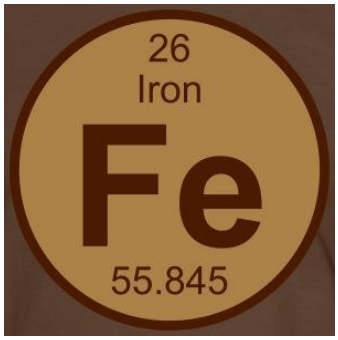

Nano iron

Available in dark violet glass bottles of 200 ml and 1 liter

- Cold hands and feet
- Shortness of breath, altitude sickness
- Blood loss due to menstruation, childbirth, surgery or injury
- Absence of menstruation
- Intensive sports practice
- Frequent drinking of coffee and tea
- To supplement vega(n) or low calorie diet/lifestyle
- Pregnancy and breastfeeding

Composition:
Purified water, nano iron clusters and ions, 25 ppm.
Excipients: None

Suggested use:
Take before meals. Preferably hold in mouth for 1 minute before swallowing. This promotes direct absorption through the oral mucosa. Do not put the bottle to your mouth, but use the measuring cup provided, a cup of your own or a spoon. This may also be a metal spoon.

Dosage from 13 years of age:

For iron deficiency / iron deficiency anemia: 1 to 3 two weeks 60 - 90 ml ó every other day. (2 to 3 measuring cups or 6 to 9 tablespoons.)

In case of bleeding, such as an injury, minor surgery or a nosebleed: about 1 week 60 - 90 ml ó every other day, to supplement lost iron.

Long-term supplementation:
In case of low iron intake or higher consumption, for example with a vega(n) or low-calorie diet, intense exercise or drinking more than 4 cups of coffee per day, occasional iron supplementation is desirable [8,15,42]. Minor deficiencies, can already cause significant performance impairment or fatigue. This can be easily solved with supplementation of nano iron.
Taking 30 ml of nano iron about 3 to 4 times a week is then usually sufficient to maintain iron stores. Depending on diet and level of exercise, this need may be greater.

Menstruation: women lose twice as much iron during menstruation. Taking extra iron every month during menstruation can prevent or reduce fatigue and emotional imbalance.
Take 60 -90 ml óm every other day for 1 week.

Intake

As desired in the morning, afternoon or evening, before meals or at least one hour after eating or drinking.
Taking iron every other day, rather than every day, promotes good absorption [15,29].

Babies and children:
0 - 1 year: approximately one teaspoon to one tablespoon every other day for 1 to 2 weeks.
1 - 8 years: about one to two tablespoons every other day for 1 to 12 weeks, as appropriate.
8 - 13 years: about two to three tablespoons every other day for 1 to 12 weeks, as appropriate.
May be repeated.

Pregnancy and breastfeeding
Approximately 60 ml every other day, depending in part on diet and level of exercise.

Note: For the absorption of iron and incorporation into the hemoglobin, a number of **cofactors** are required: Vitamin C, copper, B2, B12, folate, B6 and Vitamin A. [7,9,10,15] A good multivitamin is recommended in addition to iron supplementation. Phytoplankton is a natural multivitamin (AND omega) that contains iron itself and also helps, sluicing iron from the diet, into the bloodstream.

Note on infections: when there are infections (overgrowth of pathogens), this can inhibit iron absorption because pathogens also absorb iron [13,29]. This also applies to a small extent to nano iron. By first rinsing the mouth with silver (and swallowing it), the pathogens are killed off and the iron is available to the body's own cells [44].

Special features: nano iron usually works much faster than iron tablets or iron drinks, due to its particularly rapid and almost complete absorption.
Nano iron does not cause constipation as many iron compounds do. The risk of accumulation is virtually zero. See also "benefits of nano iron."

In case of uncertainties, use of medication or advice during pregnancy: consult a health advisor/specialist, who is familiar with nano minerals.

Shelf life: The dark violet glass optimally protects against oxidation. The bottles therefore do not need to be stored in the refrigerator. After opening they will keep for at least 12 months.
Nano minerals are generally transparent, odorless and tasteless. Sometimes very subtle color, odor and taste changes can occur.
Large changes in color, taste or odor may have oxidized the product.
We then recommend that it no longer be used (internally).

Iron in brief
Our planet Earth consists of about 35% iron, or one-third. In the Earth's crust, iron is the fourth most abundant element, but the core is full of iron. The metal (mineral) falls under the heavy metals [35,36] and is a good example of how important heavy metals are, and that they are not always (unquestionably) toxic to health. Iron is essential for the uptake of oxygen, making it perhaps the most important mineral for

our bodies. After all, without oxygen, we don't last long. Every cell of our body therefore contains iron [36].
Iron is very important for our energy levels, both physical and mental. It plays an important role in cognitive functions, hemoglobin production, DNA protection, blood flow (healthy complexion), warm hands and feet, functioning muscles and a healthy immune system [35,36,40,42].
The symbol of iron is Fe26. Where Fe stands for the Latin word ferrum, meaning iron, and 26 on the number of electrons each iron atom carries.

Symptoms that may indicate iron deficiency [2,3,6,7,35]

- Persistent fatigue
- Paleness
- Brittle and or spoon-shaped nails
- Concentration problems
- Depression (dejection)
- Dizziness
- Dark circles under the eyes
- Fainting, feeling of fainting
- Behavioral Disorders
- Hair loss
- Heart palpitations
- High blood pressure
- High coffee and tea intake
- Headache
- Cold hands and feet
- Shortness of breath
- Menstrual period
- Inflammations
- Developmental delay
- Tinnitus
- Operations (blood loss)
- Growing children and teens
- Excessive sweating
- Chest pain (for narrowed coronary arteries)
- Restless legs
- Poor skin or yellowing of the skin/eye white
- Muscle weakness
- Depletion
- Fatigue, physical and mental
- Reduced sports performance
- Pregnancy and breastfeeding

Iron and medication interactions:

- Anti-inflammatory medications such as **aspirin and ibuprofen**, for example, can enhance iron loss through intestinal bleeding by damaging the mucosa.
- Tetracyclines (antibiotics) and high doses of aspirin inhibit iron absorption. (Willow bark and hawthorn can often replace aspirin well)
- **Antacids**: Histamine inhibitors (H2-receptor antagonists), gastric acid binders (antacids), and Proton pump inhibitors (omeprazole, lansoprazole, esomeprazole, pantoprazole) can lower iron status.
- Allopurinol, against uric acid formation in gout and kidney stones, can also lower iron status. (Harpaghophytum or devil's claw may be an alternative).
- Pancreatic enzymes and cholestyramine may reduce iron absorption.
- Iron (as iron salt) can reduce the absorption of certain medications: methyldopa, levodopa, levothyroxine, penicillamine, antibiotics (fluoroquinolone, tetracycline antibiotics) and bisphosphonates (clodronate). Do not take iron at the same time as these medications.
- **Iron and copper** must be balanced for proper absorption of both.
- Iron is a pro-oxidant. Increasing iron levels can sometimes lead to additional oxidative processes. With insufficient antioxidants, the body can sometimes inhibit iron absorption.
- In some cases, liquid iron can cause discoloration of the teeth but this is only temporary. Can also be remedied at the dentist by polishing.
  [35,40]

Iron and nutrition interactions:

- High intakes of other minerals, particularly **calcium, but** also magnesium and zinc, can inhibit iron absorption [15,31].
- Iron from food (especially plant-based), tablets and drinks, easily binds to tannins, **tannins**, oxalic acid and **phytic acid**, preventing its absorption into the bloodstream. It is then excreted through the feces. In particular, coffee, tea (black, green, rooibos), wine, spinach, grains, beans and nuts interfere with iron absorption. Whole wheat bread today has much higher phytic acid levels due to its shortened travel time [7,41].
- A lack of stomach acid (when taking **antacids**) interferes with the absorption of iron and other minerals. Also, a lack of stomach acid, increases the risk of **bacterial overgrowth** in the (small) intestine. Bacteria and other pathogens also like to feed on iron and rob it from the body before it is absorbed [12,13,45].
- **Vit B12**, folic acid/folate, B6, vit A and vit B2 play important roles in the iron cycle [10].
- **Vitamin C** is necessary, if not essential, for iron absorption, as is **copper**. Other acids such as malic acid also promote iron absorption[6,7].

Interactions iron and pathogens:

- **Pathogens** (pathogens), like all other living things and cells, **feed on iron;** for energy production. If an overgrowth of bacteria, fungi, parasites, yeasts or viruses is present, then iron supplementation can feed these pathogens and thus make them stronger. This is especially true for iron tablets and drinks that must be absorbed through the gastrointestinal tract [42,45].
- **In infections and inflammations,** pathogens play an important role. Although the **body** then needs **extra iron** for its immune cells, you run the risk of feeding the pathogens [45]. **Nano iron then offers the best solution.** It bypasses the intestines and can enter the bloodstream directly from the mouth, giving pathogens significantly less chance.
- **Lactoferrin** is a protein that resides in mucous membranes to **trap iron ions** (nano iron) to **starve pathogens** and provide iron to the body [42].

Nano iron bypasses complications and is absorbed quickly

Because **nano iron** is offered as neutral, unbound iron particles and iron ions, through the many capillaries under the tongue, it is **absorbed** super-fast **from the mouth**. Thus, most **complications** are **bypassed**. The chance of being bound to dietary substances, such as phytates, is negligible when taken before or at least an hour after eating or drinking. All the complicated processes for absorption of iron into the bloodstream from the gut play little or no role with nano iron. The hijacking of iron by pathogens is virtually no problem because the nano iron particles are so small that they have a **secret entrance door**, so to speak, namely the capillaries under the tongue. So all **pathogens in the gut** have **no chance** anyway and the oral bacteria have only a very short time to strike. To prevent hijacking by pathogens in the mouth, about 10 minutes before taking nano iron, you can rinse/spray the mouth with **nano silver**, which **kills off** (most) **pathogens** [44].

Note: nano silver does not kill healthy oral flora bacteria.

As a result, you only need a very small dose of **nano** iron because it guarantees optimal absorption. **Safe, fast and effective.**

Safety of (nano) iron supplementation

Iron is vital because of its bond with oxygen. **Because iron reacts so well with oxygen,** iron, as free iron in the bloodstream, can react as a **pro-oxidant**. This causes damage and has been linked to cardiovascular damage [19]. Excess iron in the gut, especially from eating excessive amounts of red meat, or from exentrically high iron supplementation (which is unfortunately common), has also been linked to colon and other cancers [20,21]. However, a side note must be made that the vast majority of red meat is processed with chemicals and additives that could also contribute to disease. Other, more recent research shows that red meat in particular contains a mutated gene, which causes health problems in humans, and that this gene is thought to be the main cause of the development of cancer and other diseases [22]. As is often the case, it probably involves a combination of factors.

The fact remains that free iron, can give oxidation damage and therefore the body has devised an ingenious system, to transport and store iron safely all the time. The body does this with the help of **specific proteins,** which act as a kind of "VIP **cabs**," **preventing** the **oxidation** of iron [28]. Taking in too much iron can be harmful for two reasons.

1. It could potentially oxidize.
2. It can potentially feed pathogens.

Don't panic. While it is not wise to (continue to) take extra iron "indiscriminately," it is also a fact that about 80% of the population is mildly to severely iron deficient, especially children, menstruating and pregnant women, athletes and vegans [7,34,35,39,42].
Risk of harm from iron consumption comes into play only with long-term, excessive iron consumption. With nano iron, this is virtually impossible anyway.

Feeding pathogens with iron is obviously not desirable but of course not directly life-threatening. This risk is also almost negligible with nano iron.
If iron deficiency is suspected, symptoms should be checked extra carefully, and the effects of iron intake should be evaluated within three weeks.
The type of iron, the amount, the moments of intake as well as the co-factors, are extremely decisive. Thereby, nano iron is almost always a safe choice [18].

Except for nano iron, all iron supplements on the market are **"iron salts."**
Minerals, such as magnesium, zinc and iron, fall under the heading "metals" in chemistry. A metal bound to a nonmetal is called a "salt" in chemistry. For example, iron fumarate or iron sulfate.
These iron salts must first be decomposed of their binding factor before the body can convert and absorb the iron. The type of binding or **"salt" determines safety and effectiveness.**

To date, **iron fumarate** is the most commonly prescribed iron supplement (iron salt) by doctors. Up to 600 mg per day. Normally, the body only needs to absorb 1 to 2 mg of iron per day to supplement the iron we lose daily. With iron deficiency, we need a little more.
The extremely high doses that are or were prescribed by mainstream doctors are because of the poor absorption of iron fumarate. It is labeled "safe" because it won't make you seriously ill or kill you, but all the excess iron remains in the gut and does cause **symptoms.** Most common are **constipation, diarrhea, nausea** and **dizziness, in** addition to **black coloring of the stool.** A wide variety of symptoms can also occur as a result of **disturbed intestinal flora,** and due to the excessive amount of iron, oxidative damage can occur [28]. Fortunately, more and more physicians are moving to lower dosages, in part because of poor compliance due to side effects.

Fortunately, there is a better **alternative: iron chelates**. This iron salt is bound to amino acids. The iron salt wears a "jacket" of protein, and is therefore absorbed through a different channel. As a result, absorption is much better and it is **much gentler** on the stomach and intestines. Usually about 15 to 30 mg of such an iron supplement per day or ó every other day is sufficient. For short periods, you can even increase the dosage to 45-60 mg per day or every other day, if there is a lot of

blood loss, for example. With iron chelates**, however,** there is still significant **loss through the stool and you can also feed pathogens with it** [45]. Moreover, in a disturbed intestinal flora, where nutrient absorption is limited anyway, it will not reach its potential.

Nano iron offers the solution
Nano iron is absorbed from the mouth and therefore not limited in its absorption. Also, no iron remains in the intestine which can cause complaints. It has **no side effects** and the **absorption** rate is **90 to 100%.** It is **completely safe.**

What is nano iron?

Nano iron is made in a unique way, via electrolysis. This produces **ultra small, pure iron particles** that float in the water. They are not iron salts, but elemental iron particles. Because of their own energy field, the particles repel each other and remain distributed in the water. This energy field is expressed in **zeta potential**. The special production method ensures an optimal zeta potential, so the particles retain their strength and do not clump together or sink to the bottom. **This keeps them super-small and superior in absorption, which** also ensures safety [18]. Such small particles also do not reflect light, and do not impart taste perception, making the product colorless, odorless and tasteless. The smaller the particle, the more powerful the energy field, the better the absorption. This is also called high energy value or complete bioavailability. **With iron fumarate and iron sulfate, you lose a lot of iron through the stool,** about 75 to 95%. Hence, constipation or diarrhea occurs and the color of your stool turns black.
With iron chelates, you lose much less, about 40 to 60%, so you already need much less as well, with few side effects. **With nano iron, you lose** almost **nothing,** 10% at most**,** and there are no side effects. Because it is absorbed so well, you **only need what you need to supplement.**

The RDA for iron is approximately:
10 mg per day for men
16 mg per day for women
[35]

The RDA includes in the advice that about 90% of the amount ingested is lost in bowel movements. So that effectively leaves you with 1, to 1.6 mg from the above advice. Because you lose almost nothing with nano iron, the effective dose is therefore about 0.75 to 1.5 mg per day. 30 to 60 ml.
That is about 0.014 mg per kg body weight, at a body weight of 70kg.
An extensive study with nano iron particles of 40 nm showed that the safe limit for nano iron was at 5 mg per kilogram, or 350 mg per day. Thus, nano iron particles are not only extremely effective but also super safe [18].

Benefits of nano iron:

- 100% organically available.
- It often works within a week, sometimes within a day.
- Elemental iron, unbound, directly absorbable. No burden on intestines, liver and kidneys.
- The ultra-small particles allow it to be absorbed from the oral mucosa into the bloodstream already.
- Both physiological and energetic action.
- Because of its powerful action, the dosage is much lower, making it extremely safe.
- Works faster than any other form of iron.
- 100% pure, completely free of excipients.
- It is tasteless, colorless and odorless. Easy for anyone to take.

Functions of iron:

- Force
- Energy
- Growth and recovery
- Warm hands and feet
- Healthy skin, hair and nails
- Healthy complexion
- Strong defenses
- Endurance

Iron is vital **for** our **first necessity of life: oxygen.** The uptake and transport of oxygen to all cells, tissues and organs is vital and does not succeed without iron. Iron, after releasing oxygen, also takes with it the waste product carbon dioxide, created during energy production [1,3,6].
In addition, iron has, ironically, in the mitochondria (our energy factories), a function as a co-factor for enzymes, such as catalase and cytochromes, which prevent oxidative damage to cells and DNA. The production and assembly of DNA, RNA, (thyroid) **hormones** and neurotransmitters such as **dopamine and serotonin** are also, in part, dependent on iron. [6,14,15,21,35,40].
As many as **25% of all enzymes** contain iron ions or depend on **iron ions** for their function [15].

Iron further has an important role in defense (resistance). It is needed for energy for the **immune system** and inhibits inflammation. In this way, iron supports normal growth and development, energy, healthy body weight, strong defenses, good body temperature, ability to concentrate and learn, healthy complexion, skin, hair and nails, good athletic performance and quick recovery [6,35,39,42].

According to the World Health Organization, 80% of the population has mild to severe iron deficiency, or reduced iron levels. About 55% actually have (had) iron deficiency anemia, or iron deficiency anemia [34].

Symptoms of iron deficiency:

Complaints that often occur with iron deficiency where there is no anemia (yet) are: fatigue and decreased concentration, learning ability and physical work capacity. Also decreased fitness and worse recovery after sports. This certainly applies to children and teenagers as well.
Symptoms associated with iron-deficiency anemia include: severe fatigue, a feeling of weakness, dizziness, (feeling of) fainting, palpitations, excessive sweating, headaches, tinnitus, hair loss, pallor, cold hands and feet, wanting to sleep all day, muscle fatigue, poor recovery, poor fitness, increased susceptibility to infection and restless legs. Brittle and spoon-shaped nails as well as chronic dark circles under the eyes are often symptoms of advanced iron deficiency.
[2,3,6,7,15,35,39,42]

As many as 40% of children and 1 in 3 women are iron deficient [34,39].

Animal and vegetable iron? How is it absorbed?

Plants absorb iron from the soil, through their roots.
This iron occurs as **Fe3+,** or trivalent iron, also called plant iron or ferric iron. Fe stands for Ferrum, the Latin name for iron.
Animals (including humans) **eat the plants** with Fe3+ (spinach, wheat, berries, nuts....) but cannot absorb it in the intestinal wall cells. Therefore, with the help of enzymes and vitamin C, this trivalent iron is **converted to Fe2+** in the gut**.** Also called divalent or ferrous iron. Fe2+ is also called animal iron, but that is incorrect. (Only "heme iron" is animal iron, see below.) Next, Fe2+ are absorbed into the intestinal wall cell through the DMT channel, which stands for Divalent Metal Transporter.
When this **Fe2+** is absorbed **into** the **blood**, it can be **formed** in the bone marrow together **with heme** (also written as heam), **and globulins**, into the complex protein **hemoglobin**. Thus, we make our own from plant iron, animal iron, or heme iron [14,15,41].

Heem-iron:

Heme is a pigment protein, which forms a complex compound with the iron ion Fe2+. In the process, the iron ion is protected by a kind of ring called porphyrin molecule. Heme attaches to a globulin protein, and four of these heme-globulin proteins (2 alpha and 2 beta globulins), together form the protein hemoglobin [9,15]. **Heme iron is** thus **Fe2+ bound to heme**, which we can make ourselves from plant iron using mitochondria [14] or ingest directly from meat. Myoglobin is also a protein with heme

iron, which is mainly found in muscles and the heart, for the necessary supply of oxygen. The redder the meat, the more hemoglobin and myoglobin, and therefore the more iron. In digestion, the heme iron detaches from the globin, and is then **absorbed through a special protein channel (access door) called** HCP. "Heam Carrier Protein." HCP only opens its door to heme iron [15,41].
Heme iron is thus not the same as Fe2+, but is often confused with it. Heme binds very strongly to Fe2+, but if it were to be released, this Fe2+ would not be taken up through HCP, but through the DMT channel, where it must compete with other minerals such as calcium and magnesium, and can also be captured away by substances such as phytates [15,41].

Animal iron or heme iron is better absorbed than plant iron

Because **heme iron** can enter the intestinal cell directly through the HCP (own doorway), and also **does not** have to **compete with other minerals**, the percentage of absorbed iron, is much greater. Also, heme iron is **less bound to substances such as calcium and phytates**, further increasing absorption. However, it is not the case that animal iron now simply enters the intestinal wall. Heme iron is also inhibited by binding substances such as phytates, and if in digestion the heme is not split from the globin, the iron is never released for absorption [15,41].
Heme iron is taken up approximately 15% - 35%. Non-heme iron is absorbed **about 1% - 15%**. You can, however, increase the absorption of non-heme iron with additional copper and vitamin C intake, and probably other acid sources as well [4,8,15,41].

Oxidation of iron is necessary but must be limited.

Iron oxidizes easily, which is why it adheres well to oxygen. It is also essential for absorption. Fe3+ reduction to Fe2+, is an oxidation process**.**
Free iron in the bloodstream, however, can cause free radical damage, resulting in damage to cells and cellular organs such as mitochondria and tissues. Therefore, **iron in the body** is **always transported and stored in protective proteins:** transferrin, ferritin and hemoglobin**.** Respectively transport, store and bind oxygen [14,15,41].
Taking antioxidants can help increase iron absorption, as it reduces the risk of radical damage. **Lactoferrin** is a special protein that resides in our mucous membranes, where it traps iron, to be transported to the bloodstream. It is also an antioxidant. It may therefore be helpful to supplement lactoferrin in addition to iron supplementation [15,42].

How does iron enter the bloodstream from the gut?

Iron is absorbed from the intestinal contents, into the intestinal wall cells. Heme iron or animal iron (Fe2+ bound to heme) is absorbed through the HCP channel. Non-heme iron or plant iron (Fe3+) is reduced (converted) to Fe2+, and then absorbed through the DMT channel. Free Fe is quickly scavenged by nutrients and minerals and thus has less chance of being absorbed into the intestinal cell. Fe3+ is too large for the DMT channel.

However, Fe2+ oxidizes much faster, so for storage and transport it is always back-formed to Fe3+ ASAP. [14].

Once it arrives in the intestinal cell, the heme is uncoupled, and from both channels **Fe2+** is **transformed back to Fe3+** so that it can be bound to the storage protein ferritin, for storage within the cell. After all, no free iron is allowed to "hang around" in the cell, due to danger of free radical damage. When the body, with the help of signaling proteins**,** detects an **iron deficiency, a "little door"** opens on the other side of the intestinal cell, which lies against the bloodstream**: ferroportin** (iron gate). Ferroportin is a protein.
Ferritin then releases some iron, which is reduced to Fe2+ and can then enter the bloodstream via ferroportin.
When iron is through the gate as Fe2+, it must immediately be converted back to Fe3+. This is done with the help of the enzyme hepheastin, **which** in turn depends on **Vitamin C as well as copper**. In the **absence** of copper or vitamin C, the **iron gate** will remain closed because iron is not allowed to remain in the bloodstream as Fe2+ [15,29].
Note that heme iron, or animal iron, is thus also copper- and vitamin C-dependent for absorption into the bloodstream. However, plant iron also requires vitmine C for absorption from the intestine into the intestinal wall cell.
After conversion of Fe2+ to Fe3+, the iron is incorporated into a transport protein: transferrin. **Transferrin transports iron** mainly **to the bone marrow (75%)** for the synthesis of hemoglobin.
The rest is transported to storage sites, particularly **liver, heart and macrophages**, where it is stored in the protein ferritin and used for muscle function and cellular respiration in the mitochondria [14].

Iron regulation
Ferroportin can be blocked by **hepcidin,** a **hormone** produced in liver cells, or hepatocytes [15,29,41]. Several signaling proteins, including interleukin 6 and transferrin receptors, register the amount of circulating iron in the blood, upon which the production of hepcidin is **stimulated or inhibited.** Hepcidin attaches **itself to ferroportin**, blocking **iron absorption** into the bloodstream, which in turn blocks **iron absorption.** Both from the small intestine, as well as from other iron stores such as the liver, heart and macrophages (immune cells).
Hepcidin, together with the signaling proteins, thus provides regulation of iron absorption [15,29].

Anemia, anemia and iron deficiency anemia

Anemia is the literal translation of the medical term "anemia": poverty of the blood. Anemia, or anemia, occurs when there are too few red blood cells, or when the red blood cells do not work properly. This in turn often has to do with too little hemoglobin. In **anemia**, then, there is not too little blood but an **insufficient quality of blood** [5,6,9].
Anemia can include severe fatigue and a feeling of weakness, dizziness, the feeling of fainting, palpitations, excessive sweating, headaches and tinnitus, hair loss, pallor and cold limbs.

So anemia or anemia can be caused by iron deficiency, which is also usually the cause, but **can also be caused by other factors**. For example, vitamin B12 deficiency or liver failure [1,2,3,6,10,39].
Anemia due to iron deficiency is therefore officially called: iron deficiency anemia.

Total body iron content should be about 4 to max 5 grams [28]. Approximately 50 mg/kg body weight .

5 causes of iron deficiency anemia (IJGA):

1. **Blood loss** is the leading cause of IJGA**,**[2,3,11,39]

With blood loss, you **quickly** lose more **iron** than you can replenish with your diet. **We lose about 1 to 2 mg of iron** daily, through cell renewal and clearance. To **compensate** for this loss, we need to **eat about** 10 to **20 mg of iron** daily. In fact, we lose about 80 to 95% of this in digestion [8,15,41].
Iron-rich products contain about 1 mg of iron per serving.
So you have to eat **10 to 20 servings of iron-rich foods a day** to get your iron. That's quite a **challenge**.
When you lose extra iron due to **blood loss**, you will **need to eat even more iron.**

*Increased **bleeding can be** very **obvious**, such as from an injury, nosebleed, childbirth or menstruation, **but** it can **also go** fairly **unnoticed**.*

Minor surgeries such as pulling a molar, cutting a pinching hand tendon, removing a mole, or eyelid surgery can result in **iron loss**, which is not replenished as quickly with nutrition. Chronic inflammation, (internal) hemorrhoids, crohn's disease, colitis, worm infections, helicobacter pylori, gastritis, frequent use of NSAIDs, paradontitis or tumors in the gastrointestinal tract often cause **damage** to **mucous membranes**, causing very small amounts of **blood to leak out** daily. However, this can lead to IJGA [2,3,6,11].

***Blood, and therefore iron loss,** is thus **more common than thought. Iron deficiency anemia** occurs worldwide, in about **60% of** the population [34].*

How much iron do you actually lose with blood loss?

Each ml of blood contains about 0.5 mg of iron [39]. Thus, with a small wound, daily iron loss can quickly double. With larger **injuries, surgery** or childbirth, you can easily **lose 5 to 30 mg of iron**. It then takes **several weeks to months** before you **restore** your iron supply through your diet. Without supplementation, it can take **6 months to a year** for a woman to regain her iron status **after a** (major) **delivery** [43]. This is partly because a pregnant or lactating woman needs extra iron for her child's growth. During **menstruation,** women lose approximately two to as much as three times more iron per day than normal [16,39]. Iron intake does increase slightly in

such a case, but to compensate, up to **twice as much iron** must still be eaten. The RDA is therefore a lot higher for women [35], but it is difficult to achieve that with food. It is not surprising that women have chronically lower iron levels than men.
A **blood donation** costs you about **230 mg of iron**, and without supplementation takes **15 to 30 to 30 weeks** to **recover** from it [38,39].

2. **Lifestyle that calls for more iron**
   A lot of exercise, or a vegan diet, for example, encourages iron deficiency. This also falls under iron deficiency anemia (IJGA).

A **diet low in iron or** containing **only plant** sources of **iron** gives **high(er) risk of IJGA** [3,6,7,39].
With your food choices, you can positively or negatively affect your iron status.

Sports or strenuous physical activity, also **increases your need for iron**. The more and more intense your sports, the more iron you need. For women, this is all the more true [3,7,42]. Athletes have up to a 70% higher iron consumption [39,42].

A vegetarian or vegan diet contains less B12 [2,35] and more difficult to absorb iron, which can easily cause iron deficiency. Partly due to a lack of L-carnitine, which affects iron status [7].

3. **Conditions that call for extra iron**
   Things like hormonal changes, growth and illness, increase your iron consumption and can lead to IJGA.

Growth
During pregnancy and **lactation**, and in infants, toddlers, children and growing **teens**, more iron is needed. When **fatigue sets in**, **magnesium** is then **quickly grabbed.** Because magnesium deficiency is also very common, this is usually fine advice, but if **iron** is the **real cause**, the problem **is not solved.** An improvement in symptoms through **magnesium supplementation** can **mask** an **iron deficiency.** So pay close attention to the symptoms.

Recovery
Recovering from over-exercising, after **illness,** infection, **injury** or, for example, a **medical procedure**, also leans on iron status. After all, iron is needed for energy, which allows cells to be repaired and replaced again. The **immune system** also needs iron to perform its function. Especially with **inflammation,** more iron is consumed [11,40,42].

Living at high altitudes
High in the air is less oxygen. Therefore, the body has to work harder to compensate. In the Netherlands, of course, we do not suffer from this, but if you are going to venture to high altitudes, think about your iron status. Oxygen can only bind to iron (hemoglobin). Taking extra **iron** can help **prevent** or alleviate **altitude sickness**.

4. **Iron deficiency due to digestive problems**
   In the gastrointestinal tract, several complications can lead to iron deficiency.

A lack of stomach acid
A lack of stomach acid **inhibits the absorption of iron** and other minerals. Stomach acid also helps the necessary conversion of Fe3, to Fe2.
Gastric acid also has the important task of killing off pathogens. A lack of stomach acid therefore promotes an overgrowth of pathogens in the gastrointestinal tract, leading to disruption of the intestinal flora. Then such pathologies as: SIBO, leaky gut, infections and PDS. **Pathogens** need iron as much as we do and even produce substances called siderophores to **hijack** our iron [12,13,17,42,45]. Lactoferrin battles the siderophores and in these cases can help fight the pathogens and restore **iron** status [42].

*When **iron** is supplemented **through the gastrointestinal tract**, **pathogens** are also **fed.** In case of infection, the immune system is then undermined.*
*You can **solve** this **with Nano iron** because it bypasses stomach and intestines.*

Helicobacter pylori
This bacterium, found in the stomach of many people, can cause gastric ulceration and **blood leakage, as** well as impair iron absorption, directly or indirectly through damage to intrinsic factor [10]. In a study of 29 patients with unexplained iron deficiency anemia, a gastric ulcer was found to be present, and when treated, the iron deficiency anemia resolved in 16 people [6].

Stomach Reduction or Bypass
With gastric bypass, **pre-digestion** is severely **compromised** and with bypass, an entire section of the small intestine, where **nutrients** are absorbed, is **skipped.** In these cases, lifelong supplementation with a broad spectrum of nutrients including vitamins, minerals, amino acids and antioxidants is usually required. Phytoplankton, which also contains iron, and B12, is then good basic advice. **Nano minerals** such as nano iron, can be supplemented in case of (symptoms of) deficiency. These are **always absorbed** through the oral mucosa**.**

5. **Impaired production of red blood cells.**
   This form of anemia is not caused by iron deficiency, but a condition in which the ruby blood cells and or hemoglobin cannot be formed properly.

Both heme and **red blood cells** are **produced** in the bone marrow **using folic acid, vitamin B12 and vitamin B6, among others. Deficiency of these vitamins,** therefore**, can lead to anemia** [3,6,9,10,14].
Chronic gastritis (**inflammation of the stomach**) can thus indirectly lead to anemia by interfering with the absorption of **B12.** Because the mucosa is constantly irritated by gastritis, the function of a certain enzyme called intrinsic factor is severely impaired. **Intrinsic factor** is essential for absorption of B12, which in turn is essential in iron metabolism. **Iron deficiency** as a result is called **pernicious anemia** [7,10]. This form is quite common, and can usually be easily remedied.

Other anemias
There are many types of anemia with a wide range of causes. They are fortunately rare, and should be detected and treated with the help of a physician.
Sideroblastic anemia. In this case, iron is not properly incorporated into the heme. Can be caused by a hereditary defect, but also by mutations, due to heavy metal poisoning or **B6 deficiency**, for example (due to alcohol abuse)**.** [6,14]**.**

Aplastic anemia: disease of the bone marrow involving insufficient formation of red blood cells in the bone marrow. Probably an autoimmune disease. Can be caused by toxic chemicals, radiation or viruses [1,3].
Hemolytic anemia: red blood cells are destroyed (= hemolysis) before their normal life span has expired. Healthy red blood cells are usually removed from the body after about 4 months. In hemolytic anemia, the body breaks down red blood cells faster than the bone marrow can replace them [9,15].
Oncological diseases such as leukemia and Kahler's disease: risk of disruption of healthy bone marrow that compromises red blood cell production [1,3,9,23].

Iron therapy in cancer
Anemia is a common finding in cancer patients, especially when chemotherapy is used [23,25,28]. In addition to the fact that both the body and the tumor consume extra iron, a variety of complications can also promote iron deficiency. **Although many cancer patients benefit from taking extra iron, it can also be counterproductive.** Excessive amounts of exogenous iron can promote cancer cell proliferation, induce free radical damage and suppress the body's own cell immunity [28].

The **cause of anemia in cancer patients,** can be determined by many factors. The synthesis of hemoglobin (HB) can be impaired by **nutritional deficiencies**, such as iron, folate or B12. The production of erythrocytes (red blood cells) can be suppressed by **chemotherapy, renal failure,** insufficient bone marrow due to metastases, for example, or by deficiency of the hormone erythropoietin (EPO) [25,28]. Anemia may also result from attempts by the host to trigger an **inflammatory response**, with the goal of quelling neoplasms (uncontrolled tissue growth) [28].

It is clear that therapy for the correction of anemia in cancer patients **requires accurate knowledge** of its cause**.** [11,15,28]

If the anemia is caused or complicated by an iron deficiency, it is obviously important to supplement iron.

Anemia caused by chemo often involves **medication** that stimulates red blood cell production (epoetin beta or EPO), **or blood transfusion** [24,25,26].
Giving **supplemental iron,** in addition or instead of it**,** has been shown by several studies to help raise iron status more quickly and thus **improve quality of life more quickly** [24,25]. The effect of EPO may be hindered, or even prevented, in the absence of iron [28]. Giving an iron supplement, prior to colorectal surgery, has been found to dramatically reduce the need for blood transfusions, which are risky [26].

An **oral iron supplement** is a **widely accepted treatment** for chemotherapy-induced anemia, but regular oral iron supplements, involve many inconveniences. These include the **usual complaints** such as: nausea, constipation or just diarrhea and black stools. Recovery of serum levels also often takes a long time [27]. Also, as with intravenous iron administration, there is the risk of a variety of complaints due to excessive iron administration [28]. **Nano iron works quickly, and produces no side effects** [18]. Of course, the administration of oral iron supplementation, including nano iron, in cancer should be advised only if there is clearly an iron deficiency, and under the guidance of a practitioner knowledgeable in the field.

Nutrition and iron

Influence of diet on iron status

"White foods" contain little iron. White bread, white rice, white sugar, white pasta, white noodles, white almond paste.... All foods, stripped of their brown skin, are up to about 84% deprived of micro nutrients, including iron [46. Dairy products such as milk, yogurt, cottage cheese, cheese,cream e ice cream, also "white foods," contain a lot of **calcium** which **inhibits iron absorption** [15,31].
Vega(n) diets usually include more vegetables, fruits, nuts and beans, but just as often even there, a lot of "white foods" such as white rice, white pasta and sweets are still consumed.

Iron-rich foods consist mainly of **red meat, organ meats**, fish, egg, poultry, beans, dried fruits, whole grain cereals and leafy vegetables. In the plant sector, **apple syrup, rye bread and goji berries are** especially high in iron [6,35].

To illustrate:
One whole grain sandwich contains 0.9 mg of iron.
One serving of chicken 0.6 mg.
One egg 1 mg.
100 grams of spinach 1.2 mg.
1 serving of red meat 2.5 mg.
1 slice of rye bread 1.6 mg.
1 serving of apple syrup* 2.2 mg [37].

Note that **animal iron** is absorbed **15 -35%**.
Vegetable iron 1 to 15% [4,8,15,41].
*Only apple syrup with sugar beet contains that much iron. Pure apple syrup contains much less iron.

Cofactors: nutrients required for iron absorption.

- **Vitamin C** is required for the reduction (conversion) of Fe3+ to Fe2+ so that iron can be incorporated as Fe2+ into the DMT channel in intestinal wall cells. (Iron from plant source.) [15,].
- **Copper and vitamin C** are required together for the same reduction, for absorption of iron into the bloodstream. (Iron from both plant and animal sources.)

- **Vitamin A** helps release stored iron in tissues [15].
- **B6, B12 and folate** are required for red blood cell formation (carriers of hemoglobin). [10,14]
- **B2** is required for absorption of iron into hemoglobin [6].
- **B12, vitamin C and folate** combine to break down proteins from which hemoglobin can be formed.
- **Zinc** is required for production of proteins such as hemoglobin [31].
- **L-carnitine** affects iron status and can rapidly decrease with physical exertion or a vegan diet [7].

A **lack of one or more cofactors, can prevent iron absorption.**
For example, a british study showed that 90% of teenage girls with IJGA were deficient in Vit B2, thus indirectly causing iron deficiency.
B12 deficiency, is a **common, indirect cause** of **low iron levels**. So the cofactors are very important. Especially with plant-based iron sources, it is helpful to take vitamin C to promote iron absorption, but copper is also essential for adequate iron metabolism [7].

In a **study** of 554 subjects with **reduced Vit D** levels (> 75 nm/l), 49% of the subjects were also found to have excessively **low hemoglobin levels**. How this relates to each other is still unclear, but the result is remarkable and invites more research [6].

Iron, friend and foe in inflammation

Both the body **and** the **pathogens** (bacteria, fungi and viruses) that inhabit it **need iron** [12,13,28,45]. Iron is indispensable for a properly functioning immune system. In addition to **iron's role** in (mitochondrial) cellular respiration and **energy production**, iron as a cofactor also plays important roles in **protecting** against free radical damage and the **function** of various neurotransmitters and **immune cells** [6,14,16]. At the same time, iron enhances the growth and **virulence** of **pathogens** [28,42],

*So **with a healthy iron status,** you are **better armed** against infections from pathogens, but once you have an infection, iron can **also** become **your enemy**.*

Particularly in a **disturbed intestinal flora** where pathogens have gained the upper hand, (allopathic) iron **tablets** can be **counterproductive.**
The likelihood of increasing **pathogen load,** in such a case is particularly high, putting further pressure on the immune system and the health of the host, [42].
For that reason, during infections, **iron absorption by the body** will be **inhibited**, via the hormone **hepcidin** [29]. For short-term infections, such as a mild flu, this is a perfect mechanism. The immune system then claims the spare iron from storage, while starving the pathogens causing the infection [28,29,42].
However, with **long-term, recurrent and chronic infections, such** as acute rheumatoid arthritis, leaky gut, and bladder infections, it becomes **complicated** [11,12,28,39].
When the reserve iron runs out, the immune system becomes weakened [16]. The typical IJGA symptoms, including severe fatigue, may then develop as well.
Hepcidin, however, when pathogens overgrow, prefers to keep the gate closed [28].

A tricky **dilemma**: advise iron **supplementation or not?**

Nano iron then offers **the solution**. Nano iron **bypasses the gut,** giving pathogens little or no chance to strike. Because it is fully absorbed, no iron will remain in the (intestinal) mucosa either, and virtually all the iron becomes **available to** the hemoglobin, mitochondria and **immune cells.**
This effect can be **enhanced by using lactoferrin** in addition to nano iron. A protein that nests in oral and intestinal mucosa, trapping iron there before pathogens have a chance [12,15,42]**.**
In long-term infections accompanied by IJGA, it is often **unavoidable** to **supplement** iron for energy management, cognitive abilities and strengthening of the immune system. **Nano iron** is then the **most appropriate iron supplement.**
Tip: For infection control, **nano silver** can be used to **fight** the **pathogens** without loss of pro-biotics. The mouth can also be disinfected with nano silver. This way you help the body fight the infection AND you ensure that the nano iron becomes fully available for oxygenation and immune cells [44].

Hemochromatosis or iron accumulation

Hemochromatosis (abbreviated **HH,** from "Heriditary Hemochromatosis") is the official name for iron accumulation, in which the body absorbs more iron than it needs.
It is **primarily** a **genetic disorder** that you can only get if both parents carry the gene. Approximately 0.5% of people in the Netherlands have iron accumulation or hemochromatosis. This involves a mutation in the relevant gene, which **inhibits the** action of the hormone **hepcidin. Iron absorption** is therefore not or **insufficiently regulated** [9,15,29].

It is possible that this gene mutation provided relief in the Neolithic era when there was a lack of (iron-rich) food to prevent iron deficiency [33]. However, with today's abundance of (iron-rich) food, this gene mutation may cause health problems. An **excess of iron** is hereby **absorbed** without inhibition, into **the blood, and "stacked"** in the liver, joints, heart, skin and spleen [9,15].
Complaints that may arise are:

- Extreme and prolonged fatigue
- Joint complaints
- Abdominal pain in the upper abdomen
- An enlarged liver and abnormal liver functions
- Heart problems
- Libido loss and impotence
- Skin pigmentation
- Diabetes

Complaints usually **do not** appear **until after the age of 40**. After all, iron is not absorbed very easily, so even without inhibition of hepcidin, it takes a long time for expression of the accumulation to be felt and seen [47].

HH can also develop **secondarily**. For example, **by** receiving frequent **blood transfusions** or **taking far too much iron for years**.
Taking iron fumarate or other iron salts for months at a time, up to 600 mg per is unfortunately more common than desired, due to lack of knowledge of the drawbacks, or adequate research into missing factors such as vitamin B2 deficiency for example. Nevertheless, secondary HH is very rare [9,15,47].

IJGA or HH?
Extreme and prolonged fatigue is an obvious symptom of IJGA, but also occurs in iron accumulation. The other symptoms are very different, however, and can be conclusive. In the unlikely event that **nano iron** is **supplemented in** someone with **HH,** it is undesirable but **certainly not dangerous** [9,18].

Nano iron is very safe
Taking iron for a few weeks will not lead to (secondary) HH, either with nano iron or other iron supplements.
In (primary) genetic HH, only extremely high doses of iron salts, up to 600 mg per day, can possibly cause harm, but only if the iron accumulation is already at the toxic limit [9,15,47] With nano iron, such doses can never be reached and is in that respect **always safe**. In two weeks, a total of at most 8 to 12 mg of additional iron enters the body. More than enough to make up for an iron deficiency, but insufficient to constitute a health threat in the presence of HH. Of course it is important to **monitor symptoms and blood levels** and to be aware of the possible presence of HH.
If there is no improvement (despite the presence of co-factors) or symptoms worsen, it is wise to discontinue iron intake and conduct further investigation into the cause.

The rapid action of nano iron helps ensure safety
When the cofactors are also present, in the case of IJGA, **nano iron** almost always gives **results within three weeks.** Often within as little as one to two weeks, and **sometimes** within **a few days,** depending on the complaint and degree of IJGA.
To illustrate:
A severe iron deficiency can cause extreme fatigue and blue circles under the eyes, for example, but a very **slight iron deficiency** can cause an **afternoon dip, among other things**. Then iron is not readily considered, whereas nano iron can generate renewed energy within 20 minutes.
If there is **no improvement** in symptoms and or iron levels **within 3 weeks of** supplementation with nano iron, then there may be a **complication or there** may not have been IJGA, but **another cause** of the symptoms.

Treatment for hemachromatosis

Should HH be present, it is necessary to remove iron from the body. Classically, therapy is applied through **venesection.** This is the most effective and fast way to empty a lot of iron: **about** 225 - 250 mg of iron per half liter of blood [38,39]. However, the body loses many other nutrients in the process, including proteins, vitamins and other minerals [34].
With less urgency, an alternative option is **IP6** (Inositol hexaphosphate). This captures away iron as do phytates. This also involves loss of other minerals but all other nutrients are spared. Drinking lots of coffee and black tea also helps lower iron status [15,29,41].

Iron and hepcidin

The hormone hepcidin is produced in liver cells (hepacytes) and regulates iron absorption. A complex system, in which the signaling proteins interleukin 6 and tranferrin receptors 1 and 2 are crucial, signals the amount of **free iron in the blood**. When these levels are **too high**, **hepcidin** is **released** into the blood, which binds to the receptors ferroportin, thereby blocking its function. The **"iron gates"** to the bloodstream close**"**. As a result, **iron** is **no longer absorbed.** When the **iron levels** have **dropped**, **downregulation** of the hormone hepcidin, via the signaling proteins, decreases the amount of **hepcidin** again, so that ferroportin is no longer blocked in its function and the iron is absorbed again. The **"iron doors** open **again"** [15,29].

*When supplementing with **iron supplementation,** it is advisable to take iron **every other day** so that hepcidin levels do not become too high.*

Hepcidin and related signaling proteins, together also form an innate **antimicrobial defense system.**
Because iron also feeds pathogens, hepcidin lowers iron levels in the case of **infections**, such as candida, (influenza) virus or sepsis. **Iron** is reduced in both blood plasma and extracellular fluids [29]. The transport and storage proteins transferrin and ferritin, in particular lactoferrin, as well as macrophages (immune proteins), can capture the remaining free iron, to "starve out" the pathogens [15,42]. In short-term infections, this mechanism is ideal.
However, with **chronic infections and low-grade inflammation**, the body can become **iron deficient** due to this mechanism [42] In that case, you can **use nano iron** to **nourish and strengthen** the **body** without providing iron to the pathogens. Nano iron does not provide excess iron that can be chewed away in the intestines by pathogens. The proper amount is delivered directly into the mucous membranes and bloodstream, from the mouth. The risk of feeding pathogens with iron from the oral cavity is very small, but however, this risk can be captured by **killing** off **pathogens** with **nano silver** [44].

Blood values iron
There are a number of ferrous proteins that are (can be) measured to determine iron levels [2,4,5,11].

Hemoglobin
Hemoglobin is an iron-bearing protein that provides oxygen.

Each hemoglobin protein consists of 4 protein chains (2 alpha and 2 beta globulins) with a heme structure attached to each protein chain, each surrounding (protecting) an iron ion. An ion is an atom missing an electron that makes it active.

All red blood cells are (normally) 1/3 filled with hemoglobin. We have about 5 million red blood cells and each red blood cell contains about 270 million hemoglobin proteins, each containing 4 iron ions. The iron ions attach to the inhaled **oxygen (O2**) in the lungs, then they release it back to all the body cells, transported by the red blood cells. After releasing oxygen, they reabsorb the waste product of energy production: **carbon dioxide (CO2),** which is then excreted back into the lungs. (Exhalation). Muscles, including the heart, contain **myoglobin**; a related substance of hemoglobin that maintains the oxygen supply in muscles. Myoglobin contains one iron ion.

Blood levels:
In **men,** hemoglobin (HB) levels average **10 mmol/l**.
In **women 8.5 mmol/l**. [4,5,11]
Lower levels usually indicate **iron deficiency anemia.**

MCV
Mean corpuscular volume or **MCV:** average volume of erythrocytes, or red blood cells, in the blood.
With a (long-term) iron deficiency, no or less heme iron with globulins will be formed into hemoglobin. As a result, the volume of red blood cells will decrease. With a reduced HB level with red blood cells of normal size is we speak of:
Normocytic anemia, usually indicating incipient iron deficiency anemia.
When the HB level is reduced with reduced red blood cells, we speak of: **Microcytic anemia**, indicating advanced iron deficiency anemia.

MCV is usually used as part of a complete blood test to detect a particular condition.

The reference value is around 80 -100 femtoliters [4,11].

Transferrin - transport iron
Transferrin comprises a family of proteins that take up free iron from the serum (bloodstream) and mucous membranes. It takes up iron to prevent **oxidation** and hijacking by pathogens. Transferrin **transports iron to** the **bone marrow**, **liver, heart and macrophages** (immune cells) [9,15].
Transferrin can also bind zinc, causing iron to compete with zinc. Decreased zinc levels have shown a correlation with iron deficiency anemia [31].
In iron deficiency anemia, transferrin is **usually elevated** as the body attempts to take in more iron by increasing transport proteins ("taxa").
In infections, however, transferrin is **often reduced.** In infections, the body wants to starve the pathogens [42,46]. The PH value changes, causing transferrin, which transports iron from the intestine and storage to the bloodstream, to function less

well. Ferritin, which absorbs free iron from the blood in distress, can then still absorb and deliver iron to body cells [15].
Transferrin has two iron binding sites. Also called **TIJBC** (Total iron binding capacity) [4,11].

TIJBC or total iron binding capacity
It is also measured in some cases.
The reference values are: 45 -80 µmol/L
An **elevated TIJBC** or transferrin could fit with iron deficiency. However, TIJBC can also be elevated in pregnancy and when taking the (birth control) pill.
A **lowered TIJBC** or transferrin could fit with an excess of iron in the body, such as in hemochromatosis. Certain (hereditary) forms of anemia may also be associated with iron accumulation. A lowered TIJBC or transferrin could also indicate protein-deficient diet, infection or impaired liver function [4,11].

Lactoferrin
Lactoferrin is a **special type of transferrin**. It has an extremely high affinity for binding iron and is found **mainly in the mucous membranes** (mouth, nose, intestines, genitals), and sweat and tears, where aerobic pathogens can enter.
Lactoferrin thus **deprives** the **pathogens of iron** to starve them out, thus feeding their own body cells [12,42].
Breast milk and colostrum (the first breast milk) contain extremely high doses of lactoferrin to protect against infections. Newborns do not yet have a developed immune system and thus need extra help.
Lactoferrin **can also kill bacteria on its own** and is also a strong antioxidant.
In combination with nano iron, it may well help increase iron levels and fight infections. [11,42]

Ferritin
Ferritin proteins provide **storage of (spare) iron** within cells.
Iron supply is so important that all cells are capable of producing ferritin. Ferritin is a hollow protein that can harbor as many as 4500 iron ions [11]. It is found mainly in the **bone marrow** (where red blood cells are made), **liver, heart, spleen and macrophages** (immune cells). There is always a small amount of ferritin in the blood, which can trap free iron from the blood in an emergency, or during infections.
The **normal values of Ferritin are far apart**: **25-250 µg/l**.
That the range is so large is because reserves can drop significantly before need arises. For fertile women (premenopausal), the range is smaller: **25-150 µg/l.**

It is assumed that values **< 15 ug/l** indicate **iron deficiency anemia** and that at **> 100 ug/l iron deficiency anemia** is ruled out. **Provided there** is **no infection**. Then values may be different [4,5,11,28].

Hematocrit
The hematocrit value (Ht) shows **how many red blood cells** are **present** in a given amount of blood.

Lowered hematocrit often indicates (iron deficiency) anemia. Causes of lowered hematocrit may include iron deficiency, vitamin deficiency, hemorrhage, liver disease or cancer. (Cancer cells often use extra iron as well).

Elevated Ht levels may indicate dehydration, dysfunction of the lungs (lack of oxygen), or the disease polycytemia, in which the bone marrow makes too many red blood cells [4,5,11].

Reference values in % per 100 ml of blood are:
Men 41 - 51
Women's 36 - 47

Serum Iron
This involves measuring the **total content of iron in the blood serum**: iron linked to the proteins: hemoglobin, transferrin and ferritin, and enzymes such as catalase and cytochromes.
Serum iron fluctuates enormously and by itself is by no means a reliable source for iron measurement. However, it can be useful in combination with other values [4,5,11,

Saturation
By comparing the total level of iron in the blood (serum iron) with the amount of transferrin (transport iron), the amount of occupied binding sites ("taxisite sites") can be determined: saturation, or **saturation.**
Huge fluctuations in serum iron occur in healthy people, including those related to meals, exercise and menstruation [7,16].
In complex forms of iron deficiency anemia, various values, such as serum iron, hematocrit, saturation, and TIJBC, can be **juxtaposed** to detect or exclude certain pathalogies [4,11].

Can't figure it out?

Your own (family) physician can contact the **Radboudumc Center of Excellence for Iron Metabolism Diseases** to determine whether a referral to the center or an internist at a hospital in your area is appropriate.

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