Dr. Rath Health Foundation

DIABETES MELLITUS

Micronutrients for natural and effective blood sugar control

Diabetes mellitus – Micronutrients for natural and effective blood sugar control
Dr. Rath Research Institute, San Jose, California

1st Edition

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DIABETES: A GLOBAL HEALTH PROBLEM

Diabetes mellitus – or diabetes for short – is a rapidly growing health problem worldwide. It is a metabolic disorder in which the pancreas does not produce enough insulin, or the body does not respond properly to this hormone. This leads to rising blood sugar levels which can seriously damage many organs.

Worldwide, an estimated 537 million adults aged 20 to 79 suffer from diabetes. This number is predicted to rise to 643 million by 2030 and 783 million by 2045. About 1.5 million deaths per year are directly attributed to diabetes.

The high number of undiagnosed cases of diabetes is further concerning. Globally, an estimated 240 million people are living with undiagnosed diabetes. This is a serious problem because untreated diabetes can worsen, leading to severe complications. In 2019, for instance, this metabolic disease caused 460,000 deaths from kidney failure and was responsible for about 20% of deaths from cardiovascular disease.

This shows that, despite using a wide range of pharmacological approaches, diabetes treatment remains inadequate. We have known for decades that micronutrients (cellular nutrients), especially vitamin C, are crucial in the prevention and supportive treatment of diabetes, and that a chronic deficiency of specific nutrients can trigger or exacerbate this metabolic disease. Numerous studies in the field of Cellular Medicine *(see page 33)* and natural health show that micronutrients, in optimal dosages and composition, can effectively control several important cellular mechanisms associated with impaired glucose metabolism. Unfortunately, this knowledge has been ignored.

The aim of this brochure is to empower you with knowledge of how to control blood glucose levels based on progress in Cellular Medicine and natural health. It presents the lesser-known facts about different aspects of diabetes and documents the importance of specific nutrients in managing type 2 diabetes mellitus. This booklet provides fascinating insights into recent research, particularly from the Dr. Rath Research Institute ***(see page 34)*****, on multiple benefits of micronutrients in diabetes. It is your health guidance on practical aspects of how to prevent and manage diabetes in everyday life.**

WHAT IS DIABETES MELLITUS

Diabetes mellitus is a chronic metabolic disorder characterized by high blood sugar levels. There are three main types of the disease: congenital (type 1), acquired (type 2), and gestational diabetes. All forms of diabetes are caused by the absence or insufficient production of **insulin** or an inadequate body response to this hormone. Insulin, secreted by the pancreas, is essential for sugar (glucose) to be transported from the blood inside the body's cells, thereby lowering circulating blood glucose levels.

When people talk about diabetes, they usually mean **type 2 diabetes**, which accounts for over 90% of cases. It usually develops later in life and is also called **adult-onset diabetes**. However, an increasing number of younger people, even children, are being diagnosed with this condition.

In type 2 diabetes, the cells of the pancreas can produce insulin, but the body's cells don't respond to this hormone. Unhealthy diet and obesity significantly contribute to this condition known as **insulin resistance**. To compensate, the pancreas produces more and more insulin causing **hyperinsulinemia**, but this does not help to increase glucose transport from the blood into the body's cells. Thus, both blood sugar and insulin levels remain chronically elevated. Over time, the insulin-producing cells of the pancreas become exhausted and insulin production drops.

In **type 1 diabetes**, which usually develops in childhood or adolescence, the insulin-producing cells of the pancreas are attacked and destroyed by the body's own immune system. As a result, insulin production declines over time, and the cells can no longer efficiently absorb and process sugar from food.

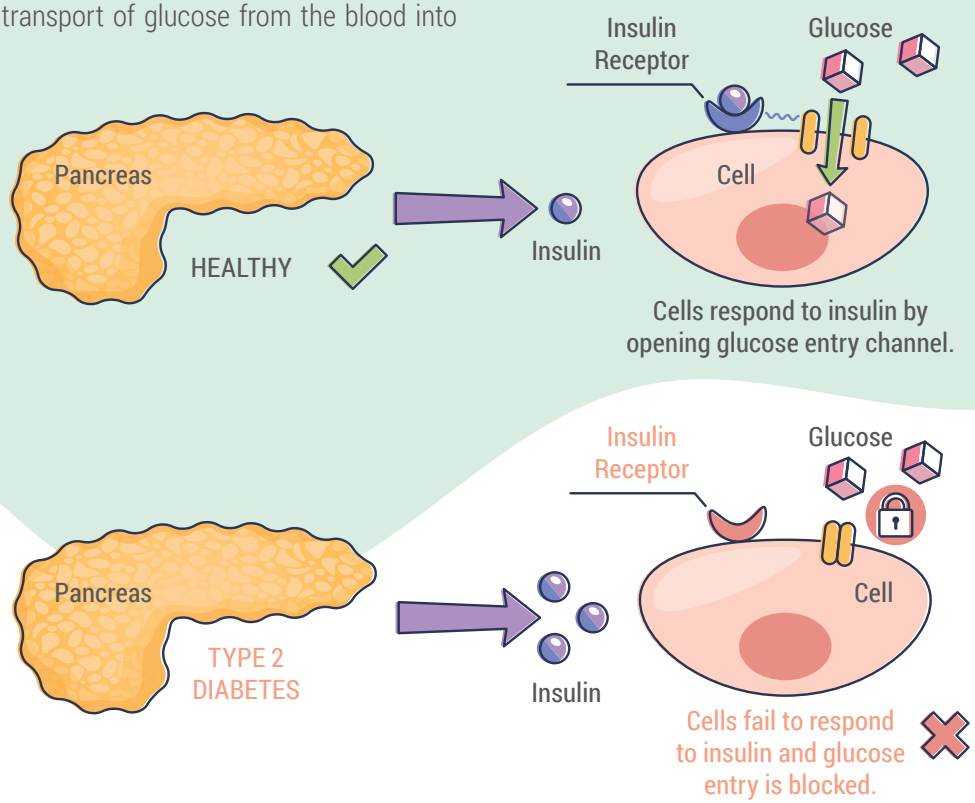
In both cases, rising levels of unabsorbed sugar keep circulating in the blood.

Gestational diabetes is a temporary increase in blood sugar levels during pregnancy that can affect the course of pregnancy and the baby's health. At this stage cells absorb sugar from digested food more slowly, causing blood glucose levels to rise. Blood glucose levels usually return to normal after delivery. However, women with gestational diabetes have a higher risk of developing type 2 diabetes later in life and should check their blood sugar levels more often.

UNDERSTANDING BLOOD GLUCOSE AND INSULIN

Glucose is one of a group of carbohydrates known as simple sugars. After a meal, the body absorbs glucose into the bloodstream from the small intestine. This sends signals to specific cells in the pancreas, called beta cells, to release insulin into the bloodstream.

Insulin binds to specific receptors on the body's cells surface and facilitates the transport of glucose from the blood into the cells, where it serves as an energy source for our metabolism. Insulin, therefore, is essential in regulating blood sugar levels. In diabetes, this normal glucose metabolism is disturbed. A lack of insulin or cells' resistance to it leads to elevated blood glucose levels and consequently, long-term health problems.



Normal glucose matabolism vs. disturbed glucose metabolism in type 2 diabetes melitus.

CONSEQUENCES OF ABNORMAL BLOOD SUGAR LEVELS AT THE CELLULAR LEVEL

In general, sugar (glucose) plays an important role in many processes in the body, including being a main source of cellular energy. Our brain and nervous system in particular use a lot of sugar to support their high energy needs. However, excess sugar molecules over a long period of time can cause serious damage to almost every organ in the human body resulting in heart attacks, strokes, peripheral vascular disease, nerve damage, loss of vision, and many other complications.

Complications of diabetes at the organ level are the consequences of cellular damage done by their exposure to too much sugar. The disruption of cellular processes, resulting from high blood sugar, can have the following impacts:

- **Impaired oxygen supply** to all cells in the body caused by damage of oxygen-carrying hemoglobin in the red blood cells (erythrocytes) by high blood sugar.
- **Lower immune system function,** resulting from the negative effects of sugar on the white blood cells (leukocytes).
- **Inflammatory processes** all over the body.
- **Impaired intracellular glucose transport** due to the limited effectiveness of insulin.
- **Formation of complex sugar structures** known as advanced glycation end products (AGEs), which are deposited in the walls of blood vessels and other organs such as the kidneys, eyes, nerves, and liver, significantly impairing their function.
- **An increasing number of free radicals are generated,** which attack the cells, altering their structure, disrupting their function and even damaging their DNA.
- **Oxidative stress,** which is caused by an excess of free radicals, can accelerate the aging process in the body and contribute to the development of various chronic and acute diseases.
- **Weak connective tissue due to impaired collagen production.** This is the consequence of vitamin C deficiency inside the cells caused by high glucose competing with intracellular transport of vitamin C, which creates a "scurvy-like" condition.

Insufficiency of vitamin C in cell metabolism decreases collagen production, especially in blood vessels, thereby increasing risk of cardiovascular problems. In addition, it negatively affects the functions of other organs in the body that are made up of connective tissue, thereby promoting the development of secondary diseases and weakening cellular defenses against oxidative stress, among others. *(Read more about this in the chapter "Diabetes-related conditions and long-term complications".)*

WHAT ARE THE SYMPTOMS OF DIABETES?

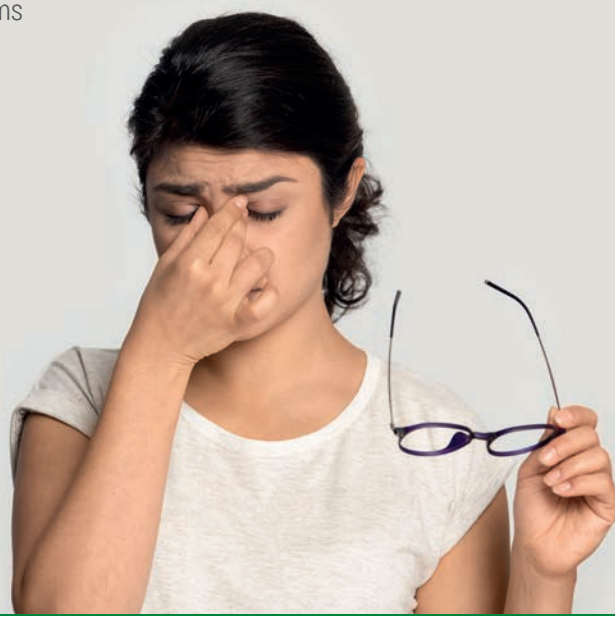
All types of diabetes develop gradually and may remain unnoticed for a long time. Typical symptoms usually only appear when blood glucose level rises dramatically, and metabolism gets out of control. The first sign of diabetes is frequent urination. The body tries to get rid of the excess sugar through urine leading to increased thirst. Other typical diabetes symptoms include:

- Food cravings
- Feelings of nausea
- Lack of concentration
- Dizziness
- Itching
- Tiredness and fatigue

Additional symptoms that occur at later stages include:

- Susceptibility to infections
- Impaired wound healing
- Tingling, pain, or numbness in the hands/feet
- Weak potency
- Impaired vision

In the advanced stages organs can be damaged.



DIABETES-RELATED CONDITIONS AND LONG-TERM COMPLICATIONS

Blood vessel damage by high blood glucose or other factors leads to secondary diseases. The underlying cause of this vascular damage is usually a long-term deficiency of vitamins and other essential nutrients in the cells that build blood vessel walls. If the cellular nutrient deficiency is not corrected promptly, there is a risk of serious complications, such as cardiovascular disease, blindness from diabetic eye disease, and amputation of the foot from diabetic foot syndrome.

Cardiovascular disease

Diabetics are up to three times more likely to suffer from cardiovascular disease than healthy people. Cardiovascular disease is also the leading cause of death in diabetics.

Persistently high blood glucose levels in diabetes damages blood vessel walls in different ways. It can lead to atherosclerosis, manifested by a buildup of fats, cholesterol and other substances in the artery walls that can clog blood flow causing heart attacks or strokes. Atherosclerosis is usually initiated and promoted by deficiency of vitamin C and other micronutrients that cause structural weakness of the blood vessel walls. In response to this metabolic condition, the body triggers biological "repair" mechanisms by increasing the production of cholesterol, lipoproteins and other compounds to be deposited in the weakened areas of the vessel wall to stabilize the artery. This is accompanied by thickening of the blood vessel walls, which increases the risk of developing high blood pressure and various circulatory disorders. This metabolic process is exacerbated by high blood glucose levels, which inhibit the transport of vitamin C inside the vascular cells, thereby aggravating vitamin C deficiency and further impairing collagen production and weakening the blood vessels. If the cause of the structural weakness of the blood vessels, which is vitamin C deficiency, is not eliminated, the risk of atherosclerotic deposits blocking the blood vessels and causing heart attack dramatically increases.

Stroke

People with diabetes are at greater risk of ischemic stroke, caused by a blockage of blood vessels in the brain or carotid artery, cutting off its blood supply. This risk is more than three times higher in diabetics than in non-diabetics.

Strokes, like heart attacks, are mostly caused by arteriosclerosis, which is triggered and aggravated by a long-term deficiency of vitamins and other cellular nutrients.

Neuropathy

Nerves are supplied with oxygen and nutrients carried in the blood by small blood vessels. Persistently high blood sugar levels may damage these blood vessels, leading to nerve damage. This is known as diabetic neuropathy. This disease of the peripheral nerves is known as "polyneuropathy" or "autonomic neuropathy."

Polyneuropathy affects the nerves that control muscle movement and skin sensitivity. Patients experience sensory disturbances such as tingling, numbness or pain in the feet and hands. About 30% of people with type 1 and type 2 diabetes are affected by this form of neuropathy.

Autonomic neuropathy affects the nerves that control internal organs. This form of neuropathy can cause problems with gastrointestinal tract function (peristalsis) and regulation of the heart rate. Also, sexual problems such as erectile dysfunction and problems with ejaculation are common.

Retinopathy

Too-high blood sugar levels can cause eye problems by damaging the small blood vessels in the retina. This condition is known as diabetic retinopathy. Globally, the prevalence of diabetic retinopathy among diabetic patients is estimated to be about 27%, which results in 0.4 million cases of blindness. In Europe diabetic retinopathy in those over age 60 is highest in France, followed by Germany.

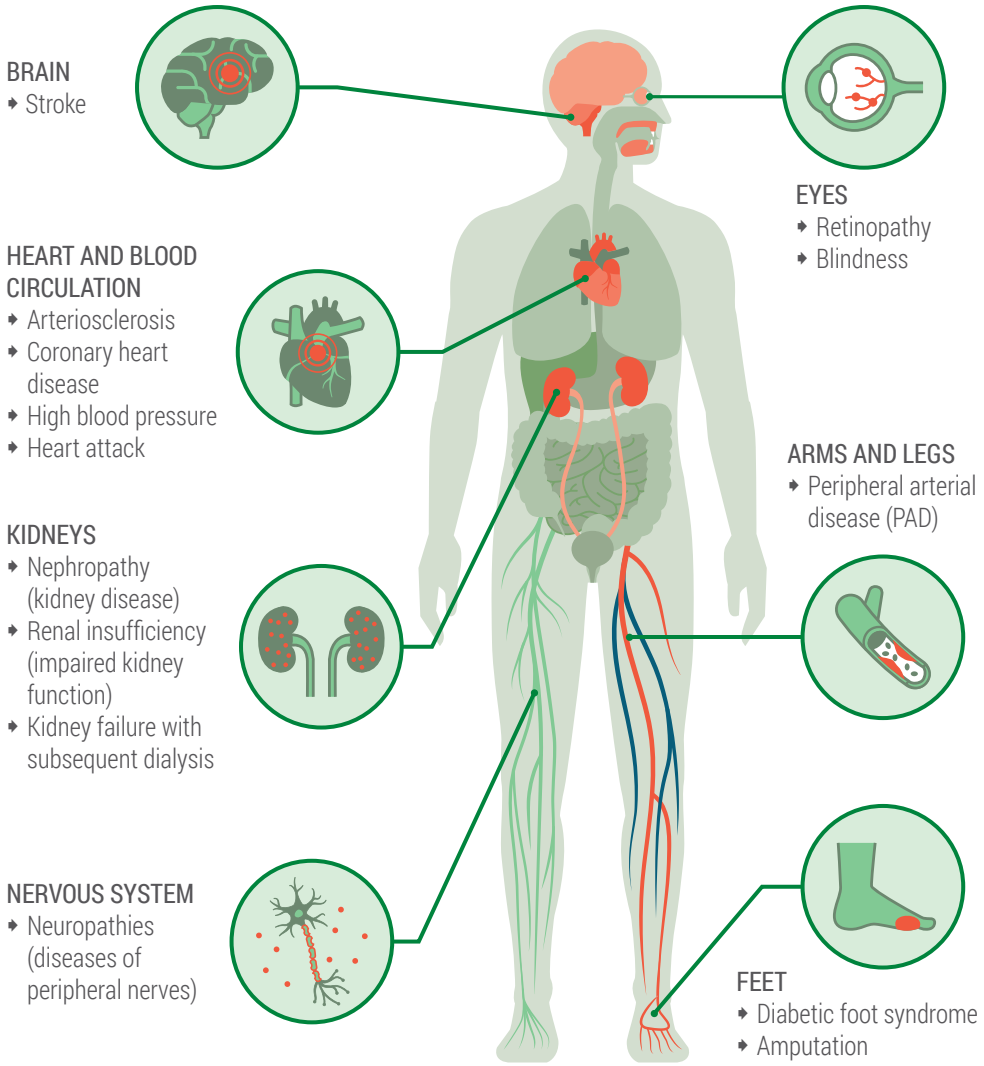
Initially asymptomatic, diabetic retinopathy progresses over time, leading to symptoms such as blurred and distorted vision, appearance of dark spots and a grey or red haze in the field of vision. If not diagnosed and treated early, it can lead to blindness.

Nephropathy

One of the most common consequences of diabetes mellitus is damage to the kidneys, known as "diabetic nephropathy". About 20-50% of people with type 2 diabetes will eventually develop diabetic kidney disease.

Diabetic nephropathy occurs when persistently high blood glucose levels damage the blood vessels in the kidneys that filter waste products from the blood. When these biological waste products are no longer removed from the blood properly, they can cause kidney failure. Patients with complete kidney failure are permanently dependent on dialysis.

LONG-TERM CONSEQUENCES OF DIABETES



People with diabetes have an increased risk of many health complications. The organs above are the most affected.

Peripheral arterial disease (PAD)

Blood circulation problems in diabetes also affect the arms and legs. When these are no longer adequately supplied with blood, a condition called peripheral arterial disease (PAD) occurs. It is usually caused by atherosclerosis, in which arteries that supply blood to the extremities become narrowed or blocked by vascular deposits. *(See "Cardiovascular disease".)* PAD is a global burden affecting more than 200 million patients, with 1 million in Germany and 12 million in the United States.

Diabetic foot syndrome

High blood sugar levels can damage the nerves and blood vessels in the feet of people with diabetes, leading to diabetic foot syndrome. It is manifested as tingling or pain in your feet, loss of sense of touch or ability to feel heat or cold. This also means that injuries or small cuts can remain unnoticed and develop into larger wounds or infections that are difficult to heal. In combination with circulatory problems, entire areas of tissue on the foot may be at risk of necrosis. Diabetic foot syndrome is one of the most common causes of foot amputation.

The lifetime risk of developing diabetic foot syndrome is 19-34%, with an annual incidence rate of around 2%. About 70% of all foot amputations are performed in people with diabetes mellitus.

Sucrose Sugar Molecule

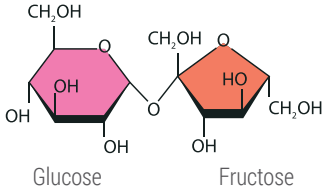


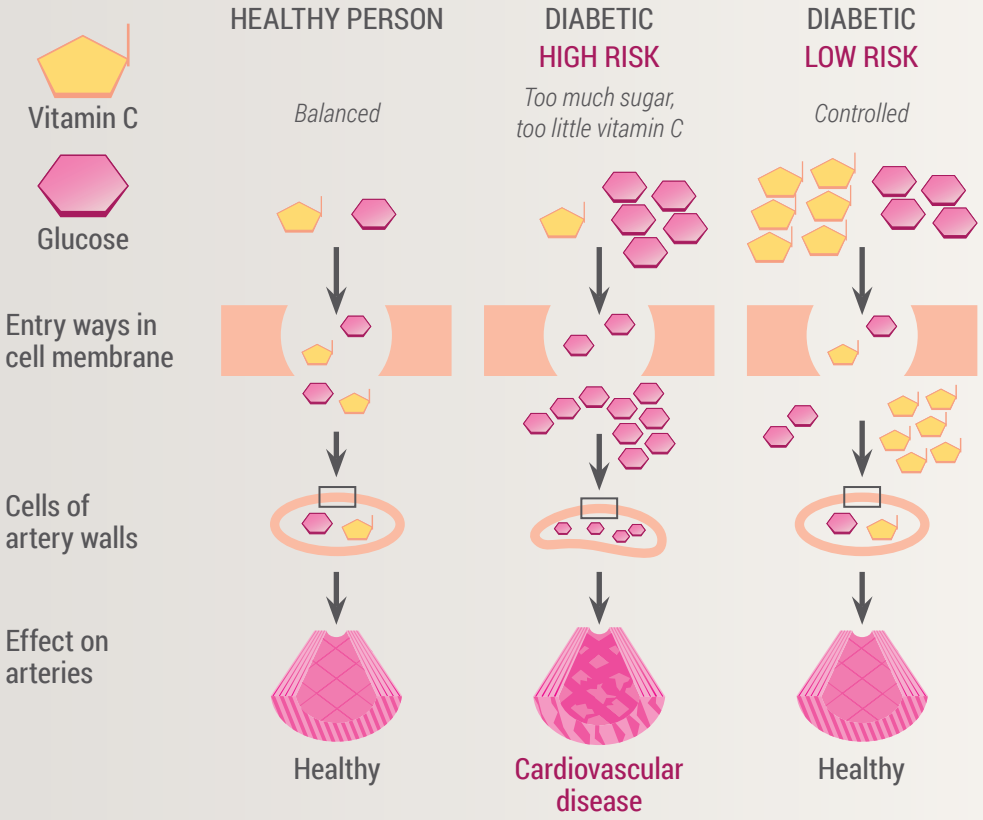
Table sugar (sucrose) is made up of glucose and fructose molecules.

CAUSES AND RISK FACTORS OF DIABETES

Unlike type 1 diabetes, which is an autoimmune disease, type 2 diabetes is called a **disease of civilization**. It develops because of unhealthy lifestyles particularly prevalent in industrialized countries. These include a poor diet based on processed food, chronic micronutrient deficiencies, obesity, and physical inactivity.

Other factors that increase risk of type 2 diabetes include older age, family history, elevated blood lipids, high blood pressure, smoking, stress, and certain medications (including glucocorticoids, diuretics, beta blockers prescribed for high blood pressure, and popular cholesterol-lowering drugs, statins).

Many of these factors are linked to a lack of specific cellular nutrients. For example, the body uses more vitamins when under stress or when responding to environmental toxins, such as smoking. Older people often suffer from micronutrient deficiencies, due to poor diet and taking multiple medications that often facilitate micronutrient depletion. Unfortunately, conventional medicine overlooks the aspect of chronic nutrient deficiency in the insulin-producing cells of the pancreas, which Cellular Medicine identified as the primary cause of diabetes decades ago. This chronic nutrient deficiency expands to the cells building arterial walls and other organs of the body, leading to the long-term negative health consequences described earlier.



Vitamin C supplementation is an essential measure for diabetic patients in preventing cardiovascular disease.

CAUSE OF DIABETIC VASCULAR COMPLICATIONS: CONFUSION OF VITAMIN C AND SUGAR MOLECULES

The key to understanding diabetic vascular complications lies in the glucose and vitamin C molecules, which are structurally very similar and use the same entry ways (transporters) to get inside the cells *(see page 14)*. When there is a high sugar concentration in the blood, these entry ways are overloaded with sugar molecules at the expense of vitamin C. As a result, the blood vessel walls cells become deficient in vitamin C. This impairs their critical functions, including collagen production and antioxidant defense, among many others. Consequently, various biological mechanisms are involved that lead to thickening of the walls throughout the blood vessel pipeline and formation of deposits that put the body organs at risk for infarctions.

HOW DIABETES IS DIAGNOSED

If type 2 diabetes is suspected, a physical examination is followed by blood tests to measure and determine glucose levels and various related blood parameters.

Because blood glucose levels are not constant and are subject to natural fluctuations, several different tests are usually used to assess them:

- **Fasting blood glucose** is measured after at least 8 hours without food. A fasting blood glucose of 126 mg/dl (7.0 mmol/l) or higher indicates diabetes.

- **Oral glucose tolerance tests** are used to measure how well the body can process larger amounts of sugar. To this end, the patient drinks a glucose solution after an 8-hour fast. Two hours later, the blood glucose level is tested. A result of 200 mg/dl (11.1 mmol/l) or higher indicates type 2 diabetes.

- Blood glucose and oral glucose tolerance tests only show the current amount of sugar in the blood. However, **measuring the amount of glycosylated hemoglobin (HbA1c)** provides a long-term evaluation of blood glucose levels. An HbA1c test estimates how much glucose was in your blood over the past two to four months. Diabetes is diagnosed when HbA1c is 6.5% or higher. HbA1c stands for "hemoglobin A1c" and reflects the "glycated" part of the red blood pigment hemoglobin that is formed when glucose in the blood at-

taches to hemoglobin molecules. The more sugar in the blood, the more sugar binds to hemoglobin and the higher the HbA1c level.

- **A random blood test** measures the blood sugar level at any given time, regardless of the time or when the patient last ate. If the blood glucose value is 200 mg/dl or higher during such a test, diabetes is likely.

When blood glucose levels are above the normal range but below the threshold for a diagnosis of type 2 diabetes, this is known as **prediabetes**. People with prediabetes have an increased risk of developing diabetes. Early diagnosis of prediabetes is therefore important to prevent the development of type 2 diabetes.

If the doctor detects high blood glucose, he or she will usually carry out further tests to confirm a diagnosis of diabetes, as a single elevated reading does not necessarily indicate diabetes.

Note: When we talk about "diabetes" on the following pages, we are referring to type 2.

OVERVIEW OF DIFFERENT TESTS USED TO DIAGNOSE DIABETES

	No diabetes	Prediabetes	Diabetes
Fasting Blood Sugar	below 100 mg/dl	100 – 125 mg/dl	126 mg/dl or above
HbA1c	below 5.7 %	5.7 – 6.4%	6.5 % or above
Glucose Tolerance	below 140 mg/dl	140 – 199 mg/dl	200 mg/dl or above
Random Blood Sugar	n/a	n/a	200 mg/dl (11,1 mmol/l) or above

Official guidelines and tests used to diagnose diabetes mellitus.

MEDICAL INTERVENTIONS AND NATURAL STRATEGIES FOR THE TREATMENT OF TYPE 2 DIABETES

Patients diagnosed with diabetes usually get recommendations to adopt a healthy lifestyle, change their diet and exercise more. This is accompanied by – usually lifelong – artificial control of blood glucose levels with the help of diabetes medication, so-called antidiabetics and/or insulin injections. However, these pharmacological interventions do not treat the underlying cause of diabetes and vascular damage throughout the body caused by elevated blood sugar levels.

Lowering blood glucose levels is essential for people with diabetes, but it is not enough. To prevent and treat diabetes effectively, it's important to understand the complexity of this disease and underlying factors that cause it.

A varied diet, with plenty of whole grains, fresh fruit and vegetables, milk and dairy products, meat and fish, provides many essential nutrients and is therefore an important part of preventing and managing diabetes. But following a healthy diet alone is often not enough. Supplementing your diet with a targeted combination of cellular nutrients is important, especially if you are at increased risk of or already have diabetes. This compensates for the micronutrient deficiencies often found in diabetics, protects cells from damage caused by elevated blood glucose levels, and optimizes glucose metabolism in the long term.

CELLULAR NUTRIENTS – SPECIFIC, PREVENTATIVE, AND SUPPORTIVE

Cellular Medicine identifies chronic deficiencies of essential micronutrients in the cells of the insulin-producing pancreas, vascular walls and other organs as a primary cause of developing type 2 diabetes and its complications. This understanding forms the basis for a rational approach to preventing and treating diabetes using optimal amounts of vitamins, minerals, phytonutrients, and other natural components. When provided in specific amounts and combinations, these nutrients not only help to reduce the risk of developing type 2 diabetes, but also improve blood glucose control and lower the risk of diabetes-related complications.

Micronutrients have a wide range of important functions that benefit people with diabetes, including:

- Reducing damage caused by oxidative stress: especially important are vitamin C, vitamin E, carotenoids, minerals, and secondary plant substances (phytonutrients).
- Protecting against inflammation by naturally reducing the production of several biological factors involved in the diabetic inflammatory process.

- Supporting function of the immune system impaired in diabetes, including preventing growth of bacteria and fungi favored by high blood sugar levels.

In addition, specific nutrients can directly affect important cellular mechanisms in diabetes:

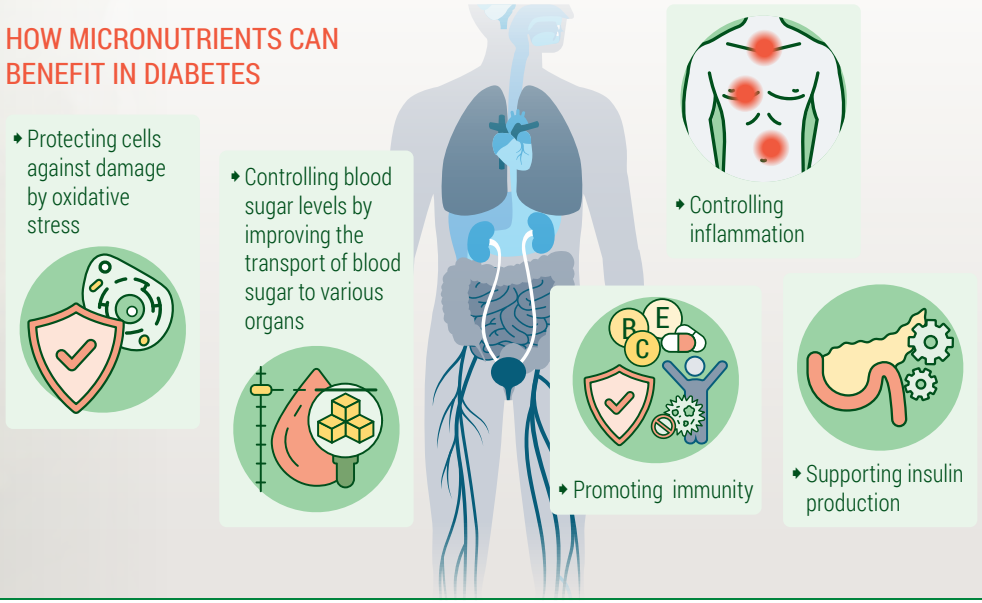
- Several vitamins, minerals, amino acids, and plant compounds can **enhance the uptake of glucose** by the cells. More glucose taken up by the cells means less sugar remains in the bloodstream. This is an essential step for managing diabetes effectively and preventing its complications.

- Specific micronutrients can **enhance insulin production** in pancreatic cells. Increased insulin production facilitates more efficient uptake of sugar from the blood into cells, thereby reducing blood glucose levels.

- High blood glucose levels favor the formation and deposition of complex sugar-encrusted structures (AGEs), which are particularly toxic to the nervous system. Certain micronutrients can **protect against damage by AGEs**.

Cellular nutrients have multiple metabolic benefits in diabetes beyond a pharmaceutical drug. They can not only improve and normalize blood sugar levels, but also provide protection against various cell-damaging mechanisms associated with diabetes. And all without negative side effects.

HOW MICRONUTRIENTS CAN BENEFIT IN DIABETES



ESSENTIAL MICRONUTRIENTS FOR DIABETES MANAGEMENT

The first step in the effective prevention or supportive treatment of type 2 diabetes is a regular daily intake of the widest possible range of vitamins, minerals, trace elements, and amino acids. Supplementation will compensate for specific nutrient deficiencies that may occur because of an individual's increased requirements, poor or inadequate diet, and other factors. The following nutrients are especially important.

Vitamin C

Ascorbic acid is one of the most important cellular nutrients with a cell-protecting effect. It is not produced in a human body and comes only from a diet rich in fresh fruits and vegetables. Supplementation with vitamin C is essential as it can compensate for shortages of intracellular vitamin C caused by its displacement during cellular transport by excess of sugar molecules.

Vitamin C is the most important antioxidant protecting cells against oxidative damage caused by free radicals. This damage is one of the

factors contributing to the development of insulin resistance. As an essential molecule in the production of collagen and healthy connective tissue, vitamin C helps to protect and stabilize blood vessel walls, thereby preventing serious diabetic complications. This vitamin is also needed for energy production, normalizing cholesterol levels, and other functions.

B vitamins

Vitamins B1, B2, B3, B5, B6, B12 and biotin are bio-energy carriers in cellular metabolism. They improve metabolic performance, especially in the liver, the control center of the body's metabolism.

Vitamin B1 (thiamine) is needed to convert complex carbohydrates into glucose. A deficiency can cause fluctuations in blood sugar levels and increase neuropathic symptoms often seen in diabetics.

Vitamin B3 (niacin) can improve the insulin sensitivity of cells, which means that cells can absorb more glucose from the blood, so blood glucose levels are better controlled. Niacin also lowers blood levels of fat-carrying lipoproteins that are often elevated in people with type 2 diabetes.

Vitamin B6 (pyridoxine) is involved in insulin productionand energy metabolism of amino acids. B6 deficiency can lead to elevated homocysteine levels, further increasing the risk of cardiovascular disease.

Biotin (vitamin B7) is needed for the synthesis of fatty acids, the sources of biological energy, thereby supporting glucose utilization by cells. An optimal supply of biotin can help reduce fluctuations in blood glucose levels. Biotin also stimulates a liver enzyme that converts excess glucose into its storage form (glycogen).

Folate (various forms of vitamin B9) has anti-inflammatory properties and can therefore have beneficial effects on the progression of diabetes, and it may lower A1C hemoglobin. Folate deficiency facilitates elevated levels of the amino acid homocysteine in the blood, associated with an increased risk of cardiovascular disease, a typical complication of diabetes.

Vitamin B12 (cobalamin) is important for the formation of red blood cells and the functioning of the nervous system. A deficiency of B12 can lead to neuropathic symptoms, which are common in people with diabetes.

Vitamin E

This fat-soluble vitamin is a powerful antioxidant that protects cells from damage caused by free radicals associated with diabetic metabolic state.

Arginine
Arginine is an amino acid that serves as a source of nitric oxide (NO) important in growth, anti-aging, and immunity. Its dietary supplementation can help to reduce high blood pressure, decrease obesity, ameliorate insulin resistance, and normalize blood vessel dysfunction, all affected by diabetes.

Lysine
This essential amino acid, important for the formation and maintenance of collagen and connective tissue, is not produced in our body and its only source is our diet or nutritional supplements. Lysine is a component of collagen, providing strength and elasticity to our blood vessels and thus important in the prevention of arteriosclerosis and other complications of diabetes. In addition, it can reduce blood glucose and non-enzymatic glycation of proteins.

Calcium
This vital mineral plays a role in the secretion of insulin from the beta cells of the pancreas. Optimum calcium levels can improve insulin sensitivity. Calcium also helps to regulate blood pressure. As high blood pressure is a common accompanying symptom in people with type 2 diabetes, normalizing blood pressure is important to reduce the risk of diabetic complications, particularly cardiovascular disease.

Magnesium
Magnesium plays an important role in regulating glucose metabolism, bioenergy production, and can help to stabilize blood sugar levels. Magnesium deficiency increases the risk of neuropathy (nerve damage) and painful muscle cramps, which are common in people with diabetes.

Chromium
A biocatalyst, this trace element is essential for the metabolism of glucose and insulin. Together with magnesium, it is involved in the regulation of insulin activity.

Manganese
Manganese is an essential trace element and acts as a co-factor for several antioxidant enzymes that protect cells from oxidative stress, common in diabetes.

Zinc
One of the most important trace elements in the body, zinc is a catalytic and structural component of many enzymes and proteins that carry out vital cellular functions. Zinc plays an important role in insulin metabolism, and, as an antioxidant, it protects cells from oxidative stress. Zinc also supports wound healing and immune system function, often impaired in people with diabetes.

Inositol and choline

These two compounds are components of lecithin, a constituent of the cell membranes, and are essential for the proper transport of nutrients into the cells and many other functions. Inositol helps to regulate blood sugar levels, while choline is involved in fat metabolism and regulates cholesterol levels. Choline also has anti-inflammatory properties.

Various plant extracts

Plant extracts such as green tea extract, cinnamon extract and grape seed extract are rich in flavonoids, polyphenols, and other secondary plant compounds with antioxidant and anti-inflammatory properties. Studies show that cinnamon can lower blood sugar and help to manage various diabetic complications.

Catechins in green tea help to improve insulin sensitivity, and grape seed extract can improve markers of inflammation and glycaemia in diabetes.

PREVENTION AND SUPPORTIVE TREATMENT WITH CELLULAR NUTRIENTS: SYNERGY IS THE KEY

The principle of biological synergy is central to the research and development of cellular nutrient combinations at the Dr. Rath Research Institute. Nutrient synergy refers to the enhanced biological effect that is achieved by specifically selected and properly combined nutrients when compared with their individual effects. Micronutrient synergies, with optimally balanced ingredients, produce superior and more lasting effects than the same nutrients used individually.

SCIENTIFICALLY CONFIRMED: THE BENEFITS OF CELLULAR NUTRIENTS IN DIABETES

Numerous scientific studies have investigated the effects of different natural components on diabetic metabolism. Most of these studies focus on individual micronutrients, overlooking their final effects when used in specific combinations.

By contrast, from early on, the team of scientists at the Dr. Rath Research Institute took an approach that focuses on the effects of specific combinations of micronutrients, known as micronutrient synergies *(see page 23)*. This approach promises a comprehensive management of diabetes, including its complications and associated cellular and tissue damage. Interestingly, an in vivo study conducted by the Dr. Rath Research Institute found that a specific nutrient combination was even more effective than the commonly prescribed diabetes drug metformin.

Here are some interesting results of this research:

- In an ***in vivo study*** with mice fed a high-sugar (fructose) diet, a combination of natural substances led to a 4% lower concentration of fructosamine (an indicator of sugar bound to proteins) in the blood of these animals. By contrast, mice treated with metformin had a 15% increase in fructosamine concentrations.

  Serum fructosamine levels indicate the level of glycated (damaged) proteins in the blood for up to three weeks prior to testing. For comparison, measurements of hemoglobin A1c (HbA1c) reflect sugar damage over a longer period of two to four months. Metformin use that causes higher fructosamine levels indicates inadequate blood glucose control.

  Further analysis also showed that the mice treated with metformin had decreased insulin levels, while the blood insulin in mice taking micronutrients returned to normal. **This result is significant because an increase in insulin helps to improve the uptake of glucose into the cells, thereby reducing blood glucose levels.**

- A pilot **clinical study** has also confirmed the effectiveness of specific nutrients in lowering elevated blood glucose levels in people with type 2 diabetes. The subjects were given a combination of certain vitamins, ami-

no acids, and minerals for 6 months. Their blood glucose levels fell by 23% – from an average of 155 mg/dl at the start of treatment to 120 mg/dl at the end of the study. In addition, HbA1c levels fell by an average of 9.3%.

As research in the field of Cellular Medicine continues to advance, the cellular nutrient combinations studied at the Dr. Rath Research Institute are constantly being revised and tested to improve and confirm their effectiveness. On the following pages we present the latest research on a specific nutrient synergy that represents a unique, universal, and safe approach to controlling blood sugar levels.

NATURAL CONTROL OF KEY DIABETES MECHANISMS THROUGH NUTRIENT SYNERGIES

Scientists at the Dr. Rath Research Institute have selected specific nutrients and studied their combinations for their ability to affect key cellular mechanisms involved in the onset and development of diabetes and its complications. Three micronutrient combinations were included in the studies: a **core formula** containing vitamin C, vitamin E, B vitamins, choline, zinc, magnesium, chromium, cinnamon extract, green tea extract, grape seed extract, inositol, arginine, and lysine; a **mineral formula** containing calcium, magnesium, zinc, manganese, other minerals, and further cellular nutrients; and a **formula containing vitamins D3 and K2**.

1. Effect of different compositions of nutrients on glucose uptake

All test nutrient combinations had significant effects on glucose uptake into cells, even in the absence of insulin. The core formulation was the most effective, increasing glucose uptake by 235%. The three nutrient combinations used together enhanced this effect by increasing glucose uptake into muscle cells by as much as 450%. These nutrient formulations worked even better in the presence of low doses of insulin, increasing glucose uptake by cells by almost 1,445%. **This corresponds to a more than five-fold increased efficacy compared with the effect of insulin alone.**

2. Effect of micronutrients on the protection of cells from damage caused by AGEs

The nutrients combinations showed a remarkable protection of nerve cells from damage caused by toxic byproducts of high blood sugar levels (AGE). Among various nutrient combinations the highest protective effect was obtained by the

D3-K2 formulation, resulting in the survival of 40% of the cells. When all three formulas were used simultaneously, 80% of the nerve cells survived the damage caused by the AGEs. **This finding is important because nerve damage and disease (neuropathy) are among the most common complications of diabetes.**

3. Effect of micronutrients on insulin secretion by pancreatic cells

These experimental tests documented that nutrients are effective in improving insulin production: The combination of these three formulations used at high doses increased pancreatic insulin production by over 230% compared to the control. **More insulin means better cellular uptake of glucose and therefore a reduction in elevated blood glucose levels.**

The results are shown in **Figures 1 to 3** below and on page 27.

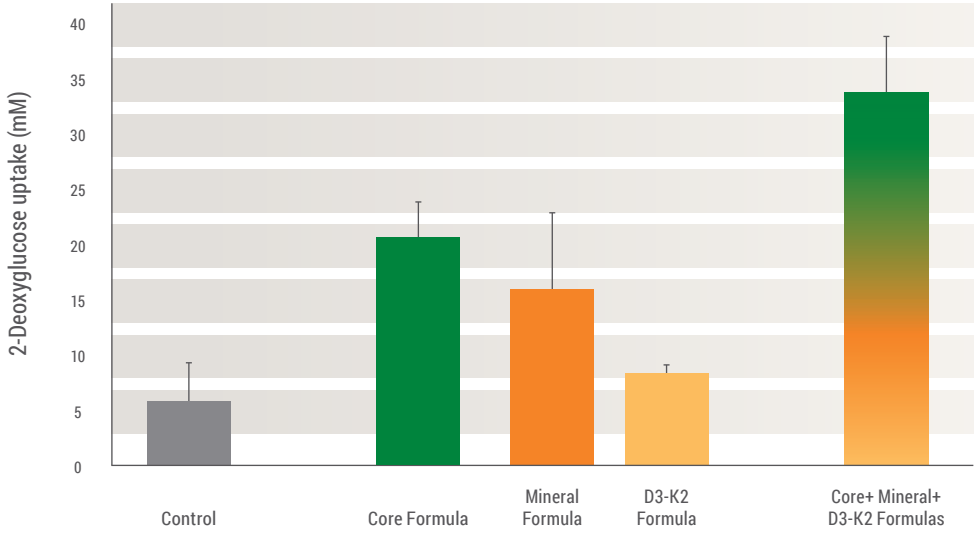


Figure 1: Different micronutrient combinations can significantly increase the uptake of sugar by skeletal muscle cells.

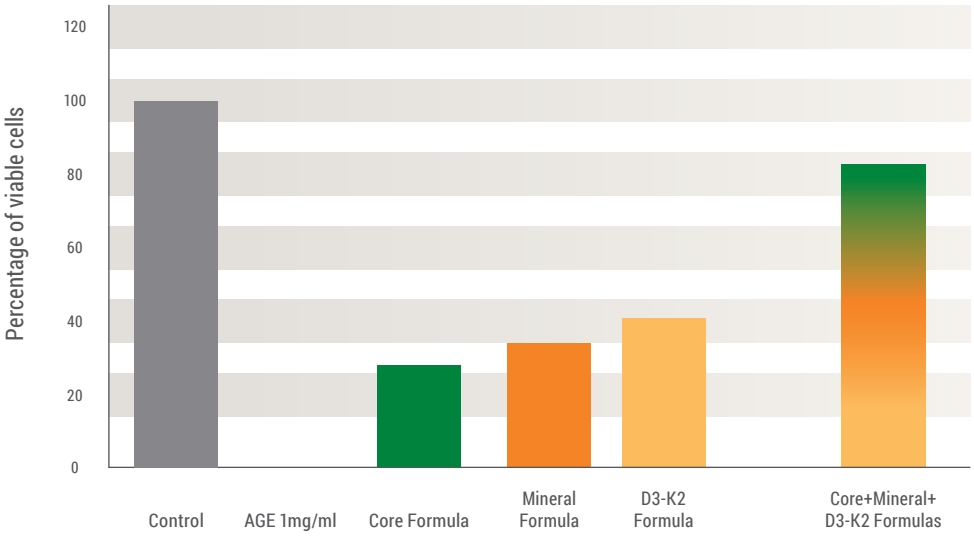


Figure 2: A triple combination of micronutrients can protect up to 80% of nerve (glial) cells from the deadly damages caused by AGEs.

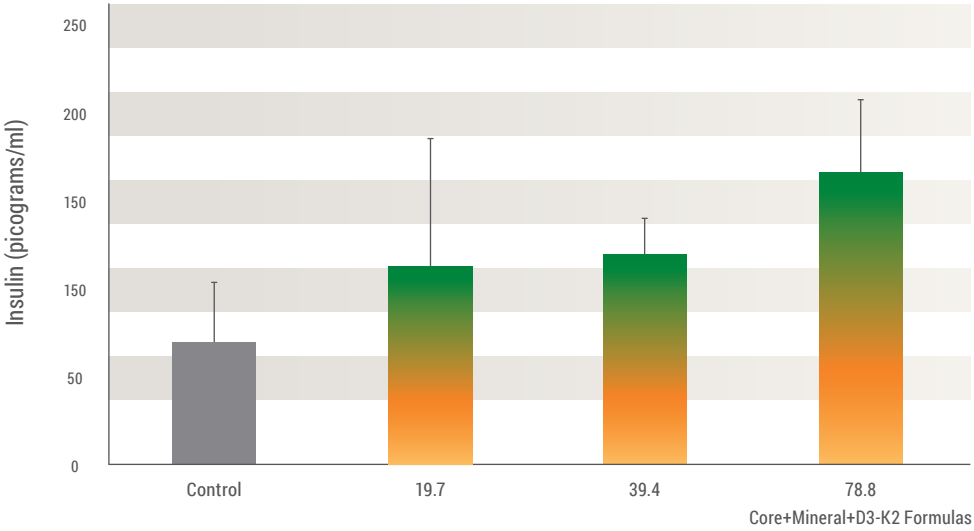


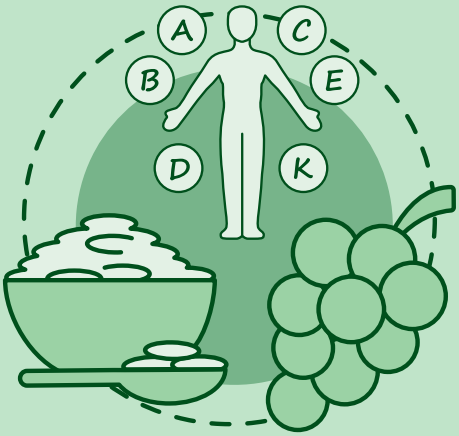
Figure 3: Micronutrient combinations can stimulate the production of insulin in human pancreas cells.

HOW YOU CAN PREVENT AND CONTROL DIABETES IN EVERYDAY LIFE

Individuals with diabetes or those at risk of developing this disease are advised to make positive lifestyle changes that last. Alongside regular blood glucose monitoring and targeted micronutrient supplementation, dietary modifications and regular exercise are the pillars of effective diabetes management, improving quality of life, and even enabling a largely symptom-free daily life.

EATING HEALTHY

Essentially, a healthy diet is based on wholefoods: Replacing simple carbohydrates with fiber-rich whole grains can help lower blood sugar levels and reduce the workload on the pancreas. Complex carbohydrates present in beans, vegetables, whole-grain bread, and whole-grain rice and pasta, are digested more slowly than simple sugars. However, in type 2 diabetes it is important to limit the intake of carbohydrates to 100g per day, as the body may not use (metabolize) them effectively.



It is important to read labels on products you buy, paying attention to their sugar content, especially the presence of high fructose corn syrup. Fructose itself has been implicated in an increase in obesity and diabetes, including in children. It is used as a cheap sugar substitute in sweets, ketchup, and other products, especially in the USA.

A healthy diet can be achieved by consuming 500g of a diverse range of colorful vegetables daily. Some studies suggest that eating vegetables first and carbohydrate last can ameliorate postprandial blood glucose and insulin concentrations. The diet should also be low in fat, with vegetable fats preferred to animal fats. Healthy sources of fat include olive oil, rapeseed oil, linseed oil, nuts, and avocados. When cooking, it's a good idea to replace salt with herbs and spices.

It's also important to note that two to three regular meals with a four-hour break in between will help to reduce blood sugar spikes. Regularly spaced meals are better than constant snacking.

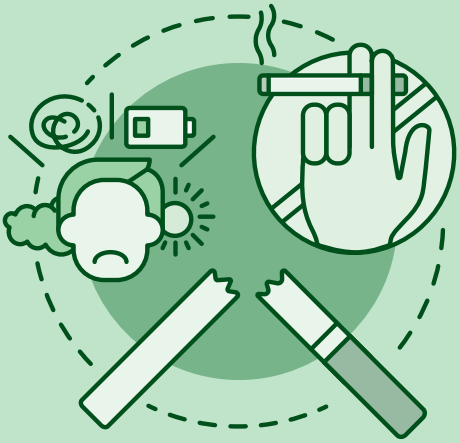
DIETARY SUPPLEMENTATION

While many health officials still reject the fact that vitamins or other supplements will help people with diabetes, the scientific evidence and clinical studies point to multiple health benefits of targeted supplementation. You do not need to guess which nutrients to supplement and how to combine them. The information presented in this booklet is a complete and reliable guide. You should share it with your doctor.

REGULAR EXERCISE

Regular physical activity has many health benefits. For overweight people it is one of the most important weight-loss measures, along with a healthy diet.

Regular exercise helps to lower blood glucose levels, reduce the need for insulin, improve fat metabolism and blood circulation, and reduce risk of complications associated with diabetes, including neuropathy.



LIMITING ALCOHOL, QUITTING SMOKING, AND MANAGING STRESS

Alcohol is a cytotoxin that affects various organs in the body, including those that may already be damaged by diabetes. Alcohol can also promote an abnormally low level of glucose in the blood (hypoglycemia). People with diabetes should, therefore, **limit drinking, or avoid alcohol** altogether.

Smoking is also dangerous for diabetics because the toxins in cigarettes increase the already high risk of many secondary diseases. It is therefore essential to **stop smoking**. Studies also show that smoking promotes the development of diabetes. High workloads, family issues, and ongoing time pressures place many people under persistent stress. This chronic stress can adversely impact health and worsen blood sugar levels, affecting diabetes management. Various relaxation techniques, such as autogenic training, progressive muscle relaxation, meditation, and yoga, can help to **manage stress levels** and consequently optimize blood sugar levels in the long term.

There's nothing quite like enjoying a meal with friends and family. It's one of the simple pleasures that can make everyday life more enjoyable.

PATENTED EFFICACY

The results of the research outlined here were so compelling that the US Patent Office granted a patent (Patent No.: US 11,351,148 B1) recognizing the uniqueness of these nutrient compositions in important aspects associated with high glucose levels. These compositions have also been granted EU and international patents. This is an official recognition of our combination of natural substances as an exclusive strategy for non-pharmacological control of elevated blood sugar levels. No other supplement manufacturers can claim this!

A detailed description of this health technology and its proven effects can be found in the patent publication, which you can access by scanning the QR code.

For a selection of additional clinical studies from around the world highlighting the importance of micronutrients in diabetes, please visit our independent health library.

www.healthlibrary.info

Note: Our information is based on the latest scientific research and can help you to make informed decisions about your health. However, it should not replace the personalized advice of your doctor.

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www.dr-rath-education.org

CELLULAR MEDICINE

Cellular Medicine is based on the simple fact that all organs in our body are made up of cells that need specific micronutrients for optimal function. Regular supply of micronutrients forms the basis for healthy functions of our body organs and the entire body. Chronic, long-lasting deficiencies or a low intake of vitamins, minerals, amino acids and other micronutrients is the most common cause of diseases such as cardiovascular disease, diabetes, osteoporosis, cancer and many others.

Cellular Medicine applies a nutrient synergy approach in designing and scientifically testing specific nutrient combinations to increase their efficacy and range of health benefits. This approach proves that desired health outcomes cannot be achieved by one vitamin or nutrient alone, but only by a specific combination of many micronutrients working together.

Therefore, in addition to a healthy diet and lifestyle, a regular daily supplementation of properly selected vitamins and other micronutrients is necessary to maintain optimal health.

THE DR. RATH RESEARCH INSTITUTE

Located in California, USA, the Dr. Rath Research Institute is a hub for renowned scientists in the fields of medicine, biochemistry, and nutrition. Led by Dr. Aleksandra Niedzwiecki, this team is conducting groundbreaking research in natural health, exploring the synergies of nutrients, and developing innovative health strategies to prevent and control various diseases. The institute builds on Dr. Rath's groundbreaking discoveries in major health areas such as cardiovascular disease and cancer. These findings are routinely disseminated through publications in global scientific journals.

www.drrathresearch.org

RESEARCHERS

Dr. Aleksandra Niedzwiecki

Currently the Director of Research at the Dr. Rath Research Institute, Dr. Niedzwiecki is a leading biomedical researcher in the development of nutrient synergy approaches in various aspects of health and disease. Her work in the areas of cardiovascular health, cancer and infections has won her recognition for her research into the biochemical link between disease and nutrients.

Maddy Chatterjee, Ph.D.

Dr. Chatterjee completed her Ph.D. at the University of Massachusetts Medical School in Worcester, Massachusetts. In her doctoral work she investigated tissue damage and intestinal responses to bacterial pathogens and chemical oxidants. She has worked on several research projects in the field of microbiology and genetics. Her research interests include nutrition, cell biology and gene regulation.

Dr. Matthias Rath

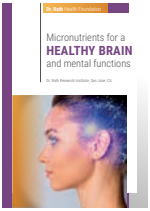
Dr. Rath is a world-renowned physician and scientist known for his pioneering research in natural and cellular health. He is the founder of the scientific concept of Cellular Medicine – the systematic introduction into clinical medicine of the biochemical knowledge of the role of micronutrients as biocatalysts in a multitude of metabolic reactions at the cellular level.

FURTHER INFORMATION MATERIAL

Please feel free to order further brochures from this series by telephone: 0031-457-111 222
or by email: *info@dr-rath-foundation.org*
All publications are also available online at: *www.issuu.com/drrath*

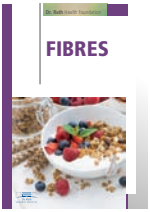
MICRONUTRIENTS AGAINST HIGH BLOOD PRESSURE

High blood pressure, or hypertension, is a common health condition affecting well over 1 billion people worldwide. It is becoming increasingly accepted that the risk of high blood pressure can be controlled and prevented by natural means. The unique information provided in this booklet is an important step in this direction.



MICRONUTRIENTS FOR A HEALTHY BRAIN AND MENTAL FUNCTIONS

Our brain is a complex organ. It controls all our body's functions, such as motor skills, vision, breathing, also our mental alertness, thoughts, memory, emotions, and so much more. Its optimal function is essential for our general health and longevity. Maintaining brain health also involves reducing risk factors and providing essential nutrition to our brain cells, to help to protect, maintain, and improve the brain's complex and multiple functions.



FIBRES

Although dietary fibre is indigestible for the human body, it has a positive influence on health. By directly and indirectly influencing various metabolic processes, fibre can protect against the development of certain diseases or contribute to their treatment. Consequently, dietary fibre should always be taken into account as a component of a health-promoting, wholesome and balanced diet.

MICRONUTRIENTS FOR HEALTHY EYES

The eye is one of the most sophisticated organs in the human body. It can detect colors, light and darkness, and by capturing millions of images, it allows us to see the world around us. Taking care of our eyes is really important to our vision and overall health. By understanding the role and importance of micronutrients for eye health, we can take proactive steps to protect our vision and maintain healthy eye function to improve our quality of life.

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