anderson JW et al 2004; Hodge AM et al 2004).

The HCF diet is high in cereal grains, legumes, and root vegetables and restricts simple sugar and fat intake. The caloric intake consists of 50 to 55 percent complex carbohydrates, 12 to 16 percent protein, and less than 30 percent fat, mostly unsaturated. The total fiber content is between 25 and 50 g daily.

The HCF diet produces many positive metabolic effects, including the following: lowered postmeal hyperglycemia and delayed hypoglycemia; increased tissue sensitivity to insulin; reduced low-density lipoprotein (LDL) cholesterol and triglyceride levels and increased high-density lipoprotein (HDL) cholesterol levels; and progressive weight loss.

A healthy diet for diabetics is also rich in potassium. Potassium improves insulin sensitivity, responsiveness, and secretion. A high potassium intake also reduces the risk of heart disease, atherosclerosis, and cancer. Insulin administration induces potassium loss (Khaw KT et al 1984; Norbiato G et al 1984).

Nutritional Supplementation for Diabetics

[Lipoic Acid](#) [Biotin](#) [Carnitine](#) [Carnosine](#) [Chromium](#) [CoQ10](#) [DHEA](#) [Essential Fats](#) [Fiber](#) [Flavonoids](#)

Type 1 diabetics will need to be on insulin therapy for life, although the supplements mentioned in this section may help offset some of the complications caused by diabetes (e.g., reduced antioxidant capacity and glycation) as well enhance glucose metabolism.

Type 2 diabetics can counteract the progression of their disease by improving insulin sensitivity, enhancing glucose metabolism, and attempting to mitigate the complications of diabetes. The following supplements have been shown to improve blood sugar control or limit diabetic damage:

Lipoic acid

As a powerful antioxidant, lipoic acid positively affects important aspects of diabetes, including blood sugar control and the development of long-term complications such as disease of the heart, kidneys, and small blood vessels (Jacob S et al 1995, 1999; Kawabata T et al 1994; Melhem MF et al 2002; Nagamatsu M et al 1995; Song KH et al 2005; Suzuki YJ et al 1992).

Lipoic acid plays a role in preventing diabetes by reducing fat accumulation. In animal studies, lipoic acid reduced body weight, protected pancreatic beta cells from destruction, and reduced triglyceride accumulation in skeletal muscle and pancreatic islets (Doggrell SA 2004; Song KH et al 2005).

Lipoic acid has been approved for the prevention and treatment of diabetic neuropathy in Germany for nearly 30 years. Intravenous and oral lipoic acid reduces symptoms of diabetic peripheral neuropathy (Ametov AS et al 2003). Animal studies have suggested that lipoic acid is more effective when taken with gamma-linolenic acid (GLA) (Cameron NE et al 1998; Hounsom L et al 1998).

Diabetes also damages deep nerves that control vital organs, such as the heart and digestive tract. In a large clinical trial, people with diabetes who had symptoms caused by nerve damage affecting the heart showed significant improvement without significant side effects from 800 mg oral lipoic acid daily (Ziegler D et al 1997a,b).

Biotin

Biotin enhances insulin sensitivity and increases the activity of glucokinase, the enzyme responsible for the first step in the utilization of glucose by the liver. Glucokinase concentrations in diabetics are very low. Animal studies have shown that a high biotin diet can improve glucose tolerance and enhance insulin secretion (Zhang H et al 1996; Furukawa Y 1999).

Carnitine

An extensive body of literature supports the use of carnitine in diabetes (Mingrone G 2004).

Carnitine lowers blood glucose and HbA1c levels, increases insulin sensitivity and glucose storage, and optimizes fat and carbohydrate metabolism. Carnitine deficiency is common in type 2 diabetes. In a large human trial, acetyl-L-carnitine helped prevent or slow cardiac autonomic neuropathy in people with diabetes (Turpeinen AK et al 2005).

Carnosine

Carnosine is a glycation inhibitor that has been shown to exhibit protective effects against diabetic nephropathy and reduce the formation of AGEs (Janssen B et al 2005).

Chromium

Chromium is an essential trace mineral that plays a significant role in sugar metabolism. Chromium supplementation helps control blood sugar levels in type 2 diabetes and improves metabolism of carbohydrates, proteins, and lipids. Several studies have shown encouraging results from chromium supplementation:

A controlled human study of type 2 diabetics compared two forms of chromium (brewer's yeast and chromium chloride) (Bahijiri SM et al 2000). Both forms of chromium significantly improved blood sugar control. Positive results were also seen in two smaller human trials (Ghosh D et al 2002; Jovanovic L et al 1999).

A large human trial compared the effects of 1000 mcg chromium, 200 mcg chromium, and placebo (Anderson RA et al 1997). HbA1c values improved significantly in the group receiving 1000 mcg after two months and in both chromium groups after four months. Fasting glucose was also lower in the group taking the higher dose of chromium.

Coenzyme Q10

Coenzyme Q10 (CoQ10) improves blood sugar control, lowers blood pressure, and prevents oxidative damage caused by disease. In a controlled human trial, type 2 diabetics given 100 mg CoQ10 twice daily experienced improved glycemic control as measured by lower HbA1c levels and blood pressure (Hodgson JM et al 2002).

In a separate study, CoQ10 improved blood flow in type 2 diabetics, an outcome attributed to CoQ10's ability to lower vascular oxidative stress (Watts GF et al 2002). In a third study, improved blood flow correlated with decreased HbA1c (Playford DA et al 2003).

In animal studies, CoQ10 quenched free radicals, improved blood flow, lowered triglyceride levels, and raised HDL levels, suggesting a role for CoQ10 in preventing and managing complications of diabetes (Al-Thakafy HS et al 2004). Animal studies have also shown that CoQ10 levels are depleted by diabetes (Kucharska J et al 2000).

Dehydroepiandrosterone (DHEA)

Recent studies have yielded very encouraging results supporting dehydroepiandrosterone (DHEA) supplementation in diabetics. DHEA has been shown to improve insulin sensitivity

and obesity in human and animal models (Yamashita R et al 2005). Although its mechanism of action is poorly understood, it is thought that DHEA improves glucose metabolism in the liver (Yamashita R et al 2005).

Animal studies have also demonstrated that DHEA increases beta cells on the pancreas, which are responsible for producing insulin (Medina MC et al 2006).

In humans, DHEA levels are sensitive to elevated glucose: higher glucose levels tend to be associated with decreased DHEA levels (Boudou P et al 2006). One proposed mechanism of action in humans is linked to DHEA's metabolism into testosterone.

DHEA is an adrenal hormone that can be converted into either testosterone or estrogen. Studies have shown that testosterone improves insulin sensitivity in men, suggesting that DHEA's conversion into testosterone may be responsible for its beneficial effects in improving insulin sensitivity (Kapoor D et al 2005).

Essential fatty acids

In human experiments, omega-3 fatty acids lowered blood pressure and triglyceride levels, thereby relieving many of the complications associated with diabetes. In animals, omega-3 fatty acids cause less weight gain than other fats do; they have also been shown to have a neutral effect on LDL, while raising HDL and lowering triglycerides (Petersen M et al 2002). There are two types of essential fatty acids:

Omega-3. Marine oil contains omega-3 fatty acids. The research on omega-3 fatty acids stems from studies of the Inuit (Eskimo) people, who seldom suffer from heart attacks even though their diets contain an enormous amount of fat from fish, seals, and whales, presumably because those sources of fat are very high in omega-3 fatty acids.

Omega-3 fatty acids found in marine oil, lower blood triglyceride levels, contribute to "thinning" the blood, and also decrease inflammation (Ebbesson SO et al 2005). These effects partially explain many of fish oil's benefits.

Omega-6. Diabetic neuropathy is a gradual degeneration of peripheral nerve tissue. There is some evidence that GLA, an omega-6 fatty acid, can be helpful if given long enough to work. In one double-blind, placebo-controlled study, 111 people with mild diabetic neuropathy received either 480 mg daily of GLA or placebo.

After 12 months, the group taking GLA was doing significantly better than the placebo group in 13 out of 16 measures of nerve function, with patients whose diabetes was under control doing best (Keen H et al 1993). There is also evidence that GLA is more effective for diabetic neuropathy when it is combined with lipoic acid (Hounsom L et al 1998).

Fiber

It is difficult to overstate the benefits from fiber in regard to blood glucose control. Eating a diet rich in high-fiber foods prevents and reduces the harm caused by chronically elevated

blood glucose.

One study reported the results of diabetic individuals consuming a diet supplying 25 g soluble fiber and 25 g insoluble fiber (about double the amount currently recommended by the American Diabetes Association). The fiber was derived from foodstuffs, with no emphasis placed on special or unusual fiber-fortified foods or fiber supplements. A high-fiber diet reduced blood glucose levels by an average of 10 percent (Chandalia et al 2000).

Fiber is also valuable because it produces a feeling of satiety, reducing the desire to overeat. Because high-fiber foods are digested more slowly than other foods, hunger pangs are forestalled. For the most part, fibrous foods are healthful (nutrient dense and low in fat).

Fiber should be added slowly, gradually replacing low-fiber foods, for the following reasons: (1) insulin and prescription drugs may have to be adjusted to accommodate lower blood glucose levels, and (2) without a gradual introduction of the new material, intestinal distress could occur, including bloating, flatulence, and cramps.

Some individuals prefer to bolster fiber volume by adding supplemental fiber in the form of pectin, gums, and mucilages to each meal. Calculate the amount of fiber gained from foodstuffs and supplement with enough to compensate for shortfalls. Monitor blood glucose levels closely to assess gains and to adjust oral or injectable hypoglycemic agents.

Flavonoids

Flavonoids are antioxidants that help reduce damage associated with diabetes. In animal studies, quercetin, a potent flavonoid, decreases levels of blood glucose and oxidants. Quercetin also normalizes levels of the antioxidants superoxide dismutase, vitamin C, and vitamin E. Quercetin is more effective at lower doses and ameliorates the diabetes-induced changes in oxidative stress (Mahesh T et al 2004).

Botanical Supplements for Diabetes

[Cinnamon](#) [Coffee berry](#) [Green tea](#) [Ginkgo](#)

Before insulin, botanical medicines were used to treat diabetes. They are remarkably safe and effective. However, because many botanical medicines function similarly to insulin, people taking oral diabetes medications or insulin should use caution to avoid hypoglycemia.

Botanical medicines should be integrated into a regimen of adequate exercise, healthy eating, nutritional supplements, and medical support.

Cinnamon

Cinnamon has been used for several thousand years in traditional Ayurvedic and Greco-European medical systems. Native to tropical southern India and Sri Lanka, the bark of this evergreen tree is used to manage conditions such as nausea, bloating, flatulence, and anorexia.

It is also one of the world's most common spices, used to flavor everything from oatmeal and apple cider to cappuccino. Recent research has revealed that regular use of cinnamon can also promote healthy glucose metabolism.

Coffee berry

Coffee berry contains some well-studied phytochemicals such as chlorogenic acid, caffeic acid, ferulic acid, and quinic acid (Charles-Bernard M et al 2005). Some of coffee berry's most impressive effects can be seen in blood glucose management. Chlorogenic acid and caffeic acid are the two primary nutrients in coffee that benefit individuals with high blood sugar. Glucose-6-phosphatase is an enzyme crucial to the regulation of blood sugar.

Green tea

The compounds in these plants, including epicatechin, catechin, gallic acid, and epigallocatechin, are powerful antioxidants, particularly against pancreas and liver toxins (Okuda T et al 1983). Animal studies have shown that epigallocatechins, in particular, may have a role in preventing diabetes (Crespy V et al 2004).

In studies with rats, epigallocatechins prevented cytokine-induced beta cell destruction by downregulating inducible nitric oxide synthase, which is a pro-oxidant (Kim MJ et al 2004; Song EK et al 2003). This process could help slow the progression of type 1 diabetes. In vitro studies have also shown that green tea suppresses diet-induced obesity (Murase T et al 2002), a key risk factor in developing diabetes and metabolic syndrome (Hung PF et al 2005).

Ginkgo biloba

Animal studies demonstrate that ginkgo improves glucose metabolism in muscle fibers and prevents atrophy (Punkt K et al 1999). Animal studies also show that Ginkgo biloba extracts significantly inhibit postmeal sugar levels and act as antihyperglycemic agents (Tanaka S).

Please visit the [The Life Extension Foundation](#) for more information on innovative prevention and treatment strategies.

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