



Iodine

Iodine is an essential nutrient. Thirteen per cent of the world's population is thought to be affected by iodine deficiency with a further 30% at risk. Around 50 million people worldwide have some degree of brain damage as a result of iodine deficiency, making it the leading cause of brain damage in the world.

What does iodine do?

Iodide is produced from iodine in the gut and is absorbed into the bloodstream. The thyroid gland absorbs iodide from the blood and uses it to make the hormones, thyroxin and triiodothyronine. These hormones are very important; they regulate cell activity and growth throughout the body and are essential in the processes of growth and mental development.

What are the effects of iodine deficiency?

Initially it was thought that the only symptom of iodine deficiency was goitre, which is a swelling of the thyroid gland that may be clearly visible as an extremely swollen neck. However, iodine deficiency is now known to cause a range of effects and these are covered by the term *Iodine-deficiency disorders (IDD)*.

Effects on unborn babies: When a woman is iodine deficient during pregnancy, she has an increased risk of a stillbirth or of losing the baby during pregnancy, or the baby may develop a wide range of serious health problems. When



iodine intakes are particularly low, cretinism can occur. Cretinism is a condition that includes extreme mental deficiency, deaf-mutism, dwarfism and other problems.

Effects on infants: Low intake of iodine via the diet (e.g. low iodine levels in breast milk or formula milk or lack of these) can lead to goitre in the infant along with poor functioning of the thyroid gland.

Effects on children: Poor iodine intake during childhood can permanently reduce physical and mental development, which can result in lower IQ (intelligence quotient). It can also cause goitre.

Effects in adults: While goitre is one possible effect of iodine deficiency in adults, the most common symptoms are apathy and reduced mental functioning.

While the severe forms of iodine deficiency, such as cretinism, are devastating, the more important problem for public health is the small degree of brain damage and reduced cognitive ability in the entire population of those affected. Overall, it has been reported



that there is a 13.5 point reduction in IQ in people living in communities affected by severe IDD compared to those in comparable communities without IDD. This has potentially huge economic consequences.

Is there a problem in the Pacific?

Unfortunately, for most countries in the Pacific region, there are no published studies on iodine deficiency, which has rarely been included in any national nutrition surveys. It is therefore difficult to assess whether there are problems. However, international evidence clearly shows that IDD problems may exist without obvious signs such as goitre. Therefore, countries that have never undertaken even small-scale surveys on iodine deficiency should not be considered free of IDD just because no cases of goitre have been seen.

A few countries in the region, including Papua New Guinea and Fiji, have found problems. Until recently Australia and New Zealand were thought to be free of IDD problems, partly because of laws concerning the sale of non-iodised salt, but in the last few years, problems have been detected in some groups. IDD may be becoming more common, perhaps due to declining levels of iodine in the soil and reduced salt intake, along with increasing use of pre-prepared foods that do not include iodised salt.

Dietary sources of iodine

Most iodine is found in the oceans; there are also variable amounts in soils. Areas with heavy rainfalls or frequent flooding generally have a lower soil content of iodine because it washes away into the sea. The amount of iodine contained in water and crops can vary a hundred-fold according to the particular soil. The foods that generally contain the most iodine are fish and shellfish from the sea with freshwater fish having much lower levels. Other foods that contribute smaller amounts of iodine are meat, milk, eggs, cereal grains, fruits, vegetables and legumes (beans and lentils). Levels of iodine are reduced during cooking because it leaches into the cooking water.

Foods that prevent iodine absorption

Unfortunately, a number of foods contain substances (cyanogenic glycosides) that break down in the body to form thiocyanate, which is a goitrogen (it reduces the uptake of iodine by the thyroid gland). Eating a diet high in these natural goitrogens can therefore induce IDD even if the diet is quite rich in iodine. The following foods can cause these problems: cabbage, legumes, chaya leaves (*Cnidioscolus chayamansa*) and cassava. Goitrogen levels can be reduced by boiling these foods in water, but they may still cause problems if eaten often and in large amounts, and if the crop is particularly high in cyanogenic glycosides. For example, different cassava cultivars contain different levels of goitrogen. Generally, the types preferred in the Pacific contain lower levels than types preferred in other parts of the world.

(Note: there is also concern about the release of cyanide when the cyanogenic glycosides, which are toxic, are being digested in the body. Deaths due to cyanide release have been reported internationally but have only occurred when highly malnourished people have eaten unprocessed roots high in cyanide. Even then, cretinism is the more common effect.)

Requirements for iodine

Recommended intakes of iodine vary according to age, with more being required during pregnancy and breastfeeding. Adults who are not pregnant or lactating require about 150 µg/day (WHO 1996).

Assessing iodine status

The geography of a region (e.g. whether it is mountainous, etc.) used to be considered a good indicator of risk of IDD in a population. However, more recent evidence has shown that this theory is incorrect and that IDD is widespread and can occur almost anywhere, even in places where it has never been reported previously. It is therefore recommended that periodic urinary iodine measurements be taken in all countries.



- (i) *Goitre rate*: Initially, goitres were detected through examination and observation. Now, however, the preferred approach is to use ultrasound to detect the size of the thyroid gland. A public health problem is considered to exist when more than 5% of all children aged 6–12 years have an enlarged thyroid gland.
- (ii) *Urinary iodine*: Excess iodine is excreted via the kidneys into the urine. Therefore levels of urinary iodine are an indication of iodine intake. International standards are set for levels that indicate severe, moderate and mild IDD.
- (iii) *Thyroid hormone levels (TSH)*: Levels of the thyroid hormone TSH can also be measured, but this is an indirect method of assessing iodine intake.

Prevention and treatment

The main method promoted internationally for tackling the problem of iodine deficiency is universal salt iodisation (USI). This approach has been used successfully in many countries. Over

90 countries now iodise their salt and many (including Fiji Islands) have national legislation forbidding the importation and sale of salt that is not iodised. An ongoing problem with USI is ensuring that all segments of the population are eating this salt (and not, for example, making their own).

The level of iodine in the salt is also reduced by heating or leaving it uncovered. Continued efforts are needed to ensure that the salt being sold contains adequate levels of iodine. Internationally there are recommendations to reduce salt intakes with intake levels far exceeding requirements in many countries. This would not, however, be a problem for a salt iodisation programme, as the levels of iodine added could be modified periodically to counteract this changing intake. Other foods can also be iodised, e.g. water, grains and dairy products.

Another approach is to inject IDD populations with iodised oil. The effect of these injections lasts for up to two years. A combination of injections and iodised salt is used in a number of countries, including Indonesia and China. Injections are considered appropriate for isolated communities with almost no access to the outside world. More recently, iodised oil has been given orally in some places and has been shown to be effective for up to one year.

Toxicity

Relatively high intakes of iodine are not toxic, but long-term consumption of high levels can cause health problems, including damage to the thyroid gland and excess production of thyroid hormone. It is, of course, important to monitor the levels of iodine in any fortified salt to ensure that they do not exceed the approved levels.