Diabetes Mellitus

Diabetes mellitus is a condition in which a person has excess amounts of glucose (sugar) in the blood due to inadequate production or inefficient use of insulin. Insulin is a hormone produced by the beta cells of the pancreas, an organ located behind the stomach and is seen in the below illustration.

![Image](image.jpg)

*The image is in the public domain and is provided by the University of Minnesota*

Common **symptoms** (symptoms are signs of a health condition) of diabetes include frequent urination, thirst, hunger, weight loss (despite thirst and hunger), and fatigue. Diabetes is a significant health issue because its **complications** (complications are problems that can result from a health condition) include vision problems, kidney disease, and cardiovascular disease.

The goal of insulin is to facilitate the movement of glucose into the body's cells, and the cells use the glucose for energy. After a meal, a person's blood glucose levels rise, triggering the release of insulin. When insulin is released from the pancreas, the insulin travels through the bloodstream, with the objective of binding cell receptor that are specific to insulin. Once the insulin binds to receptors, a cascade of operations occur within the cell that ultimately trigger a glucose transporter inside the cell to move toward the cell membrane, engulf glucose, and bring it into the cell so it can be used for energy. There are a variety of transporters, one of which is "GLUT-4," a protein inside muscle and fat cells.

Since diabetes interferes with optimal insulin release or use, blood glucose cannot move into the cell. If the cells do not receive the necessary glucose, they will start to break down their own fats and proteins for energy. This process can result in a loss of body weight, one symptom of diabetes. If the body is unable to use the blood sugar, it tries to eliminate the excess, leading to another symptom: excessive urination. The loss of body water from excess urination leads to yet another symptom of diabetes, excessive thirst.

There are two general types of diabetes: Type 1 and Type 2.

**Type 1 Diabetes Mellitus**

In Type 1 diabetes, occurring among approximately 5-10% of all diabetics, the person has little or no insulin to move glucose into a cell. Without insulin, blood glucose cannot move into the cells that need it. Persons diagnosed with Type 1 diabetes rely on insulin injections to live. The Type 1 diabetes diagnosis stereotypically occurs during childhood or adolescence, but not in all cases.

The exact causes of Type 1 diabetes are unknown. What is known, however, is that the most common form of Type 1 diabetes appears to be triggered by an autoimmune response. In this response, a person may develop antibodies that destroy the insulin-making beta cells in the pancreas, therefore halting any insulin production. As a result, those who have Type 1 diabetes must take insulin in order to survive. In the 1990s the...
American Diabetes Association suggested this form be known as "Type 1a diabetes," though this nomenclature did not seem to move forward.¹

Although the causes of Type 1 diabetes are not yet identified, both genetics and the environment may play roles in the condition. Individuals whose family members are diagnosed with Type 1 diabetes, for instance, are more likely to develop the condition. From the environmental perspective, research has proposed the timing of introducing cereal into an infant's diet can impact a person's susceptibility for the condition. For instance, Colorado University published research in 2013 that supported the importance of timing an infant's introduction to soft food (O). CBS News' "The Early Show" (O) provides the story in writing, while NPR's website offers a report in audio (O). While pancreatic cell transplantation has become an alternative for some with Type 1 diabetes, those who can undergo the procedure still remain on medications to avoid organ rejection. At this time, there are no widely-accepted methods for preventing Type 1 diabetes, though there have been, and continue to be, clinical trials to investigate this possibility.

Type 1 diabetes also occurs for reasons not related to autoimmunity, though those reasons are not well known. This form of Type 1 diabetes is sometimes known as "idiopathic diabetes."² Idiopathic diabetes is a form of Type 1 diabetes that has unknown origin. While the mechanism for this form of diabetes is not yet known, research indicates chromosomal abnormality or viral infections may be possible contributors. Individuals of African American, Hispanic and Asian descent are more frequently diagnosed with with form of diabetes than are Caucasians. Insulin therapy is frequently given to those diagnosed with idiopathic diabetes, but some may control their condition with oral medication.


**Type 2 Diabetes Mellitus**

According to the Centers for Disease Control, Type 2 diabetes makes up approximately 90%³ of diabetic cases, and many who have Type 2 do not know they have it. Although many children have been diagnosed with Type 2 diabetes, the stereotypical sufferer is an individual over the age of 50. In Type 2 diabetes the individual may have a supply of insulin, but may have developed a decreased sensitivity to the hormone. In such a scenario, the pancreas must produce more insulin than normal to get the desired effect of moving carbohydrate out of the blood and into the body's cells. The overworked pancreas, over time, may have a reduced ability to secrete insulin, so excess glucose may remain in the blood, a condition known as insulin insensitivity. Insulin insensitivity can lead to the diagnosis of Type 2 diabetes.

For some individuals the pancreas continues to produce the insulin needed to shuttle glucose out of the blood, but the amount of insulin required to do the job is higher than normal, so can lead to the diagnosis of hyperinsulinemia. Hyperinsulinemia is associated with obesity (especially in the abdominal region), high triglyceride levels in the blood, high blood pressure, and other cardiovascular health markers.

Insulin insensitivity or hyperinsulinemia may be triggered by inadequate insulin production, an uncontrolled insulin release rate, a decrease in the number of insulin receptors on cells, or antibodies that may "hook on" to such receptor sites, blocking the binding of insulin to cells (which means glucose cannot enter).

BUPA Health's animation, [How Type 2 Diabetes Develops](https://www.youtube.com/watch?v=Qn7yY5R5o3A), is available via YouTube (R) stable.
Latent Autoimmune Diabetes of Adulthood (LADA)

Traditionally, Type 1 diabetes appears in childhood or adolescence. More recently, however, clinicians and researchers have noticed Type 1 diabetes symptoms appearing in adults. Latent Autoimmune Diabetes of Adulthood (LADA) is described as a form of Type 1 diabetes that takes place in adulthood. In LADA, individuals demonstrate challenges with blood sugar control similar to Type 2 patients, but do not share Type 2 characteristics such as obesity. As described in a publication from the Diabetes and Lipid Clinic of Alaska (R--go to the "Diabetes" menu item on the left, then select, "Type 1 diabetes," and then select "Latent Autoimmune Diabetes of Adulthood"), LADA is one of several names attached to a condition with features distinguished from traditional Type 1 and certainly Type 2 diabetes. LADA typically requires insulin therapy, but since the condition develops over a longer period of time than Type 1 diabetes, LADA is often misdiagnosed as Type 2.

Diabetes Complications

Diabetes appears to damage the blood vessels in the body, which can cause further complications. Damaged vessels more easily pull in lipids (fat) from the blood. Since Type 1 diabetics break down more fat for energy, more lipids are in the bloodstream, which subsequently puts the diabetic at risk for cardiovascular disease. In fact, diabetics have double the risk for heart disease. This reality makes the primary risk factors associated with cardiovascular disease all the more important for a diabetic.

Vessel damage in the kidneys makes them less effective in filtering waste products. In extreme circumstances, a diabetic must cleanse the blood with dialysis machinery or obtain a kidney transplant.

Changes in blood vessels supplying the eye's retina with blood can cause leaking of blood into the vitreous humor in the eye. In such a case, early diagnosis is very important to prevent blindness.

The below two images are the same, except the one on the right shows potential eyesight damage due to diabetes.

Nerve damage, which may also occur from diabetes, can cause dulled sensation in the limbs of the body. Coupled with a decreased blood flow brought by vessel damage, people increase their risk for sores that won't heal, especially in the feet. Amputation may be necessary in extreme situations. For tips on foot care to prevent amputations, visit the National Institute for Diabetes and Digestive and Kidney Diseases (O).

Diabetes and Ethnicity

Japanese, Chinese, South African blacks, Swedes, Finnish, and some Native American tribes have higher rates for diabetes than other ethnic groups. According to the American Diabetes Association (ADA), African Americans have are 1.7 times more likely to have diabetes than non-Latino whites. African American women experience a higher incidence than do African American males. The American Diabetes Association has more information on diabetes complications in African Americans (O). The reasons for this group's increased risk for the disorder are multifactorial: a combination of lifestyle factors such as obesity, diet and physical activity with suspected genetic factors are probably involved. Many Asian and Pacific Islanders do not experience a high incidence of diabetes, whereas many Native American tribes, such as Pimas, do. The American Diabetes Association provides information about Diabetes Among Native Americans (O). Pima Indians: Pathfinders for Health describes diabetes and other conditions found in this population (O). If you have Adobe's "Acrobat Reader" software, you can read about Diabetes in Asian and Pacific Islander Populations at the Diabetes in America website (O).
Diagnosis

Diabetes and prediabetes (prediabetes occurs when blood sugar levels are elevated, but not to the extent of a diabetes diagnosis) are diagnosed through blood glucose tests. The amount of glucose present in the blood can be measured, as can the amount of glucose carried by one's red blood cells. The first measure is simply known as a "blood glucose" test, while the second is known as an "A1c" test. The A1c test is a measure of how well glucose has been managed over time. Glucose binds to hemoglobin in red blood cells. The more glucose there is in the bloodstream, the more glucose will be present in red blood cells. Red blood cells live approximately three months, so an A1c test will provide the healthcare practitioner with information on how well the patient has managed glucose levels over that timeframe. In contrast, a blood glucose test just provides information about glucose levels at the time of the blood draw. The below chart represents diagnostic glucose levels for the fasting blood glucose test, the oral blood glucose tolerance test, and the A1c test.

Table 1. Blood Glucose Risk Categories.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Fasting Blood Glucose (mg/dl)</th>
<th>Oral Blood Glucose Tolerance Test (mg/dl)</th>
<th>A1c Test (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt; 100</td>
<td>&lt; 140</td>
<td>&lt; 5.7</td>
</tr>
<tr>
<td>Prediabetes</td>
<td>100-125</td>
<td>140-199</td>
<td>5.7-6.4</td>
</tr>
<tr>
<td>Diabetes</td>
<td>≥ 126</td>
<td>≥ 200</td>
<td>≥ 6.5</td>
</tr>
</tbody>
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Source: