

Energy Fuel

Hormones

fasting

Blood  
Glucose

# How to lower morning highs

BY Hope S. Warshaw, R.D., CDE ILLUSTRATIONS BY Margaret Lee

Stumped by high fasting blood glucose results? Join the club. "It just doesn't compute. When I snack before bed, my fastings are lower than when I limit my night nibbles," says Pete Hyatt, 59, PWD type 2, of Vancouver, Washington.

"It's logical for people to point the finger for high fastings at what they eat between dinner and bed, but surprisingly food isn't the lead villain," says Robert Chilton, M.D., a cardiologist and professor of

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medicine at the University of Texas Health Science Center at San Antonio. The true culprit is compromised hormonal control of blood glucose levels.

### The essential hormones

During the years (up to a decade) that type 2 diabetes develops, the hormonal control of blood glucose breaks down. The four hormones involved in glucose control are:

**Insulin**, made in the beta cells of the pancreas, helps the body use glucose from food by helping it to move into the body's cells. People with type 2 have slowly dwindling insulin production and reserves and increasing insulin resistance.

**Amylin**, secreted from the beta cells, slows the release of glucose into the bloodstream after eating by slowing stomach-emptying and increasing the feeling of fullness. People with type 1 and type 2 diabetes are amylin-deficient.

**Incretins**, a group of hormones secreted from the intestines that includes glucagon-like peptide 1 (GLP-1), enhance the body's release of insulin after eating. This in turn slows stomach-emptying, promotes fullness, delays the release of glucose into the bloodstream, and prevents the pancreas from releasing glucagon, putting less glucose into the blood.

**Glucagon**, made in the alpha cells of the pancreas, breaks down glucose stored in the liver and muscles and releases it to provide energy when glucose from food isn't available.

### What's normal

When diabetes is not present, the body handles the changing supply of and demand for glucose (the energy from food) 24 hours a day. This system involves the four hormones—the messengers—and a continuous feedback loop that moves messages between the brain, gut, pancreas, and liver. Here's how the system works:

**When fasting:** As blood glucose falls after peaking from the last food eaten, the pancreas puts out less insulin. At the same time, two other hormones wane: amylin and glucagon-like peptide 1 (GLP-1), which help store and use glucose. A fourth hormone, glucagon, kicks into gear to offer a constant flow of glucose. Glucagon sends messages to the liver and muscles to make glucose from stored energy.

**After eating:** Food raises blood glucose and sends a message to the intestines to release GLP-1, which primes the insulin and amylin spigots. These hormones help cells use the glucose from food to fuel the body. The glucagon spigot turns off because there's little need for glucose from the liver or muscles when food is available. The impact of food on blood glucose, even for a large, high-fat meal, lasts less than six hours.

## Type 2 diabetes during sleep

During the years type 2 diabetes slowly develops, hormonal control of blood glucose breaks down. Eventually, here's what happens during sleep to a person with type 2 diabetes:

"Overnight, the liver and muscles get the message from excess glucagon to ramp up the glucose supply" because the person is sleeping, not eating, says Marty Irons, R.Ph., CDE. "There's not enough GLP-1, insulin, or amylin to stem the tide of excess glucose from the liver and muscles, essentially throwing this feedback loop out of whack." High

fasting blood glucose levels, particularly in the earlier years of type 2 diabetes, result from this hormonal imbalance. Evening meals and snacks may get the blame for morning highs, but hormones actually deserve it.



Take Control

## Your actions can make up for the hormonal imbalance of type 2 diabetes and give you better morning numbers.

### You can't completely reverse the hormonal imbalance of type 2 diabetes, but

a combination of actions can solve the high fasting blood glucose problem. "With your health care provider's guidance, experiment," says Arlene Monk, R.D., CDE, a dietitian and diabetes educator at the International Diabetes Center at Park Nicollet in Minneapolis. Here are some actions that may improve morning numbers:

#### Start, change, or add medication.

"Most people need to start a blood glucose-lowering drug at diagnosis to fight the insulin resistance and the hormonal imbalance," says Marty Irons, R.Ph., CDE. The most common starting medication, metformin, cuts down on glucose overproduction overnight. Beth DeLauder, 46, PWD type 2, from Stafford, Virginia, takes metformin, as does Pete. They both say it's been one factor among many lifestyle changes to help lower their fasting blood glucose levels.

Newer drugs are prescribed as starting or add-on medications when blood glucose goals aren't met. The oral dipeptidyl peptidase-4 (DPP-4) inhibitors Januvia and Onglyza keep

more GLP-1 hormone circulating. The more potent injectable GLP-1 agonists Byetta (twice daily) and Victoza (once daily) increase the amount of GLP-1 available. Some people also experience weight loss while using these medications.

"As type 2 progresses, especially beyond 10 years, many people need to add insulin to control fasting and other blood glucose levels through the day," Irons says. "For starters, most providers use long-acting Lantus or Levemir."

**Shed pounds.** Weight loss, especially soon after diagnosis of type 2 diabetes, can help the hormonal disturbances, increase insulin sensitivity, and lower blood glucose levels. The best approach: "Make lifestyle changes, choose more healthy foods, trim the portions of less healthy foods, and crank up your physical activity," Monk says.

You'll see blood glucose drop before the pounds do. "Losing weight pushed my A1C from 6.9 percent to 5.8 percent and my average fasting blood glucose from 140 to 100," Beth says. She's lost 35 pounds by minimizing processed foods and added sugars and sticking to her carb counts. Pete, who weighs about

220 pounds, has focused on not gaining weight—a realistic goal. For people who have had type 2 diabetes for many years, losing weight alone is unlikely to correct fasting highs—medications are needed.

#### Nibble a bit before bed.

A small bedtime snack containing no more than 20 grams of carbohydrate can help you wake up with better fasting blood glucose, Monk says. A bedtime snack shortens the time span that the liver is in overdrive producing glucose. Pete says this has been one of several fasting fixes that work for him.

**Get physical.** No matter what kind of aerobic activity you do or what time of day you do it, moving more enhances the body's response to insulin. "Being inactive is bad for us. Some is better than none; more is better than less," Monk says.

#### Work with your provider to mix and match solutions.

Consider the blood glucose numbers on your meter, your A1C results, your lifestyle, your schedule, the medications your health plan covers, and what you can afford. Use meter checks and regular A1C results to

assess the solutions you try. Fasting blood glucose numbers tell you how you made it through the night. Checks midway through your sleep cycle cast light on what's happening overnight. Be ready to change your solutions if you don't hit your targets immediately and as your years with diabetes add up. 📱

### Other whys for morning highs

Here are two other situations that may cause high fasting blood glucose levels:

**Dawn phenomenon** happens as part of the body's normal circadian rhythm to wake you up and get you going. Hormones, such as growth hormone and cortisol, are released and raise glucose. Without diabetes, the body simply responds to this early morning effect by putting out more of the hormones that keep blood glucose in control. That doesn't happen when you have type 1 or type 2 diabetes.

**Somogyi effect** is very high fasting blood glucose thought to be caused by the liver making a lot of excess glucose in response to hypoglycemia (low blood glucose) during the night. Somogyi effect is uncommon in type 2 diabetes. There's controversy as to whether it even exists with the rapid- and long-acting insulins available today.



Hope Warshaw, R.D., CDE, BC-ADM, coauthored *Real Life Guide to Diabetes* (American Diabetes Association, 2009) and is a contributing editor to *Diabetic Living*.