Hypoglycemia

What is hypoglycemia?

Hypoglycemia, also called low blood glucose or low blood sugar, occurs when blood glucose drops below normal levels. Glucose, an important source of energy for the body, comes from food. Carbohydrates are the main dietary source of glucose. Rice, potatoes, bread, tortillas, cereal, milk, fruit, and sweets are all carbohydrate-rich foods.

After a meal, glucose is absorbed into the bloodstream and carried to the body's cells. Insulin, a hormone made by the pancreas, helps the cells use glucose for energy. If a person takes in more glucose than the body needs at the time, the body stores the extra glucose in the liver and muscles in a form called glycogen. The body can use glycogen for energy between meals. Extra glucose can also be changed to fat and stored in fat cells. Fat can also be used for energy.

When blood glucose begins to fall, glucagon—another hormone made by the pancreas—signals the liver to break down glycogen and release glucose into the bloodstream. Blood glucose will then rise toward a normal level. In some people with diabetes, this glucagon response to hypoglycemia is impaired and other hormones such as epinephrine, also called adrenaline, may raise the blood glucose level. But with diabetes treated with insulin or pills that increase insulin production, glucose levels can't easily return to the normal range.

Hypoglycemia can happen suddenly. It is usually mild and can be treated quickly and easily by eating or drinking a small amount of glucose-rich food. If left untreated, hypoglycemia can get worse and cause confusion, clumsiness, or fainting. Severe hypoglycemia can lead to seizures, coma, and even death.

In adults and children older than 10 years, hypoglycemia is uncommon except as a side effect of diabetes treatment. Hypoglycemia can also result, however, from other medications or diseases, hormone or enzyme deficiencies, or tumors.

What are the symptoms of hypoglycemia?

Hypoglycemia causes symptoms such as

- hunger
- shakiness
- nervousness
- sweating
- dizziness or light-headedness
- sleepiness
- confusion
- difficulty speaking
- anxiety
- weakness

Hypoglycemia can also happen during sleep. Some signs of hypoglycemia during sleep include

- crying out or having nightmares
- finding pajamas or sheets damp from perspiration
- feeling tired, irritable, or confused after waking up

What causes hypoglycemia in people with diabetes?

Diabetes Medications

Hypoglycemia can occur as a side effect of some diabetes medications, including insulin and oral diabetes medications—pills—that increase insulin production, such as

- chlorpropamide (Diabinese)
- glimepiride (Amaryl)
- glipizide (Glucotrol, Glucotrol XL)
- glyburide (DiaBeta, Glynase, Micronase)
- nateglinide (Starlix)
- repaglinide (Prandin)
- sitagliptin (Januvia)
- tolazamide

- tolbutamide

Certain combination pills can also cause hypoglycemia, including

- glipizide + metformin (Metaglip)
- glyburide + metformin (Glucovance)
- pioglitazone + glimepiride (Duetact)
- rosiglitazone + glimepiride (Avandaryl)
- sitagliptin + metformin (Janumet)

Other types of diabetes pills, when taken alone, do not cause hypoglycemia. Examples of these medications are

- acarbose (Precose)
- metformin (Glucophage)
- miglitol (Glyset)
- pioglitazone (Actos)
- rosiglitazone (Avandia)

However, taking these pills along with other diabetes medications—insulin, pills that increase insulin production, or both—increases the risk of hypoglycemia.

In addition, use of the following injectable medications can cause hypoglycemia:

- Pramlintide (Symlin), which is used along with insulin
- Exenatide (Byetta), which can cause hypoglycemia when used in combination with chlorpropamide, glimepiride, glipizide, glyburide, tolazamide, and tolbutamide

Other Causes of Hypoglycemia

In people on insulin or pills that increase insulin production, low blood glucose can be due to

- meals or snacks that are too small, delayed, or skipped
- increased physical activity
- alcoholic beverages

How can hypoglycemia be prevented?

Diabetes treatment plans are designed to match the dose and timing of medication to a person's usual schedule of meals and activities. Mismatches could result in hypoglycemia. For example, taking a dose of insulin—or other medication that increases insulin levels—but then skipping a meal could result in hypoglycemia.

To help prevent hypoglycemia, people with diabetes should always consider the following:

- **Their diabetes medications.** A health care provider can explain which diabetes medications can cause hypoglycemia and explain how and when to take medications. For good diabetes management, people with diabetes should take diabetes medications in the recommended doses at the recommended times. In some cases, health care providers may suggest that patients learn how to adjust medications to match changes in their schedule or routine.
- **Their meal plan.** A registered dietitian can help design a meal plan that fits one's personal preferences and lifestyle. Following one's meal plan is important for managing diabetes. People with diabetes should eat regular meals, have enough food at each meal, and try not to skip meals or snacks. Snacks are particularly important for some people before going to sleep or exercising. Some snacks may be more effective than others in preventing hypoglycemia overnight. The dietitian can make recommendations for snacks.
- **Their daily activity.** To help prevent hypoglycemia caused by physical activity, health care providers may advise
    - checking blood glucose before sports, exercise, or other physical activity and having a snack if

the level is below 100 milligrams per deciliter (mg/dL)
    - adjusting medication before physical activity
    - checking blood glucose at regular intervals during extended periods of physical activity and having snacks as needed
    - checking blood glucose periodically after physical activity

- **Their use of alcoholic beverages.** Drinking alcoholic beverages, especially on an empty stomach, can cause hypoglycemia, even a day or two later. Heavy drinking can be particularly dangerous for people taking insulin or medications that increase insulin production. Alcoholic beverages should always be consumed with a snack or meal at the same time. A health care provider can suggest how to safely include alcohol in a meal plan.
- **Their diabetes management plan.** Intensive diabetes management—keeping blood glucose as close to the normal range as possible to prevent long-term complications—can increase the risk of hypoglycemia. Those whose goal is tight control should talk with a health care provider about ways to prevent hypoglycemia and how best to treat it if it occurs.

What to Ask the Doctor about Diabetes Medications

People who take diabetes medications should ask their doctor or health care provider

- whether their diabetes medications could cause hypoglycemia
- when they should take their diabetes medications
- how much medication they should take
- whether they should keep taking their diabetes medications when they are sick

- whether they should adjust their medications before physical activity
- whether they should adjust their medications if they skip a meal

How is hypoglycemia treated?

Signs and symptoms of hypoglycemia vary from person to person. People with diabetes should get to know their signs and symptoms and describe them to their friends and family so they can help if needed. School staff should be told how to recognize a child's signs and symptoms of hypoglycemia and how to treat it.

People who experience hypoglycemia several times in a week should call their health care provider. They may need a change in their treatment plan: less medication or a different medication, a new schedule for insulin or medication, a different meal plan, or a new physical activity plan.

Prompt Treatment for Hypoglycemia

When people think their blood glucose is too low, they should check the blood glucose level of a blood sample using a meter. If the level is below 70 mg/dL, one of these quick-fix foods should be consumed right away to raise blood glucose:

- 3 or 4 glucose tablets
- 1 serving of glucose gel—the amount equal to 15 grams of carbohydrate
- 1/2 cup, or 4 ounces, of any fruit juice
- 1/2 cup, or 4 ounces, of a regular—**not diet**—soft drink
- 1 cup, or 8 ounces, of milk
- 5 or 6 pieces of hard candy
- 1 tablespoon of sugar or honey

Recommended amounts may be less for small children. The child's doctor can advise about the right amount to give a child.

The next step is to recheck blood glucose in 15 minutes to make sure it is 70 mg/dL or above. If it's still too low, another serving of a quick-fix food should be eaten. These steps should be repeated until the blood glucose level is 70 mg/dL or above. If the next meal is an hour or more away, a snack should be eaten once the quick-fix foods have raised the blood glucose level to 70 mg/dL or above.

For People Who Take Acarbose (Precose) or Miglitol (Glyset)

People who take either of these diabetes medications should know that only pure glucose, also called dextrose—available in tablet or gel form—will raise their blood glucose level during a low blood glucose episode. Other quick-fix foods and drinks won't raise the level quickly enough because acarbose and miglitol slow the digestion of other forms of carbohydrate.

Help from Others for Severe Hypoglycemia

Severe hypoglycemia—very low blood glucose—can cause a person to pass out and can even be life threatening. Severe hypoglycemia is more likely to occur in people with type 1 diabetes. People should ask a health care provider what to do about severe hypoglycemia. Another person can help someone who has passed out by giving an injection of glucagon. Glucagon will rapidly bring the blood glucose level back to normal and help the person regain consciousness. A health care provider can prescribe a glucagon emergency kit. Family, friends, or coworkers—the people who will be around the person at risk of hypoglycemia—can learn how to give a glucagon injection and when to call 911 or get medical help.

Physical Activity and Blood Glucose Levels

Physical activity has many benefits for people with diabetes, including lowering blood glucose levels. However, physical activity can make levels too low and can cause hypoglycemia up to 24 hours afterward. A health care provider can advise about checking the blood glucose level before exercise. For those who take insulin or one of the oral medications that increase insulin production, the health care provider may suggest having a snack if the glucose level is below 100 mg/dL or adjusting medication doses before physical activity to help avoid hypoglycemia. A snack can prevent hypoglycemia. The health care provider may suggest extra blood glucose checks, especially after strenuous exercise.

Hypoglycemia When Driving

Hypoglycemia is particularly dangerous if it happens to someone who is driving. People with hypoglycemia may have trouble concentrating or seeing clearly behind the wheel and may not be able to react quickly to road hazards or to the actions of other drivers. To prevent problems, people at risk for hypoglycemia should check their blood glucose level before driving. During longer trips, they should check their blood glucose level frequently and eat snacks as needed to keep the level at 70 mg/dL or above. If necessary, they should stop for treatment and then make sure their blood glucose level is 70 mg/dL or above before starting to drive again.

Hypoglycemia Unawareness

Some people with diabetes do not have early warning signs of low blood glucose, a condition called hypoglycemia unawareness. This condition occurs most often in people with type 1 diabetes, but it can also occur in people with type 2 diabetes. People with hypoglycemia unawareness may need to check their blood glucose level more often so they know when hypoglycemia is about to occur. They also may need a change in their medications, meal plan, or physical activity routine.

Hypoglycemia unawareness develops when frequent episodes of hypoglycemia lead to changes in how the body reacts to low blood glucose levels. The body stops releasing the hormone epinephrine and other stress hormones when blood glucose drops too low. The loss of the body's ability to release stress hormones after repeated episodes of hypoglycemia is called **h**ypoglycemia-**a**ssociated **a**utonomic **f**ailure, or HAAF.

Epinephrine causes early warning symptoms of hypoglycemia such as shakiness, sweating, anxiety, and hunger. Without the release of epinephrine and the symptoms it causes, a person may not realize that hypoglycemia is occurring and may not take action to treat it. A vicious cycle can occur in which frequent hypoglycemia leads to hypoglycemia unawareness and HAAF, which in turn leads to even more severe and dangerous hypoglycemia. Studies have shown that preventing hypoglycemia for a period as short as several weeks can sometimes break this cycle and restore awareness of symptoms. Health care providers may therefore advise people who have had severe hypoglycemia to aim for higher-than-usual blood glucose targets for short-term periods.

Being Prepared for Hypoglycemia

People who use insulin or take an oral diabetes medication that can cause low blood glucose should always be prepared to prevent and treat low blood glucose by

- learning what can trigger low blood glucose levels
- having their blood glucose meter available to test glucose levels; frequent testing may be critical for those with hypoglycemia unawareness, particularly before driving a car or engaging in any hazardous activity
- always having several servings of quick-fix foods or drinks handy
- wearing a medical identification bracelet or necklace
- planning what to do if they develop severe hypoglycemia
- telling their family, friends, and coworkers about the symptoms of hypoglycemia and how they can help if needed

Normal and Target Blood Glucose Ranges	
Normal Blood Glucose Levels in People Who Do Not Have Diabetes	
Upon waking—fasting	70 to 99 mg/dL
After meals	70 to 140 mg/dL
Target Blood Glucose Levels in People Who Have Diabetes	
Before meals	70 to 130 mg/dL
1 to 2 hours after the start of a meal	below 180 mg/dL

Source: American Diabetes Association. Standards of Medical Care in Diabetes—2008. *Diabetes Care*. 2008;31:S12–S54.

For people with diabetes, a blood glucose level below 70 mg/dL is considered hypoglycemia.

Hypoglycemia in People Who Do Not Have Diabetes

Two types of hypoglycemia can occur in people who do not have diabetes:

- Reactive hypoglycemia, also called postprandial hypoglycemia, occurs within 4 hours after meals.
- Fasting hypoglycemia, also called postabsorptive hypoglycemia, is often related to an underlying disease.

Symptoms of both reactive and fasting hypoglycemia are similar to diabetes-related hypoglycemia. Symptoms may include hunger, sweating, shakiness, dizziness, light-headedness, sleepiness, confusion, difficulty speaking, anxiety, and weakness.

To find the cause of a patient's hypoglycemia, the doctor will use laboratory tests to measure blood glucose, insulin, and other chemicals that play a part in the body's use of energy.

Reactive Hypoglycemia

Diagnosis

To diagnose reactive hypoglycemia, the doctor may

- ask about signs and symptoms
- test blood glucose while the patient is having symptoms by taking a blood sample from the arm and sending it to a laboratory for analysis*
- check to see whether the symptoms ease after the patient's blood glucose returns to 70 mg/dL or above after eating or drinking

A blood glucose level below 70 mg/dL at the time of symptoms and relief after eating will confirm the diagnosis. The oral glucose tolerance test is no longer used to diagnose reactive hypoglycemia because experts now know the test can actually trigger hypoglycemic symptoms.

Causes and Treatment

The causes of most cases of reactive hypoglycemia are still open to debate. Some researchers suggest that certain people may be more sensitive to the body's normal release of the hormone epinephrine, which causes many of the symptoms of hypoglycemia. Others believe deficiencies in glucagon secretion might lead to reactive hypoglycemia.

A few causes of reactive hypoglycemia are certain, but they are uncommon. Gastric—or stomach—surgery can cause reactive hypoglycemia because of the rapid passage of food into the small intestine. Rare enzyme deficiencies diagnosed early in life, such as hereditary fructose intolerance, also may cause reactive hypoglycemia.

To relieve reactive hypoglycemia, some health professionals recommend

- eating small meals and snacks about every 3 hours
- being physically active
- eating a variety of foods, including meat, poultry, fish, or nonmeat sources of protein; starchy foods such as whole-grain bread, rice, and potatoes; fruits; vegetables; and dairy products
- eating foods high in fiber
- avoiding or limiting foods high in sugar, especially on an empty stomach

The doctor can refer patients to a registered dietitian for personalized meal planning advice. Although some health professionals recommend a diet high in protein and low in carbohydrates, studies have not proven the effectiveness of this kind of diet to treat reactive hypoglycemia.

Fasting Hypoglycemia

Diagnosis

Fasting hypoglycemia is diagnosed from a blood sample that shows a blood glucose level below 50 mg/dL after an overnight fast, between meals, or after physical activity.

Causes and Treatment

Causes of fasting hypoglycemia include certain medications, alcoholic beverages, critical illnesses, hormonal deficiencies, some kinds of tumors, and certain conditions occurring in infancy and childhood.

Medications. Medications, including some used to treat diabetes, are the most common cause of hypoglycemia. Other medications that can cause hypoglycemia include

- salicylates, including aspirin, when taken in large doses
- sulfa medications, which are used to treat bacterial infections
- pentamidine, which treats a serious kind of pneumonia
- quinine, which is used to treat malaria

If using any of these medications causes a person's blood glucose level to fall, the doctor may advise stopping the medication or changing the dose.

Alcoholic beverages. Drinking alcoholic beverages, especially binge drinking, can cause hypoglycemia. The body's breakdown of alcohol interferes with the liver's efforts to raise blood glucose. Hypoglycemia caused by excessive drinking can be serious and even fatal.

Critical illnesses. Some illnesses that affect the liver, heart, or kidneys can cause hypoglycemia. Sepsis, which is an overwhelming infection, and starvation are other causes of hypoglycemia. In these cases, treating the illness or other underlying cause will correct the hypoglycemia.

Hormonal deficiencies. Hormonal deficiencies may cause hypoglycemia in very young children, but rarely in adults. Shortages of cortisol, growth hormone, glucagon, or epinephrine can lead to fasting hypoglycemia. Laboratory tests for hormone levels will determine a diagnosis and treatment. Hormone replacement therapy may be advised.

Tumors. Insulinomas are insulin-producing tumors in the pancreas. Insulinomas can cause hypoglycemia by raising insulin levels too high in relation to the blood glucose level. These tumors are rare and do not normally spread to other parts of the body. Laboratory tests can pinpoint the exact cause. Treatment involves both short-term steps to correct the hypoglycemia and medical or surgical measures to remove the tumor.

Conditions occurring in infancy and childhood. Children rarely develop hypoglycemia. If they do, causes may include the following:

- Brief intolerance to fasting, often during an illness that disturbs regular eating patterns. Children usually outgrow this tendency by age 10.
- Hyperinsulinism, which is the overproduction of insulin. This condition can result in temporary hypoglycemia in newborns, which is common in infants of mothers with diabetes. Persistent hyperinsulinism in infants or children is a complex disorder that requires prompt evaluation and treatment by a specialist.
- Enzyme deficiencies that affect carbohydrate metabolism. These deficiencies can interfere with the body's ability to process natural sugars, such as fructose and galactose, glycogen, or other metabolites.
- Hormonal deficiencies such as lack of pituitary or adrenal hormones.

*A personal blood glucose monitor cannot be used to diagnose reactive hypoglycemia.

Points to Remember

Diabetes-related Hypoglycemia

- When people with diabetes think their blood glucose level is low, they should check it and treat the problem right away.
- To treat hypoglycemia, people should have a serving of a quick-fix food, wait 15 minutes, and check their blood glucose again. They should repeat the treatment until their blood glucose is 70 mg/dL or above.
- People at risk for hypoglycemia should keep quick-fix foods in the car, at work—anywhere they spend time.

- People at risk for hypoglycemia should be careful when driving. They should check their blood glucose frequently and snack as needed to keep their level 70 mg/dL or above.

Hypoglycemia Unrelated to Diabetes

- In reactive hypoglycemia, symptoms occur within 4 hours of eating. People with reactive hypoglycemia are usually advised to follow a healthy eating plan recommended by a registered dietitian.
- Fasting hypoglycemia can be caused by certain medications, critical illnesses, hereditary enzyme or hormonal deficiencies, and some kinds of tumors. Treatment targets the underlying problem.

Hope through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) was established by Congress in 1950 as one of the National Institutes of Health of the U.S. Department of Health and Human Services. The NIDDK conducts and supports research in diabetes, glucose metabolism, and related conditions. Researchers supported by the NIDDK are investigating topics such as the causes of hypoglycemia and whether use of continuous glucose monitoring devices can help prevent hypoglycemia.

Participants in clinical trials can play a more active role in their own health care, gain access to new research treatments before they are widely available, and help others by contributing to medical research. For information about current studies, visit www.ClinicalTrials.gov.

For More Information

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You may also find additional information about this topic by visiting MedlinePlus at www.medlineplus.gov.

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only because they are considered necessary in the context of the information provided. If a product is not mentioned, the omission does not mean or imply that the product is unsatisfactory.

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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 of 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 fact sheet was reviewed by Vivian A. Fonseca, M.D., F.R.C.P., Tulane University Health Sciences Center, New Orleans, LA; Catherine L. Martin, M.S., A.P.R.N., B.C.-A.D.M., C.D.E., University of Michigan Health System, Ann Arbor, MI; and Neil H. White, M.D., C.D.E., Department of Pediatrics, Washington University School of Medicine and St. Louis Children's Hospital, St. Louis, MO.

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