

INSULIN RESISTANCE INFORMATION

Insulin resistance is a complex condition in which your body does not respond as it should to insulin, a hormone your pancreas makes that's essential for regulating blood sugar levels. Several genetic and lifestyle factors can contribute to insulin resistance.

OVERVIEW

What is insulin resistance?

Insulin resistance, also known as impaired insulin sensitivity, happens when cells in your muscles, fat and liver don't respond as they should to insulin, a hormone your pancreas makes that's essential for life and regulating blood glucose (sugar) levels. Insulin resistance can be temporary or chronic and is treatable in some cases.

Under normal circumstances, insulin functions in the following steps:

- ✓ Your body breaks down the food you eat into glucose (sugar), which is your body's main source of energy.
- ✓ Glucose enters your bloodstream, which signals your pancreas to release insulin.
- ✓ Insulin helps glucose in your blood enter your muscle, fat and liver cells so they can use it for energy or store it for later use.
- ✓ When glucose enters your cells and the levels in your bloodstream decrease, it signals your pancreas to stop producing insulin.

For several reasons, your muscle, fat and liver cells can respond inappropriately to insulin, which means they can't efficiently take up glucose from your blood or store it. This is insulin resistance. As a result, your pancreas makes more insulin to try to overcome your increasing blood glucose levels. This is called hyperinsulinemia.

As long as your pancreas can make enough insulin to overcome your cells' weak response to insulin, your blood sugar levels will stay in a healthy range. If your cells become too resistant to insulin, it leads to elevated blood glucose levels (hyperglycemia), which, over time, leads to prediabetes and Type 2 diabetes.

In addition to Type 2 diabetes, insulin resistance is associated with several other conditions, including:

- ✓ Obesity.
- ✓ Cardiovascular disease.
- ✓ Nonalcoholic fatty liver disease.
- ✓ Metabolic syndrome.
- ✓ Polycystic ovary syndrome (PCOS).

What is the difference between insulin resistance and diabetes?

Anyone can develop insulin resistance — temporarily or chronically. Over time, chronic insulin resistance can lead to prediabetes and then Type 2 diabetes if it's not treated or able to be treated.



Prediabetes happens when your blood glucose levels are higher than normal, but not high enough to be diagnosed as diabetes. Prediabetes usually occurs in people who already have some insulin resistance.

Prediabetes can lead to Type 2 diabetes (T2D), the most common type of diabetes. T2D happens when your pancreas doesn't make enough insulin or your body doesn't use insulin well (insulin resistance), resulting in high blood glucose levels.

Who does insulin resistance affect?

Insulin resistance can affect anyone — you don't have to have diabetes — and it can be temporary (for example, using steroid medication for a brief period causes insulin resistance) or chronic. The two main factors that seem to contribute to insulin resistance are excess body fat, especially around your belly, and a lack of physical activity.

People who have prediabetes and Type 2 diabetes usually have some level of insulin resistance. People with Type 1 diabetes can also experience insulin resistance.

How does insulin resistance affect my body?

The development of insulin resistance typically increases insulin production (hyperinsulinemia) so your body can maintain healthy blood sugar levels. Elevated levels of insulin can result in weight gain, which, in turn, makes insulin resistance worse.

Hyperinsulinemia is also associated with the following conditions:

- ✓ Higher triglyceride levels.
- ✓ Hardening of the arteries (atherosclerosis).
- ✓ High blood pressure (hypertension).

Insulin resistance is also the main feature of metabolic syndrome, which is a set of features that link excess fat around the waist and insulin resistance to increased risk of cardiovascular disease, stroke and Type 2 diabetes.

Features of metabolic syndrome include:

- ✓ Elevated blood glucose levels.
- ✓ An elevated triglyceride level.
- ✓ Low levels of high-density lipoprotein (HDL) cholesterol.
- ✓ High blood pressure.

You don't have to have all four of these features to have metabolic syndrome.

SYMPTOMS AND CAUSES

What are the symptoms of insulin resistance?

If you have insulin resistance, but your pancreas can increase insulin production to keep your blood sugar levels in range, you won't have any symptoms.

However, over time, insulin resistance can get worse, and the cells in your pancreas that make insulin can wear out. Eventually, your pancreas is no longer able to produce enough insulin to



overcome the resistance, leading to elevated blood sugar (hyperglycemia), which does cause symptoms.

Symptoms of high blood sugar include:

- ✓ Increased thirst.
- ✓ Frequent urination (peeing).
- ✓ Increased hunger.
- ✓ Blurred vision.
- ✓ Headaches.
- ✓ Vaginal and skin infections.
- ✓ Slow-healing cuts and sores.

Many people have no symptoms of prediabetes, often for years. Prediabetes may be invisible until it develops into Type 2 diabetes. Some people with prediabetes may experience the following symptoms:

- ✓ Darkened skin in your armpit or back and sides of your neck, called acanthosis nigricans.
- ✓ Skin tags (small skin growths).
- ✓ Eye changes that can lead to diabetes-related retinopathy.

If you're experiencing any of these symptoms, it's important to see your doctor.

What causes insulin resistance?

Scientists still have a lot to discover about how exactly insulin resistance develops. So far, they've identified several genes that make a person more or less likely to develop insulin resistance. In addition, older people are more prone to insulin resistance.

Several factors and conditions can cause varying degrees of insulin resistance. Scientists believe that excess body fat, especially around your belly, and physical inactivity are the two main contributing factors to insulin resistance.

Acquired causes of insulin resistance

Acquired causes, meaning you're not born with the cause, of insulin resistance include:

- ✓ **Excess body fat:** Scientists believe obesity, especially excess fat in your belly and around your organs (visceral fat), is a primary cause of insulin resistance. A waist measurement of 40 inches or more for men and people assigned male at birth and 35 inches or more for women and people assigned female at birth is linked to insulin resistance. Studies have shown that belly fat makes hormones and other substances that can contribute to long-term inflammation in your body. This inflammation may play a role in insulin resistance
- ✓ **Physical inactivity:** Physical activity makes your body more sensitive to insulin and builds muscle that can absorb blood glucose. A lack of physical activity can have opposite effects and cause insulin resistance. In addition, a lack of physical activity and a sedentary lifestyle are associated with weight gain, which can also contribute to insulin resistance.



- ✓ **Diet:** A diet of highly processed, high-carbohydrate foods and saturated fats has been linked to insulin resistance. Your body digests highly processed, high-carbohydrate foods very quickly, which causes your blood sugar to spike. This puts extra stress on your pancreas to produce a lot of insulin, which, over time, can lead to insulin resistance.
- ✓ **Certain medications:** Certain medications can cause insulin resistance, including steroids, some blood pressure medications, certain HIV treatments and some psychiatric medications.

Hormonal disorders that can cause insulin resistance

Your body makes hundreds of hormones, which are chemicals that coordinate different functions in your body by carrying messages through your blood to your organs, muscles and other tissues. These signals tell your body what to do and when to do it.

Issues with certain hormones can affect how well your body uses insulin. Hormonal disorders that can cause insulin resistance include:

- ✓ **Cushing's syndrome:** This condition happens when there's extra cortisol in your body. Cortisol, the "stress hormone," is vital to regulating your blood sugar levels (by increasing them) and turning food into energy. Excess cortisol can counteract the effects of insulin, causing insulin resistance.
- ✓ **Acromegaly:** This is a rare but serious condition that happens when you have high levels of growth hormone (GH). High levels of GH can cause increased production of glucose, which can lead to insulin resistance.
- ✓ **Hypothyroidism:** This condition happens when your thyroid is underactive and doesn't produce enough thyroid hormone. Your thyroid plays a large role in regulating your metabolism (how your body transforms the food you eat into energy). When it makes too little thyroid hormone, it slows down your metabolism, including your glucose metabolism, which can lead to insulin resistance.

DIAGNOSIS AND TESTS

How is insulin resistance diagnosed?

Insulin resistance is difficult to diagnose because there isn't routine testing for it, and as long as your pancreas is producing enough insulin to overcome the resistance, you won't have any symptoms.

As there's no single test that can directly diagnose insulin resistance, your healthcare provider will consider several factors when assessing insulin resistance, including your:

- ✓ Medical history.
- ✓ Family history.
- ✓ Physical exam.
- ✓ Signs and symptoms.
- ✓ Test results.



Your healthcare provider may also order tests that can help diagnose other conditions that are associated with insulin resistance, such as metabolic syndrome, cardiovascular disease and polycystic ovary syndrome (PCOS).

MANAGEMENT AND TREATMENT

How is insulin resistance treated?

Since not all factors that contribute to insulin resistance can be treated, such as genetic factors and age, lifestyle modifications are the primary treatment for insulin resistance. Lifestyle modifications include:

- ✓ **Eating a healthy diet:** Your healthcare provider or nutritionist may recommend avoiding eating excessive amounts of carbohydrates (which stimulate excess insulin production) and eating less unhealthy fat, sugar, red meats and processed starches. Instead, they'll likely recommend eating a diet of whole foods that includes more vegetables, fruits, whole grains, fish and lean poultry.
- ✓ **Physical activity:** Getting regular amounts of moderate-intensity physical activity helps increase glucose energy usage and improve muscle insulin sensitivity. A single session of moderate-intensity exercise can increase glucose uptake by at least 40%.
- ✓ **Losing excess weight:** Your healthcare provider may recommend trying to lose excess weight to try treating insulin resistance. One study revealed that losing 7% of your excess weight can reduce the onset of Type 2 diabetes by 58%.

Over time, these lifestyle modifications can:

- ✓ Increase insulin sensitivity (reduce insulin resistance).
- ✓ Lower your blood glucose levels.
- ✓ Decrease blood pressure.
- ✓ Decrease triglyceride and LDL ("bad") cholesterol levels.
- ✓ Raise HDL ("good") cholesterol levels.

You may work with other healthcare providers, such as a nutritionist and endocrinologist, in addition to your regular doctor to come up with an individualized treatment plan that works best for you.

What medications are used to treat insulin resistance?

While there are currently no medications that treat insulin resistance specifically, your healthcare provider may prescribe medications to treat coexisting conditions. Some examples include:

- ✓ Blood pressure medication.
- ✓ Metformin for diabetes.
- ✓ Statins to lower LDL cholesterol.



Can I reverse insulin resistance?

Insulin resistance has several causes and contributing factors. While lifestyle changes, such as eating a healthy diet, exercising regularly and losing excess weight, can increase insulin sensitivity and decrease insulin resistance, not all causes are reversible.

Talk to your healthcare provider about what you can do to best manage insulin resistance.

How can diet affect insulin resistance?

Your diet has a big impact on your blood sugar and insulin levels. Highly processed, high-carbohydrate and high-fat foods require more insulin.

In general, eating foods that have a low to medium glycemic index and limiting foods that have a high glycemic index can help you reverse and/or manage insulin resistance. Eating foods with fiber also helps regulate blood sugar levels because it takes your body longer to digest fiber, meaning your blood sugar levels don't spike as much.

The glycemic index (GI) is a measurement that ranks foods containing carbohydrates according to how much they affect your blood sugar levels. The Glycemic Index Foundation (GIF) classifies the GI of foods as either low, medium or high, with pure glucose generally as a reference at 100:

- ✓ **Low GI:** 55 or less.
- ✓ **Medium GI:** 56–69.
- ✓ **High GI:** 70 or greater

High-GI foods generally have a lot of carbohydrates and/or sugar and low to no fiber content. Low-GI foods generally have low amounts of carbohydrates and higher amounts of fiber.

Examples of foods with a high GI include:

- ✓ White bread.
- ✓ Potatoes.
- ✓ Breakfast cereals.
- ✓ Cakes and cookies.
- ✓ Fruits such as watermelon and dates.

Examples of foods with a low GI include:

- ✓ Beans and legumes.
- ✓ Fruits such as apples and berries.
- ✓ Non-starchy vegetables, such as asparagus, cauliflower and leafy greens.
- ✓ Nuts.
- ✓ Dairy, fish and meat.

Always talk to your healthcare provider before making extreme changes to your diet.



PREVENTION

What are the risk factors for developing insulin resistance?

Certain genetic and lifestyle risk factors make it more likely that you'll develop insulin resistance or prediabetes. Risk factors include:

- ✓ Overweight or obesity, especially excess fat around your belly.
- ✓ Being age 45 or older.
- ✓ A first-degree relative (parent or sibling) with diabetes. Having a sedentary lifestyle.
- ✓ Certain health conditions, such as high blood pressure and abnormal cholesterol levels.
- ✓ A history of gestational diabetes.
- ✓ A history of heart disease or stroke.
- ✓ Having a sleeping disorder, such as sleep apnea.
- ✓ Smoking.

Although you can't change certain risk factors for insulin resistance, such as family history or age, you can try lowering your chances of developing it by maintaining a healthy weight, eating a healthy diet and exercising regularly.

OUTLOOK / PROGNOSIS

What is the prognosis (outlook) for insulin resistance?

The prognosis (outlook) of insulin resistance depends on several factors, including:

- ✓ The cause of insulin resistance.
- ✓ The severity of insulin resistance.
- ✓ How well your insulin-producing cells are working.
- ✓ How susceptible you are to developing complications from insulin resistance.
- ✓ Adherence to treatment and your body's response to treatment.

People can have mild insulin resistance that never turns into prediabetes or Type 2 diabetes.

People can also have insulin resistance that's reversible or very manageable with lifestyle changes.

For some people who have inherited conditions that cause severe insulin resistance, it can be life-threatening or lead to death.

If you have insulin resistance, ask your healthcare provider about what you can expect and how best to manage it.

What are the complications of insulin resistance?

The majority of the complications that can result from insulin resistance are related to the development of vascular (blood vessel) complications due to elevated blood sugar levels and elevated insulin levels (hyperinsulinemia).

Not everyone who has insulin resistance will have complications. If you've been diagnosed with insulin resistance, Type 2 diabetes or metabolic syndrome, it's important to see your healthcare provider regularly and follow your treatment plan to try to prevent these complications.