



Narodowe Centrum
Edukacji Żywieniowej



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INSULIN RESISTANCE

Insulin resistance is a condition in which the tissues, especially the liver, muscles and adipose tissue, are resistant to insulin, leading to increased insulin concentration in the blood. Tissue sensitivity to insulin depends on the genes, diet, degree and type of obesity, and the level of physical activity.

Insulin resistance is diagnosed with an oral glucose tolerance test (OGTT) in which glucose and insulin concentrations are measured. Firstly, while fasting and then 60 and 120 minutes after drinking a glucose solution. The results are then used to calculate the indices: HOMA-IR, QUICKI, MATSUDA, which must be interpreted by an experienced specialist: diabetologist, endocrinologist, gynaecologist.

Insulin resistance is a metabolic disorder associated with a high risk of developing type 2 diabetes within 10 years after the diagnosis.

Diet

Lifestyle modification plays a crucial role in the treatment of the disorder. Adhering to healthy diet rules is recommended in diet-based therapy of insulin resistance, i.e. regular consumption of balanced meals, reduction of simple sugars and animal fat, increased consumption of whole grain cereal products, vegetables and fruit. The diet should match the individual needs of every patient. Therefore, consider consulting a dietitian who will help change your eating habits.

Key nutritional guidelines

- 1 If you are overweight or obese, try to gradually lose weight. This will have a positive effect on the tissue sensitivity to insulin and the functioning of the whole body. Body mass reduction by only 5% has significant metabolic benefits, but the optimal body mass reduction should be at least 7%.
- 2 Eat regularly, every 3 to 4 hours, and have your last meal 2 to 3 hours before bedtime at the latest.



3 Avoid eating snacks in between meals. This also applies to energy drinks, such as coffee with milk and/or sugar, sweet teas and beverages. Every sugar-containing snack or beverage will increase glucose concentration in the blood, leading to increased insulin levels. Constant hyperinsulinemia exposes your tissues to insulin, which negatively affects their sensitivity. Additionally, hyperinsulinemia increases your appetite, making it more difficult to lose weight.

4 Try to compose your meals as presented on the Healthy Eating Plate. Make sure that half of the plate prepared for breakfast, dinner and supper is occupied by vegetables and fruit which are the source of fiber, vitamins and antioxidants. Their daily intake should be at least 400 g (3/4 of vegetables and 1/4 of fruit). Eat varied vegetables as often as you can, preferably raw or cooked al dente (let them be only slightly hard).

5 Consume fruits in smaller amounts, as they contain more simple sugars. Avoid overripe fruit, as it is more sweet and eat it raw, if you can. Berries are especially recommended, e.g. blueberries, raspberries, strawberries. You do not need to eliminate fruit such as banana, mango or melon from your diet. But try to combine fruit with products containing proteins and/or fat, as they delay the emptying of the stomach, thus prolonging the time of digestion and preventing rapid increase in glucose and insulin levels in the blood after a meal. For example, a handful of raspberries with natural yogurt and sprinkle of nuts/seeds or some peaches with cottage cheese wrapped in a whole grain pancake. Alternatively, fruit may constitute a healthy dessert served shortly after a larger balanced meal.

6 Products that are the source of carbohydrates (bread, groats, rice, pasta, cereal flakes and potatoes) should be an element of the majority of your meals and occupy approximately 1/4 of the plate. It is recommended to choose whole grain products, as they are the source of fiber, B vitamins and minerals. Wholemeal cereals are digested slowly, preventing rapid increase in glucose and insulin levels in the blood.

7 Products that are the source of protein (meat, fish, eggs, milk and dairy products, legumes) should occupy approximately 1/4 of your plate and be an element of every meal. Choose lean meats and skimmed dairy products. Substitute meat with fish once or twice a week and with legumes at least once a week. Eat red meat only occasionally, not more than 350-500 g per week, and cut down on meat products (cold meats, sausages, pâtés, offal products, etc.) to the bare minimum.

8 Eat two portions of natural dairy products daily, preferably fermented, as they are a rich source of protein and calcium (e.g. 1 portion equals 1 cup of yogurt). Choose skimmed products containing up to 3% fat and make sure they contain no sweet fruit mousses or chocolate. By increasing the amount of natural yogurt by one portion daily you reduce the risk of developing type 2 diabetes by 18%.

9 Products that are the source of fat can also be an element of a balanced meal, but should be used in smaller amounts. That is why they are shown next to the Plate image. Plant oils are especially recommended (canola oil, olive oil), as well as nuts, seeds, and avocado. So, in other words, products that are rich in anti-inflammatory unsaturated fatty acids. Individuals with insulin resistance should limit the amount of products that are the source of saturated fatty acids, such as fat meat, full-fat dairy products, butter.

10 Choose vegetables and fruit of different colours, whole grain cereal products, nuts and olive oil, as they are rich in polyphenols and antioxidants, and have a positive effect on insulin sensitivity of the tissues.

11 Limit the amount of sweets and products containing sugar. Read product labels and pick products with reduced or zero sugar content. Sometimes, sugar is replaced by sweeteners in those products. Studies have shown that natural sweeteners (stevia, xylitol) may have a positive effect on human health, as they act as antioxidants. On the other hand, research indicates that artificial sweeteners, such as sucralose or acesulfame potassium, may have a negative effect on the composition of the microbiota, and therefore should not be used on a regular basis.

12 Drink at least 1.5-2 litres of fluids a day. Replace sweetened drinks with sugar-free drinks, preferably water, as well as light tea and herbal infusions. Make sure to keep your body well hydrated by drinking small amounts of liquid more often.

13 The rate of digestion, and therefore, the rate of glucose and insulin level increase in the blood after a meal will depend on how you prepare and compose your meals. For that reason, you should avoid overcooking food. On the other hand, the following tips will help you positively affect the rate of postprandial glycaemia:

- compose your meals in accordance with the Healthy Eating Plate,
- introduce fermented and/or pickled products into your menu,
- cooling down the products that are the source of complex carbohydrates after cooking them (groats, rice, potatoes) results in the production of resistant starch,
- eat your meals slowly in a peaceful atmosphere.










14 Start your meal by eating vegetables first, then move on to the products that are the source of protein and fat, and have your carbohydrates at the very end. By keeping this order, instead of eating carbohydrates first, you will achieve lower postprandial glycaemia.

15 **If you are considering an alternative diet, consult your intention with a dietitian and/or your doctor.** Some studies suggest that low-carbohydrate diets that are based on animal products may increase the risk of death and cardiovascular diseases. However, a meta-analysis performed in 2013, covering numerous groups of volunteers, indicated that more large-scale studies are necessary to help understand complex interactions between low-carbohydrate diets and long-term results. High protein diet may help reduce body mass in a short-term perspective, as it provides the feeling of fullness. On the other hand, protein is a nutrient that stimulates insulin secretion, so using a high-protein diet for a longer period may trigger insulin resistance.











Recommended and not recommended products in insulin resistance

Remember that the overall profile of your diet, the composition of individual meals and the quality of individual products are all important aspects. In the table below you will find examples of products that should be the basis of your diet as well as those which you should limit to the bare minimum. Treat it as a guide to changing your dietary habits to healthier ones.

Products group	Recommended	Not recommended
Vegetables 	<ul style="list-style-type: none"> all fresh and frozen 	<ul style="list-style-type: none"> vegetables served with greasy sauces, roux
Fruit 	<ul style="list-style-type: none"> all fresh and frozen dried fruit in moderate quantities 	<ul style="list-style-type: none"> candied fruit fruit in syrups
Grain products 	<ul style="list-style-type: none"> wholegrain flour whole grain bread and graham bread natural cereal flakes, e.g. oat, barley flakes, spelt flakes, rye flakes, wheat, rye and oat bran groats: buckwheat, hulled barley, bulgur, quinoa rice: brown, wild, red wholegrain pasta: wheat, rye, buckwheat, spelt 	<ul style="list-style-type: none"> refined flour confectionery breads, light bread (toast bread, Kaiser roll, bread, butter rolls) sweetened breakfast cereals (cornflakes, chocolate flakes, muesli, crunchy flakes) fine-grained groats: farina, couscous, cornmeal white rice light pasta: wheat pasta, rice noodles
Potatoes 	<ul style="list-style-type: none"> boiled oven baked 	<ul style="list-style-type: none"> potatoes with fatty additives like cream or butter fried potatoes French fries, chips fried potato pancakes
Milk and dairy products 	<ul style="list-style-type: none"> reduced-fat milk (up to 2% fat) dairy products: natural (sugar-free), fermented, with up to 3% fat (e.g. yogurt, kefir, buttermilk, skyr, cottage cheese, soured milk) skimmed and semi-skimmed curd cheese mozzarella light cream cheese in moderate quantities 	<ul style="list-style-type: none"> fatty meats such as beef, pork, mutton, goose, duck, offal fatty cold cuts e.g. gammon, salami, brawn, bacon, spam canned meat, offal cold cuts, pâtés, hot dogs, kabanos sausages, sausage
Eggs 	<ul style="list-style-type: none"> soft-boiled eggs, hard-boiled eggs, poached eggs, scrambled eggs and omelettes fried without fat or with a small amount of fat 	<ul style="list-style-type: none"> eggs fried in a large amount of fat, e.g. butter, bacon, lard or salo (slanina) eggs served with mayonnaise
Meat and meat products 	<ul style="list-style-type: none"> lean skinless meat, e.g. veal, chicken, turkey, rabbit lean beef and pork (pork loin, tenderloin) in moderate quantities lean cold cuts, preferably home-made e.g. tenderloin, cooked ham, poultry cold cuts, roasted pork loin, roasted turkey/chicken breast 	<ul style="list-style-type: none"> fatty meats such as beef, pork, mutton, goose, duck, offal fatty cold cuts e.g. gammon, salami, brawn, bacon, spam canned meat, offal cold cuts, pâtés, hot dogs, kabanos sausages, sausage
Fish, fish products and seafood 	<ul style="list-style-type: none"> lean or fatty sea fish and freshwater fish, e.g. cod, sole, hake, blue grenadier, zander, bream, pike, perch, mackerel, salmon, halibut and carp herring and other fish in plant oil, smoked fish in moderate quantities 	<ul style="list-style-type: none"> canned fish
Legumes and legume products 	<ul style="list-style-type: none"> all, e.g. soybeans, chickpeas, peas, lentils, beans, broad beans legume spreads soy flour, sugar-free soy drinks, soy products: tofu, tempeh legume pastas (e.g. from beans or peas) 	<ul style="list-style-type: none"> low-quality, ready-made legume products, e.g. soy sausages, breaded soy cutlets, soy pâtés, vege burgers <p><i>*Read labels, compare ingredients and pay attention to added sugar, salt and fat content</i></p>

Recommended and not recommended products in insulin resistance

Products group	Recommended	Not recommended
Fats 	<ul style="list-style-type: none"> olive oil, canola oil, linseed oil butter and vegetable oils mix soft margarines 	<ul style="list-style-type: none"> butter and clarified butter lard, сало (slanina), tallow hard margarine (blocks) tropical oils: palm, coconut mayonnaise
Nuts and seeds 	<ul style="list-style-type: none"> nuts (e.g. walnuts, hazelnuts) and almonds seeds (e.g. pumpkin, sunflower) 	<ul style="list-style-type: none"> nuts and seeds: salted, in chocolate, in caramel, honey, sprinkled, breaded
Sugar and sweets, salty snacks 	<ul style="list-style-type: none"> dark chocolate, at least 70% cocoa natural yogurt with fresh fruit natural sweeteners e.g. xylitol, stevia, erythritol fruit purees, mousses and sorbets, jams with no added sugar in limited quantities as an element of a meal kissel and jellies without added sugar home-made pies and cakes without added sugar 	<ul style="list-style-type: none"> sugar, e.g. white, cane, brown, coconut honey, maple syrup, date syrup, agave syrup sweets high in sugar and fat, e.g. cakes, cookies, chocolate bars, milk and white chocolate, halva, doughnuts, Angel wings, candies high-sugar jam salty snacks, e.g. chips, salty sticks, crispy flakes, crackers, nachos, crisps
Beverages 	<ul style="list-style-type: none"> water sugar-free beverages, e.g. coffee, cereal coffee, tea, herbal and fruit infusions, kompots, cocoa vegetable and fruit juices in limited quantities as an element of a meal home-made lemonade with no sugar 	<ul style="list-style-type: none"> alcohol drinks sweet sparkling and still beverages energy drinks nectars, high-sugar fruit syrups drinking chocolate
Spices and sauces 	<ul style="list-style-type: none"> fresh and dried single-ingredient herbs, e.g. basil, oregano, turmeric, cinnamon, ginger salt-free spice mixtures home-made salad dressings based on a small amount of oil or yogurt, herbs, lemon 	<ul style="list-style-type: none"> salt (e.g. table salt, Himalayan salt, sea salt) spice mixtures containing large amounts of salt bouillon cubes liquid spices to enhance flavour ready-made sauces/dressings
Soups 	<ul style="list-style-type: none"> soups based on vegetable or lean meat broths soups whitened with yogurt or milk up to 2% fat 	<ul style="list-style-type: none"> soups based on fatty meat broths soups with roux, whitened with sour cream instant soups
Prepared meals 	<ul style="list-style-type: none"> frozen stir-fry vegetables mix, frozen fruit mix groats and legume blends cream soups ready-made vegetable stir-fry foods vegetable pastes and purees <p><i>*Read labels, compare ingredients and pay attention to added sugar, salt and fat content</i></p>	<ul style="list-style-type: none"> fast food, e.g. toasted open-faced sandwiches, hot dogs, hamburgers, kebab frozen pizzas, toasted open-faced sandwiches ready-made food products in breadcrumbs, fatty sauces, from refined flour instant oatmeal instant meals, e.g. sauces
Technological processing of food 	<ul style="list-style-type: none"> boiling, steaming (cereals, vegetables cooked al dente) grilling (electric grill, grill pans) baking in foil, parchment paper, roasting bags, heat-resistant dish no-fat frying stewing without pre-frying <p><i>* Small amounts of the recommended vegetable fat, e.g. olive oil or canola oil are acceptable, if used occasionally.</i></p>	<ul style="list-style-type: none"> deep frying stewing with prior deep-frying baking in large amounts of fat breadding



Quality menu ideas for individuals with insulin resistance

BREAKFAST:

Rye bread toasts with salmon cottage cheese

- wholemeal rye bread
- semi-fat cottage cheese
- natural yogurt
- smoked salmon
- cucumber
- radish
- dill

LUNCH:

Vegetable omelette

- egg
- ground oat flakes
- bell pepper
- mushrooms
- tomato
- onion

DINNER:

Ragout with chicken and buckwheat

- bell pepper
- zucchini
- onion
- tomato
- chicken breast
- buckwheat



AFTERNOON SNACK:

Chocolate and nuts smoothie

- banana
- whole grain cereal flakes
- milk 2% fat or plant drink without sugar
- peanut butter
- natural cocoa
- dark chocolate

SUPPER:

Chickpea salad

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|-------------------|--------------------|
| • potatoes | • black olives |
| • rocket | • onion |
| • canned chickpea | • olive oil |
| • tomato | • balsamic vinegar |
| • green cucumber | |



Physical activity

- 1 Make sure you exercise regularly. Physical activity is beneficial as it helps control body weight, increases tissue sensitivity to insulin, and is an important element of disease prevention. Try to be physically active for at least 30 minutes a day and adapt your activity to your abilities. Remember that simple activities, such as walking, climbing stairs, active housework, activities with children, are also beneficial.

Other lifestyle elements

- 1 Eliminate alcohol from your diet. Drinking alcohol with meals increases postprandial glycaemia, leading to increased insulin concentration.
- 2 Quit smoking. According to WHO, smoking is one of the risk factors of developing type 2 diabetes. Additionally, quitting smoking reduces the risk of heart attack and stroke.
- 3 If you are under stress, learn how to manage it effectively. Some relaxation techniques based on mindfulness and meditation may help, as well as breathing techniques or yoga.
- 4 Get enough good quality sleep (7-8 hours a day). Try to go to sleep and wake up at about the same time every day. Avoid using electronic devices (smartphone, tablet, computer, TV) one hour before bedtime. Poor sleep hygiene increases the risk of type 2 diabetes.
- 5 If you take metformin, make sure to control B12 vitamin level in the blood.

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