

Insulin Resistance

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I vividly remember my first day of medical school in 1988 when the professor said, "half of what we teach you in the next four years is wrong - unfortunately we don't know which half". This statement proved true when we were told to recommend eating a low fat, low cholesterol diet. Back then it was believed that dietary cholesterol and fat were the primary cause of high blood cholesterol and body fat, that in turn caused medical problems including diabetes and heart disease. Therefore, people at that time significantly decreased dietary protein and fat (that we have been eating for thousands of years) and replaced it with significantly less healthy refined carbohydrates/sugar. This contributed to the greatest obesity epidemic in US history. Two thirds of US adults are now overweight and since 1970, the diabetes rate has tripled. Finally, after years of high-level research, the FDA in 2015 lifted restrictions on dietary fat and cholesterol and instead recommended reducing refined carbohydrates.

Your body gets its fuel from three kinds of food: Carbohydrates, protein, and fat. Carbohydrates are plant food such as fruits, vegetables, grains and sugar. Fat and protein come from animal products, including eggs, meat, and dairy as well as from fatty vegetables such as nuts and olives. Each kind of food has its own building block. For carbohydrates, it is a type of sugar called glucose. For proteins it is amino acids, and for fat it is fatty acids. When you eat food, your body breaks down each kind of food into its building block before it gets absorbed. When these fuels enter the blood stream, your body needs insulin to process the glucose from carbohydrates, but hardly any insulin at all to process amino acids and fatty acids from animal products and fatty vegetables. Therefore, the amount of insulin your body produces depends mainly on how many carbohydrates you eat. Additionally, when a person eats what they believe to be a relatively healthy diet of carbohydrates such as bread, potatoes, pasta and rice, they may not realize that their body breaks these down into glucose, the same as if they ate cake and candy. Both types of food will spike your insulin levels, but the bread and potatoes will give you good nutrition whereas the cake and candy will not.

Dietary recommendations today are to eat about 2000 calories per day for women and 2500 calories per day for men, with a ratio of about 50% carbohydrates, 30% fat and 20% protein. If you have insulin resistance, consider decreasing the carbohydrate percent. Most importantly, you want to decrease certain types of carbohydrates. Refined carbohydrates are grain products that have been processed so the whole grain is no longer intact. This removes dietary fiber, minerals and vitamins and increases your risk of developing diabetes. These include foods like white bread, white rice, regular spaghetti. Classic unhealthy carbohydrates include foods like pancakes, soft pretzels, bread products, cereal, potatoes, corn, pastries, cookies, cakes, ice cream, sugary drinks and pop. Eating these types of foods can trigger insulin resistance which in turn causes abdominal fat and a wide variety of serious medical conditions.

What is insulin resistance? Insulin resistance is a reduced response to the hormone insulin. When we eat a high carbohydrate diet, high levels of insulin are needed to regulate the increased sugar. After years of doing this, the body frequently becomes less responsive to insulin. The pancreas responds by making even more insulin. **The key feature of insulin resistance is that blood levels of insulin are higher than they used to be, and the insulin does not work as well. By reducing carbohydrates (sugar) in your diet, we do not need as much insulin and insulin resistance improves.**

Belly fat - the canary in the coal mine: In the last 50 years, our bellies have increased in size significantly more than any other part of the body. In this same time frame, the most significant calorie increase came from carbohydrates/sugars - especially pop and fruit juices. Visceral obesity (beer gut, pot belly) occurs when subcutaneous fat (that you can pinch) from around the hip and thighs is re-distributed deep underneath the muscles of the abdomen and wrapped around the abdominal organs. This is the unhealthiest area to have fat and is associated with a multitude of medical conditions. Insulin resistance is the primary cause of moving fat from the subcutaneous areas of the buttock and thighs to the very unhealthy visceral area under the abdomen.

How to diagnose insulin resistance:

History: Excess abdominal fat (see below), high blood pressure, family history of heart disease, elevated triglycerides, water retention, skin tags, family members with diabetes, polycystic ovarian disease. Yes, two of the above equals insulin resistance. Scientists believe over half of adults in the United States have insulin resistance, and most do not know it.

Physical exam:

1. An increase in abdominal fat compared to hip and thighs. For females, the ratio of the circumference of the waist (at the belly button) should be less than 0.8 compared to the widest part of the hips. If the hips are 40 inches, the waist should be less than 32 inches (40" times 0.8 equals 32") For males this should be less than 0.9-0.95. A general guideline is that your waist circumference should be less than half your height (a 6' person should have a waist less than 36"). You most certainly have insulin resistance if the waist is greater than 35 inches in a female and 40 inches in a male.
2. Blood pressure should be less than 130/85.

Laboratory findings:

1. **12 hour fasting insulin level should be less than 7.** Average is 8-9 for men and women in the United States. Greater than 18 is prediabetes/diabetes.
2. 12 hour fasting blood sugar should be less than 100.
3. Hemoglobin A1c (measures blood sugar over the previous 3 months) should be less than 5.7.
4. **Homeostatic model assessment (HOMA) score:** Fasting glucose level times fasting insulin level divided by 405 (e.g. fasting blood sugar is 105 times fasting insulin level of 9 divided by 405 equals 2.3). Normal should be less than 1.6. Insulin resistant 1.6-3.0. Prediabetes/diabetes greater than 3.0. **This is probably the best lab test for insulin resistance.**
5. Triglycerides should be less than 120.
6. HDL (good cholesterol) should be greater than 40 in men and greater than 50 in women.
7. Triglycerides/HDL ratio – should be less than 2. If your HDL is 50, your triglycerides should be less than 100.
8. LDL (bad cholesterol) should be less than 90 or less than 70 if you have coronary artery disease.
9. Apolipoprotein A – this is the primary protein associated with HDL (the good cholesterol) so you want the lab value to be above mid range.
10. Apolipoprotein B – this is a protein that is attached to the “bad” cholesterol (LDL and VLDL) so you want the lab value to be below average.
11. Sex hormone binding globulin – low levels of this hormone is associated with insulin resistance especially polycystic ovarian disease so you want the levels to be above average.
12. C-reactive protein more accurately predicts cardiovascular disorders than cholesterol levels.

The obesity epidemic: In the 1960's, Americans typically ate three meals per day with very limited snacking. **In the late 1970's, we significantly increased sugar in our diet and doubled our snacking between meals. As a result, our insulin levels remained constantly elevated.**

This is the primary reason for the American obesity epidemic as the constantly elevated insulin levels increased the body weight set point of millions of Americans.

Obesity and the body weight set point: Every person has a body weight set point that their body wants to weigh. In obese people, the set point is too high. If you weigh more than your set point, your body will increase your metabolism to try to lower your weight. If you weigh less than your set point, your body will decrease your metabolism to try to increase your weight. This is why almost all diets initially work, then as your weight gets below your set point, your metabolic rate drops and you gain the weight back. **What causes the body weight set point to be too high in obese people? Genetics and insulin resistance. You cannot change your DNA, but you can decrease your insulin levels, which can help lower your set point.**

Requirements for developing insulin resistance: There are two requirements for the development of insulin resistance: High insulin levels and insulin levels that never drop below average. **To prevent/reverse insulin resistance we need to decrease the high insulin levels (by eating a low sugar diet) and also must periodically get our insulin levels low (by not snacking between meals and intermittently fasting).**

Medical problems associated with insulin resistance: Alzheimer's dementia, heart disease, neuropathy (numb feet), polycystic ovarian disease, erectile dysfunction, cancer (breast, prostate, colorectal), migraines, acanthosis nigricans (dark skin where skin rubs together), skin tags, muscle loss, gallstones, gastroesophageal reflux disease, high cholesterol, diabetes, high blood pressure, nonalcoholic fatty liver disease, kidney stones, metabolic syndrome, obesity. If you or family members have any of these medical conditions, you have a higher chance of developing insulin resistance.

Insulin resistance and neuropathy: Neuropathy is a nerve disorder that causes pain, weakness, and numbness in the feet. As it progresses, loss of balance, erectile dysfunction and numbness in the hands can occur. Diabetes accounts for about 50% of all cases of neuropathy. Other common causes include excessive alcohol intake, chronic kidney disease, chemotherapy, cancer, B12 and folate deficiencies. About one third of all cases of neuropathy are idiopathic, which means we do not know the underlying cause. After diagnosing thousands of cases of neuropathy with EMG/NCS studies, I now believe that the majority of "idiopathic" neuropathies are actually due to insulin resistance. The typical person is in their 50's with a chief complaint of pins and needles sensations in the feet. They almost always have abdominal obesity and frequently have high blood pressure and high cholesterol and men frequently have erectile dysfunction. When they arrive in my office, they almost always have had a fasting blood sugar and a hemoglobin A1C performed that ruled out diabetes. Unfortunately, their physician never checked a fasting insulin level to diagnose the real cause – insulin resistance. Almost always, their fasting insulin is over 7 and their HOMA score (see above) is over 2.

Leptin Resistance: Leptin is a hormone that tells us that we are full and to stop eating. In people with insulin resistance with elevated insulin levels, leptin also becomes resistant and does not tell us that we are full.

Ethnicity: The Hispanic population has the greatest risk, then Asian, then African, then Caucasian.

Cortisol: Cortisol is a stress hormone and high levels can cause insulin resistance - so lower your stress.

Hypothyroidism: Can contribute to insulin resistance.

Gynecoid fat pattern: Subcutaneous fat (superficial fat just under the skin) located mainly on the hips and thighs, with less in the upper body and visceral (deep) abdomen. Pear shaped due to Estrogen - does not cause insulin resistance.

Android fat pattern: Causes deep visceral abdominal fat (fat wrapped around the organs). Less subcutaneous fat on the hips, thighs, arms. Pot/beer belly - does cause insulin resistance.

Lifestyle factors that contribute insulin resistance: Air pollution, cigarette smoke, things we eat and drink especially carbohydrates and sugar, lack of sleep and lack of exercise.

Glycemic index: Compares carbohydrates to white bread (whose number is 100). The higher the number, the worse the insulin resistance. How much does 50 g of a carbohydrate increase blood glucose/insulin relative to 50 g of white bread.

Glycemic load: a number that estimates how much a particular carbohydrate food will raise your blood glucose after you eat it. Over 20 is high and includes sugary drinks, candy, white pasta, bread, french fries, baked potatoes. Medium is 11-19 and includes whole-wheat pasta, brown rice, sweet potatoes, some fruits. Low as 10 or below and includes beans, cashews, peanuts, fiber rich vegetables and some fruits.

Primary culprits of insulin resistance:

1. Starch – flour, potatoes, rice.
2. Sugar beverages – pop, fruit juice.

Foods with high glycemic index/loads: These foods trigger insulin resistance and should be limited in your diet to prevent belly fat/diabetes, etc. Processed food, potatoes, French fries, bread, pasta, rice, cereal bars, pancakes, muffins, maple syrup, non-diet pop and Gatorade, fruit drinks, most candy, cakes, pastries, cookies, crackers, pretzels, potato chips, beer.

Foods with moderate glycemic index/loads: Okay to eat these foods but they should not be the main staple of your diet. Most fruits such as apple, banana, grapes, orange, peaches, raisins, apricots, honey, dark chocolate, beans, sugar-free chocolate milk, pizza with minimal crust.

Foods with low glycemic index/load: Can eat these foods frequently as long as calories not too high. Beef, pork, chicken, fish, lamb, cheese, peanuts, walnuts, almonds, cashews, most vegetables (avoid potatoes and corn on the cob), eggs, full fat Greek yogurt, cottage cheese, pickles, mayonnaise.

Continuous glucose monitoring: You can get a continuous glucose monitor that you attach to your arm for about \$40. You can then use your phone to monitor your glucose levels 24 hours a day seven days a week for two weeks. You will then know exactly which foods elevate your glucose levels. Most surprising to me was that large high calorie meals such as cheeseburgers, pizza, and a large steak with vegetables only increased my glucose levels by about 15 to 20 points but sugary drinks, cereal, french fries, cake and chocolate increased my glucose levels by about 40 points for two hours.

Good meal options:

Breakfast: Bacon, eggs, sausage, omelet, whole fat yogurt, cottage cheese with berries, almond milk smoothie. Limit fruit juice, cereal, cereal bars, muffins, pastries, pancakes with syrup.

Lunch: Hamburger without bread, cob salad, cheese, hard boiled eggs, sugar-free chocolate milk.

Supper: Beef, pork, chicken, fish, lamb, cheese, most vegetables. Limit pasta, potatoes, rice and bread.

Dessert/snacks: Chicken wings, chocolate, low-carb ice cream, nuts, seeds. Sugar-free Reese's peanut butter cups taste similar to the original but contain maltitol which can cause gas/diarrhea if you eat more than a couple. Limit potato chips, pretzels, cookies, cakes.

Drinks: Probably the easiest way to limit calories/sugars. Do not drink your calories. Do drink water (flavored and sparkling), unsweetened tea and coffee. Avoid fruit drinks and nondiet drinks. Diet forms of pop, tea and Gatorade will not increase blood glucose, but can increase your insulin levels.

Alcohol: Spirits such as whiskey, rum and tequila have a low glycemic index/load. Avoid mixing with nondiet fruit drinks and pop. Wine has a low glycemic index/load. Beer has a high glycemic index/load. Michelob ultra and Corona premier have significantly less carbs than most beer.

Intermittent fasting: Fasting for 12-24 hours significantly decreases insulin resistance. Some believe the best meal to skip is breakfast. This is because we need significantly more insulin to control blood glucose in the morning than we do in the afternoon and evening. Additionally, breakfast food is notorious for sugar and starch such as juice, cereal, bagels, toast. Most people can easily skip their evening snack a few days per week to allow them to fast for over 12 hours. I skip the evening snack and breakfast about twice a week to give me an 18-hour fast. This is relatively easy to do. For a person with significant obesity and a high body weight set point, you could consider occasionally fasting for 24 to 36 hours. Intermittent fasting is more important after binge eating/drinking over the holidays. If you are diabetic, you need to be very careful with any fasting as it can drop your glucose too low.

How to lower the insulin spike if you do eat a high carbohydrate meal:

1. Eat fruits and vegetables - do not drink them as this is less healthy and increases insulin.
2. Eat carbohydrates with meat and vegetables.
3. Do not eat carbs on an empty stomach.
4. Eat cheese, nuts, salad with oil dressing 15 minutes before the main meal. This slows how fast your stomach empties and slows insulin spike.
5. Eat a pickle that contains vinegar.
6. Eat high fiber foods such as berries, vegetables, beans, nuts.
7. Eat plenty of protein with the meal.
8. Drink a glass of water with 2 tablespoons raw apple vinegar cider before the meal. This will slow the glucose/ insulin surge.
9. Take Psyllium husks supplements.
10. Decreasing table salt may help slightly. That is because table salt is a minor contributor to salt intake which is much higher in bread and processed food.
11. Go for a walk after the meal. This will decrease the glucose spike.

How to reverse insulin resistance:

1. **Low carbohydrate diet:** This is the most important step in preventing/reversing insulin resistance.
2. **Intermittent fasting:** This is easy to do a couple days per week.
3. **Physical activity:** Both resistance exercise and aerobic exercise significantly decrease insulin resistance. High intensity interval training is the most effective. Should exercise for 20-45 minutes 5 days per week.
4. **Adequate sleep:** Sleeping less than 7 hours per night is strongly associated with obesity and developing insulin resistance.
5. **Lower stress and cortisol levels** with good sleep, meditation, yoga, massage, and enjoying life.
6. **Treat underlying medical conditions:** blood pressure, elevated triglycerides, polycystic ovarian syndrome.

Supplements that may lower insulin resistance: magnesium, vitamin D, zinc, Berberine.

Diet or Lifestyle Choices: If you want to gain weight, one of the best ways is to go on a diet. Studies show that about two-thirds of all people who go on a diet, quit within a year, then re-gain as much or more weight than they lost. Unhealthy foods and drink are positively correlated with happiness - birthday cake, popcorn at the movies, cold beer on the beach. You should be able to enjoy all of the foods that you eat and still be healthy by making easily obtainable lifestyle choices. Eat only when hungry, not when stressed or bored. Do not “clean your plate”. Be self-aware of the calories and glycemic load of the foods you eat and drink. Get enough exercise and sleep and limit the cholesterol/sugars you ingest.

Medications that can reverse insulin resistance:

1. **Metformin:** This is a diabetes drug that directly improves insulin sensitivity at the muscle and liver and lowers blood glucose and insulin levels. Promotes weight loss, lowers triglycerides and increases HDL. Main side effect is temporary diarrhea. Overall grade is an A-.
2. **Natural supplements (Berberine and/or Inositol):** 500 mg twice daily (range is 1 to 4 capsules/day). Helps with insulin resistance and regulates blood sugar levels but typically does not cause diarrhea commonly seen with Metformin.
3. **Hormone replacement therapy:** Appropriate hormone levels decrease visceral fat and improves insulin resistance and diabetes. **Testosterone** is most beneficial but needs very close monitoring in men and women. **Estrogen (postmenopausal women only)** and **thyroid** can be very helpful. **DHEA** (10-25 mg in females and 50-100 mg in males) is an over-the-counter hormone that can help decrease visceral fat and insulin resistance. Overall grade is an A-.
4. **Glucagon-like Peptide-1 (GLP-1)** These are new incredible drugs that significantly decreased visceral fat and thereby decrease insulin resistance. They are used for diabetes and for weight loss. They reduce appetite and food intake and increase satiety. Examples include Mounjaro (tirzepatide) and Ozempic (semaglutide). Common side effects include nausea, vomiting, diarrhea, constipation and abdominal pain. They are associated with muscle loss, so eat plenty of protein and lift weights. Overall grade is an A-.
5. **Aspirin:** Decreases inflammation, reduces insulin resistance and atherosclerotic events. Overall grade is B.

How to get started:

1. Document your starting point. Measure your weight (I prefer Friday morning, minimal/no clothes, after toileting) on an accurate scale. Measure your hip and waist circumference. Get labs (fasting glucose, fasting insulin, Hemoglobin A1c, lipid panel - HDL, LDL, total cholesterol, triglycerides). I calculate HOMA score (page 2) using both fasting and average glucose levels.
2. Decrease unhealthy carbohydrates in your diet, intermittently fast a couple of days per week, try to exercise 5 times per week, sleep 7 hours per night, and enjoy life and treat underlying medical conditions.
3. Consider supplements, hormones and medications to help reverse insulin resistance if indicated.
4. Re-evaluation: Measure your weight and hip/waist circumference once every week/month. Recheck labs in 3-6 months.

Good books to read:

1. *The Insulin Resistance Solution* by Rob Thompson M.D.
2. *Why We Get Sick* by Benjamin Bikman, PhD.
3. *Estrogen Matters* by Avrum Bluming, M.D. and Carol Tavaris, Ph.D.
4. *The Obesity Code* by Jason Fung, M.D.
5. *Outlive* by Peter Attia, M.D.