

Diabetes Mellitus

It is estimated that about one person in 20 in the United States has diabetes mellitus. The word *diabetes* refers to copious production of urine, and *mellitus* is from the Greek word for honey, indicating that the urine of an untreated diabetic is copious and sweet. The cause of diabetes is inadequate secretion or action of insulin. Two major forms of diabetes occur in humans: **Type 1**, or **juvenile-onset diabetes**, and **Type 2**, or **maturity-onset diabetes**. The latter was not recognized as a distinct disease until relatively recently.

As the name suggests, **juvenile-onset diabetes** generally appears suddenly during childhood, but can develop as late as young adulthood. In juvenile diabetes the beta cells are destroyed and secrete little or no insulin. Evidence suggests that juvenile-onset diabetes may be an autoimmune disease, since most individuals with this form of the disease have antibodies against the beta cells in their own pancreas. The antibodies destroy the beta cells, resulting in insulin deficiency. Just what precipitates the autoimmune response is still in question, but there is probably a genetic predisposition. Having a close relative with diabetes makes one 10-12X more likely than an average individual to get it (in the Caucasian population). Most (though not all) of the individuals with this form of diabetes possess two specific genes. Having these genes does not automatically mean that one will become diabetic; in fact, the majority with this genotype will not. Infections with particular viruses appear to be a precipitating factor. This type of diabetes is treated with injections of insulin, so it is sometimes referred to as insulin-dependent diabetes mellitus (IDDM). Affected individuals must give insulin injections for the remainder of their life. These individuals must carefully monitor their intake of insulin every day, to adjust the levels of insulin to match current blood glucose levels and estimate for future needs. For example, one always needs to presuppose the amount of food ingested at each meal to ingest the proper amount of insulin beforehand. Activities such as sports must be controlled for. Caution must be exerted to avoid "insulin shock" - too much insulin injected will cause hypoglycemia, which can cause neurological symptoms such as hallucinations, and then excessive perspiration and shock, similar to the effects of acidosis (for hyperglycemia).

The more common form (i.e., about 90 percent of the cases) of diabetes is **maturity-onset diabetes**, which has a slow onset and usually occurs in middle age, but can occur as young as age 20. . These individuals generally have normal beta cells, and insulin levels in their blood are often normal or even above normal. Here the defect usually has to do with the insulin receptors and is due to a decreased number of receptors or reduced binding. The insulin receptor level is actually influenced by the basal insulin level; as the basal insulin level goes up, the receptor concentration goes down. Most patients with this form of diabetes are overweight, and have low levels of insulin receptors on their adipose cells. These cells are unable to respond properly to normal insulin levels, and for this reason maturity-onset diabetes is also known as non-insulin-dependent diabetes mellitus (NIDDM). The disease may occur when individuals chronically overeat, which stimulates high insulin production and high insulin levels in the blood. Prolonged exposure of adipose cells to high insulin levels appears to lead to a "down regulation" in the number of receptors on the cells. In many such individuals, loss of weight restores the normal concentration of insulin receptors, and the symptoms disappear. In over half the cases, diet alone can control the disease. If this is not sufficient, oral drugs are available that increase insulin secretion and stimulate tissue responsiveness to insulin. Some late onset diabetics are somewhat insulin resistant and must inject insulin. There may be a genetic component to this form of diabetes; about one-third of such diabetics have a relative with the disease.

What are the symptoms of diabetes?

- hyperglycemia (high blood sugar). A diabetic's blood glucose levels can be as high as 1000mg/100mL, where 70-110mg/100mL is normal.
- glycosuria --glucose in the urine. This occurs because the glucose levels in the blood are so high that the threshold for glucose in the kidney is exceeded. The kidney cannot reabsorb all the glucose from the urine.
- polyuria (much urine). This occurs because the osmotic concentration of the urine is so high that water remains in the urine rather than being reabsorbed by osmosis in the kidney. Polyuria results in frequent urination, sometimes as much as once every 15-20 minutes.
- polydipsia (excessive thirst). Since the individual is losing water by producing copious amounts of urine, he or she becomes dehydrated and very thirsty, sometimes drinking 8-10 glasses of water per hour.
- polyphagia (excessive hunger). Without sufficient insulin or insulin receptors, glucose cannot be properly taken into the cells and metabolized. The cells are deprived of a source of energy and begin to break down proteins (e.g., muscle proteins) and fats for energy.
- Ketoacidosis (keto-acids in the blood resulting from incomplete fat metabolism). In juvenile diabetics the rate of fat synthesis lags behind the rate of fat breakdown and large numbers of fatty acids are released into the blood, thereby lowering the pH of the blood. The liver breaks down these fatty acids into keto acids, which are also acidic and lower the pH of the blood even more. This low pH can affect the action of enzymes and the ability of oxygen to bind to hemoglobin (remember: low pH \square less affinity for oxygen). In extreme cases, low pH can lead to coma or death. Acetone (a by-product of fat metabolism) is found in the breath and urine. Ketoacidosis is characteristic of an uncontrolled juvenile diabetic but not the mature-onset type

Untreated diabetes mellitus can have serious consequences, both short-term and long-term. Juvenile-onset diabetics risk going into diabetic coma or becoming unconscious due to the accumulation of toxic substances, changes in the pH of the blood (ketoacidosis), and electrolyte imbalances. Other complications affect all diabetics, and occur many years after the onset of the disease. Pathologic changes occur in the blood vessels, which causes diabetics to have a higher susceptibility to (1) kidney failure, (2) scarring of the retina (diabetic retinopathy) with loss of vision, and (3) circulatory problems in the legs. Diabetics also have a higher incidence of atherosclerosis, with its attendant risk of high blood pressure, strokes, and heart attacks. Many of these complications are treatable, so early detection and control of the disease is important. On the other hand, diabetes doesn't have to hinder one's life. In fact, keeping in control is a good indicator of good nutrition and cardiovascular health. Also, keeping in control leads to levels of self-confidence.