

10

11

12

13

14

15



Diabetes Home

## National Diabetes Information Clearinghouse (NDIC)

A service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), NIH

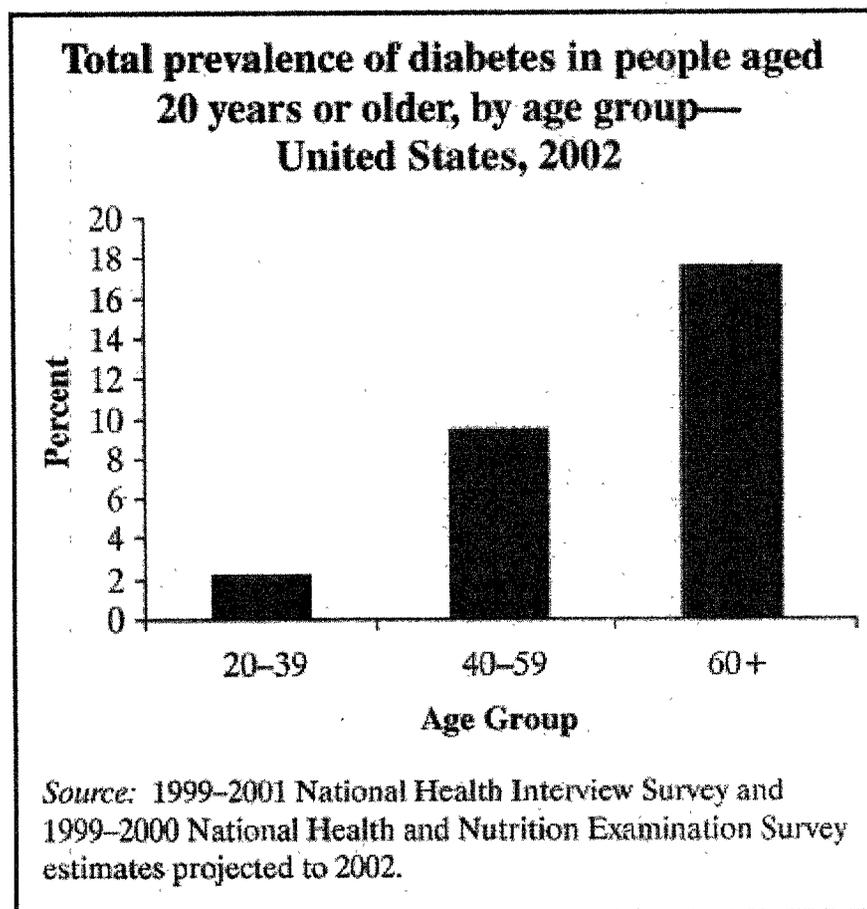
[Intro](#)[Treatments](#)[Complications](#)[Statistics](#)[Clinical Trials](#)[in Spanish](#)[Resources](#)[Order](#)[About Us](#)[Search](#)Home : [Diabetes A-Z List of Topics and Titles](#) : [Diabetes Overview](#)Email To A  
Friend 

## Diabetes Overview

### On this page:

- [What is diabetes?](#)
- [What are the types of diabetes?](#)
- [What tests are recommended for diagnosing diabetes?](#)
- [What are the other forms of impaired glucose metabolism, also called pre-diabetes?](#)
- [What are the scope and impact of diabetes?](#)
- [Who gets diabetes?](#)
- [How is diabetes managed?](#)
- [Hope Through Research](#)
- [What will the future bring?](#)
- [Points to remember](#)
- [For More Information](#)

Almost everyone knows someone who has diabetes. An estimated 18.2 million people in the United States—6.3 percent of the population—have diabetes, a serious, lifelong condition. Of those, 13 million have been diagnosed, and about 5.2 million people have not yet been diagnosed. Each year, about 1.3 million people aged 20 or older are diagnosed with diabetes.



[Top]

### What is diabetes?

Diabetes is a disorder of metabolism—the way our bodies use digested food for growth and energy. Most of the food we eat is broken down into glucose, the form of sugar in the blood. Glucose is the main source of fuel for the body.

After digestion, glucose passes into the bloodstream, where it is used by cells for growth and energy. For glucose to get into cells, insulin must be present. Insulin is a hormone produced by the pancreas, a large gland behind the stomach.

When we eat, the pancreas automatically produces the right amount of insulin to move glucose from blood into our cells. In people with diabetes, however, the pancreas either produces little or no insulin, or the cells do not respond appropriately to the insulin that is produced. Glucose builds up in the blood, overflows into the urine, and passes out of the body. Thus, the body loses its main source of fuel even though the blood contains large amounts of glucose.

[Top]

### What are the types of diabetes?

The three main types of diabetes are

- type 1 diabetes
- type 2 diabetes
- gestational diabetes

### **Type 1 Diabetes**

Type 1 diabetes is an autoimmune disease. An autoimmune disease results when the body's system for fighting infection (the immune system) turns against a part of the body. In diabetes, the immune system attacks the insulin-producing beta cells in the pancreas and destroys them. The pancreas then produces little or no insulin. A person who has type 1 diabetes must take insulin daily to live.

At present, scientists do not know exactly what causes the body's immune system to attack the beta cells, but they believe that autoimmune, genetic, and environmental factors, possibly viruses, are involved. Type 1 diabetes accounts for about 5 to 10 percent of diagnosed diabetes in the United States. It develops most often in children and young adults, but can appear at any age.

Symptoms of type 1 diabetes usually develop over a short period, although beta cell destruction can begin years earlier. Symptoms include increased thirst and urination, constant hunger, weight loss, blurred vision, and extreme fatigue. If not diagnosed and treated with insulin, a person with type 1 diabetes can lapse into a life-threatening diabetic coma, also known as diabetic ketoacidosis.

### **Type 2 Diabetes**

The most common form of diabetes is type 2 diabetes. About 90 to 95 percent of people with diabetes have type 2. This form of diabetes is associated with older age, obesity, family history of diabetes, previous history of gestational diabetes, physical inactivity, and ethnicity. About 80 percent of people with type 2 diabetes are overweight.

Type 2 diabetes is increasingly being diagnosed in children and adolescents. However, nationally representative data on prevalence of type 2 diabetes in youth are not available.

When type 2 diabetes is diagnosed, the pancreas is usually producing enough insulin, but for unknown reasons, the body cannot use the insulin effectively, a condition called insulin resistance. After several years, insulin production decreases. The result is the same as for type 1 diabetes—glucose builds up in the blood and the body cannot make efficient use of its main source of fuel.

The symptoms of type 2 diabetes develop gradually. Their onset is not as sudden as in type 1 diabetes. Symptoms may include fatigue or nausea, frequent urination, unusual thirst, weight loss, blurred vision, frequent infections, and slow healing of wounds or sores. Some people have no

symptoms.

### **Gestational Diabetes**

Gestational diabetes develops only during pregnancy. Like type 2 diabetes, it occurs more often in African Americans, American Indians, Hispanic Americans, and among women with a family history of diabetes. Women who have had gestational diabetes have a 20 to 50 percent chance of developing type 2 diabetes within 5 to 10 years.

[Top]

### **What are the tests for diagnosing diabetes?**

The fasting plasma glucose test is the preferred test for diagnosing type 1 or type 2 diabetes. It is most reliable when done in the morning. However, a diagnosis of diabetes can be made after positive results on any one of three tests, with confirmation from a second positive test on a different day:

- A random (taken any time of day) plasma glucose value of 200 mg/dL or more, along with the presence of diabetes symptoms.
- A plasma glucose value of 126 mg/dL or more after a person has fasted for 8 hours.
- An oral glucose tolerance test (OGTT) plasma glucose value of 200 mg/dL or more in a blood sample taken 2 hours after a person has consumed a drink containing 75 grams of glucose dissolved in water. This test, taken in a laboratory or the doctor's office, measures plasma glucose at timed intervals over a 3-hour period.

Gestational diabetes is diagnosed based on plasma glucose values measured during the OGTT. Glucose levels are normally lower during pregnancy, so the threshold values for diagnosis of diabetes in pregnancy are lower. If a woman has two plasma glucose values meeting or exceeding any of the following numbers, she has gestational diabetes: a fasting plasma glucose level of 95 mg/dL, a 1-hour level of 180 mg/dL, a 2-hour level of 155 mg/dL, or a 3-hour level of 140 mg/dL.

[Top]

### **What are the other forms of impaired glucose metabolism (also called pre-diabetes)?**

People with pre-diabetes, a state between "normal" and "diabetes," are at risk for developing diabetes, heart attacks, and strokes. However, studies suggest that weight loss and increased physical activity can prevent or delay diabetes. There are two forms of pre-diabetes.

#### **Impaired Fasting Glucose**

A person has impaired fasting glucose (IFG) when fasting plasma glucose is 100 to 125 mg/dL. This level is higher than normal but less than the level indicating a diagnosis of diabetes.

### **Impaired Glucose Tolerance**

Impaired glucose tolerance (IGT) means that blood glucose during the oral glucose tolerance test is higher than normal but not high enough for a diagnosis of diabetes. IGT is diagnosed when the glucose level is 140 to 199 mg/dL 2 hours after a person drinks a liquid containing 75 grams of glucose.

About 35 million people ages 40 to 74 have impaired fasting glucose and 16 million have impaired glucose tolerance. Because some people have both conditions, the total number of U.S. adults ages 40 to 74 with pre-diabetes comes to about 41 million. These recent estimates were calculated using data from the 1988–1994 National Health and Nutrition Examination Survey and projected to the 2000 U.S. population.

[[Top](#)]

### **What are the scope and impact of diabetes?**

Diabetes is widely recognized as one of the leading causes of death and disability in the United States. In 2000, it was the sixth leading cause of death. However, diabetes is likely to be underreported as the underlying cause of death on death certificates. About 65 percent of deaths among those with diabetes are attributed to heart disease and stroke.

Diabetes is associated with long-term complications that affect almost every part of the body. The disease often leads to blindness, heart and blood vessel disease, stroke, kidney failure, amputations, and nerve damage. Uncontrolled diabetes can complicate pregnancy, and birth defects are more common in babies born to women with diabetes.

In 2002, diabetes cost the United States \$132 billion. Indirect costs, including disability payments, time lost from work, and premature death, totaled \$40 billion; direct medical costs for diabetes care, including hospitalizations, medical care, and treatment supplies, totaled \$92 billion.

[[Top](#)]

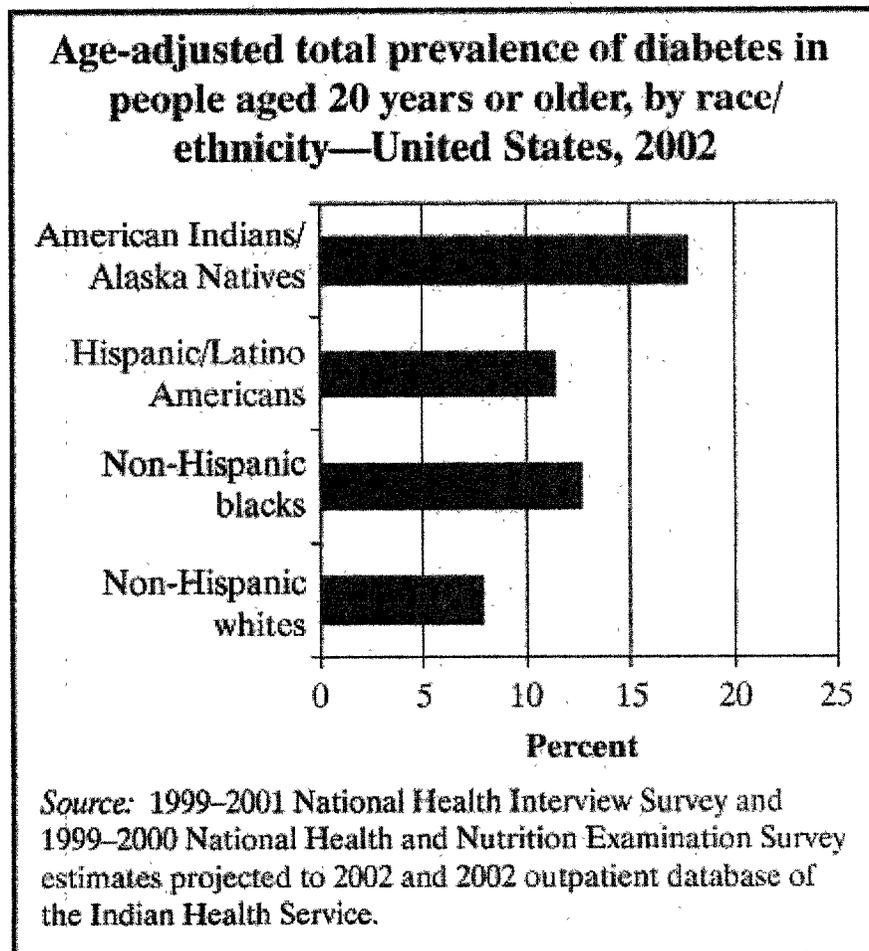
### **Who gets diabetes?**

Diabetes is not contagious. People cannot "catch" it from each other. However, certain factors can increase the risk of developing diabetes.

Type 1 diabetes occurs equally among males and females, but is more common in whites than in nonwhites. Data from the World Health Organization's Multinational Project for Childhood Diabetes indicate that type 1 diabetes is rare in most African, American Indian, and Asian populations. However, some northern European countries, including

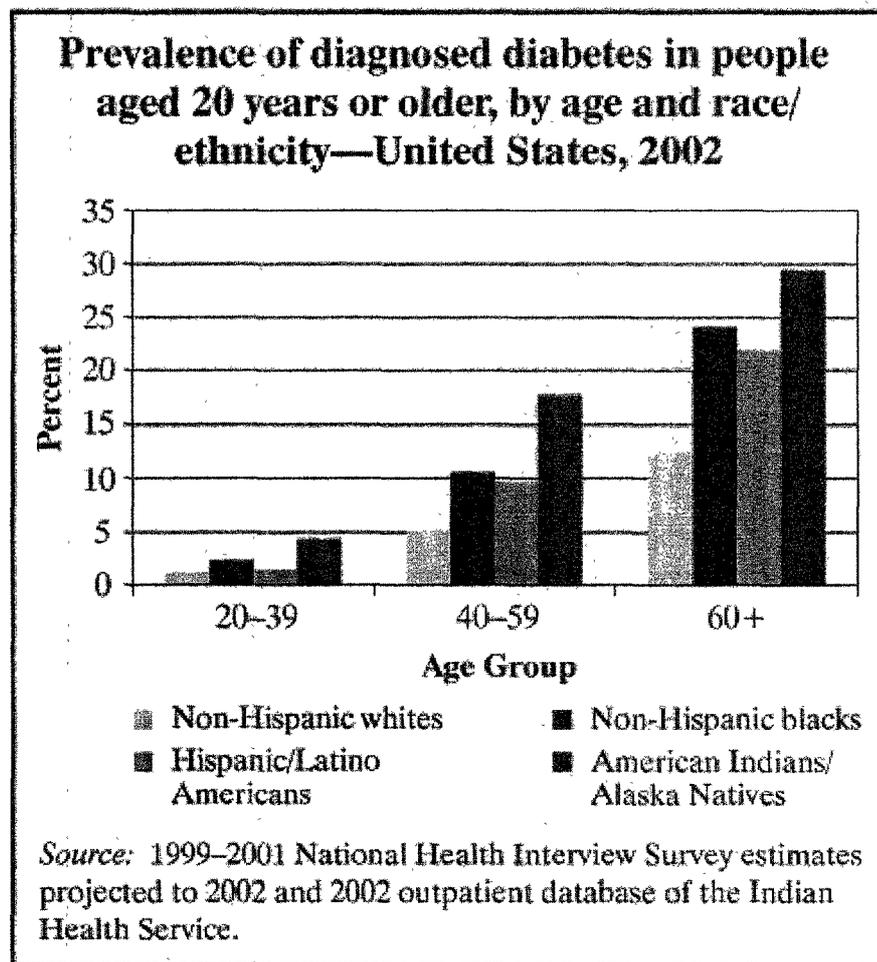
Finland and Sweden, have high rates of type 1 diabetes. The reasons for these differences are unknown.

Type 2 diabetes is more common in older people, especially in people who are overweight, and occurs more often in African Americans, American Indians, some Asian Americans, Native Hawaiians and other Pacific Islander Americans, and Hispanic Americans. On average, non-Hispanic African Americans are 1.6 times as likely to have diabetes as non-Hispanic whites of the same age. Hispanic Americans are 1.5 times as likely to have diabetes as non-Hispanic whites of similar age. American Indians have one of the highest rates of diabetes in the world. On average, American Indians and Alaska Natives are 2.2 times as likely to have diabetes as non-Hispanic whites of similar age. Although prevalence data for diabetes among Asian Americans and Pacific Islanders are limited, some groups, such as Native Hawaiians and Japanese and Filipino residents of Hawaii aged 20 or older, are about twice as likely to have diabetes as white residents of Hawaii of similar age.



The prevalence of diabetes in the United States is likely to increase for several reasons. First, a large segment of the population is aging. Also, Hispanic Americans and other minority groups make up the fastest-growing segment of the U.S. population. Finally, Americans are increasingly overweight and sedentary. According to recent estimates,

the prevalence of diabetes in the United States is predicted to reach 8.9 percent of the population by 2025.



[Top]

### How is diabetes managed?

Before the discovery of insulin in 1921, everyone with type 1 diabetes died within a few years after diagnosis. Although insulin is not considered a cure, its discovery was the first major breakthrough in diabetes treatment.

Today, healthy eating, physical activity, and taking insulin via injection or an insulin pump are the basic therapies for type 1 diabetes. The amount of insulin must be balanced with food intake and daily activities. Blood glucose levels must be closely monitored through frequent blood glucose checking.

Healthy eating, physical activity, and blood glucose testing are the basic management tools for type 2 diabetes. In addition, many people with type 2 diabetes require oral medication, insulin, or both to control their blood glucose levels.

People with diabetes must take responsibility for their day-to-day care.

Much of the daily care involves keeping blood glucose levels from going too low or too high. When blood glucose levels drop too low—a condition known as hypoglycemia—a person can become nervous, shaky, and confused. Judgment can be impaired, and if blood glucose falls too low, fainting can occur.

A person can also become ill if blood glucose levels rise too high, a condition known as hyperglycemia.

People with diabetes should see a health care provider who will help them learn to manage their diabetes and who will monitor their diabetes control. An endocrinologist is a doctor who often specializes in diabetes care. In addition, people with diabetes often see ophthalmologists for eye examinations, podiatrists for routine foot care, and dietitians and diabetes educators to learn the skills needed for day-to-day diabetes management.

The goal of diabetes management is to keep blood glucose levels as close to the normal range as safely possible. A major study, the Diabetes Control and Complications Trial (DCCT), sponsored by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), showed that keeping blood glucose levels close to normal reduces the risk of developing major complications of type 1 diabetes.

This 10-year study, completed in 1993, included 1,441 people with type 1 diabetes. The study compared the effect of two treatment approaches—intensive management and standard management—on the development and progression of eye, kidney, and nerve complications of diabetes. Intensive treatment aimed to keep hemoglobin A1C as close to normal (6 percent) as possible. Hemoglobin A1C reflects average blood glucose over a 2- to 3-month period. Researchers found that study participants who maintained lower levels of blood glucose through intensive management had significantly lower rates of these complications. More recently, a followup study of DCCT participants showed that the ability of intensive control to lower the complications of diabetes has persisted 8 years after the trial ended.

The United Kingdom Prospective Diabetes Study, a European study completed in 1998, showed that intensive control of blood glucose and blood pressure reduced the risk of blindness, kidney disease, stroke, and heart attack in people with type 2 diabetes.

[Top]

## Hope Through Research

NIDDK conducts research in its own laboratories and supports a great deal of basic and clinical research in medical centers and hospitals throughout the United States. It also gathers and analyzes statistics about diabetes. Other Institutes at the National Institutes of Health (NIH) conduct and support research on diabetes-related eye diseases, heart and vascular complications, pregnancy, and dental problems.

Other Government agencies that sponsor diabetes programs are the Centers for Disease Control and Prevention, the Indian Health Service, the Health Resources and Services Administration, the Department of Veterans Affairs, and the Department of Defense.

Many organizations outside the Government support diabetes research and education activities. These organizations include the American Diabetes Association, the Juvenile Diabetes Research Foundation International, and the American Association of Diabetes Educators.

In recent years, advances in diabetes research have led to better ways of managing diabetes and treating its complications. Major advances include

- development of quick-acting and long-acting insulins
- better ways to monitor blood glucose and for people with diabetes to check their own blood glucose levels, including advances in noninvasive blood glucose monitoring
- development of external insulin pumps that deliver insulin, replacing daily injections
- laser treatment for diabetic eye disease, reducing the risk of blindness
- successful kidney and pancreas transplantation in people whose kidneys fail because of diabetes
- better ways of managing diabetes in pregnant women, improving their chances of a successful outcome
- new drugs to treat type 2 diabetes and better ways to manage this form of diabetes through weight control
- evidence that intensive management of blood glucose reduces and may prevent development of diabetes complications
- demonstration that two types of antihypertensive drugs, ACE (angiotensin-converting enzyme) inhibitors and ARBs (angiotensin receptor blockers), are more effective than other antihypertensive drugs in reducing a decline in kidney function in people with diabetes
- promising results with islet transplantation for type 1 diabetes reported by the University of Alberta in Canada
- evidence that people at high risk for type 2 diabetes can lower their chances of developing the disease through diet, weight loss, and physical activity

[Top]

## What will the future bring?

### Prevention of Diabetes

Researchers continue to look for the cause or causes of diabetes and ways to prevent and cure the disease. Scientists are searching for genes that may be involved in type 1 or type 2 diabetes. Some genetic markers for type 1 diabetes have been identified, and it is now possible to screen relatives of people with type 1 diabetes to determine whether they are at risk.

### Type 1 Diabetes

The Diabetes Prevention Trial—Type 1 (DPT-1) identified relatives at risk for developing type 1 diabetes and investigated two ways to delay or prevent type 1 diabetes. Results showed that neither low-dose insulin injections nor an oral form of insulin were successful in delaying or preventing type 1 diabetes in people at risk.

The DPT-1 was funded by the NIDDK, the National Institute of Allergy and Infectious Diseases, the National Institute of Child Health and Human Development, and the National Center for Research Resources within the National Institutes of Health, as well as the American Diabetes Association and the Juvenile Diabetes Research Foundation International.

Researchers are working on a way for people with type 1 diabetes to live without daily insulin injections. In an experimental procedure called islet transplantation, islets are taken from a donor pancreas and transferred into a person with type 1 diabetes. Once implanted, the beta cells in these islets begin to make and release insulin.

Scientists have made many advances in islet transplantation in recent years. Since reporting their findings in the June 2000 issue of the *New England Journal of Medicine*, researchers at the University of Alberta in Edmonton, Alberta, Canada, have continued to use a procedure called the Edmonton protocol to transplant pancreatic islets into people with type 1 diabetes. A multicenter clinical trial of the Edmonton protocol for islet transplantation is currently under way, and results will be announced in several years. According to the International Islet Transplant Registry, as of June 2003 about 50 percent of the patients have remained free of the need for insulin injections up to 1 year after receiving a transplant. A clinical trial of the Edmonton protocol is also being conducted by the Immune Tolerance Network, funded by the National Institutes of Health and the Juvenile Diabetes Research Foundation International.

The goal of islet transplantation is to infuse enough islets to control the blood glucose level without insulin injections. For an average-sized person (70 kg), a typical transplant requires about 1 million islets, extracted from two donor pancreases. Because good control of blood glucose can slow or prevent the progression of complications associated with diabetes, such as nerve or eye damage, a successful transplant

may reduce the risk of these complications. But a transplant recipient will need to take immunosuppressive drugs to stop the immune system from rejecting the transplanted islets.

Researchers are trying to find new approaches that will allow successful transplantation without the use of immunosuppressive drugs. These drugs have significant side effects and their long-term effects are still unknown. Immediate side effects of immunosuppressive drugs may include mouth sores and gastrointestinal problems, such as stomach upset or diarrhea. Patients may also have increased blood cholesterol levels, decreased white blood cell counts, decreased kidney function, and increased susceptibility to bacterial and viral infections. Taking immunosuppressive drugs increases the risk of tumors and cancer as well.

Researchers do not fully know what long-term effects islet transplantation may have. Although the early results of the Edmonton protocol are very encouraging, more research is needed to answer questions about how long the islets will survive and how often the transplantation procedure will be successful.

A major obstacle to widespread use of islet transplantation will be the shortage of islet cells. The supply available from deceased donors will be enough for only a small percentage of those with type 1 diabetes. However, researchers are pursuing alternative sources, such as creating islet cells from other types of cells. New technologies could then be employed to grow islet cells in the laboratory.

## Type 2 Diabetes

In 1996, NIDDK launched its Diabetes Prevention Program (DPP). The goal of this research effort was to learn how to prevent or delay type 2 diabetes in people with impaired glucose tolerance (IGT), a strong risk factor for type 2 diabetes.

The findings of the DPP, which were released in August 2001, showed that people at high risk for type 2 diabetes could sharply lower their chances of developing the disease through diet and exercise. In addition, treatment with the oral diabetes drug metformin also reduced diabetes risk, though less dramatically.

Participants randomly assigned to intensive lifestyle intervention reduced their risk of getting type 2 diabetes by 58 percent. On average, this group maintained their physical activity at 30 minutes per day, usually with walking or other moderate intensity exercise, and lost 5 to 7 percent of their body weight. Participants randomized to treatment with metformin reduced their risk of getting type 2 diabetes by 31 percent.

Of the 3,234 participants enrolled in the DPP, 45 percent were from minority groups that suffer disproportionately from type 2 diabetes: African Americans, Hispanic Americans, Asian Americans and Pacific Islanders, and American Indians. The trial also recruited other groups

known to be at higher risk for type 2 diabetes, including individuals aged 60 and older, women with a history of gestational diabetes, and people with a first-degree relative with type 2 diabetes.

### **Prevention and Treatment of Cardiovascular Disease**

The National Institutes of Health (NIH) is studying the best strategies to prevent and treat cardiovascular disease (CVD) in people with diabetes in three trials: Look AHEAD, ACCORD, and BARI 2D. These studies are all joint efforts of the NIDDK and the National Heart, Lung, and Blood Institute.

The Look AHEAD: Action for Health in Diabetes study will be the largest clinical trial to date to examine the long-term health effects of voluntary weight loss. This multi-center, randomized clinical trial will study the consequences of a lifestyle intervention designed to achieve and maintain weight loss over the long term through decreased caloric intake and increased exercise. Look AHEAD will focus on the disease most associated with overweight and obesity, type 2 diabetes, and on the outcome that causes the greatest morbidity and mortality in people with type 2 diabetes, cardiovascular disease.

The Action to Control Cardiovascular Risk in Diabetes (ACCORD) study, a randomized multi-center trial, is being undertaken by the NIH to study three key approaches to preventing major cardiovascular events in individuals with type 2 diabetes. The primary outcome to be measured is the first occurrence of a major cardiovascular disease event, specifically heart attack, stroke, or cardiovascular death. In addition, the study will investigate the impact of the treatment strategies on other cardiovascular outcomes; total mortality; limb amputation; eye, kidney, or nerve disease; health-related quality of life; and cost-effectiveness.

The Bypass Angioplasty Revascularization Investigation in Type 2 Diabetics (BARI 2D) trial, a 5-year, multi-center clinical trial, will compare medical versus early surgical management of patients with type 2 diabetes who also have coronary artery disease and stable angina or ischemia. At the same time, BARI 2D will study the effect of two different strategies to control blood glucose—providing insulin versus increasing the sensitivity of the body to insulin—on the risk of cardiovascular mortality and morbidity.

A complete listing of clinical research studies can be found at <http://ClinicalTrials.gov>.

Several new drugs have been developed to treat type 2 diabetes. By using the oral diabetes medications now available, many people can control blood glucose levels without insulin injections. Studies are under way to determine how best to use these drugs to manage type 2 diabetes.

[Top]

## Points to Remember

### What is diabetes?

- a disorder of metabolism—the way the body digests food for energy and growth

### What are the main types of diabetes?

- type 1 diabetes
- type 2 diabetes
- gestational diabetes

### What are the impacts of diabetes?

- It affects 18.2 million people—6.3 percent of the U.S. population.
- It is a leading cause of death and disability.
- It costs \$132 billion per year.

### Who gets diabetes?

- people of any age
- people with a family history of diabetes
- others with high risk: commonly older people, overweight and sedentary people, African Americans, Alaska Natives, American Indians, Asian Americans, Native Hawaiians, some Pacific Islander Americans, and Hispanic Americans

[Top]

## For More Information

To learn more about type 1, type 2, and gestational diabetes, as well as diabetes research, statistics, and education, contact

### **National Diabetes Education Program**

1 Diabetes Way  
Bethesda, MD 20892-3600  
Phone: 1-800-438-5383  
Internet: [www.ndep.nih.gov](http://www.ndep.nih.gov)

The following organizations also distribute materials and support programs for people with diabetes and their families and friends:

**American Diabetes Association**  
National Service Center

1701 North Beauregard Street  
Alexandria, VA 22311  
Phone: 1-800-342-2383 or 703-549-1500  
Internet: [www.diabetes.org](http://www.diabetes.org)

**Juvenile Diabetes Research Foundation International**  
120 Wall Street, 19th Floor  
New York, NY 10005  
Phone: 1-800-533-2873 or 212-785-9500  
Internet: [www.jdrf.org](http://www.jdrf.org)

[Top]

---

### **National Diabetes Information Clearinghouse**

1 Information Way  
Bethesda, MD 20892-3560  
Email: [ndic@info.niddk.nih.gov](mailto:ndic@info.niddk.nih.gov)

The National Diabetes Information Clearinghouse (NDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1978, the Clearinghouse provides information about diabetes to people with diabetes and to their families, health care professionals, and the public. The NDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about diabetes.

Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts.

This e-text is not copyrighted. The Clearinghouse encourages users of this e-pub to duplicate and distribute as many copies as desired.

---

NIH Publication No. 05-3873  
January 2005

[Top]

[Diabetes Home](#) | [Introduction](#) | [Treatments](#) | [Complications](#) | [Statistics](#) | [Clinical Trials](#) | [in Spanish](#) | [Additional Resources](#) | [Order Publications](#) | [About Us](#) |

[A-Z List of Diabetes Topics and Titles](#) | [Contact Us](#) | [Health Information](#)

The NDIC is a service of the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health

National Diabetes Information Clearinghouse  
1 Information Way  
Bethesda, MD 20892-3560

Phone: 1-800-860-8747  
Fax: 703-738-4929  
Email: [ndic@info.niddk.nih.gov](mailto:ndic@info.niddk.nih.gov)



[Privacy](#) | [Disclaimer](#) | [Accessibility](#)