Diabetes Mellitus

A PowerPoint presentation (no narration) containing much of this information is available here. Those without PowerPoint can view the information in pdf format here.

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, the organ seen in the below image.

To identify where the pancreas is located, travel to a WebMD page and click on the first animation, located toward the top of the screen (O). Common symptoms of diabetes include frequent urination, thirst, hunger, weight loss (despite thirst and hunger), fatigue and vision impairment.

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 to a specific cell receptor. To view an animation of insulin being released from the pancreas' beta cells, travel to WebMD (R--click on the "Anatomy/Function" link at the top of the page, then click on the first animation, toward the top of the screen). The binding of insulin to the receptor triggers a glucose transporter inside the cell to allow glucose cell entry. WebMD has an animation of this process (R--click on the "Causes" link at the top of the page, then click on the second animation link). One example of a glucose transporter is "GLUT-4," a protein inside muscle and fat cells. When insulin binds to the muscle or fat cell, GLUT-4 travels to the cell membrane. Once this GLUT-4 protein meets with the membrane, it becomes a transporter for glucose: glucose enters the cell via the GLUT-4 molecule. You can visit Wiley Publishers Fundamentals of Biochemistry to see an animation of the GLUT-4 transporter working to move glucose into a cell (O).

The movement of glucose into the cell requires insulin; even if the body's blood sugar levels are high, the cells cannot use the sugar without the assistance of insulin. If the cells do not receive the necessary glucose, they will start to break down their own fats and proteins for energy. This is reflected in loss of body weight, one symptom of diabetes. Another symptom of diabetes is excessive urine production, which occurs because the kidneys are trying to rid the body of the extra sugar--and water follows the sugar. The loss of body water leads to yet another symptom of diabetes, excessive thirst. To learn more about insulin (R--reading the opening paragraph is sufficient), visit the American Diabetes Association. To read about the discovery and early development of insulin, travel to the University of Toronto Libraries Fisher Library's Digital Collections (O).

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. The Type 1 diabetes diagnosis stereotypically occurs during childhood or adolescence, but not in all cases. In its most common form, Type 1 diabetes may be triggered from an autoimmune disorder. 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. 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."

The most common of Type 1 diabetes, is caused 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. WebMD has an animation showing the reduced insulin production in a person with this form of
Type 1 diabetes (R--click on the "Causes" link at the top of the page, then click on the first animation to view what happens to pancreatic cells when antibodies damage them). Persons diagnosed with Type 1 diabetes rely on insulin injections to live.

Research published in the Journal of the American Medical Association in October of 2003 describes how the timing of introducing cereal into an infant's diet, along with genetic predisposition, may impact a person's susceptibility for the condition. In 2013 Colorado University published research information that also 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.

"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 Type 1B diabetes than are Caucasians. Insulin therapy is frequently given to those diagnosed with Type 1B diabetes, but some may be able to discontinue insulin and subsequently control their condition with oral medication.


Type 2 Diabetes Mellitus

According to the Centers for Disease Control, Type 2 diabetes makes up approximately 90% of diabetic cases, and many who have Type 2 do may 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). To see an animation illustrating the concept of insulin resistance, visit diabetes.com (O--click on "Diabetes Animation - Go"). Type 2 diabetes can often be controlled with diet, exercise, and--if necessary--oral medication.

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 I and certainly Type 2 diabetes. LADA typically requires insulin therapy, but since the condition develops over a longer period of time than Type I 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.

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).

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