
بسم الله الرحمن الرحیم

Iodine

Thyroid function and community health

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Iodine

- Iodine is a chemical element; the heaviest of the stable halogens in soil and water.
- The element was discovered by the French chemist Bernard Courtois in 1811.

Iodine cycle in the nature

Most iodine is found in the oceans (≈50 μg/L), which volatilizes into the atmosphere and is returned to the soil by rain, completing the cycle.

However, iodine cycling in many regions is slow and incomplete, and soils and ground water become deficient in iodine.

In plant foods grown in deficient soils, iodine concentration may be as low as 10 μg/kg dry weight, compared to ≈1 mg/kg in plants from iodine-sufficient soils

Iodine

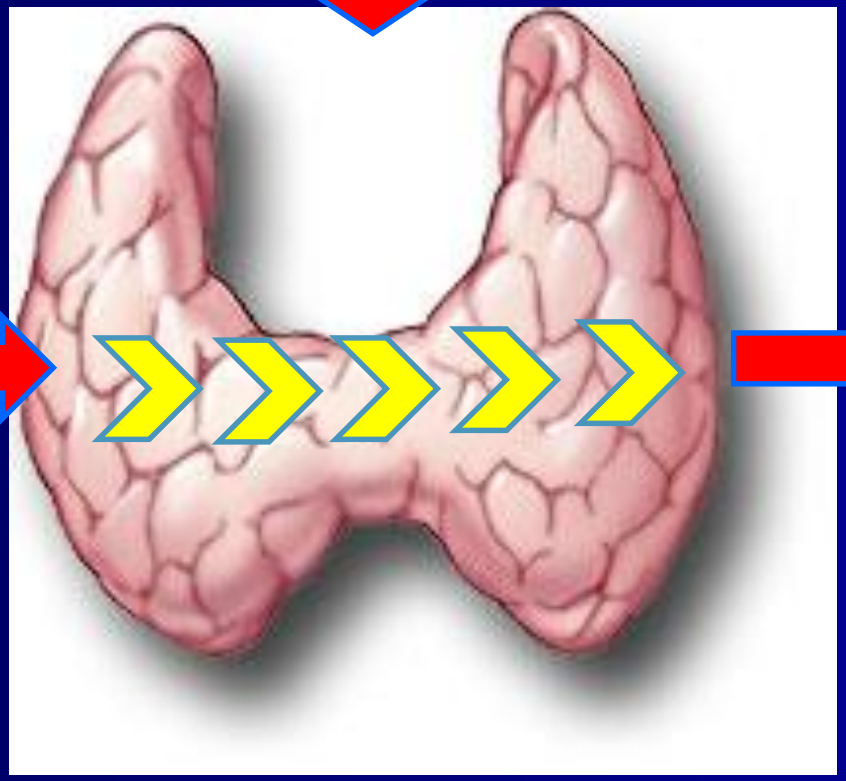
- Iodine is a micronutrient of crucial importance for the health and well-being of all individuals.
- Total quantity present in body is 15-2 mostly in thyroid gland (60%).
- Iodine contributes 65% of T_4 and 59% of molecular weight.

- Most forms of iodine are reduced to iodide in the gut.
- Iodide is nearly completely absorbed in the stomach and duodenum.
- Iodide is cleared from the circulation primarily by the thyroid and kidney.

Thyroid hormones synthesis

- Normal thyroid gland
- Normal H.P.T axis
- Adequate iodine

TSH



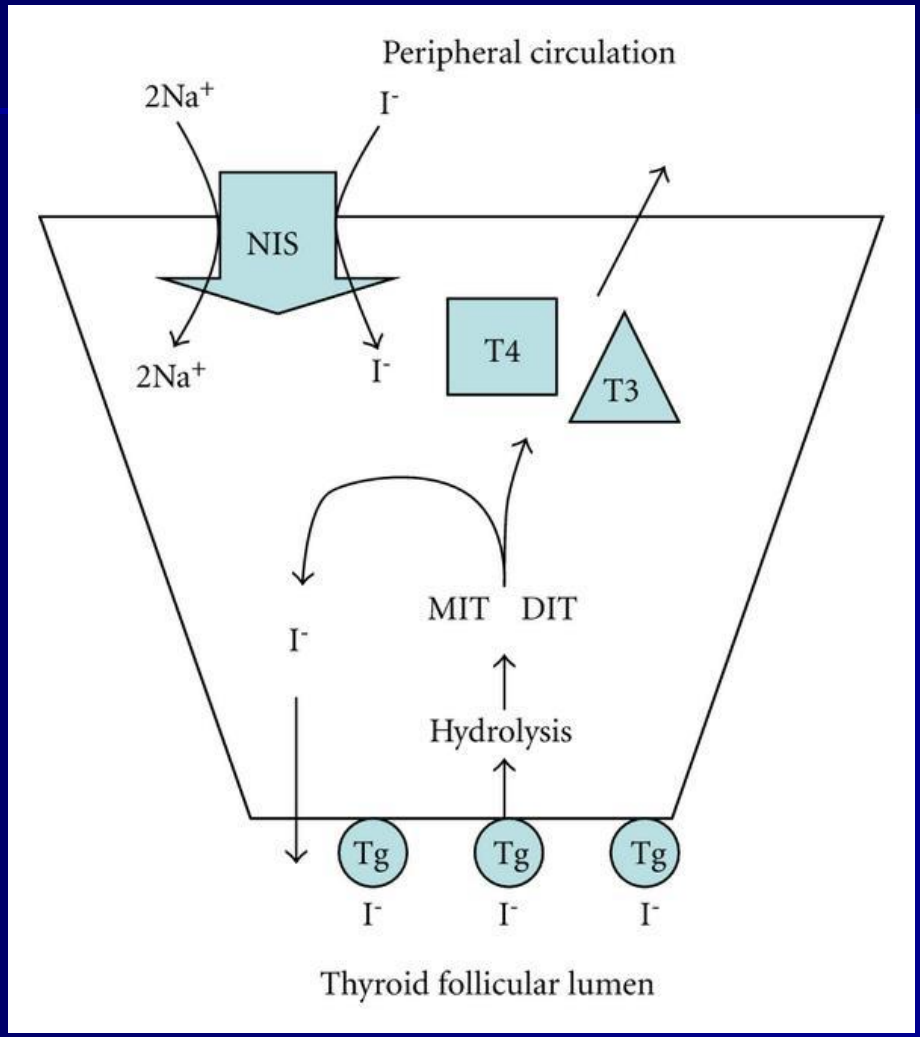
Iodine

T3

T4

Thyroid Hormone Synthesis

Thyroid gland plays a central role in the metabolism of iodine.



Thyroid Hormone

- Optimal mental & physical development
- Regulation of body metabolism
- Generation & utilization of body energy

Under normal circumstances, plasma iodine has a half-life of approximately 10 hours, but this is shortened if the thyroid is overactive, as in iodine deficiency or hyperthyroidism.

The mean daily turnover of iodine by the thyroid is approximately 60–95 μg in adults in iodine-sufficient areas.

The body of a healthy adult contains from 15 to 20 mg of iodine, 70%–80% of which is in the thyroid.

How Much Do We Need?

Age group	Daily requirement	Tolerable upper level
Preschool children	90 μg/day	200
Schoolchildren(6-12 y)	120 μg/day	300-450
Adult (>12 y)	150 μg/day	600-1100
Pregnant & Lactating women	250-300 μg/day	600-1100

What happens if we don’t get enough iodine?

An insufficient dietary supply of iodine results in the development of a variety of disorders of thyroid function and development of the fetus and young infants, grouped under the general heading of Iodine Deficiency Disorders, IDD

The spectrum of Iodine Deficiency Disorders (**IDD**)

AGE GROUP	IODINE DEFICIENCY DISORDERS
Fetus	Abortions Stillbirths Congenital anomalies Increased perinatal mortality Increased infant mortality Neurological cretinism: mental deficiency, deaf mutism, spastic Diplegia squint Myxoedematous cretinism: mental deficiency, dwarfism, hypothyroidism Psychomotor defects
Neonate	Neonatal hypothyroidism
Child & Adolescent	Retarded mental and physical development
Adult	Goitre and its complications Iodine-induced hyperthyroidism (IIH)
All Ages	Goitre Hypothyroidism Impaired mental function Increased susceptibility to nuclear radiation

Most important consequences of the spectrum of IDD

- Goiter
- Mental Retardation
- Hypothyroidism
- Cretinism
- Increased morbidity and mortality of Infants and Neonates.

Iodine Deficiency Disorders

- Endemic goiter constitutes the most common disorder from the clinical and epidemiological point of view.
- However, the most serious consequence of iodine deficiency is the impact on neuro-intellectual development at a population level, varying from endemic mental retardation to the complete picture of endemic cretinism.

Brain damage and irreversible mental retardation are the most important disorders induced by iodine deficiency.

- In 1990 it was estimated that among the 29 % of the world population exposed to iodine deficiency , 11.2 million were affected by overt cretinism, and another 43 million people were affected by some degree of intellectual impairment .

- Thus, iodine deficiency was a leading global cause of preventable mental impairment.

Global Iodine Nutrition in 2022 (IGN)

Insufficient (mUIC < 100 µg/L) : **21** Countries

Adequate (mUIC 100 -299 µg/L) : **118** Coun.

Excess (mUIC > 300 µg/L) : **13** Countries

UIC surveys have been done in 152 out of 194 countries in the past 15 years.

The number of countries with adequate iodine intake has nearly doubled from 67 in 2003 to 118 in 2022.

However, 21 countries remain deficient, while 13 countries have excessive intakes.

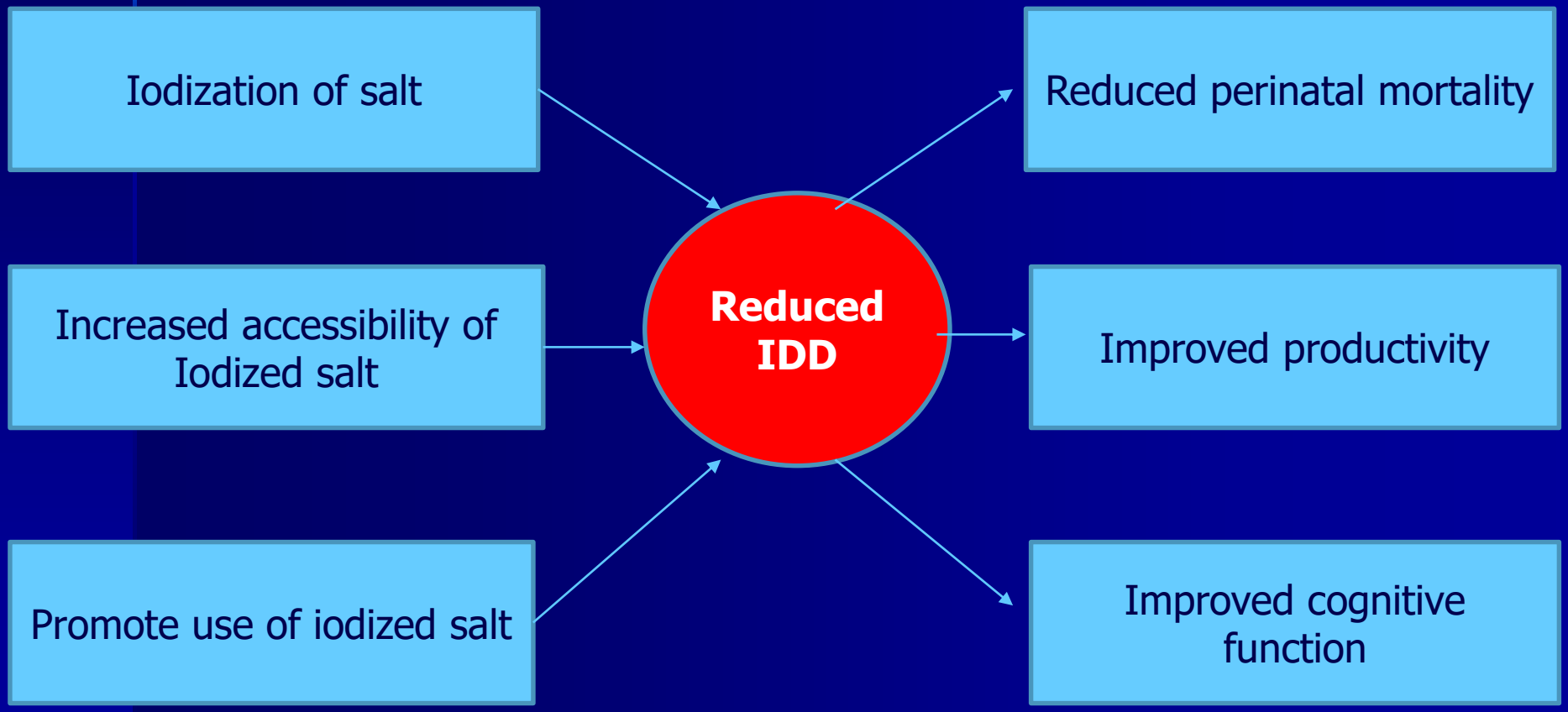
IDD Prevention

◇Since 1994, the WHO and the UNICEF have recommended universal salt iodization as a safe, cost-effective and sustainable strategy to ensure sufficient intake of iodine by all individuals

◇In 2020, 124 countries had legislation for mandatory salt iodization and 21 had legislation allowing voluntary iodization. As a result, 88% of the global population uses iodized salt.

◇38 million newborns in developing countries every year remain unprotected from the lifelong consequences of brain damage associated with iodine deficiency disorders.

Measures and impact of IDD control



Vulnerable groups

The target groups to the effects of iodine deficiency at a population level are, by order of priority:

- -The fetus
- -The newborn
- -The pregnant woman
- -The child
- -The adult

Iodine Deficiency in the Neonate

- Increase perinatal mortality

(Iodized oil injections during pregnancy was with a substantial fall in infant mortality with improved birth weight in Zaire. This has been demonstrated in the longer term follow up in Papua New Guinea in children up to the age of 12 years and in Indonesia) .

- Brain damage

(The brain of the human infant at birth has only reached about one third of its full size and continues to grow rapidly until the end of the second year. Thyroid hormone, dependent on an adequate supply of iodine, is essential for normal brain development).

- An increased susceptibility of the thyroid gland to radioactive fall-out

(The turnover rate for intra-thyroidal iodine is 25-30 times higher in young infants than in adolescents and adults).

Iodine Deficiency in the Child

- Low verbal IQ, perception, motor and attentive functions.
- Lower capacities learning.
- Retardation in psychomotor development.
- Neuromuscular and neurosensorial abnormalities.
- Lower velocity of motor response to visual stimuli.

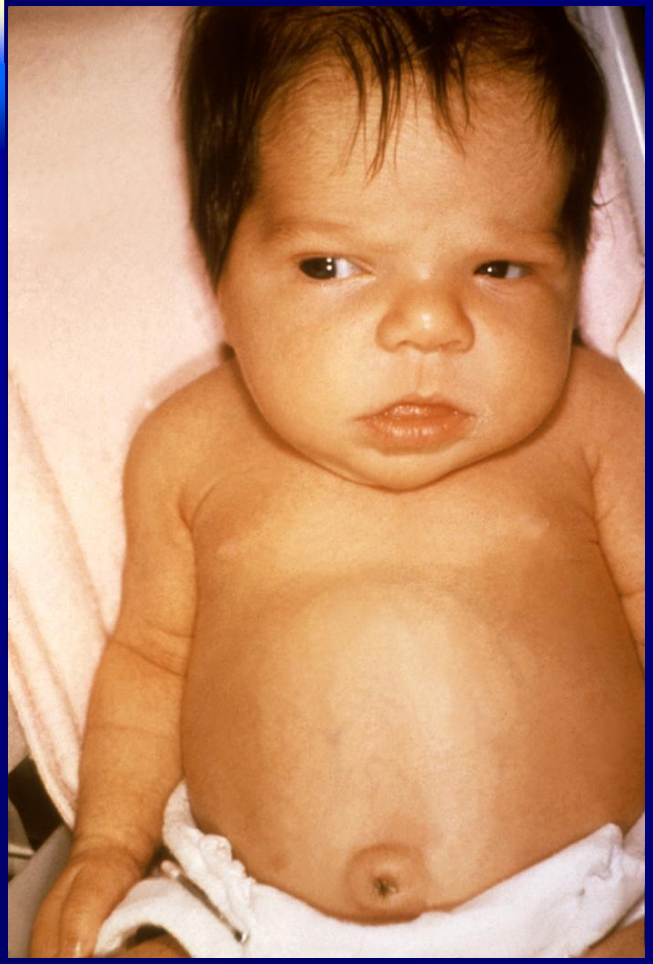
Iodine deficiency in the adult

- Goitre
- Hypothyroidism
- Hyperthyroidism
  (chronic thyroid stimulation results in an increase in the prevalence of toxic nodular goitre).

Iodine deficiency and goiter

- Iodine deficiency is the most common cause of goiter and worldwide is estimated to affect 2.2 billion people.
- The incidence of Goiter is based on the degree of iodine deficiency:
  - -Mild iodine deficiency = 5% to 20%.
  - -Moderate deficiency =20% to 30%,
  - -Severe iodine deficiency, > 30%

Congenital Hypothyroidism



Endemic goiter

More than 5% of school age children (6-12 years) have enlarged thyroid gland.

Simple Goiter

Three women of the Himalayas with stage II goiters.

Cretinism was described by McCarrison in north-western India in 1908

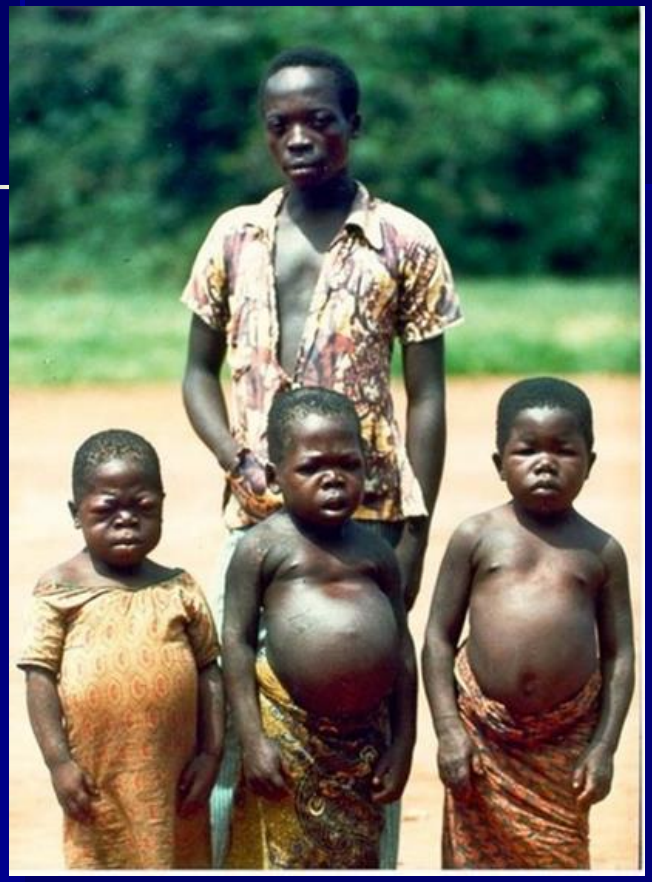
Neurologic form, with predominantly neuromotor defects, including strabismus, deaf-mutism, spastic diplegia, and other disorders of gait and coordination with a goiter.

Myxedematous form, with severe hypothyroidism, short stature, and markedly delayed bone and sexual maturation, a thyroid normal in size and position, and seldom deaf.

Neurologic Cretinism

Male from South western China with the typical facies of neurological cretinism, who is also deaf-mute and suffering from less severe proximal muscle weakness in lower limbs.

Myxedematus Cretinism



A normal male and three females with myxedematus cretinism with dwarfism, retarded sexual development, puffy features, dry skin and hair and severe mental retardation.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