German Federal Institute for Risk Assessment

FAQ

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Iodine intake in Germany is not optimal – tips for ensuring an adequate iodine intake

Questions and answers on iodine intake and preventing iodine deficiency

Iodine is an essential trace element for the production of thyroid hormones, which regulate a wide range of metabolic processes in the body. Iodine must be taken up from the diet. As soil iodine levels in Germany are low, agricultural products contain very little iodine. Sea fish and seafood, on the other hand, are high in iodine but do not contribute significantly to iodine intake due to the infrequent consumption of these foods. Overall, the natural iodine content of our food is insufficient to ensure an adequate iodine intake for the population in Germany.

The measure recommended since the mid-1980s – the use of iodised table salt in the food industry, by food producers and in private households (iodised salt prophylaxis) – has improved the population's iodine intake in Germany. The use of iodine as a feed additive, which led to higher iodine levels in milk and dairy products, also contributed to the refinement of the situation. However, current data show that the population's iodine intake is still not optimal or is showing a downward trend. To improve the population's iodine intake, therefore, from the perspective of health risk assessment, acceptance of a sustainable and continuous iodine-salt prophylaxis programme should be increased. In doing so, measures to prevent iodine deficiency should also take different dietary patterns into account

What is iodine, and what is it needed for in the body?

Iodine is an essential trace element that must be taken up from food. It is primarily required for the production of thyroid hormones, which play a central role in regulating a wide range of metabolic processes in the body. Among other things, these hormones are necessary for normal growth, bone formation, brain development and energy metabolism. If iodine is taken up in amounts below the required level over a prolonged period, the thyroid gland

produces too few hormones, which can lead to (in some cases serious) adverse health consequences.

How much iodine does the body need?

A person's iodine requirements vary from individual to individual and depend on several factors, such as age. The German Nutrition Society (DGE) updated its dietary recommendations for iodine in 2025. To ensure an optimal supply, the DGE now recommends age-specific iodine intakes of 80 micrograms per day (µg/day) for infants and 90 to 150 µg/day for children, adolescents and adults. Daily intakes of 220 and 230 µg are recommended for pregnant women and breastfeeding women respectively.

The European Food Safety Authority (EFSA) last derived reference intakes for iodine in 2014; the Authority considers an intake of 70 µg/day to be adequate for infants from 7 months of age, 90 to 120 µg/day for children aged 1 to 14 years, and 130 to 150 µg/day for adolescents aged 15 years and over and adults. For pregnant and breastfeeding women, EFSA considers a daily intake of 200 µg to be appropriate.

Table1 : Iodine intake recommendations from the German Nutrition Society (DGE) e. V. (Date of derivation: 2025)

Age groups	**Recommended iodine intake in µg/day**	
Infants	up to under 4 months	80
	4 to 12 months[a]	80
Children and adolescents	1 to under 4 years	90
	4 to under 7 years	90
	7 to under 10 years	120
	10 to under 13 years	120
	13 to under 15 years	150
	15 to under 19 years	150
Adults	aged 19 and over	150
Pregnant women[b]		220
Breastfeeding women[c]		230

[a] Infants who are fed only home-made baby food should receive a supplement of approximately 50 µg of iodine per day.
[b] In addition to a balanced diet containing iodised table salt, pregnant women should take a daily supplement containing 100 µg (up to 150 µg) of iodine. In the case of thyroid disorders, a doctor should be consulted before taking any supplements.
[c] Whilst breastfeeding, in addition to a balanced diet containing iodised table salt, a supplement containing 100 µg per day should be taken.

What should pregnant and breastfeeding women bear in mind?

Pregnant women and women who are breastfeeding have an increased need for iodine due to their specific metabolic requirements. To reduce the risk of iodine deficiency and the potential health consequences for both mother and child, it is recommended that pregnant women and women who are breastfeeding take an iodine supplement after consulting their gynaecologist. In addition to a diet comprising foods naturally rich in iodine and those

prepared using iodised salt, as well as the use of iodised salt when cooking at home, they should take an iodine supplement in tablet form at a dose of 100 to 150 µg per day.

What levels of iodine intake should not be exceeded?

According to the European Food Safety Authority (EFSA), long-term intake of up to 600 micrograms (µg) of iodine per day does not pose a health risk to adults. For children, correspondingly lower maximum intakes (*tolerable upper intake levels*, ULs) have been derived on an age-dependent basis: 200 µg/day for 1- to 3-year-olds, 250 µg/day for 4- to 6-year-olds, 300 µg/day for 7- to 10-year-olds, 450 µg/day for 11- to 14-year-olds and 500 µg/day for 15- to 17-year-olds.

What is meant by 'iodised salt prophylaxis'?

'Iodised salt prophylaxis' is a health measure recommended by the World Health Organisation (WHO) which involves fortifying salt with iodine to prevent iodine deficiency and related diseases. In Germany, as in many other countries, the natural iodine content of food is insufficient to ensure an adequate iodine intake for the population. For this reason, the use of iodised table salt has been recommended in this country since the mid-1980s, both in the food industry and in food-related trades, as well as in private households.

In Germany, its use is voluntary; in other words, manufacturers can decide for themselves whether to use iodised table salt in food production and processing. The minimum and maximum levels of iodine in salt are regulated: the minimum level is currently 15 milligrams per kilogram (mg/kg) and the maximum level is 25 mg/kg of salt. One gram of salt therefore allows the body to take up approximately 15 to 25 micrograms (µg) of iodine.

Does the iodisation of salt pose any health risks?

The minimum and maximum amounts of iodine that may be added to salt are regulated and range between 15 and 25 milligrams (mg) of iodine per kilogram (kg) of salt. The maximum amount is set so that health effects are highly unlikely for both healthy people and those with thyroid conditions. Calculations by the Max Rubner Institute (MRI) have shown that even with 100 per cent utilisation of iodised salt in processed food and an above-average total iodine intake (from the usual diet), the risk of an iodine intake that is harmful to health is very low. The calculations are based on data from the National Consumption Study II, a study which assessed the nutrient intake of the German population aged between 14 and 80.

Compliance with the legally prescribed iodine levels is monitored by the food monitoring authorities. Furthermore, model calculations by the German Federal Institute for Risk Assessment (BfR) and the Max Rubner Institute (MRI) have shown that, even if the iodine content in salt were increased by 5 mg per kg to a maximum of 30 mg per kg of salt, no health effects would be expected at the current level of iodised salt use. However, this measure alone would not significantly reduce the risk of insufficient iodine intake. A refinement in iodine intake would therefore only be possible if the level of iodised salt used in processed foods were also increased.

Why is iodine-enriched salt necessary in Germany?

As iodine levels in the soil are low in this country, many agricultural products contain very little iodine. Although sea fish and seafood have high iodine levels, they do not contribute significantly to iodine intake due to the low frequency of consumption. Overall, the natural iodine content of our food is insufficient to ensure an adequate iodine intake for the population in Germany. Continuous iodine-enriched salt prophylaxis is therefore necessary.

Following the introduction of iodine deficiency prevention measures in the mid-1980s – which recommended the use of iodised table salt in the food industry, in artisan food production and in private households – iodine intake in Germany improved significantly in the years that followed. The use of iodine as a feed additive, which leads to higher iodine levels in milk and dairy produce, also contributed to this improvement. However, data from the Robert Koch Institute (RKI) show that the iodine intake of the German population has deteriorated again (German Adult Health Survey (DEGS; 2008 to 2011) ; Second wave of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2; 2014 to 2017, in German only). At the same time, results from market surveys indicate that, in recent years, there has been a renewed decline in the use of iodised table salt in the production of processed food.

What is the iodine intake with and without the use of iodised salt in food?

The median daily iodine intake from conventional food, excluding iodised table salt, is around 75 micrograms (µg) for adults in Germany (estimated on the basis of urinary iodine excretion). This corresponds to half of the daily intake of 150 µg of iodine recommended by the German Nutrition Society (DGE) and the European Food Safety Authority (EFSA) for adolescents and adults.

In order to achieve an adequate iodine intake among adolescents and adults with the current average iodine fortification of 20 milligrams per kilogram (mg/kg) of salt, around 40 per cent of all processed foods would need to be produced using iodised salt. To ensure that children's iodine intake meets the recommended levels, a roughly comparable rate of iodised salt use would be necessary; however, there are greater variations here due to age-dependent variations in recommended intake levels and differences in median salt consumption. The proportion of artisanally and industrially produced foods currently made with iodised salt is, however, far below this level.

How high would the level of iodised salt use in food need to be to ensure an adequate iodine intake whilst reducing salt consumption?

As part of the National Reduction and Innovation Strategy for Sugar, Fat and Salt in Processed Foods (NRI), the concentrations of sugar, fat and salt in certain food groups have been reduced in Germany. The aim is to reduce the prevalence of overweight and obesity and the diseases often associated with them. However, the desirable reduction in salt intake may simultaneously lead to a reduced iodine intake via iodised table salt. Given the current average iodine content in salt of 20 milligrams per kilogram (mg/kg) and a 10 per cent reduction in salt consumption, around 45 per cent of all foods would need to be produced using iodised salt to ensure an adequate iodine intake for the adult population (compared with 40 per cent without a reduction in salt consumption; see the question 'What is the

iodine intake with and without the use of iodised salt in foods?'). For children, the desirable level of iodised salt use under these conditions would be in a similar range; however, due to age-dependent variations in intake recommendations and differences in median salt consumption, there are greater fluctuations here.

What level of iodised salt use would be required to ensure adequate iodine intake if, whilst taking into account a reduction in salt consumption, the iodine content in salt were simultaneously increased?

If salt consumption were reduced by 10 per cent whilst the iodine content in salt were increased by 5 mg/kg – i.e. to an average of 25 milligrams per kilogram (mg/kg) of salt, approximately 36 per cent of all foodstuffs would need to be produced using iodised salt to ensure an adequate iodine intake for the adult population (compared with 45 per cent without an increase in iodine content; see the question 'What is the iodine intake with and without the use of iodised salt in food?'). For children, the desirable level of iodised salt use under these conditions would be in a similar range; however, due to age-dependent variations in intake recommendations and differences in median salt consumption, there are greater fluctuations here.

How widespread is iodised salt in processed food?

As early as 2019, a market survey by the University of Giessen showed that the recommendation to use iodised table salt in processed foods in Germany is only partially implemented. Overall, less than 30 per cent of food products made with salt contained iodised salt.

More recent representative product monitoring data from the Max Rubner Institute (MRI) even show a downward trend in the use of iodised salt: according to the 2025 survey, the proportion of processed foods containing iodised salt in the product groups examined – bread and small baked goods, sausages and other meat products – from 2020 to 2025: from 13 to 9 per cent for bread and small baked goods, from 48 to 34 per cent for sausages, and from 19 to 16 per cent for other meat products. The use of iodised salt in stews also fell from 29 per cent in 2022 to 19 per cent in 2025. A supplementary evaluation of product monitoring data from 2024 also showed a reduction in the use of iodised salt between 2021 and 2024 in cold sauces, including ketchup, from 2.4 per cent to 1.3 per cent, and in meat and sausage substitutes from 6.4 per cent to 5.7 per cent.

In organic products in particular, little to no iodised table salt is used (see the question 'How much iodine do organic foods contain?').

Which foods are good sources of iodine?

Iodine is found primarily in animal food products, although the iodine content can vary considerably within a single food category. As soil iodine levels are low in this country, local agricultural products contain very little iodine. Sea fish is naturally rich in iodine, but is not consumed very frequently.

Seaweed also contains iodine; however, depending on the type of seaweed, the season, cultivation methods or processing, the iodine content in seaweed can be so high that

consumption may pose health risks, particularly for vulnerable population groups such as pregnant women, women who are breastfeeding and people with thyroid disorders or impaired kidney function (see also the BfR opinion on this).

Milk and dairy products, on the other hand, are important sources of iodine, as iodine is added to cows' feed and is thus passed into the milk. Furthermore, iodine is primarily taken up via iodised table salt and food produced using it. When iodised salt is used in food, bread, sausages and other meat products are also important sources of iodine. However, iodised salt is used only to a very limited extent in the production of organic food, particularly in bread and small baked goods.

How much iodine do organic foods contain?

Under the Organic Regulation, the use of iodised salt in organic food products is permitted; however, the direct fortification with iodine is generally prohibited. Organically produced plant-based drinks must therefore not contain any added pure iodine.

Although almost all organic trade associations permit the use of iodised salt in food processing, the results of market surveys indicate that iodised salt is used only to a very limited extent in the production of organic food, particularly in bread and small baked goods.

The use of iodine as a feed additive is also authorised on organic farms. Nevertheless, individual studies show that organic milk contains only around 60 to 85 per cent of the iodine found in conventionally produced milk. These differences are likely due to variations in the animals' iodine intake, which may be either seasonal (pasture forage and reduced intake of iodine-containing supplementary feed often lead to lower iodine levels in milk during the grazing season) or due to a potentially lower overall use of feed containing additives (such as iodine, amongst others) on organic farms.

Apart from iodine, what other nutrients, foods or environmental factors can influence thyroid function?

Iodine metabolism can be influenced by the supply of other nutrients, particularly selenium and iron. Both substances are components of enzymes that play an important role in the production of thyroid hormones.

Furthermore, a high intake of certain foods – such as cabbage, cress, radish, linseed or millet – can lead to reduced intake of iodine by the thyroid gland. The reason for this reduced intake is the formation of thiocyanate, which competes with iodide for binding to a transport protein that actively transports iodide into the thyroid gland. Cabbage, cress and radish contain glucosinolates, which are broken down into thiocyanate, amongst other compounds, whilst linseed and millet contain cyanogenic glycosides that can be converted into thiocyanate in the body. However, this is irrelevant when the amounts of these foods consumed are typical.

Of the environmental factors, smoking is particularly relevant, as thiocyanate is also produced in this context.

How can consumers ensure an adequate intake of iodine through their diet?

An adequate iodine intake is possible by ensuring the consumption of iodine-rich foods. This means that, when shopping, one should look out for foods produced using iodised salt (check the labelling or, for loose goods, ask whether iodised salt has been used). Iodised salt should also be used consistently when preparing meals at home.

It is also recommended to eat sea fish (e.g. cod, mackerel or herring) once or twice a week, as this provides omega-3 fatty acids as well as iodine. Pregnant women should take care to avoid predatory fish species (e.g. tuna, swordfish), as these are at the top of the marine food chain and may have higher concentrations of substances that are harmful to health.

Finally, the daily consumption of milk and dairy produce contributes to iodine intake. It should be noted, however, that milk from organic farms may contain less iodine than that from conventional farms.

How can consumers tell whether food has been produced using iodised salt?

When buying pre-packaged food, the list of ingredients on the label will indicate whether iodised salt was used in its production. For loose goods at a bakery or butcher's, consumers can ask whether iodised salt is used.

Are there any groups of people who should take particular care to ensure an adequate iodine intake?

Avoiding animal food products (meat, fish, milk, eggs) increases the risk of an inadequate iodine intake. People following a vegetarian or vegan diet should therefore take particular care to ensure an adequate iodine intake, as should consumers who have to avoid fish or dairy produce due to an allergy to cow's milk or fish, or a lactose intolerance (see question: 'How can consumers ensure an adequate iodine intake through their diet?').

Women should ensure they have an adequate iodine as soon as they are planning a pregnancy, as iodine is important for the baby's healthy growth and development. Children and adolescents also need sufficient iodine for their physical and mental development.

Finally, pregnant and breastfeeding women have an increased need for iodine due to their specific metabolic situation and should therefore take particular care to ensure an adequate iodine intake or, after consulting their gynaecologist, take 100 to 150 micrograms (µg) of iodine per day in tablet form.

What should consumers bear in mind if they want to or need to limit their salt intake?

People who wish to or need to limit their salt intake should ensure they consume foods with naturally higher iodine content, such as sea fish (1 to 2 times a week) or milk and dairy produce. Particularly when reducing salt intake, iodised salt should be used consistently instead of non-iodised salt, and when choosing processed foods, those containing iodised salt should be preferred. If necessary, you should discuss with a doctor whether taking iodine tablets is advisable.

How much iodine does milk contain?

Milk and dairy produce are one of the main sources of iodine for humans. The iodine content in milk varies between 100 and 150 micrograms per litre (µg/l). The iodine intake of dairy cows via their feed plays an important role here. Furthermore, animal feed may contain substances that inhibit iodine absorption (e.g. glucosinolates). Seasonal variations in husbandry practices (indoor and pasture rearing) as well as the use of iodine-containing udder disinfectants can also influence the iodine content in milk.

Studies have shown that organic milk contains only around 60 to 85 per cent of the iodine found in conventionally produced milk (see also the question 'How much iodine do organic foods contain?').

How much iodine do plant-based alternatives to milk (plant-based drinks) contain?

The main ingredients of plant-based drinks, such as grains (e.g. oats, rice), nuts (e.g. almonds, cashews) or pulses (e.g. soya, peas), contain very little iodine, which is why these drinks are also very low in iodine unless they have been fortified with it. As conventional milk is one of the most important sources of iodine, people who drink plant-based drinks (either exclusively or in part) instead of conventional milk are at increased risk of an inadequate iodine intake. The BfR therefore recommends – in contrast to the previous recommendation to fortify only salt with iodine – that plant-based drinks should also be fortified with iodine. The iodine content of fortified plant-based drinks should correspond to the natural iodine concentration in milk (median: 14 micrograms per 100 millilitres).

Is iodine intake from seaweed a health concern?

Seaweed is sustainable and rich in nutrients. However, iodine levels in seaweed can be particularly high because the iodine contained in seawater is taken up by seaweed and, in some species, heavily concentrated. Iodine levels vary considerably depending on the type of seaweed, the season, cultivation methods or processing.

Marine macroalgae, commonly referred to as seaweed, are classified according to their pigment composition into brown algae (*Phaeophyceae*), red algae (*Rhodophyta*) and green algae (*Chlorophyta*). Brown algae in particular, especially species of the genera *Laminaria* and *Saccharina* (collectively known as 'kombu'), can have very high iodine content (on average around 2,000 milligrams (mg) per kilogram (kg) of dry weight), but the brown alga wakame is also relatively rich in iodine (on average around 200 mg per kg of dry weight). Red algae, such as nori, usually contain significantly lower amounts of iodine (on average around 80 mg per kg of dry weight), whilst green algae, such as Ulva species, generally have low iodine contents.

Where iodine levels are high – as is the case, for example, with kombu – even 1 to 2 grams (g) of dried seaweed in a single portion of ready-to-eat food can result in the taking up of several thousand micrograms (µg) of iodine – an amount far exceeding the tolerable maximum chronic iodine intake of 600 µg per day for adults. Such a high (excessive) intake of iodine can lead to the occurrence of adverse health effects, depending on the dose and the sensitivity of the person consuming it. In particular, for at-risk groups – such as pregnant women or their unborn babies, infants and young children, or people with certain thyroid

conditions – an acutely very high iodine intake and the resulting extreme excess of iodine in the thyroid gland can have adverse health effects. These include, for example, iodine-induced hyperthyroidism – which can in some cases be severe – or (prolonged) hypothyroidism.

Is there a maximum limit for iodine in seaweed?

At EU level, a maximum iodine concentration in seaweed is currently under discussion (as of autumn 2026). The proposed concentration is 1 gram (g) of iodine per kilogram (kg) of dry matter. Calculations by the BfR have shown that the maximum level under discussion is suitable for reducing very high single-intake levels ('exposure peaks') when consuming seaweed or seaweed products. This can help to mitigate the acute hazards associated with excessive iodine intake from seaweed.

However, with regard to regular consumption and the resulting long-term iodine intake from seaweed and seaweed products, the maximum level under discussion would not be sufficient to ensure a safe level of iodine intake for all consumers of seaweed and seaweed products.

The maximum level of 0.02 g (20 mg) of iodine per kg of dry matter, last recommended by the BfR in 2007, is no longer supported by the BfR, partly because it would be impracticable in reality, as even the average iodine levels in seaweed generally exceed this value.

What should consumers look out for when buying seaweed?

Seaweed is sustainable and rich in nutrients. However, in order to adequately protect consumers from excessive iodine intake from seaweed and seaweed products, the BfR recommends mandatory labelling of iodine content, along with consumption guidelines and supplementary warnings on ready-to-eat end products.

Stating the iodine content alone is not considered sufficient, as actual iodine intake is largely determined by portion sizes, frequency of consumption and the method of preparation of the seaweed. Supplementary consumption guidelines can help to ensure the efficacy of limiting iodine intake from seaweed and seaweed products. When purchasing seaweed, care should therefore be taken to ensure that, in addition to the iodine content, consumption and preparation instructions are also listed on the label.

How is the population's iodine status determined?

Generally, the iodine status of population groups is determined on the basis of iodine excreted in urine. The World Health Organisation (WHO) recommends measuring iodine in spontaneous urine and assigns a specific status to the respective urinary iodine concentration (Table 2).

Table2 : WHO classification of iodine status based on iodine concentration in spontaneous urine.

Median urinary iodine excretion (µg/l)	Iodine intake	Iodine status
School-age children and adults		
<20	inadequate	Severe iodine deficiency
20–49	inadequate	Moderate iodine deficiency
50–99	inadequate	Mild iodine deficiency
100–199	Adequate	Adequate iodine status
200–299	Above requirements	likely to be an adequate intake for pregnant and breastfeeding women, but may carry a slight risk of excessive intake in the general population
>300	excessive	Risk of adverse health effects (iodine-induced hyperthyroidism or hypothyroidism)
Pregnant women		
<150	inadequate	
150–249	Adequate	
250–499	Above requirements	
≥500	excessive	excessive means well above the amount needed to prevent and guard against iodine deficiency
Breastfeeding women*		
≥100	Adequate	
Children under 2 years of age		
≥100	Adequate	

* Although breastfeeding women have the same requirements as pregnant women, the adequate median urine concentration is lower because iodine is also excreted via breast milk.
According to the World Health Organisation (WHO, 2007), modified.

However, the iodine concentration in spontaneous urine depends heavily on fluid intake. Depending on how much has been drunk, the urine may be 'diluted' or 'concentrated', which can lead to misjudgements of iodine status. The gold standard for assessing a population's iodine status is therefore the measurement of daily iodine excretion in a 24-hour urine sample. However, collecting urine samples over an entire day is considerably more labour-intensive. By normalising against specific biochemical reference systems (creatinine), daily iodine excretion can also be estimated from spontaneous urine.

Another method for estimating the population's iodine status involves determining the percentage of the population whose daily iodine intake is below the *Estimated Average Requirement* (EAR). Ideally, this proportion should be only 2 to 3 per cent.

In principle, none of the laboratory methods listed are suitable for estimating an individual's iodine status, as individual iodine excretion can vary greatly depending on iodine intake on a given day. To date, there are no laboratory analytical methods that can determine an individual's iodine status with sufficient accuracy. However, a dietary history can help to estimate an individual's iodine intake to a reasonable degree.

What is the iodine intake of the German population?

The population's iodine status can be estimated, amongst other things, on the basis of urinary iodine excretion (see question: 'How is the population's iodine status determined?'). As around 85 to 90 per cent of the iodine ingested in the diet is excreted in the urine (the remaining 10 to 15 per cent is lost through sweat and faeces), daily iodine intake can be estimated on the basis of the daily amount of iodine excreted. Representative data on urinary iodine excretion for the German population were collected as part of the Robert Koch Institute's (RKI) national health surveys: 'Study on the Health of Children and Adolescents in Germany' (KiGGS study, survey period 2003 to 2006 and 2014 to 2017) and 'Study on the Health of Adults in Germany' (DEGS, survey period 2008 to 2011) (in German only).

The data show that 32 per cent of the adults included in the study and 44 per cent of the children and adolescents included in the study in Germany have an iodine intake below the estimated average requirement and are therefore at health risk due to insufficient iodine intake. Among children and adolescents, the estimated daily iodine intake has fallen by 13 per cent since the KiGGS baseline survey (2003 to 2006).

What are the potential health consequences of iodine deficiency?

The health consequences of an inadequate iodine intake depend on its severity and duration.

Severe maternal iodine deficiency during pregnancy increases the risk of miscarriage and stillbirth, as well as physical and mental malformations in the child. In particular, severe iodine deficiency in the foetus and infant can lead to cretinism. Typical symptoms of cretinism include skeletal malformations (short stature), severe impairment of cognitive abilities (intellectual disability) and, in many cases, deafness and mutism. In the early 19th century, cretinism was a common condition in Europe, particularly in the Alpine region. Thanks to improved iodine intake and newborn screening, the occurrence of this condition has virtually disappeared in Europe.

In addition, there are also symptoms caused by moderate to mild iodine deficiency.

For example, prolonged iodine deficiency can lead to an enlargement of the thyroid gland (goitre). This enlargement represents a physiological adaptive response by the body to compensate for chronic iodine deficiency by producing more hormone-producing tissue. Where the enlargement is uniform, the condition is referred to as 'diffuse goitre', whilst where the enlargement involves the formation of nodules, it is termed 'nodular goitre'. In so-called 'cold nodules', the cells have ceased to function and no longer produce thyroid hormones. The vast majority of cold nodules are benign; in very rare cases, they may be malignant. In so-called 'hot' nodules, active or overactive cells produce too much hormone

regardless of the body's needs (functional autonomy). 'Hot' nodules are usually benign. However, a sudden, very high intake of iodine can trigger an acute episode of hyperthyroidism, which in some cases can be a life-threatening metabolic disturbance (thyrotoxic crisis).

Functional autonomy often goes unrecognised, i.e. undiagnosed. Affected persons are particularly older people who lived through the period before the introduction of iodine prophylaxis and were therefore exposed to a more severe iodine deficiency over the long term.

Furthermore, chronic iodine deficiency can lead to hypothyroidism – characterised by reduced production of thyroid hormones – in both adults and children. In children and adolescents, hypothyroidism can result in reduced mental and physical performance as well as delayed development. Some studies have shown an improvement in certain cognitive functions following iodine supplementation in children with mild to moderate iodine deficiency.

The consequences of mild to moderate iodine deficiency during pregnancy have been studied to a lesser extent. Several studies indicate an association between mild iodine deficiency during pregnancy and reduced cognitive abilities in children. However, a clear causal relationship cannot be established from this.

What are the causes of iodine excess?

An 'excess of iodine' is generally defined as an iodine intake of more than 1,000 micrograms (µg) per day. Causes of an excess of iodine may include the use of iodine-containing contrast agents and iodine-containing medicines, or the consumption of seaweed that is particularly rich in iodine.

Such a high intake cannot be achieved through a normal diet without seaweed – even when taking into account the use of iodised salt.

What are the potential health consequences of excessive iodine intake, and which groups of people are particularly sensitive to it?

A healthy thyroid gland is able to physiologically compensate for even high intakes of iodine and adapt to an increased intake. This occurs via the so-called Wolff–Chaikoff effect, in which acute, excessive iodine intake leads to a temporary blockage of thyroid hormone synthesis. This mechanism serves as a safeguard against excessive hormone production. The excess iodine is shedded in the urine. After a few days, a healthy thyroid gland resumes its normal hormone synthesis, i.e. it 'escapes' the Wolff–Chaikoff effect.

In the presence of existing thyroid disorders, these regulatory mechanisms may fail, leading to the occurrence of iodine-induced hyperthyroidism or hypothyroidism.

People with functional autonomy of the thyroid, for example, are particularly at risk. In this condition, the thyroid gland has so-called 'hot' nodules, which produce thyroid hormones independently of physiological requirements. The excess iodine is used uncontrollably by the 'hot' nodules for hormone production, which can lead to the formation of hyperthyroidism, sometimes of a severe nature. Functional autonomy may also be undiagnosed.

In people with Graves' disease, an autoimmune disorder of the thyroid gland associated with hyperthyroidism (overactive thyroid), increased iodine intake can exacerbate the existing hyperthyroidism in addition to the underlying condition.

Furthermore, iodine-induced hyperthyroidism has also been observed in people with an enlarged thyroid gland (goitre) who otherwise have a normal (euthyroid) metabolic state.

However, following high iodine exposure, the occurrence of iodine-induced hypothyroidism may also occur. The physiologically beneficial inhibition of hormone production following excessive iodine intake (the Wolff–Chaikoff effect) is temporary in people with healthy thyroids. In cases of Hashimoto's thyroiditis, this inhibition may persist to some extent. However, even in foetuses, the mechanism for overcoming this inhibition is not yet fully developed by the 36th week of pregnancy. Consequently, very high iodine intake by the expectant mother can cause foetal hypothyroidism to form.

Breastfed infants may also develop a blockage in hormone production – and consequently, usually a temporary hypothyroidism – if the mother's iodine intake is very high.

Furthermore, excessive iodine intake can have a negative impact on the course of autoimmune diseases such as Hashimoto's thyroiditis or Graves' disease. However, the mechanisms involved are not yet fully understood.

In patients with *dermatitis herpetiformis Duhring,* a very high iodine intake can lead to the occurrence of an exacerbated skin reaction.

What are the symptoms of an overactive thyroid (hyperthyroidism)?

In hyperthyroidism, the thyroid gland produces too many thyroid hormones (free thyroxine (fT4) and triiodothyronine (fT3)). The occurrence of these symptoms can include a racing heart, irregular heartbeat, high blood pressure, unintentional weight loss, nervousness, hand tremors, sleep disturbances, increased sweating, diarrhoea and, in women, menstrual irregularities.

What symptoms occur in hypothyroidism?

In hypothyroidism, the thyroid gland produces too little thyroid hormone (free thyroxine (fT4) and triiodothyronine (fT3)). The occurrence of these symptoms can include tiredness, weakness, reduced mental and physical performance, a reduced basal metabolic rate with weight gain, a slow heart rate, dry and pale skin, brittle nails, apathy, difficulty concentrating, loss of appetite, constipation and depressive moods.

What is Hashimoto's thyroiditis?

Hashimoto's thyroiditis refers to an inflammation of the thyroid gland which, in its early stages, can lead to hyperthyroidism, but which, as the condition progresses, usually results in hypothyroidism due to scarring and, in most cases, atrophy of the thyroid tissue. The condition is the result of an autoimmune reaction and is influenced by genetic factors. As the condition progresses, antibodies are produced against the body's own thyroid tissue, and the thyroid gland becomes infiltrated with immune cells, leading to chronic

inflammation of the thyroid. The persistent inflammation of the thyroid gland results in scarring and hypothyroidism.

The progression of this condition is very slow, meaning that the occurrence of hypothyroidism often does not occur until years or even decades after thyroid autoantibodies are first detected. However, a positive autoantibody titre does not always lead to Hashimoto's disease and hypothyroidism; thyroid function may also remain normal throughout a person's life.

What is Graves' disease?

Graves' disease is an autoimmune disorder in which the immune system produces antibodies against a protein located on the so-called TSH (thyroid-stimulating hormone) receptors on the thyroid gland. fillerWhilst the release of TSH is subject to a feedback mechanism – meaning that the binding of TSH to this receptor leads to the production of thyroid hormones in line with the body's needs – the binding of the antibody to the TSH receptor results in a persistently increased production of thyroid hormones and thus to hyperthyroidism.

This autoimmune disorder can also lead to protrusion of the eyes (*endocrine orbitopathy*) and fluid retention in the shins (*pretibial myxoedema*).

Is it safe to consume food made with iodised salt if you have Hashimoto's thyroiditis or Graves' disease?

Yes, in both Hashimoto's thyroiditis and Graves' disease, consuming food made with iodised salt poses no health risk, as only relatively small amounts of iodine are taken up in this way. However, one should avoid additional high intakes of iodine, such as iodine-containing food supplements or seaweed with particularly high iodine content.

Can iodine trigger allergies?

An allergy is a hypersensitivity reaction caused by the immune system being stimulated by an allergen. The iodine compounds used in iodised salt are too small to act as allergens.

However, allergies to iodine-containing products, such as X-ray contrast media, can occur. In suh cases, the allergen is the carrier substance to which the iodine is bound.

Can iodine cause 'iodine acne'?

'Iodine acne' is an intolerance reaction accompanied by skin changes and occurs only when daily iodine intakes in the milligram or gram range – and thus far above the possible iodine intake based on iodine deficiency prevention and also far above the *Tolerable Upper Intake Level* (UL) – are taken up. An iodine intake on this scale can result, for example, from taking iodine-containing medicines.

Further information on the BfR website on iodine

BfR opinion: Binding Maximum Iodine Levels in Edible Seaweeds May Help Reduce Health-Relevant Intake Levels
https://www.bfr.bund.de/en/opinions/binding-maximum-iodine-levels-in-edible-seaweeds-may-help-reduce-health-relevant-intake-levels/

microco.info on iodine
https://www.microco.info/minerals/iodine/

BfR opinion: Declining iodine intake in the population: model scenarios to improve iodine intake in children and adolescents
https://www.bfr.bund.de/en/opinions/declining-iodine-intake-in-the-population-model-scenarios-to-improve-iodine-intake-in-children-and-adolescents/

BfR opinion: Update (2025): maximum levels proposed for iodine in foods, including food supplements
https://www.bfr.bund.de/en/opinions/update-2025-maximum-levels-proposed-for-iodine-in-foods-including-food-supplements/

About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the German Federal Ministry of Agriculture, Food and Regional Identity (BMLEH). It protects people's health preventively in the fields of public health and veterinary public health. The BfR provides advice to the Federal Government as well as the Federal States ('Laender') on questions related to food, feed, chemical and product safety. The BfR conducts its own research on topics closely related to its assessment tasks.

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Publisher:
German Federal Institute for Risk Assessment
Max-Dohrn-Straße 8-10
10589 Berlin, Germany
T +49 30 18412-0
F +49 30 18412-99099
bfr@bfr.bund.de
bfr.bund.de/en

Institution under public law
Represented by the President Professor Dr Dr Dr h. c. Andreas Hensel
Supervisory Authority: Federal Ministry of Agriculture, Food and Regional Identity
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