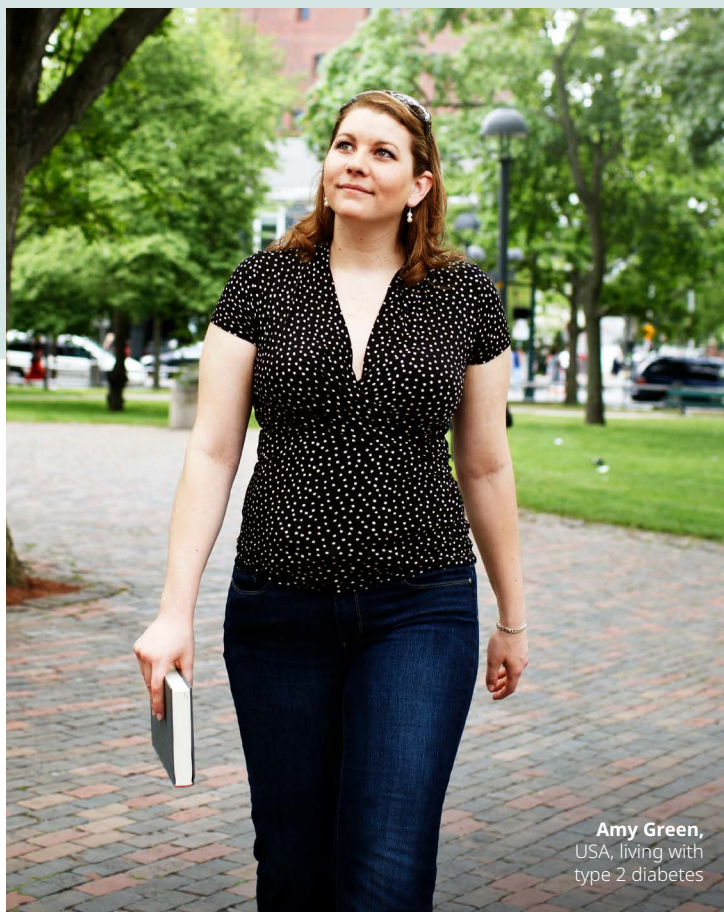


Diabetes Guide



Amy Green,
USA, living with
type 2 diabetes

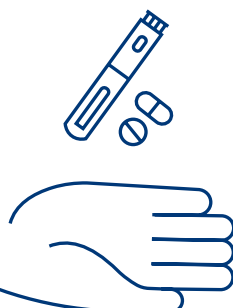
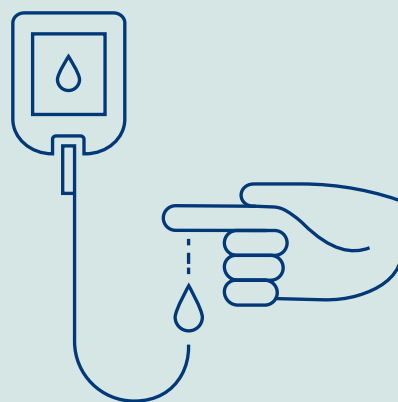




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Foreword

Dear Reader,

Diabetes mellitus (commonly referred to as simply diabetes) exists in every country around the world. Approximately 500,000 people are estimated to be living with diabetes in Switzerland. In addition, there are many people who do not know they have diabetes. Because untreated diabetes can lead to numerous complications, it is extremely important to diagnose the condition as early as possible.

The term “diabetes mellitus” is derived from the Greek word “diabetes” (= passing through) and the Latin word “mellitus” (= honey-sweet). This is a reference to the sugar that is excreted in urine instead of being absorbed by the body’s cells. Diabetes was already known in antiquity. It wasn’t until 1921, however, that the Canadians Banting and Best succeeded in extracting insulin, which is responsible for regulating sugar in the body, from pancreatic tissue and treating a dog with diabetes. A person with diabetes was first successfully treated with insulin in 1922.

With this guide, we would like to give you an overview of diabetes, how it develops, and diabetes therapy.

What is diabetes?

People living with diabetes have a sugar metabolism disorder. Sugar cannot be absorbed properly by the body's cells, which leads to an excessive increase in the amount of sugar in the blood, or blood sugar. The cause of this is a deficiency of insulin, a hormone produced naturally by the body, or resistance to insulin in the body's cells.

This means that

- the pancreas produces too little or no insulin and/or
- the body's own insulin is not sufficiently effective.

Type 1 diabetes

When the pancreas does not produce any insulin at all, this is referred to as type 1 diabetes. This form of diabetes usually occurs suddenly, often in children and adolescents, which is why it was also called "juvenile diabetes" in the past. An immediate and completely external supply of insulin is needed. Type 1 diabetes develops when the body's immune system (defence system) begins to destroy the insulin-producing cells in the pancreas. This immune system defect is also called autoimmunity.

Type 2 diabetes

Type 2 diabetes was formerly also called "adult-onset diabetes" because it often occurs in middle to old age. However, it is also increasingly affecting adolescents and young adults. In type 2 diabetes, the pancreas initially pro-

duces a greater amount of insulin, but the body's cells are often so resistant to the insulin that they absorb less sugar and blood sugar levels rise. As the disease progresses, the cells of the pancreas can no longer keep up with the increased need for insulin and decrease their production, which results in an insulin deficiency. This form of diabetes progresses gradually at first and thus often remains undetected for years. In the case of type 2 diabetes, the first step is to try to reduce the elevated blood glucose level by means of a targeted diet and, in the case of obesity, in particular through a balanced diet and increased exercise. However, type 2 diabetes is a chronic progressive disease. It may therefore be necessary to undergo additional medicinal therapy after some time. Risk factors for type 2 diabetes include a genetic predisposition, being overweight, a sedentary lifestyle, and previous gestational diabetes.

Gestational diabetes

Another form of diabetes is gestational diabetes. This form of diabetes occurs during pregnancy and often disappears after the baby is born.

However, in some women, the metabolic disorder may persist after giving birth, or type 2 diabetes may develop after five to ten years. It is therefore important to regularly monitor blood sugar levels after having had gestational diabetes.



Digestion and metabolism in a healthy organism

Nutrients and digestion

Our bodies are made up of billions of cells. Numerous complex chemical reactions take place in these cells. These processes are called metabolism. The body depends on this metabolism for performing muscle activities and for renewing or multiplying cells (e.g., skin and hair). A constant supply of nutrients is needed for metabolism to be maintained. The body obtains nutrients from the food ingested, which consists of the following three main nutrients:

1. Carbohydrates
2. Proteins
3. Fats

Carbohydrates and fats primarily act as energy-providing nutrients; proteins are used to build cells and perform numerous tasks. Ingested food is first digested, or broken down, in the stomach and intestines because the cells can only absorb very specific, simple substances.

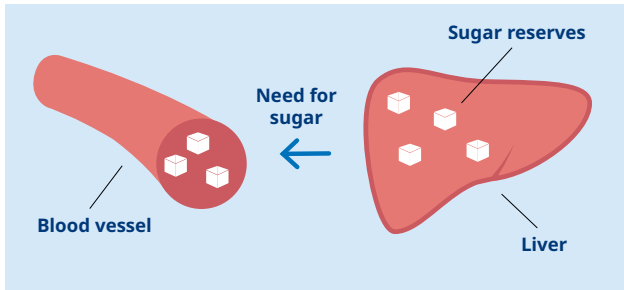
The **digestive system** breaks down complex food into the following simple building blocks:

- Carbohydrates become **glucose** ("sugar")
- Proteins become **amino acids**
- Fats become **fatty acids**

These building blocks can now pass through the intestinal wall and enter the bloodstream and cells.

Sugar metabolism

Our bodies always need energy, even when we are at rest. If this energy is not supplied through food, the cells resort to reserves in the body (such as in the liver). Sugar plays a special role in energy production because it can be quickly converted into energy if needed, such as during work or exercise.

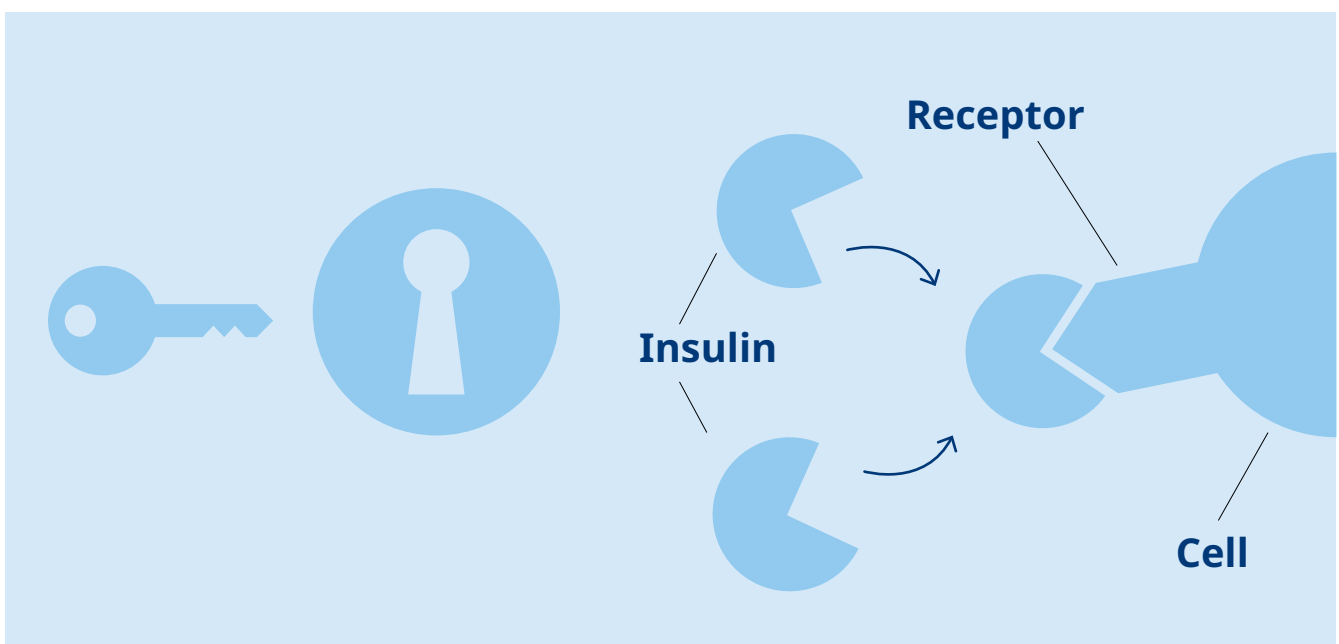


The body regulates the blood sugar level so that it is more or less constant. It ensures that, after a meal, sugar is absorbed from the bloodstream into cells and converted directly into energy there or stored in the liver as an energy reserve. Between meals, sugar from these reserves is released back into the bloodstream.

However, a “key” is needed in order to get the sugar out of the bloodstream and into the cells of the body in the first place. This “key” is insulin.

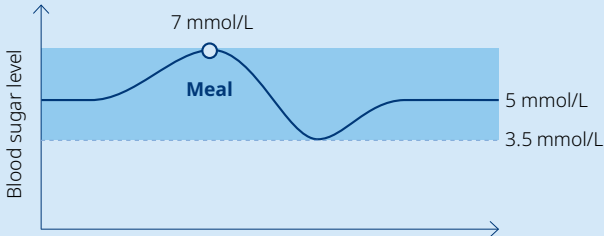
What is insulin and how does it work?

Insulin is a hormone (Greek: hormao = to drive). Hormones are signalling agents that trigger very targeted responses in the body in small amounts. Insulin is produced in the pancreas. It is released into the bloodstream by the pancreas and reaches the cells from there. On the cell surface, it encounters what are known as insulin receptors. Only when insulin binds to an insulin receptor (similar to a key and lock) can the sugar be absorbed into the cell's interior. Thus, insulin acts as the key to unlocking the cell “doors”.



Blood sugar levels in numbers

A person without diabetes has a normal blood sugar level of 5 mmol/L (90 mg/dL). Immediately after a meal, blood sugar may rise to about 7 mmol/L (126 mg/dL) or more, but then drops again. It rarely falls below 3.5 mmol/L (63 mg/dL).



The unit millimoles per litre indicates the number of sugar particles (sugar molecules) per litre of blood. There are millions of sugar particles in the blood. The unit millimole is therefore used to avoid working with such large numbers.

Blood sugar can also be indicated in milligrams of sugar per decilitre (mg/dL) of blood; 10 mmol/L are equivalent to 180 mg/dL. The conversion factor here is as follows:

From mmol/L to mg/dL: **18.016 x mmol/L = mg/dL**
From mg/dL to mmol/L: **0.0555 x mg/dL = mmol/L**

HbA_{1c}: glycated haemoglobin

Glucose “glycates” the haemoglobin in the red blood cells. This produces glycated haemoglobin, which can be measured as the so-called HbA_{1c} level and is indicated as the percentage of glycated haemoglobin. HbA_{1c} is measured approximately every three months, which corresponds to the life span of red blood cells. This provides a kind of average of the blood sugar levels during this period.

The following table shows the approximate relationship between HbA_{1c} and average blood sugar level.

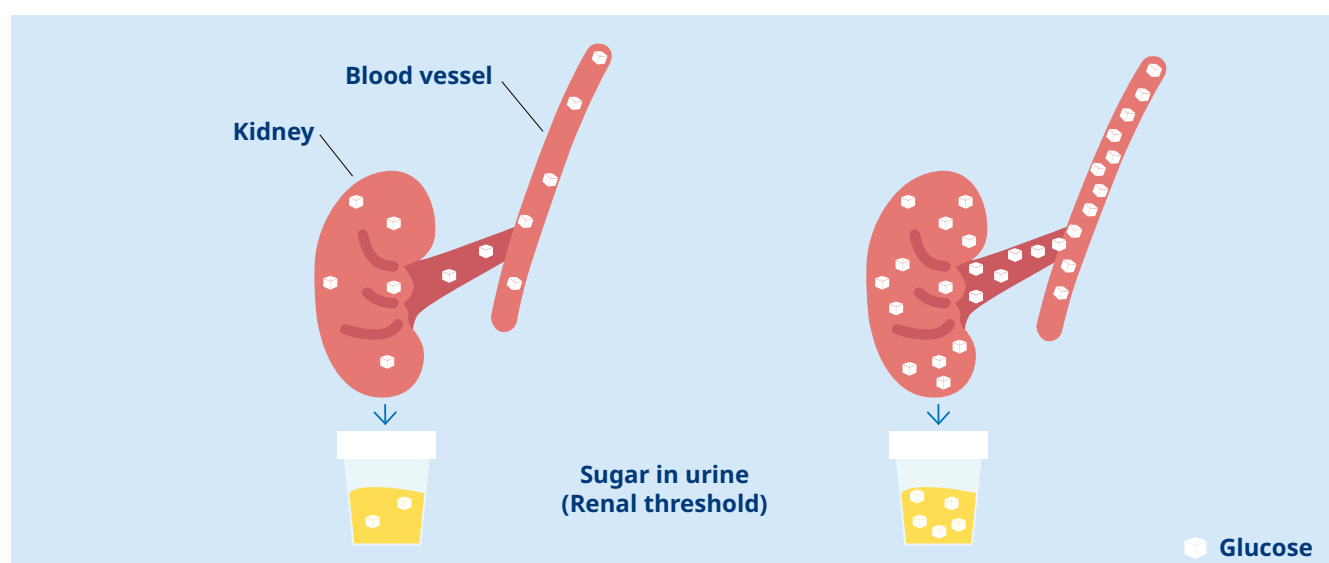
A person without diabetes has an HbA _{1c} of 4.0–6.4%	HbA _{1c} in %	Blood sugar in mmol/L
	5.5	5.0
	6.1	6.0
	6.6	7.0
	7.2	8.0
	7.7	9.0
	8.3	10.0
	8.8	11.0
	9.4	12.0
	9.9	13.0



Sugar metabolism in people with diabetes

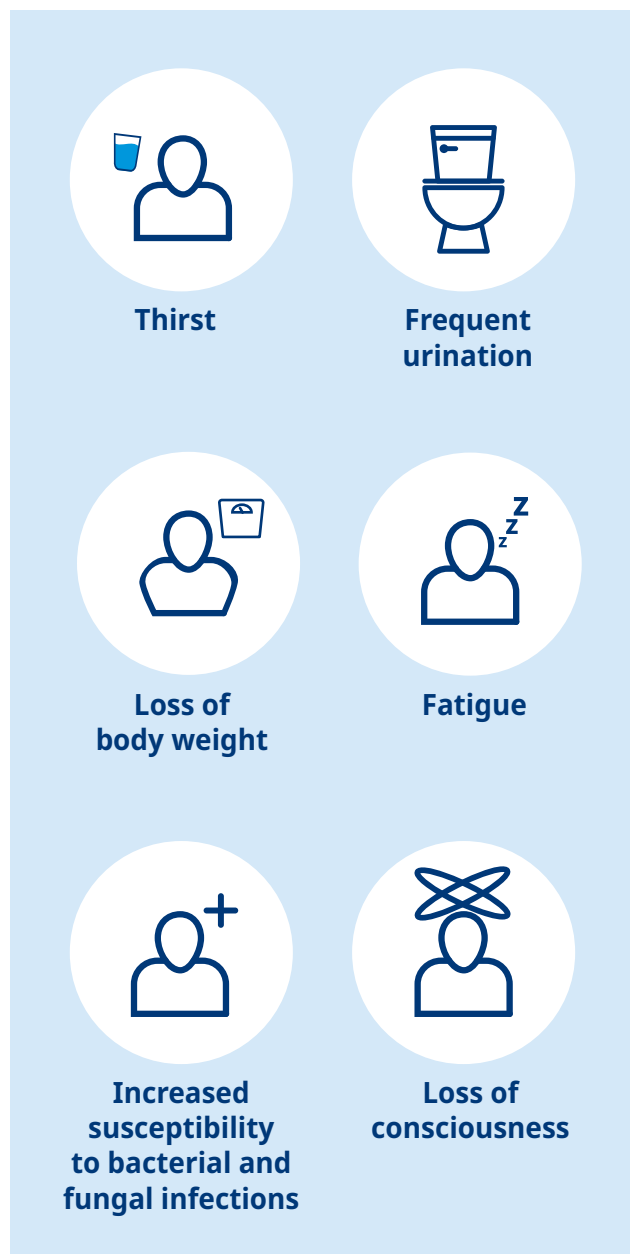
In the case of people with diabetes, the body produces little or no insulin. Sugar from food is therefore unable to be absorbed by the cells and remains in the blood. The blood sugar level can no longer be kept within the narrow limits and steadily increases. As it makes its way through the body, blood also circulates through the kidneys, which filter waste products out of the blood and

excrete them in the urine. Sugar is not a waste product and is therefore not normally excreted in urine. However, if blood sugar rises above a certain level, the kidneys also excrete sugar via urine. The blood sugar level at which the kidneys start to excrete sugar in the urine is also called the “renal threshold” and is approximately 10 mmol/L (180 mg/dL).



Symptoms of type 1 diabetes

At the time of diagnosis, most people living with type 1 diabetes already have a severe insulin deficiency. As a result, blood sugar levels rise rapidly and cause noticeable symptoms like those below:



A doctor will detect very high blood sugar as well as sugar and ketone bodies in the urine. Ketone bodies are substances that develop when the body breaks down fat in order to produce energy.

Symptoms of type 2 diabetes

People with type 2 diabetes still produce their own insulin. The insulin deficiency is less severe, and blood sugar levels do not rise as quickly as in people with type 1 diabetes. The symptoms are therefore much less pronounced. It may take years for a doctor to diagnose the diabetes. The following symptoms may occur:



Because type 2 diabetes often goes undetected for years, complications often already exist at the time of diagnosis (see the chapter titled "The Secondary Complications of Diabetes" on page 19). Detecting type 2 diabetes as early as possible is therefore extremely important! Appropriate treatment can prevent or at least lessen the severity of complications.

Diet

Food should be enjoyed. At the same time, our diet is also important for our health. The food we eat provides the nutrients, vitamins, and minerals that our bodies need in order to be healthy and active. Contrary to popular opinion, a healthy diet for people with diabetes hardly differs from a healthy diet for people without diabetes.

Nutrients

A healthy diet consists of a balanced combination of carbohydrates, fat and proteins. There are different views regarding a healthy diet as well as different food pyramids. The energy (calories/joules) that ingested food provides should be distributed as follows among nutrients:

rich in vegetables
raw or cooked*



1 protein-containing
food

1 starchy food*

* Side dish and salad dressings (e.g. French dressing or mushroom cream sauce) are often very high in calories and should be consumed in moderation.

Food and blood sugar levels

Foods usually contain various nutrients. How much and how quickly blood sugar rises depends on the quantity and type of carbohydrates and on the amount of other nutrients and dietary fibre contained. As a rule, blood sugar

increases in relation to carbohydrate content, meaning the greater the amount of carbohydrates, the greater the increase in the blood sugar level.

Blood sugar is mainly affected by carbohydrates. Carbohydrates are broken down into individual sugar components in the digestive tract and absorbed into the bloodstream. The sugar components are absorbed into cells with the help of insulin (the key). This ensures that organs are supplied with energy from sugar. Accordingly, insulin levels rise when a large amount of sugar enters the bloodstream after eating.

Dietary guide for diabetes

Diet is an important aspect of diabetes management. A dietary plan is recommended for all people with diabetes, but it is especially advisable for people with type 2 diabetes, whose eating habits frequently need to be adjusted. Get the support of a qualified dietician, and discuss your individual dietary plan.



Treating diabetes

The different forms of treatment

There is no cure for diabetes to date. Early and good treatment is the most important prerequisite for achieving the greatest possible quality of life and the best possible protection against subsequent complications.

The aim of treatment is to normalise blood sugar levels. In other words, blood sugar levels should be adjusted to correspond as closely as possible to those of people without diabetes. Ideally, the HbA_{1c} level should be below 7%. However, this must be discussed with a doctor on an individual basis.

Treating type 1 diabetes

As mentioned earlier, people with type 1 diabetes already have an absolute insulin deficiency at the time of diagnosis and are dependent on an external supply of insulin from the outset. Although the insulin is identical or very similar to the insulin of the human pancreas, there is a difference between the insulin released by the pancreas and insulin that is injected: it enters the bloodstream in a different way. In the bodies of people without diabetes, the insulin-producing cells of the pancreas measure the blood sugar and then release corresponding amounts of insulin directly into the bloodstream. The released insulin is only active in the blood for a few minutes. If more insulin is needed, it is provided by the pancreas. The body's insu-

lin requirements are thus quickly and adequately covered.

People with type 1 diabetes, however, need to inject insulin under the skin. From there, it is continuously absorbed into the bloodstream. This process takes some time. The injected insulin is absorbed into the bloodstream until it is used up, regardless of the respective blood sugar level. This is why properly managing blood sugar is not always so easy.

Treating type 2 diabetes

In type 2 diabetes, the pancreas still produces its own insulin, at least at the onset of diabetes. In many cases, however, there is insulin resistance, which means that the body's cells need more insulin in order to absorb the same amount of sugar as people without insulin resistance.

According to WHO data, 9 out of 10 people with type 2 diabetes also live with obesity, which is often the main cause of insulin resistance. The initial treatment of type 2 diabetes therefore consists of a balanced, reduced-fat diet and increased physical activity. The goal is to at least maintain a stable weight or, preferably, to lose weight. However, type 2 diabetes is often a chronic, progressive disease. Therefore, additional medicinal therapy may be required after some time.

Medicinal therapy

The number of antidiabetic drugs has increased significantly in recent years, and a variety of products are available in Switzerland. While some medication is administered by injection, there is also medication in the form of tablets. The groups of active substances are listed in alphabetical order below and briefly explained.

DPP-4 inhibitors

DPP-4 inhibitors are a class of agents used to treat type 2 diabetes. They lower blood sugar levels by protecting the intestinal hormone GLP-1 from being broken down. GLP-1 is a natural hormone that, among other things, promotes the release of insulin.

GLP-1/GIP receptor agonists

GLP-1/GIP receptor agonists are used to treat type 2 diabetes. They are based on the structure of the natural hormones GLP-1 and GIP and can bind to the receptors of both hormones. As a result, they promote insulin secretion from the beta cells of the pancreas, depending on the blood sugar, and inhibit the release of glucagon. They also slow the emptying of the stomach and increase the feeling of satiety.

Insulin

Insulins are proteins produced in the pancreas. Human insulin is insulin that corresponds to human insulin in its structure and composition. Insulin analogues are similar but not identical to the insulins found in nature. Their structure has been slightly altered so that they either are absorbed into the bloodstream more quickly than human insulins (in the case of short-acting insulins) or have a longer duration of action (in the case of long-acting insulins). Insulins are used to treat type 1 diabetes as well as type 2 diabetes. For people living with type 1 diabetes, injecting insulin is essential because their pancreatic cells produce very little or no insulin themselves.

Short-acting insulins (bolus insulins or mealtime insulins)

After a meal, the need for insulin increases sharply and quickly because sugar is absorbed into the bloodstream. Short-acting insulins are injected to cover this elevated insulin requirement. Short-acting insulins are therefore also called mealtime insulins or bolus insulins. The onset of action is very rapid. The blood sugar level does not rise as sharply after a meal when bolus insulin is injected.

Long-acting insulins (basal insulins or slow-acting insulins)

Everybody also needs small amounts of insulin between meals and at night to ensure that the basal metabolic rate is maintained. This basic requirement (basis) is needed in a small measure throughout the day and at night. Long-acting insulins are therefore called background insulins, basal insulins, or slow-acting insulins since they are absorbed into the bloodstream slowly over an extended period of time after injection.

Mixed insulins

Mixed insulins can reduce the number of injections because they contain both a proportion of short-acting insulin and a proportion of long-acting insulin. Mixed insulins are injected once or twice a day (before a meal). This regulates the rapid increase in blood sugar after the respective meal and blood sugar levels between meals.

Metformin

Metformin is often used as the first medicinal therapy when an improvement in blood sugar levels cannot be achieved with a change of diet, weight loss, and increased physical activity. The antidiabetic effect is achieved by inhibiting the formation of new glucose in the liver.

SGLT2 inhibitors

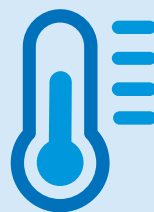
SGLT2 inhibitors are antidiabetics for people with type 2 diabetes. SGLT2 inhibitors reduce the amount of glucose that returns to the bloodstream from the urine in the kidneys, leading to increased glucose excretion in the urine. This lowers the blood sugar level and promotes a loss of calories. The effect of SGLT2 inhibitors is not dependent on insulin.

Sulphonylureas

Sulphonylureas are used to treat type 2 diabetes. They increase the secretion of insulin by the cells of the pancreas and thus reduce blood sugar.

Medication storage

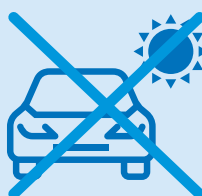
The medicines may only be used until the date labelled "EXP" on the package. For how to store your medication and, if applicable, carry it with you in your daily routine, please note the details on your medication's outer packaging and the information provided in the package leaflet. These will inform you about the storage temperature before and after your medication is opened and about its sensitivity to direct sunlight and moisture.



Observe the storage temperatures specified in the package leaflet



Protect from moisture



Avoid hotspots (e.g., glove compartment or boot)

Injection technique

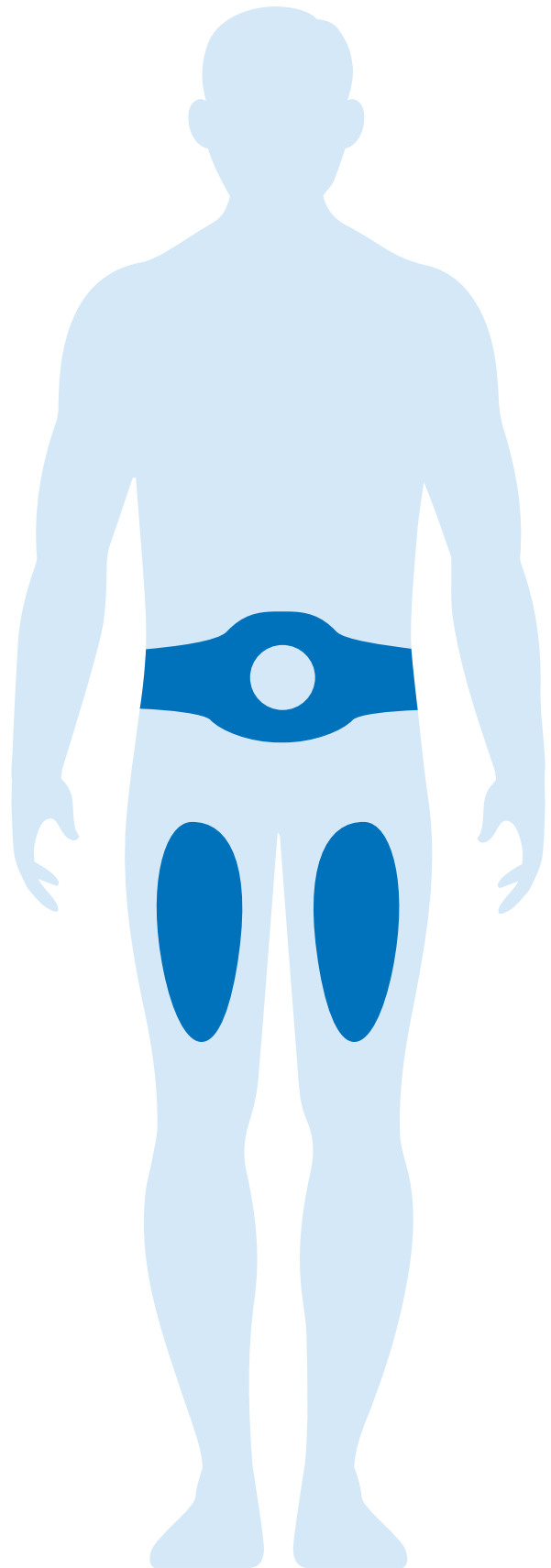
Prior to the injection, make sure you are using the correct medication, and please follow the instructions in your medication's package leaflet. Use a new needle for each injection, and discard it after use. Insulin and GLP-1 receptor agonists are injected subcutaneously, meaning under the skin. Your doctor will tell you how and where to give yourself the injection. With each dose of the medication, change the puncture site in the area of the skin where you administer the injection in order to avoid hardening and thickening of the fatty tissue (lipodystrophies). Lipodystrophies alter the absorption of the medicine and can be the cause of poor blood sugar management. The puncture sites should be approximately 3–4 cm or two finger widths apart, and the injection should only be administered to healthy, scar-free skin. Please only change the skin area (e.g., from the abdominal wall to the thigh) after consulting your doctor.



Lipodystrophy

The injection technique should be taught by medical professionals. Please follow the instructions given by these professionals. For additional information, please refer to the package leaflet of the medicine in question.

Injection needles are intended for one-time use and should therefore be replaced prior to each injection. Even after a single use, a needle is less sharp and can cause pain during the injection if used again. Sterility is no longer guaranteed, and medicine residues can stick to the needle, which can negatively affect the function of the injection device. Multiple-use injection devices are carried without a needle attached because the needle can cause the medication to leak or air to enter the pen.



Important!

Always make sure that the correct medication is being injected, and change the injection sites.



Blood sugar management

Which target levels should be achieved?

The goal of treatment is to adjust the blood sugar level of a person with diabetes so that it corresponds to that of a person without diabetes. Today, we know that good blood sugar management can prevent or lessen the severity of complications. It is therefore important to learn how to optimally manage blood sugar levels in consultation with a doctor.

The following blood sugar levels can be considered a point of reference:

	Ideal management	Acceptable management	Inadequate management
Fasting blood sugar	5.0-7.0 mmol/L	<8.0 mmol/L	>8.0 mmol/L
Post-meal blood sugar (2 hours after a meal)	<8.0 mmol/L	<10.0 mmol/L	>10.0 mmol/L

Blood sugar correction

People with diabetes on an intensified insulin therapy are aiming for the most near-normal blood sugar levels possible. To achieve this, it is necessary to measure blood sugar several times a day and correct it if necessary. People with diabetes will also learn their personal correction factors in the course of their training.

As a general rule of thumb,

- 1 unit of insulin lowers blood sugar by approx. 2–3 mmol/L (36–54 mg/dL)
- 10 grams of glucose increase blood sugar by approx. 2–3 mmol/L (36–54 mg/dL)

Uncontrolled blood sugar

It's not easy for people with diabetes to always keep their blood sugar within the normal range. In healthy people, the body continuously regulates blood sugar levels so that they are not too high or too low. However, people with diabetes have to adjust the insulin they inject based not only on the food they eat, but also on their physical activity. In addition, other factors like psychological stress or illness also affect the body's insulin requirements. This may cause uncontrolled blood sugar levels.

Blood sugar may be

- too low (hypoglycaemia)
- too high (hyperglycaemia)

Hypoglycaemia (low blood sugar)

When blood sugar is too low (below 3.9 mmol/L or 70 mg/dL), this is referred to as hypoglycaemia. The symptoms of hypoglycaemia vary from person to person. It is important for you to know your own symptoms. For most people with diabetes, sweating and/or chills are the first warning signs of hypoglycaemia, but weakness, shivering, irritability, hunger, fatigue, drowsiness, headache, and mildly impaired vision are also common symptoms. If blood sugar continues to drop too sharply, loss of consciousness may occur.

What should be done?

The first signs of low blood sugar require immediate action: you must immediately eat or drink something sugary, such as

- 3–5 sugar cubes (10 g) or dextrose (10 g)
- 1 glass (0.2 L) of orange juice, normal Coke, or other sweet beverages (no diet beverages!)

It is important to eat carbohydrate-containing foods afterwards to avoid another drop in blood sugar. For example, one slice of bread, one apple, or the like will do. If hypoglycaemia is noticed very early on, eating one or two pieces of fruit, rusk, or a slice of bread is often enough.

Important: eat first, then measure!

Blood sugar should be measured as soon as the low blood sugar has been treated. Additional measurements after 30–60 minutes may be advisable.

What causes low blood sugar?

Low blood sugar can occur in the following situations:

- When fewer carbohydrates than usual have been consumed
- When too much insulin has been injected
- During or after increased physical activity
- When alcohol has been consumed (alcohol reduces the amount of glucose released by the liver and can cause low blood sugar levels even 12 hours after consumption)

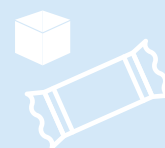
How can low blood sugar be prevented?

Your blood sugar needs to be checked regularly – this is the only way to learn how to correctly assess your blood sugar reactions. It is advisable to eat 20 g of carbohydrates before short-term, unplanned activities in order to prevent low blood sugar. Before any longer-term planned strenuous activities, it may be necessary to reduce the insulin dose – but the dose should only be adjusted after medical confirmation (see also the “Diabetes and Exercise” chapter on page 22).

In case of low blood sugar:

If you are living with diabetes, it is important for you to always carry plenty of sugar cubes or dextrose as well as your completed diabetic ID card. It is advisable to tell family and friends exactly how they should behave if you have low blood sugar and how to use the “antidote” glucagon if necessary. Glucagon has a counterregulatory effect on insulin by releasing the sugar reserves in the liver.

People with diabetes should always have sugar cubes or glucose in their emergency kit.



Low blood sugar with unconsciousness:

If low blood sugar is not treated it can lead to loss of consciousness with seizures. This condition requires immediate action to be taken by the individuals present. The unconscious person must be placed in a stable lateral position and must not be given fluids under any circumstances (risk of suffocation!). It is advisable to call the ambulance immediately and administer glucagon if it is available. Depending on the pharmaceutical form, glucagon can be injected into the muscles or the subcutaneous fatty tissue or can be administered nasally.

In case of doubt, always administer glucagon immediately; it is not physically harmful even if blood sugar is not low.

As soon as the patient is responsive again, they must immediately take dextrose and/or other carbohydrate-containing foods and beverages and then measure their blood sugar.

Hyperglycaemia (high blood sugar)

When blood sugar is too high, this is referred to as hyperglycaemia. It can be triggered by the following factors:

- Overeating
- An insulin dose that is too low
- Too little physical activity
- Illnesses or other types of stress
- Pregnancy
- Menstruation

High blood sugar can often be brought into balance again by avoiding its cause or by adjusting the treatment accordingly. If there is no adequate explanation for the high blood sugar level, medical advice should be sought.

Slightly elevated blood sugar levels caused by dietary errors can usually be corrected by omitting carbohydrates from the next meal. High blood sugar levels caused by illness or insufficient injected insulin (forgotten injection!) may possibly be corrected by adjusting the insulin dose.

Symptoms of hyperglycaemia

A variety of symptoms may indicate that the blood sugar level is too high. However, even relatively high blood sugar

levels are often not accompanied by any symptoms. In any case, it is important to note that frequent and long-lasting hyperglycaemic episodes increase the risk of diabetic complications, even if there are no recognisable symptoms at the moment.

Symptoms of high blood sugar include the following:

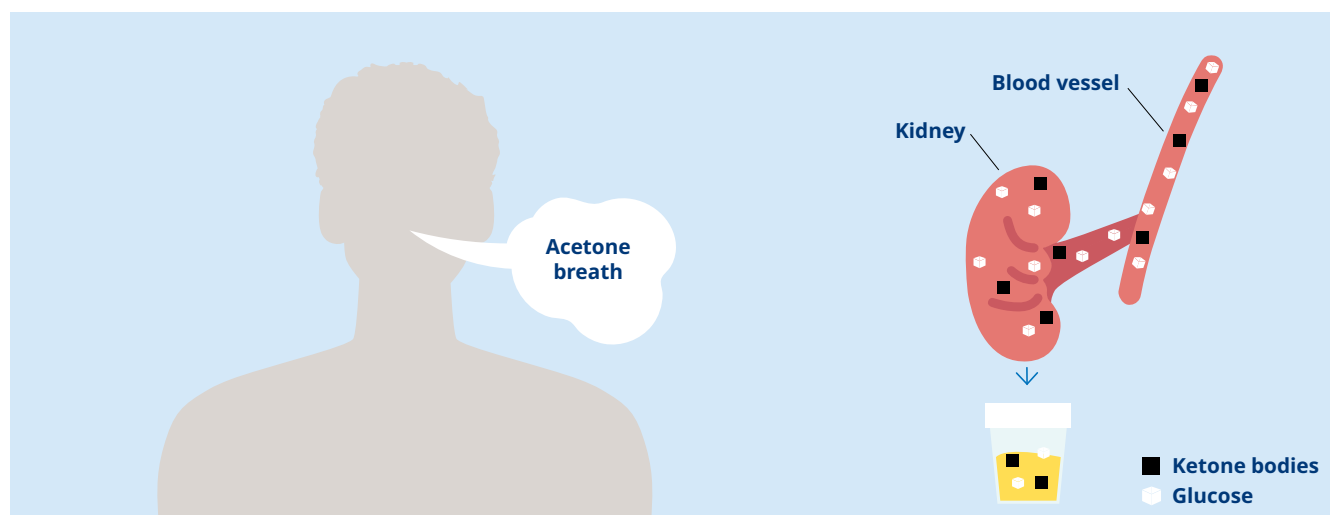
- Thirst and frequent urination
- Fatigue and drowsiness
- Impaired vision
- Weight loss
- Ketoacidosis, unconsciousness

For long-lasting hyperglycaemia:

- Leg cramps
- Poor wound healing

Diabetic ketoacidosis/ ketonuria

If sugar cannot be absorbed into cells due to insulin deficiency, fat is burned to produce energy. When fat is broken down, “ketone bodies” or “ketones” are formed. One of these ketones is acetone, which now appears in the urine and breath (sweet smell) as a sign of high blood sugar. If this condition persists for hours or days, the same symptoms appear as in the absence of diabetes treatment: large amounts of urine, thirst, and weight loss. Loss of appetite, nausea, and vomiting may also occur. Ketones can be detected in the urine with simple tests. If the blood sugar increases even further, this can lead to what is known as ketoacidosis and to loss of consciousness. It is therefore essential to contact a doctor when blood sugar levels are very high.





The secondary complications of diabetes (late complications)

What are the secondary complications of diabetes?

The secondary complications are organ damage caused by prolonged or frequent high blood sugar levels. These complications often do not appear until years after the onset of diabetes.

Protein glycation

Today, we know that glucose undergoes a chemical reaction with certain proteins in the body, leading to what is known as “protein glycation”. Protein glycation usually reverses when blood sugar levels return to normal. However, persistently or frequently high blood sugar levels result in permanent (irreversible) changes in many proteins, which stop functioning and cause tissue damage.

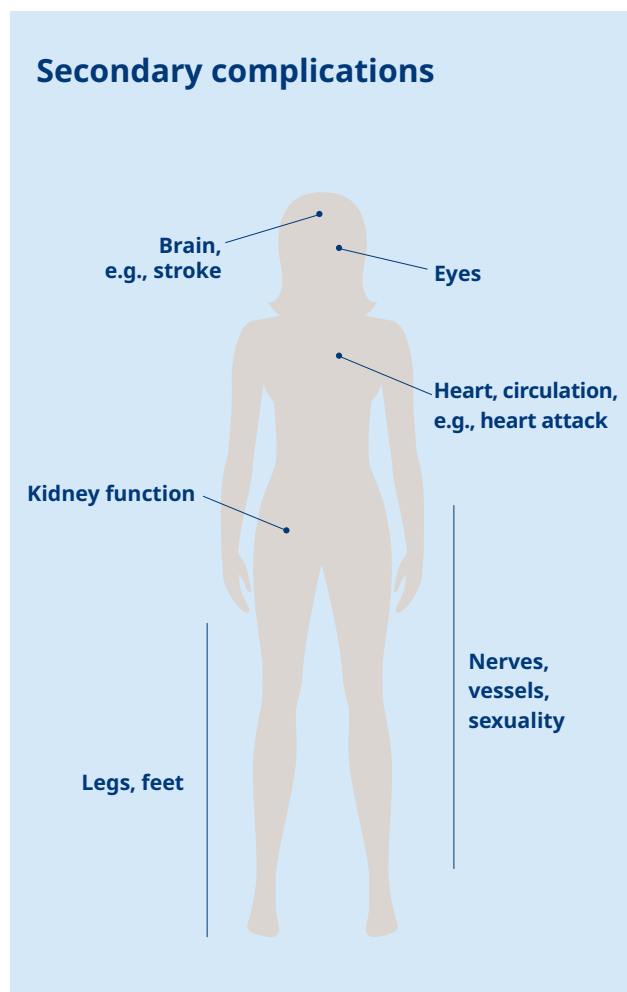
Tissue and organ damage

The nerves, kidneys, and eyes are particularly sensitive to this tissue damage. Nerve disorders may, for example, manifest themselves in numbness, pain, tingling, etc. in the extremities (neuropathies).

Eye disease (retinopathy) can lead to blindness, and kidney disease (nephropathies) can result in a complete loss of kidney function. Finally, the large blood vessels (arteries) and the brain are also affected, which can lead to cardiovascular diseases, such as heart attack.

Diabetic foot

Due to the neuropathy (nerve damage) resulting from diabetes, as described above, special attention should be paid to the feet. Loss of sensation may prevent excessive strain and sores on the feet from being perceived anymore. The often poor blood circulation in the feet increases the susceptibility to infection and impairs the healing process, which, at worst, could lead to amputations.





Personal responsibility for diabetes management

Self-management

Taking control of diabetes means taking personal responsibility and being actively involved in the treatment. This responsibility with respect to the disease is very important for people with diabetes because many things affect blood sugar in everyday life. People with diabetes must learn to take care of themselves and to decide what and when to eat and how intense their physical activity should be. Many professionals provide support for people with diabetes, which can be very helpful. This includes medical consultations, specialised diabetes counselling, as well as nutritional counselling. Ultimately, the deciding factor is how well the situation is accepted and how much of the necessary attention is invested.

Regular medical check-ups

It is very important to have not only blood sugar levels and HbA_{1c} (see page 8) but also the eyes, kidneys, nerves and cardiovascular system regularly checked by a doctor so that damage can be treated in time. Monitoring of blood lipids (cholesterol) and blood pressure is also recommended.

Basic knowledge for self-monitoring

If you are diagnosed with diabetes, it is necessary to gain an understanding of this metabolic disease and to learn how to manage daily medication and measurements. For good control of blood sugar levels to be maintained, diabetes requires constant attention.

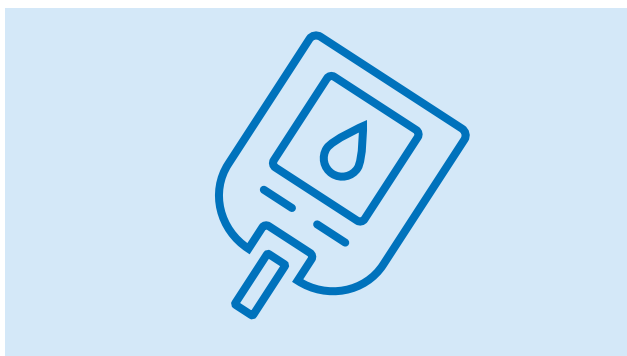
It takes a bit of experience to know

- what influences blood sugar levels to what extent. In principle, it can be said that eating increases blood sugar, that exercise tends to lower blood sugar, and that illnesses and psychological stress can tend to increase blood sugar. However, these effects vary depending on the patient.
- How and when to measure blood sugar and how to evaluate the results.
- How a healthy diet affects blood sugar management.

Measuring blood sugar

Measuring blood sugar is very important for managing diabetes. Measuring and recording blood sugar levels several times a day is especially necessary for people on intensified insulin therapy. This way, the treatment can be adjusted if needed because it is possible that the blood sugar is not being optimally managed even if there are no symptoms of the disease.

Measuring blood sugar is simple. A blood glucose meter can be used to measure the amount of sugar in the blood.



When is a blood sugar measurement useful?

How often blood sugar should be measured depends on the type of treatment. It is important to discuss this topic with your doctor.

Each blood sugar measurement gives the person with diabetes information about how various influencing factors affect blood sugar levels. However, a certain amount of experience is needed to be able to interpret the measurements and use them to adjust the diabetes management. It is therefore important to regularly take the time to interpret the results and discuss them with your doctor, both at the start of diabetes treatment and later on.

Nowadays, a variety of continuous glucose monitoring systems are available for measuring blood sugar at any time. A sensor in the skin and a device that receives the signals allow blood sugar levels to be read continuously. However, this entails the risk of measuring blood sugar too often and trying to reduce the blood sugar level with medication when even the smallest changes occur.

Measuring blood sugar is very helpful in the following situations:

- Before main meals (breakfast, lunch, dinner)
- 1–2 hours after eating
- At bedtime
- **Before** and **after** exercise
- Before long car rides
- Whenever hypoglycaemia or hyperglycaemia is suspected
- In case of illness or stress

It is important to discuss the optimal number and timing of blood sugar measurements with a healthcare professional. A diabetes diary can also provide a good basis for discussion during counselling sessions and medical treatment.

The diabetes diary

The diabetes diary (handwritten or electronic) can be an important tool in managing diabetes. Blood sugar readings with time and date will be recorded in the diary. Administered medication can also be recorded there along with the type of medication, dose, time, and date. Other important entries are meals, physical activities, illness, stress (emotional state), and measures taken to manage blood sugar. All entries are very helpful for recognising and responding to personal characteristics in the blood sugar management of a person with diabetes.

Note: Diaries are available from regional diabetes societies or diabetes specialists, for example. Various electronic alternatives (“diabetes apps”) can be found on the Internet.

Tools and sources of information

Today, a wide range of resources is available for people with diabetes. Such as apps, patient forums or websites that contain valuable information about diabetes.

Medical support

A person with diabetes requires lifelong medical support. Having a positive and trusting relationship with your doctor is important. Honest conversations, in which worries and fears can also be discussed, are part of this trusting relationship. In many cases, it also makes sense to consult a doctor specialising in diabetes.

Daily foot control

As previously mentioned, daily foot care is especially important for people with diabetes. Because of neuropathy (nerve damage), the feet are more susceptible to injuries and these heal less well. Daily foot examinations and care can play a vital role in preventing serious foot problems.

Diabetes and exercise

Exercise and physical activity are important for everyone. Physical activity is of particular importance for people with diabetes because it has a beneficial effect on blood sugar levels and is a key factor in the overall management of diabetes.

In addition, as a large proportion of people with type 2 diabetes also live with overweight or obesity, regular physical activity and the accompanying weight loss are an integral part of diabetes treatment.

In addition to diet, physical exercise is very important. Any form of physical activity (housework, walking, jogging, etc.) improves the sensitivity of cells to insulin and thus lowers blood sugar levels. It is not the type of exercise that is important, but that it is carried out regularly.

Particularly suitable types of exercise and activity

In principle, every form of exercise should be utilised in everyday life. This includes not only sports, but also everyday activities such as climbing stairs, walking instead of driving, cycling, walking the dog, etc.

In addition, moderate-intensity endurance sports such as cycling, running and hiking are particularly beneficial for people with diabetes. However, it is generally important to start new physical activities slowly and only gradually increase the intensity in line with the level of training.

It may be useful to seek advice from a specialist to discuss suitable types of sport at an appropriate intensity. It is also possible to discuss the topic of hypoglycaemia and sport and seek advice in this regard.

Regular exercise

- Reduces your daily insulin needs
- Improves your overall well-being
- Helps to reduce or maintain your weight
- Strengthens your muscles, joints, and bones
- Lowers your cholesterol
- Lowers your risk of heart attack

People with diabetes can be just as physically active as people without diabetes. However, a person with diabetes will need to be especially mindful before even starting a physical activity. It is important to consider your general health, current fitness, and blood sugar management.



What happens to blood sugar during physical activity:

- During physical activity, the body needs more energy and therefore uses more glucose from the blood. If insulin is present, this can lead to a corresponding reduction in blood sugar.
- However, very intense physical activity (overload) can also lead to the release of stress hormones that temporarily raise blood sugar levels.
- After strenuous exertion that required a lot of energy and used the body's reserves, the body rebuilds the depleted reserves, meaning it restores glycogen in the muscle cells and the liver. To this end, more glucose is absorbed from the bloodstream, which in turn leads to a drop in blood sugar (muscle bulking effect).
- Regular physical activity increases insulin sensitivity at the insulin receptors in tissue, thereby reducing insulin requirements.

Conclusion: Adequate physical activity leads to a reduction in blood sugar levels. Depending on the level of exertion, therefore, the insulin dose may need to be adjusted before and after. At the same time, it is important to eat extra carbohydrates.

Important to note before physical activity:

- Preventing hypoglycaemia: consume additional carbohydrates if necessary, possibly adjust the insulin dose
- Measure blood sugar
- Take along a supply of carbohydrates
- Drink plenty of fluids
- Prepare hypoglycaemia treatment (take along sugar/glucagon, inform accompanying individuals)

Important: when blood sugar levels are too high or too low before exercising

Your blood sugar level should be well-adjusted before physical activity, meaning it should not be too high or too low.

Do not exercise if your blood sugar level is higher than 15 mmol/L (270 mg/dL) or if ketones are present in the urine.

If the blood sugar is too high, insulin must be injected and exercise postponed until the blood sugar level has returned to normal and ketones are no longer detectable in urine.

If the blood sugar level is too low before exercising, carbohydrates must be consumed and the exercise must be put off until the blood sugar has normalised.

Minimal physical exertion

Regularly performed physical activities to which the body has already adapted or for which it is already trained usually do not require additional meals. For example: walking the dog, shopping on foot, etc.

Average physical exertion

Physical activities that take longer than an hour and present an unaccustomed challenge usually require the consumption of additional carbohydrates. For example, an additional snack in the form of bread, cereal bars, fruit, etc. is required for one hour of exercise, gardening, window cleaning, etc. Usually, 10–20 g of carbohydrates will suffice. If the exertion lasts for more than one hour, additional carbohydrates may be needed.

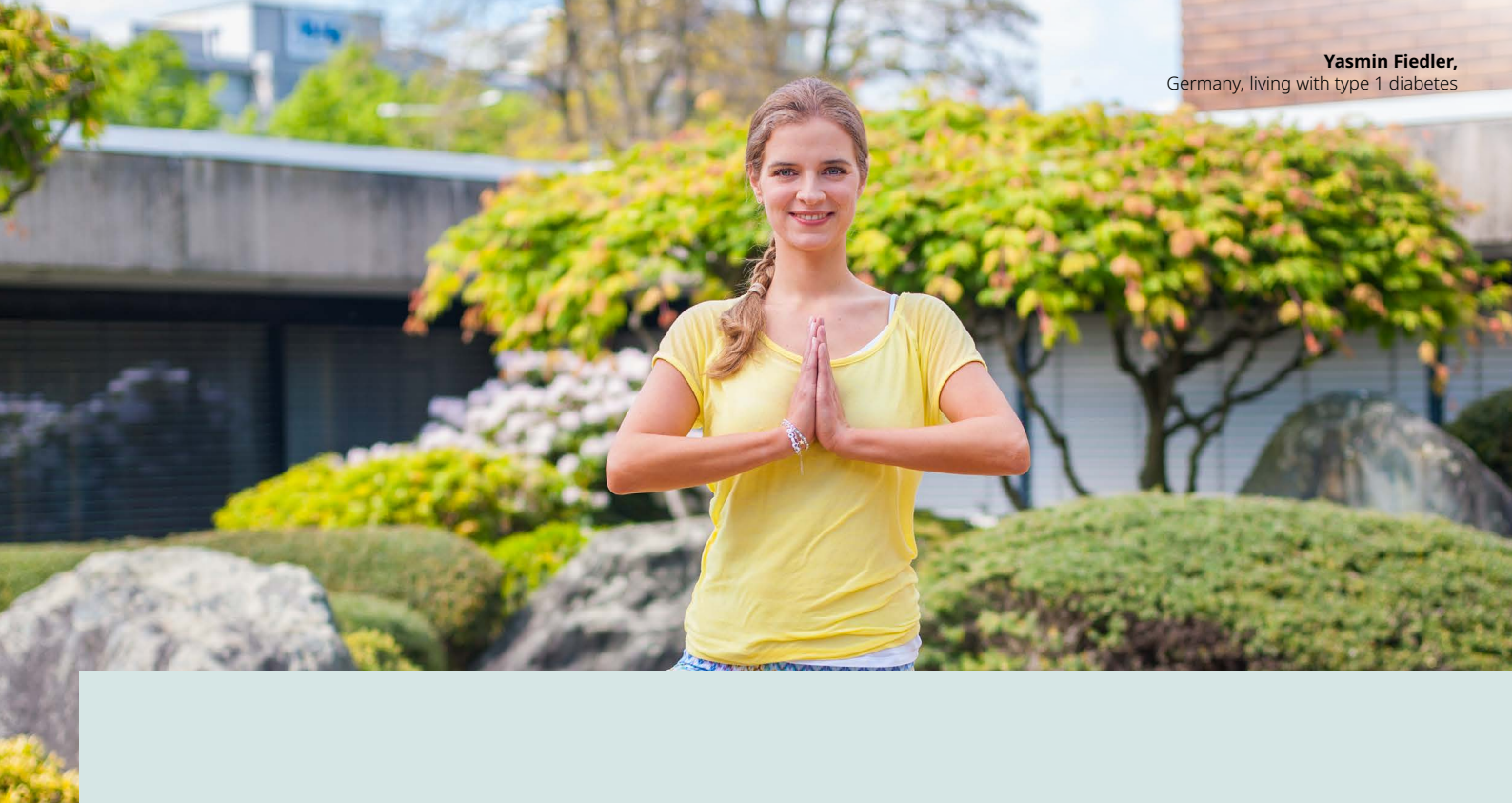
Rule of thumb: approx. 10 g of carbohydrates per 1/2 hour of moderate exertion.

Strenuous physical exertion

Strenuous physical activities, such as a marathon, cross-country skiing, a mountain hike, or a bike tour lasting several hours, require individualised meal planning that is adapted to the duration of the exertion, the current blood sugar level, the medicinal therapy, and the level of fitness. About 10 g of carbohydrates should be eaten every 30–45 minutes.

Important to note after physical activity:

- Adjust the insulin dose if necessary
- Eat additional meals if necessary (particularly before going to bed, consume “slow-acting carbohydrates”, such as dairy products)
- Take good care of feet
- Record exercise in writing (as well as effects on blood sugar levels if applicable)



Special situations

Diabetes and driving

People with diabetes are often at some risk of hypoglycaemia. The following precautionary measures should therefore be observed when driving:

- At the start of therapy, a doctor should be consulted to determine whether driving should be avoided for a few days until the effect of the medication can be assessed
- Depending on the medication, your blood sugar must be measured and documented, especially before longer drives
- When blood sugar levels are low, eat something before driving
- If there is even the slightest suspicion of hypoglycaemia, stop immediately, ingest some fast-acting carbohydrates like sugar cubes, dextrose, orange juice, or Coke (never diet beverages!) and wait a while, then measure your blood sugar
- Always take along enough fast-acting and slow-acting carbohydrates (e.g., biscuits, bread, [cereal] bars, raisins, dried fruits); you may be in congested traffic for several hours
- Plan breaks for long-distance trips
- Take along enough medication and blood glucose test strips in your car
- Take your diabetes card with you
- Have your vision tested regularly

Diabetes and illness

During an illness, such as an infection with fever, hormones are released that cause blood sugar to rise. It is therefore important to inject insulin despite any loss of appetite during an illness. Insulin requirements may be 10% to 50% higher, which is why the following precautionary measures are recommended:

- Measure your blood sugar more often than usual to avoid hypoglycaemia
- Follow your usual diet as much as possible
- In the event of loss of appetite, regularly eat easily digestible carbohydrates (e.g., oatmeal, broth (low-fat), fruit juice, fruit purée, pudding, etc.)
- Even if you don't eat anything, insulin must never be completely omitted
- Record the following:
 - When you inject insulin and how much
 - Your blood sugar levels and the time
 - Meals along with the quantity and time
- Notify your doctor
- Drink lots of fluids to compensate for fluid loss

Vomiting and diarrhoea

Vomiting and diarrhoea may result in hypoglycaemia due to the lack of food intake.

Tip: Sip the following chilled drink mixture:

1/3 black tea

1/3 orange juice

1/3 broth or brine

Coke (1 dL = 10 g carbohydrates; no Diet Coke) and pretzel sticks have proven to be an effective remedy for vomiting. The insulin dose may need to be adjusted in the short term. Do not hesitate to call a doctor.

People with diabetes in hospital

Certain situations require hospitalisation. It is important to plan the hospital stay if possible and to discuss any necessary changes in your diabetes treatment with your doctor in advance. Take your insulin with you during a scheduled procedure.

Diabetes and professional life

It is important for all people to have a fulfilling job that matches their individual interests, skills, and education. People with diabetes have only a few limitations in terms of their choice of profession. Treatment with blood-sugar-

lowering medication always entails the possibility of sudden hypoglycaemia, which is why some professions may be unsuitable.

Your employer and colleagues should be aware of your condition so that they can help you in the event of hypoglycaemia.

Diabetes and psychological stress

Everyone feels psychologically stressed at times. Pay attention to the effects such stress (problems, disappointments, test anxiety, etc.) can have on your blood sugar. When we are under stress, the body releases stress hormones like adrenaline and cortisol. These hormones ensure that sugar is released from the liver's stores into the bloodstream. They also cause fatty acids to be released from fat cells. Both sugar and fatty acids can be used as fuel by the body. People without diabetes automatically produce more insulin in response so that the sugar can be absorbed into cells. This covers the body's increased need for fuel during the period of stress. Insulin and blood sugar levels remain balanced. However, in people with diabetes, the automatic production of insulin is missing, and the physical stress causes blood sugar to rise.

Diabetes, pregnancy, and breastfeeding

Like other women, women with diabetes can also have an unproblematic pregnancy and give birth to healthy children. However, certain precautionary measures should be taken to avoid complications. The greater the deviation from normal metabolic rates, the greater the risk to the child. In the womb, glucose passes through the placenta, which is responsible for the metabolism between mother and developing child, so mother and child have the same blood sugar levels. Elevated blood sugar levels can be detrimental to the healthy development of a child in the womb. It is important to ensure optimal blood sugar management before even becoming pregnant. As a pregnant woman with diabetes, you will require careful medical supervision by your diabetologist and gynaecologist.

Women with diabetes can breastfeed their children without any problems because diabetes does not affect breastfeeding. However, they should make sure to compensate for fluctuations in blood sugar and drink plenty of fluids.



Diabetes and travel

People with diabetes can travel just like everyone else, but careful planning is important. Travel generally means a change in daily routine. Changes in diet and exercise habits can affect blood sugar.

A medical examination is sometimes advisable before travelling so that any health problems can be treated before departing and any requirements that may arise during the trip can be discussed. A doctor can also perform necessary vaccinations and prescribe sufficient medication for emergencies (e.g., insulin, glucagon, anti-diarrhoeal medication).

For air travel with major time differences, the necessary doses, changes in therapy, and the timing of meals should be discussed with a doctor.

It is advisable to measure blood sugar more frequently than usual during a holiday and to adjust the insulin dose accordingly if necessary. This way, good blood sugar management can also be maintained during holidays.

Travel checklist

Take along adequate supplies of medication and testing materials:

- Your medication
- Needles
- Blood glucose meter with test strips, lancets
- Ketone test strips
- Diabetes diary
- Diabetes card
- Sugar cubes/dextrose
- Glucagon

Carry-on luggage is the best place for transporting medication. There could be very low temperatures in the luggage compartment of the aircraft. Insulins and other medication must not freeze! It's a good idea to distribute the supplies among several pieces of luggage.

Always check the current travel regulations.



Tip:

Check (preferably with the distribution company) whether the medication is available in the destination country. Taking along a prescription in English is recommended.

Travel provisions

A sufficient quantity of travel provisions containing carbohydrate is highly recommended for bridging unexpected delays and waiting times. Crispbread, biscuits, and dried fruit are well-suited, for example.

Glossary

Obesity

Unhealthy excess weight starting at a body mass index (BMI) of 30 kg/m².

Autoimmune disease

A disease in which the immune system targets a person's own body. In type 1 diabetes, the beta cells of the pancreas are destroyed this way.

Basal insulin

Basal insulins are long-acting insulins that are slowly released into the bloodstream and used to meet the body's basic needs. They are also called background or slow-acting insulins.

Basal-bolus therapy

Insulin therapy that mimics the organism's natural insulin response, in which insulin is continuously released in small amounts (basal secretion) and increases after meals. To mimic this principle, fast-acting and long-acting insulin is needed. The long-acting insulin is injected once or twice a day ("basis"). The particularly high insulin requirements at mealtimes are covered by the fast-acting insulin ("bolus"). Multiple daily blood sugar measurements are required.

Pancreas

A gland organ that, among other things, produces digestive enzymes and hormones to regulate blood sugar. The beta cells of the pancreas produce insulin and release it into the bloodstream.

Beta cells

A type of pancreatic cell that is responsible for the production of insulin.

Blood sugar level

Refers to the concentration of glucose in the blood. Blood sugar levels can be measured. Normal fasting blood sugar levels are below 5.6 mmol/L. After a high-carbohydrate meal, blood sugar rises and then returns to normal thanks to the effect of insulin.

Diabetes mellitus

Commonly referred to as simply diabetes. This is a metabolic disease that leads to high blood sugar levels. There are two main types of diabetes: type 1 and type 2 diabetes.

Diabetic nephropathy

Kidney damage caused by diabetes. Affected people do not have any symptoms for a long time, as a result of which nephropathy is hardly ever detected in the early stages. Protein excretion in the urine is the earliest way to detect kidney damage.

Diabetic neuropathy

Damage to the nervous system due to diabetes. Both the sensorimotor nervous system and the autonomic nervous system may be affected.

Diabetic retinopathy

Diabetic retinopathy is a retinal disorder caused by blood sugar levels that are too high. It can lead to impaired vision and even blindness. The way to prevent it is optimal blood sugar management.

Diabetic foot

A secondary complication of diabetes. Due to nerve and blood circulation disorders, affected people lose sensation in their feet and are more likely to develop ulcers.

Gestational diabetes

This type of diabetes occurs during pregnancy and often disappears after the baby is born. However, in some women, the metabolic disorder may persist after giving birth, or type 2 diabetes may develop after five to ten years.

GIP

GIP is a natural hormone produced in the intestine and released into the bloodstream after food is ingested. Depending on blood sugar levels, GIP increases the release of insulin from pancreatic beta cells.

GLP-1

GLP-1 is a natural hormone produced in the intestine and released into the bloodstream after food is ingested. Depending on blood sugar levels, GLP-1 increases the release of insulin from pancreatic beta cells.

Glucagon

A hormone that acts as a counterpart to insulin and is produced in specialised cells in the pancreas. Glucagon is released when blood sugar levels are too low and results in glycogen being broken down into glucose.

Glucose

It is often simply referred to as sugar and is a type of carbohydrate. It serves as the body's main source of energy and is measured when testing blood sugar. The absorption of glucose into the body's cells is controlled by the hormone insulin.

Glucosuria

Excretion of glucose in the urine.

Glycogen

A long-chain polysaccharide that is composed of glucose units and serves as a form of energy storage.

HbA_{1c}

Average blood sugar levels over a longer period of time. Some of the haemoglobin in red blood cells is “glycated” by the presence of glucose in the blood. The HbA_{1c} level provides information about blood sugar management over the last two to three months. The normal HbA_{1c} level is below 5.7%. The goal of antidiabetic therapy is generally to achieve an HbA_{1c} level of less than 7.0%, but this depends on the patient’s individual situation.

Human insulin

Human insulin made from modified pig insulin or genetically derived from microorganisms.

Hyperglycaemia

High blood sugar. Acute signs include frequent urination and excessive thirst. If left untreated, diabetic complications, ketoacidosis, and even diabetic coma may occur.

Hypoglycaemia

Low blood sugar levels below 3.9 mmol. The cause may be an insufficient intake of carbohydrates, too much insulin, or excessive physical exertion. Symptoms like sweating, shaking, impaired vision, and coordination disorders occur. Untreated low blood sugar can lead to unconsciousness.

Incretins

Incretins are hormones produced naturally by the body in the intestine and released into the bloodstream after food is consumed. This stimulates the release of insulin from the pancreas. GLP-1 is the best-known incretin hormone.

Insulin

Insulin, a protein produced in the beta cells of the pancreas, is a hormone that lowers blood sugar. Insulin allows blood sugar to enter cells via the cell membrane.

Insulin analogues

Insulins with improved pharmacological properties, meaning they are either faster-acting or longer-acting than human insulin, due to their altered structure.

Insulin resistance

A metabolic abnormality that is often the cause of type 2 diabetes: the body’s cells do not respond adequately to insulin. Being overweight is a major risk factor for insulin resistance.

Ketoacidosis

Acidification of the blood. Insulin deficiency leads to an increased breakdown of fats, creating acidic ketone bodies that acidify the blood. If left untreated, ketoacidosis can be fatal.

Carbohydrates

Carbohydrates are energy-supplying nutrients. They are found in foods as starch and sugar and are broken down into individual sugar components in the digestive tract

and absorbed into the bloodstream. There are fast-acting and slow-acting carbohydrates.

Creatinine

A substance that is formed in the muscles and excreted by the kidneys. The amount of creatinine in the blood can therefore be used as a marker of kidney performance.

Mealtime insulin

Mealtime insulins are fast-acting insulins that have a short duration of action. They are administered at mealtimes in order to control the rise in blood sugar after eating. They are also called prandial or bolus insulins.

Metabolic syndrome

Metabolic syndrome is a combination of obesity, high blood pressure, elevated cholesterol, and high blood sugar. This combination is an important risk factor for cardiovascular disease as well as diabetes.

Microalbuminuria

The excretion of small amounts of protein that can be measured in the urine and are an early sign of nephropathy.

Mixed insulin

A pre-mixed combination of a proportion of fast-acting and a proportion of long-acting insulin. It is administered with a meal.

mmol/L

Millimoles per litre. A unit of measurement indicating the number of sugar particles per litre of blood. The conversion factor from mmol/L to mg/dL is as follows: $18.016 \times \text{mmol/L} = \text{mg/dL}$

Oral anti-diabetics (OADs)

Blood-sugar-lowering medication in tablet form. They are only suitable for the treatment of type 2 diabetes.

Type 1 diabetes

Type 1 diabetes results from a lack of the hormone insulin. The insulin-producing cells in the pancreas are destroyed by the body’s immune system. This is the typical insulin-deficiency diabetes that usually (though not always) starts during childhood or adolescence.

Type 2 diabetes

Type 2 diabetes results from reduced sensitivity of the body’s cells to insulin (insulin resistance), on the one hand, while, on the other hand, years of insulin overproduction lead to the “exhaustion” of insulin-producing cells. Type 2 diabetes is also called adult-onset diabetes because it usually starts in adulthood. However, more and more cases of type 2 diabetes are now being observed in significantly overweight adolescents.



Benny Sporre, Sweden,
living with type 2 diabetes

Weltdiabetestag



World Diabetes Day has been observed since 1991 as an International Diabetes Federation (IDF) and World Health Organization (WHO) day. Since 2007, World Diabetes Day has been an official United Nations (UN) day. It was adopted in December 2006 in Resolution 61/225. This makes it the second day dedicated to a disease after World AIDS Day, which was declared in 1988. The 14th of November was selected because this was the birthday of Frederick G. Banting, who, together with Charles Herbert Best, discovered the essential hormone insulin in 1921.

In order to give a face to World Diabetes Day and the project "Unite for Diabetes", a blue circle was chosen as the sign of unity in the fight against diabetes mellitus. The circle has always been a symbol of life and health; the colour blue unites countries under the sky and is also the official colour of the UN..

- www.worlddiabetesday.org

Helpful contact points in Switzerland

People with diabetes and their relatives can find support from the patient organisation diabetes-schweiz, headquartered in Baden, as well as various regional branches.

World Diabetes Foundation



Healthcare systems in developing countries are often unable to meet the demands resulting from the growing number of people with diabetes. Lack of diabetes awareness and education is a big problem. Experts agree that a combination of education, training, and prevention together with access to treatment options is needed in order to successfully combat diabetes. Projections suggest that 50–80% of diabetics in developing countries are undiagnosed. There is also a lack of knowledge about diabetes among doctors and nurses, a shortage of hospitals, and a lack of equipment for treating diabetes. This is why, in 2001, Novo Nordisk founded the World Diabetes Foundation, which supports various local projects in the fight against diabetes.

- www.worlddiabetesfoundation.org



About Novo Nordisk

Novo Nordisk is a leading global pharmaceutical company, founded in 1923 and headquartered in Denmark. Our purpose is to drive change to defeat serious chronic diseases, built upon our heritage in diabetes.

While millions of people across the globe rely on our life-saving medicines, we are constantly facing new challenges in healthcare. Today, it is no longer just about saving lives, but also about better health and well-being. Through prevention, early treatment and ecological sustainability, we are helping to ensure that a longer life can also be a healthier life.

Novo Nordisk Foundation

The Novo Nordisk Foundation is the main shareholder of Novo Nordisk and one of the biggest non-profit organisations worldwide. The purpose of the foundation, which was established in 1924 shortly after Nordisk Insulinlaboratorium was founded, is to provide a stable basis for the commercial and research activities of the Novo Group. With the earnings, it also supports numerous scientific, humanitarian, and social projects worldwide and makes an important contribution to social welfare.

Sustainability

We are committed to being a sustainable business that is respected for adding value to society. To achieve this, we strive to do business in a financially, environmentally, and socially responsible way – an approach reflected in our company values.



Aiming for zero environmental impact

With our environmental strategy “Circular for Zero”, we are pursuing the goal of leaving no environmental impact in all our business activities. We are the first pharmaceutical company to run 100% of our global production using renewable energy since 2020.



Access to healthcare

Millions of people around the world do not receive the care they need because medicines are not available or are too expensive for them. We are strengthening our commitment in low- and middle-income countries so that more people can receive the services they need.



Preventing chronic diseases

Medical intervention alone cannot solve the rising health challenges caused by urbanisation, socioeconomic inequalities and unhealthy lifestyles, and that is why we support prevention.

