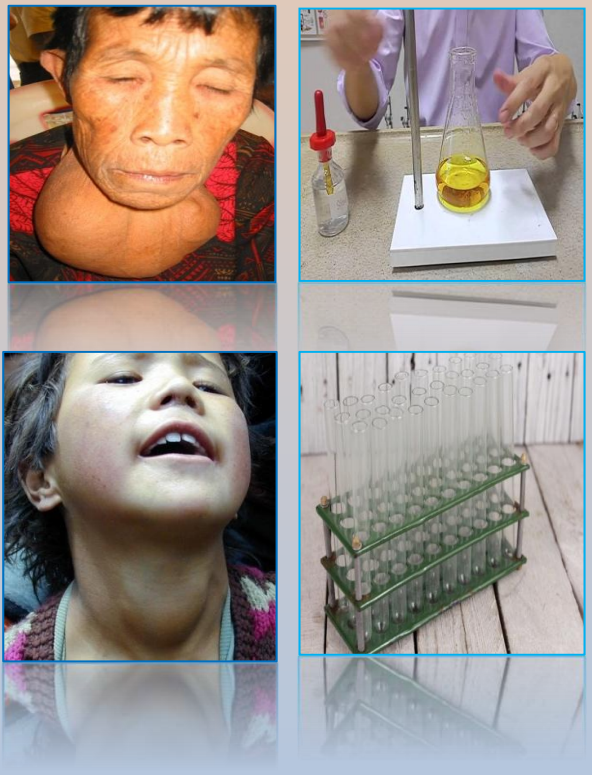
सत्यमेव जयते

Ministry of Health & Family Welfare
Government of India

Module for Training of Laboratory Technicians (ToLTs) under National Iodine Deficiency Disorders Control Programme (NIDDCP)



Organized by

National Centre for Disease Control, Delhi

In collaboration with

Nutrition and IDD cell

(Directorate General of Health Services)

Ministry of Health and Family Welfare, Government of India

TRAINING MANUAL FOR LABORATORY TECHNICIANS

under

NATIONAL IODINE DEFICIENCY DISORDERS CONTROL PROGRAMME (NIDDCP)

A LABORATORY GUIDE



Directorate General of Health Services
Ministry of Health and Family Welfare
Government of India

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PREAMBLE

Iodine is one of the essential micronutrients required for normal Mental & Physical wellbeing of Human Beings as it plays a crucial role in Thyroid Hormone production, impacting Metabolism, Growth and development.

The disorders produced in Humans as a result of nutritional Iodine deficiency are classified as **"Iodine Deficiency Disorders (IDD)"**. Iodine Deficiency Disorders (IDDs) have been known to be public health problem in almost all the parts of our country. Iodine Deficiency Disorders in human beings i.e. abortions, still births, hypothyroidism, low birth weight, cretinism (retarded mental & physical development), deaf mutism, squint and Goitre may be attributed to consumption of an Iodine deficient diet.

With a view to formulate training material for Laboratory Technicians working under National Iodine Deficiency Disorders Control Programme (NIDDCP), this Training Manual has been finalized and shall be very useful for sensitizing the Health Programme Managers.

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*Adapted from the 'Training of Laboratory Technicians' Module of the Nutrition & IDD Cell (Dte.G.H.S)

KEY OBJECTIVES OF TRAINING

1. Train participants on the causes, effects, and prevention of Iodine Deficiency Disorders (IDDs).
2. Familiarize participants with the goals, policies, and implementation strategies of the National Iodine Deficiency Disorders Control Programme.
3. Equip participants with techniques for laboratory analysis of Iodated salt and urinary iodine estimation.
4. Train participants in conducting IDD surveys, identifying goitre cases, and collecting samples for analysis.
5. Enhance participants' ability to conduct awareness campaigns on IDDs and the importance of consuming iodized salt.

PRE-TRAINING EVALUATION OF THE PARTICIPANTS

Before the start of the Training, an objective-type Multiple Choice Question paper consisting of 20 questions related to NIDDCP, management of laboratory monitoring of Iodized Salt, urinary Iodine Estimation and related knowledge & general awareness about importance of Iodine requirements is to be administered to the participants by the Training Organization.

CHAPTER- 1

BRIEF OVERVIEW OF IODINE DEFICIENCY DISORDERS

Introduction:

Iodine is an essential micronutrient required by the human body in very small amounts, but it plays a critical role in normal mental and physical wellbeing, particularly in Thyroid function. Iodine in the body is utilized by the Thyroid gland for the synthesis of Tri-Iodothyronine (T_3) and Thyroxin (T_4) hormones, essential for the growth and development, regulation of body metabolism etc. The healthy human adult body contains 15-20 mg of Iodine of which 50-80 percent is in the thyroid gland.

Iodine Requirements:

The daily requirement of Iodine is 150 micrograms per person. This works out to an amount less than a tea spoonful over a life span of 70 years. The Recommended Daily Allowances (RDA) of Iodine for different age groups is:

Daily Iodine Requirement

Age Group	Iodine Requirement
0 – 59 months	90 µg/day
6 – 12 years	120 µg/day
≥ 12 years	150 µg/day
Pregnant & Lactating Women	250 µg/day

Epidemiology of Iodine Deficiency Disorders (IDDs)

1. Iodine deficiency is a major public health concern worldwide, affecting approximately **2 billion people**, with South Asia, Africa, and parts of Europe being the most affected regions.
2. Surveys conducted across **427 districts** in India indicate that **348 districts** (over 80%) are endemic for IDDs, with a **goitre prevalence of more than 5%**.
3. Pregnant women, infants, children, and populations living in iodine-deficient regions are at the highest risk of developing IDDs due to increased physiological iodine requirements.
4. IDDs contribute to **Mental and Physical retardation, Goitre, Hypothyroidism, Stillbirths, Cretinism, and increased Infant mortality rates**, leading to long-term economic and social burdens.
5. Universal salt iodization (USI) is the most effective public health strategy, significantly reducing IDD prevalence in several countries, including India.
6. IDD control programs rely on **urinary iodine estimation, goitre prevalence surveys, and salt iodine content analysis** to assess the effectiveness of iodine supplementation strategies.
7. With government initiatives like **NIDDCP**, the production and consumption of iodized salt have improved, reducing iodine deficiency-related health issues in many regions.

Iodine Deficiency: A Disease of the Soil

The causes for Iodine deficiency in **humans** should be considered in light of the Iodine requirements in the human beings. Iodine deficiency occurs when Iodine intake falls below recommended levels. Iodine deficiency is an ecological phenomenon occurring naturally in many parts of the world. Figure illustrated below depicts the effect of the environmental iodine deficiency on humans, who are perched on top of the food chain.

Iodine deficiency is basically a disease of the soil. The atmosphere absorbs iodine from the sea which then returns through the rain and snow to the mountainous regions. It is then carried to the lower hills and plains, eventually returning to the sea (the Iodine Cycle in nature). The erosions of soils in riverine areas due to loss of vegetation from clearing for agriculture production, overgrazing by livestock and tree-cutting for firewood leads to continued and increasing loss of iodine from the soil. High rainfall and snow as well as flood further increase the loss of iodine from the soil which has already been denuded.

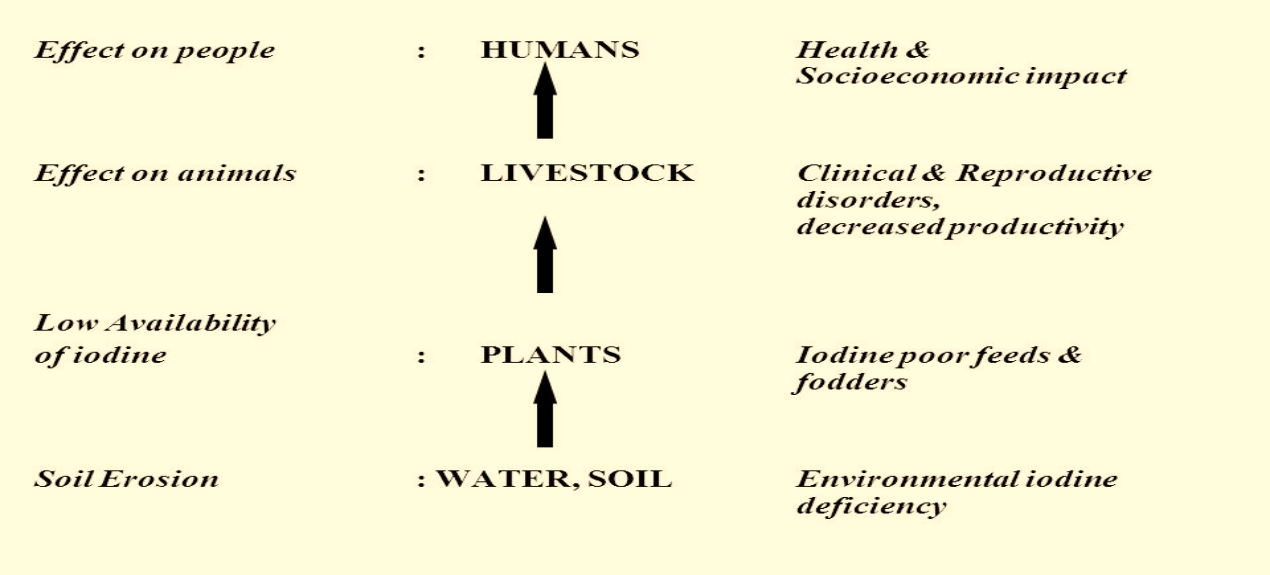


Figure: Effect of the environmental iodine deficiency on humans.

The return of iodine is slow and small in amount compared to the original loss. Groundwater and locally grown plants in these areas also lack iodine. Consequently, the animals feeding on these plants also lack iodine. This results in iodine deficiency in human beings who are dependent on these animals and plants for their dietary supply of iodine. In effect, iodine deficiency is "a disease of the soil" where the environmental deficiency results in the manifestation of the disease state in humans, perched on the top most level of the food chain. The various disorders associated with iodine deficiency are:

Category	Disorder/Effect	Symptoms/Effects	Treatment
Foetus	**Abortions**	- Increased risk of miscarriage	- Adequate iodine intake during pregnancy
	Stillbirths	- Increased risk of stillbirth	- Adequate iodine intake during pregnancy
	Congenital Anomalies	- Physical deformities (e.g., cleft lip, heart	- Adequate iodine intake during pregnancy

		defects)	
	Increased Perinatal Mortality	- Higher risk of death before or shortly after birth	- Adequate iodine intake during pregnancy
	Increased Infant Mortality	- Higher chances of death in early infancy due to underdeveloped organs	- Adequate iodine intake during pregnancy
	Neurological Cretinism	- **Mental deficiency** (low IQ) - **Deaf-mutism** (complete or partial hearing loss) - **Spastic diplegia** (muscle weakness and stiffness in legs) - **Squint** (crossed eyes or misaligned eyes)	- Early diagnosis through neonatal screening, lifelong thyroid hormone therapy - Iodine supplementation for pregnant women - Lifelong thyroid hormone replacement therapy - **Thyroid hormone replacement** to manage symptoms and improve physical and mental development
	Myxedematous Cretinism	- **Dwarfism** (short stature, stunted growth) - **Mental deficiency** (learning difficulties, low IQ) - **Psychomotor defects** (delayed motor skills, poor coordination)	- Early diagnosis and thyroid hormone replacement therapy - Iodine supplementation for pregnant women - Lifelong management with thyroid hormone therapy, early cognitive therapy for development
Neonate	**Neonatal Goitre**	- Swelling in the neck, difficulty swallowing or breathing	- Early thyroid screening and **thyroid hormone replacement therapy** to manage swelling and hormone levels
	Neonatal Hypothyroidism	- **Jaundice** (yellowing of the skin and eyes) - **Poor feeding and lethargy** (lack of energy, weak feeding) - **Slow weight gain** (failure to thrive) - **Delayed physical and mental development** (motor delays, cognitive delays)	- **Newborn screening** for thyroid function - **Thyroid hormone replacement therapy** (Levothyroxine) to support normal growth and development - Adequate iodine intake during pregnancy and **neonatal screening** for early diagnosis - Lifelong thyroid hormone therapy, early intervention for physical and cognitive delays

Child and Adolescent	**Goitre**	- **Visible swelling in the neck** (often noticeable during swallowing or in the mirror) - **Difficulty swallowing or breathing** (if the goitre is large or obstructive)	- **Iodized salt**, iodine-rich foods (e.g., seafood, dairy), and **thyroid hormone replacement** if goitre is severe - **Surgical intervention** if goitre becomes obstructive or is significantly large
	Juvenile Hypothyroidism	- **Fatigue** (low energy, tiredness) - **Weight gain** (unexplained, despite no change in diet or activity) - **Dry skin and hair loss**	- Iodine supplementation and **thyroid hormone replacement therapy** to manage symptoms of hypothyroidism - **Dietary adjustments**, including iodine-rich foods and iodized salt, along with thyroid hormone replacement therapy - **Thyroid hormone therapy** (Levothyroxine) and topical treatments for skin and hair issues
	Impaired Mental Function	- **Poor academic performance** (difficulty concentrating or retaining information) - **Learning disabilities** (difficulty with reading, writing, or problem-solving)	- Early intervention, educational support, and **cognitive therapy** for affected children - **Early cognitive therapies** to support development and **nutritional support** for iodine deficiency management
	Retarded Physical Development	- **Stunted growth** (short stature, slower growth rates)	- **Iodine supplementation**, thyroid hormone replacement therapy for physical growth, and regular monitoring of development
Adult	**Goitre with its complications**	- **Visible swelling in the neck** (lump or bulge in the throat) - **Difficulty swallowing or breathing** (if goitre is large or obstructive)	- **Iodized salt**, iodine-rich foods, and **thyroid hormone therapy** to manage goitre size and prevent further complications - **Surgical intervention** in cases of large or obstructive goitre causing difficulty breathing or swallowing

	Hypothyroidism	**- Fatigue, weight gain, cold intolerance, dry skin, hair loss** **- Slow heart rate, depression, memory issues**	- **Iodine supplementation** (iodized salt, iodine-rich foods) and **thyroid hormone replacement therapy** (Levothyroxine) - Ongoing **monitoring of thyroid function**, antidepressants and memory therapy, and support for mental health
	Impaired Mental Function	**- Depression, difficulty concentrating, low motivation**	- **Thyroid hormone replacement therapy**, **cognitive therapy**, and **psychological support**

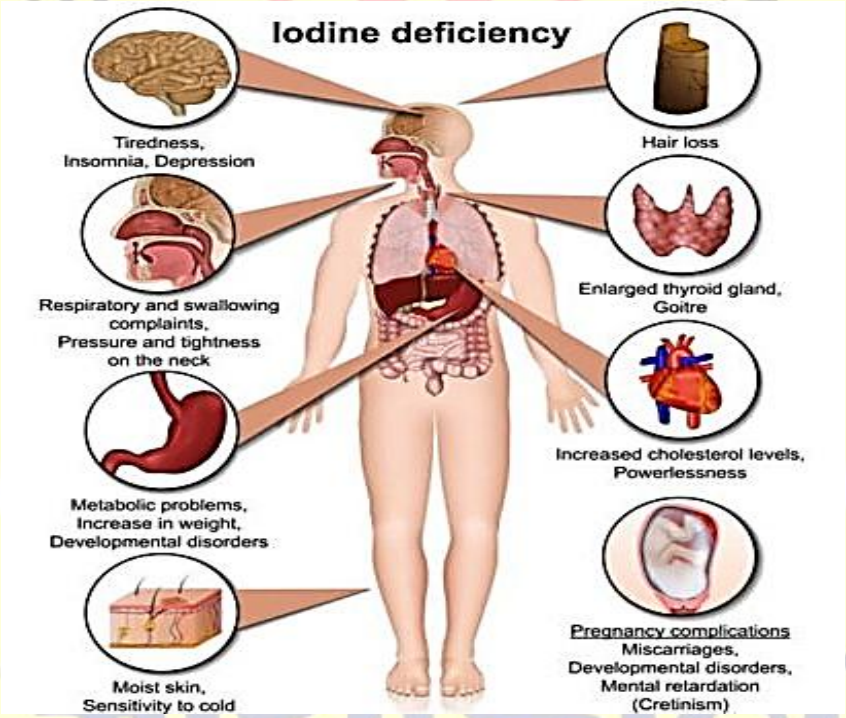


Figure: Iodine deficiency Disorders in different parts of Human Body.

The net consequence of iodine deficiency is diminished performance of the individuals and the community, which ultimately affects the entire economy of nation. Iodine Deficiencies will be eliminated through the provision of daily Iodine need to each individual. There are several strategies available to combat the prevalence of IDD but the most common is salt Iodization since salt is universally consumed by all the people.

SOURCES OF IODINE:

1. Natural Food Sources

- **Seafood** – Fish (tuna, cod), shellfish, prawns, and seaweed (kelp, nori) are rich in iodine.
- **Dairy Products** – Milk, cheese, curd, and yogurt contain iodine, primarily due to iodine-fortified cattle feed.
- **Eggs** – A good source of iodine, especially in the yolk.
- **Fruits & Vegetables** – Spinach, potatoes, bananas, cranberries, and strawberries contain moderate iodine levels, depending on soil iodine content.

2. Beverages

- **Milk & Dairy-Based Beverages** – Naturally contain iodine from fortified cattle feed.
- **Mineral Water** – Some brands contain trace amounts of iodine, depending on the source.

3. Supplements & Medicinal Sources

- **Iodine Supplements** – Prescribed for individuals with deficiency or increased iodine requirements, such as pregnant and lactating women.
- **Medications & Disinfectants** – Certain antiseptics, contrast dyes, and medications contain iodine and can contribute to intake.

FACTORS CONTRIBUTING TO IDD:

Iodine, an element present in the upper layer of earth, is an essential component of the hormones elaborated by thyroid gland. The increase in the size of thyroid, i.e. goitre, is in fact a compensatory mechanism evolved by the body to help it meet the challenge of iodine deficiency. A declined supply of this micronutrient during fetal or early postnatal life results in decreased synthesis of thyroxin, an essential hormone produced by thyroid glands. This in turn leads to a condition called Neonatal Chemical Hypothyroidism (NCH) with symptoms like retardation of physical, neuromotor, auditory, and intellectual maturation. The reason for nutritional inadequacy of iodine is its depletion in soil (due to erosion of upper layer of soil) and water in a large number of areas around the world resulting in an iodine deficient crop.

Intervention strategies in prevention and control of IDD:

Methods for Iodine Supplementation and associated difficulties:

- Iodized salt
- Iodized salt by injection
- Iodized oil by mouth

Of the above-mentioned methods, iodization of salt is a proven intervention.

The reason for this is not difficult to understand salt being a common food item used by a vast majority of population. Therefore, to ensure success of a national iodine deficiency disorders programme, it is mandatory to check that the salt being used by humans as well as animals is adequately iodized.

1. The **highly volatile nature** of iodine in all forms, potassium iodide (KI) being the most volatile and potassium iodate (KIO3) the least, makes production and quality assurance of iodinated salt quite difficult.

2. The problem may be compounded due **to fragile distribution network and faulty preservation system**, e.g. salt may be left uncovered or exposed to heat. **Addition of salt after cooking to reduce loss of iodine is advocated.**

3. The last but not the least difficult task is to **ensure actual consumption of salt.** Though the addition of iodine makes no differences in the taste of the salt, but the introduction of a new variety of salt, where a familiar one is already available, is likely to be resisted. Thus it is equally important to create a high demand and preference for iodized salt to be used in households.

Steps towards prevention of IDD:

1. In order to make the national programme of IDD elimination plausible, it is important to take up effective steps in the following directions:
2. Advocacy efforts create awareness that all populations, city dwellers and villagers as well as socio-economic groups, are equally affected. The impact of iodine deficiency on the next generation and its potential economic impact need to be highlighted.
3. Education of the masses through IEC materials will assure a demand for iodized salt.
4. Formulation of legalization that only salt with specific iodine content should be produced or imported, guarantees that only iodized salt is available in the market.
5. Quality assurance procedures should be opted for production, distribution and marketing of the salt.
6. A strategy needs to be established to verify the extent and nature of the IDD problem.

NUTRITIONAL INTERVENTIONS FOR IODINE DEFICIENCY

To effectively erase **Iodine Deficiency Disorders (IDDs)**, nutritional interventions play a crucial role. These interventions focus on **diet modification, counseling, supplementation, and avoiding food items that interfere with iodine absorption**.

Diet Editing

1. **Increase consumption of iodine-rich foods**, such as:
    - **Seafood** – Fish (cod, tuna, salmon), shrimp, and seaweed (kelp, nori).
    - **Dairy Products** – Milk, cheese, yogurt, and curd.
    - **Eggs** – Particularly the yolk, which is rich in iodine.
    - **Fruits & Vegetables** – Bananas, strawberries, spinach, potatoes, and green leafy vegetables (grown in iodine-rich soil).
2. **Ensure adequate use of iodized salt** in daily cooking.
    - Store salt in an **airtight container away from heat and moisture** to prevent iodine loss.
    - Add salt **after cooking** to **preserve iodine content**.



Diet Counseling (Guidance for Different Groups)

1. **Pregnant & Lactating Women** require **higher iodine intake** (250 µg/day) for fetal brain development and milk production. They should include **iodized salt, dairy, eggs, and seafood** in their diet and must avoid goitrogenic foods (see below) that hinder iodine absorption.
2. Encourage **breastfeeding**, as **breast milk provides iodine** to infants and children if the mother's intake is sufficient. Introduce iodine-rich solid foods like **mashed eggs, yogurt, and fish** after six months.

Vitamin & Mineral Supplementation

1. **Iodine Supplements** are available, provided in the form of **iodine capsules or potassium iodate solutions** in areas with severe deficiency. But these are only recommended under **medical supervision** to avoid excess iodine intake.
2. **Complementary Nutrients**:

- **Selenium** – Found in Brazil nuts, sunflower seeds, and fish, helps in thyroid hormone metabolism.
- **Zinc** – Found in nuts, lentils, and meat, supports thyroid hormone production.
- **Iron** – Deficiency can **worsen iodine deficiency**, so intake of iron-rich foods (spinach, legumes, red meat) is important.
- **Vitamin A & D** – Support overall metabolism and thyroid function. Found in carrots, dairy, fish, and sunlight exposure.

Food Items to Be Avoided (Goitrogenic Foods)

Certain foods, called **goitrogens**, interfere with iodine absorption and **block thyroid hormone production**. Individuals with iodine deficiency or hypothyroidism should **limit** these foods:

1. **Cruciferous Vegetables**:

- Cabbage, cauliflower, broccoli, Brussels sprouts, and kale.
- Cooking reduces goitrogenic effects, so these vegetables should not be eaten raw in large amounts.

2. **Soy Products**:

- Soybeans, tofu, soy milk, and soy flour contain **isoflavones**, which may inhibit thyroid function.
- Excessive consumption should be avoided, especially in individuals with thyroid disorders.

3. **Millets & Cassava**:

- Pearl millet, sorghum, and cassava contain **thiocyanates**, which compete with iodine absorption.
- Should be consumed in moderation in iodine-deficient regions.

4. **Highly Processed Foods**:

- Junk food, processed snacks, and fast food often **lack iodine** and should be replaced with whole, nutrient-rich foods.

CHAPTER-2

NATIONAL IODINE DEFICIENCY DISORDERS CONTROL PROGRAMME (NIDDCP)

Introduction:

As per the Surveys conducted by the Directorate General of Health Services, Indian Council of Medical Research, Health Institutions and the State Health Directorates of various States/UTs, it has been found that out of **427 districts surveyed** in all the States/UTs, **348 districts are endemic** i.e. where the prevalence of Iodine Deficiency Disorders (IDDs) is more than 5% (Annexure-I). No State/UT is free from Iodine Deficiency Disorders.

Control Programme:

Realizing the magnitude of the problem, the Government of India launched a 100 per cent centrally assisted National Goitre Control Programme (NGCP) in 1962. **In August, 1992 the National Goitre Control Programme (NGCP) was renamed as National Iodine Deficiency Disorders Control Programme (NIDDCP) with a view of wide spectrum of Iodine Deficiency Disorders like mental and physical retardation, deaf mutism, cretinism, still births, abortions etc.** The Goal of NIDDCP is to prevent and control Iodine Deficiency Disorders (IDDs) in the country.

Objectives:

1. To bring down the prevalence of Iodine Deficiency Disorders (IDD) to below 5% in the country.
2. To ensure 100% consumption of adequately Iodated salt (more than 15ppm) at the household level.

Activities:

1. Surveys to assess the magnitude of the Iodine Deficiency Disorders in the Districts.
2. Ensuring supply of adequately Iodised salt in place of common salt.
3. Resurveys to assess iodine deficiency disorders and the impact of iodated salt after every 5 years in the districts.
4. Laboratory monitoring of iodated salt and urinary iodine excretion.
5. Health Education and Publicity.

Policy:

On the recommendations of Central Council of Health in 1984, the Government took a policy decision to Iodate the entire edible salt in the country by 1992. The programme started in April, 1986 in a phased manner. To date, the annual Production and Supply of iodized salt in our country reached to 68 and 65 lakh Metric Tons respectively in 2017-18 which is adequate to meet the requirement of population of the entire country.

Nodal Ministry:

Ministry of Health & Family Welfare is the nodal Ministry for implementation of National Iodine Deficiency Disorders Control Programme (NIDDCP). The Programme is being implemented in all the States/UTs for the entire population.

Financial assistance to:

A. States/UTs

GOI provides grant for establishment of State IDD Control Cell (with sanctioned manpower one Technical Officer, one Statistical Assistant & LDC/DEO), IDD Monitoring Laboratory (with sanctioned manpower one Lab Technician and one Lab Assistant), conducting District IDD surveys and Health Education & Publicity to create awareness among population about Iodine Deficiency Disorders and consumption of Iodated salt. Funds also being provided since 2013 for procurement of Salt Testing Kit (STK) and performance-based payment to ASHA on testing of at least 50 salt samples per month for creating awareness about IDD and monitoring of iodine content of salt in order to ensure 100% consumption of adequately iodated salt at community/household level.

Important achievements under the Programme are:

- Over the years the Total Goiter Rate (TGR) in the entire country is reduced significantly.
- Production /Supply of iodized salt in the country reached to 68/65 lakh MT.
- Consumption of adequately iodized salt at household level is 78% (NISI Survey, 2014-15).
- Regulation 2.3.12 of Food Safety and Standards (Prohibition and Restriction on Sales), Regulation, 2011 restricts the sale of common salt for direct human consumption unless the same is iodized.
- National Reference Laboratory for monitoring of IDD has been set up at NCDC, Delhi. Four Regional laboratories one each at NIN, Hyderabad, AIIH&PH, Kolkata, AIIMS and NCDC, Delhi have been set up to conduct training, monitoring, quality control of salt and urine testing.
- For effective implementation of NIDDCP, States/UTs have established IDD Control Cells in their State Health Directorate and set up IDD monitoring laboratories.
- Extensive IEC activities have been carried out to create awareness about the regular consumption of Iodated salt in prevention and control of IDD through Doordarshan, All India Radio, Directorate of Field Publicity, Song and Drama, Directorate of Advertising and Visual Publicity.

Standards prescribed under Regulation 2.9.30 (2) for Iodized Salt - Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011:

Iodized Salt means a crystalline salt, white or pale, pink or light grey in colour, free from contamination with clay, grit and other extraneous adulterants and impurities. It shall conform to the following standards, namely:

Moisture	Not more than 6.0 percent by weight of the undried sample.
Sodium Chloride (NaCl).	Not less than 96.0 percent by weight on dry basis.
Matter insoluble in water.	Not more than 1.0 percent by weight on dry basis
Matter soluble in water other than Sodium Chloride.	Not more than 3.0 percent by weight on dry basis
Iodine content at:	
Manufacture level:	Not less than 30 parts per million (ppm) on dry weight basis.
Distribution channel including retail level:	Not less than 15 parts per million (ppm) on dry weight basis.

The product may contain food additives permitted in these regulations including Appendix A. The total matter insoluble in water where an anti-caking agent has been added shall not exceed 2.2 percent and sodium chloride content on dry basis shall not be less than 97.0 percent by weight.

Permitted food additives for use in Salt:

Name of Food Additives	**Edible common salt/Iodised salt & Iron fortified common salt**
(A) Anti-caking agents singly or in combination:	
Carbonates of calcium and magnesium:	20g/kg maximum, singly or in combination (Clubbed from B1 to B4)
(B) Crystal modifiers:	
Calcium or Sodium or Potassium Ferrocyanide singly or in combination expressed as Ferrocyanide:	10 ppm maximum

Restriction on sale of common salt – No person shall sell or offer or expose for sale or have in his premises for the purpose of sale, the common salt, for direct human consumption unless the same is iodized: Provided that common salt may be sold or exposed for sale or stored for sale for iodization, iron fortification, animal use, preservation, manufacturing medicines, and industrial use, under proper label declarations, as specified in the **Regulation 2.4.5 (21 & 42) of Food Safety and Standards (Packaging and Labelling) Regulations, 2011**.

Note: For further details, please refer to Food Safety and Standards (Food Products Standards and Food Additives), (Prohibition & Restriction on sales) and (Packaging & Labelling) Regulations, 2011.

Annexure-I

Statement showing the number of districts found to be endemic for Goitre in States/UTs

Sr No	Name of State/UT	Total No. of Endemic Districts	Names of Endemic Districts
1	Andaman and Nicobar Islands (UT)	3	S. Andaman, N. Andaman, Andaman and Nicobar districts
2	Andhra Pradesh	13	Anantapur, Chitturu, Cuddappa, East Godavari, Guntur, Krishna, Kurnool, Nellore, Prakasam, Srikakulam, Visakhapatnam, Vizayanagram, West Godavari
3	Arunachal Pradesh	4	Lower Subansiri, Kamle, West Siang, East Siang
4	Assam	14	Barpeta, Darrang, Dhubri, Dibrugarh, Goalpara, Jorhat, Kamrup, Karbi Anglong, Kokrajhar, Lakhimpur, Nagaon, Nalbari, Sivasagar, Tinsukia
5	Bihar	14	Begusarai, Darbhanga, East Champaran, Gopalganj, Katihar, Madhepura, Madhubani, Muzaffarpur, Patna, Purnea, Saharsa, Saran, Sitamarhi, West Champaran
6	Chandigarh (UT)	1	Chandigarh
7	Chhattisgarh	22	Baloda Bazar, Mungeli, Korba, Jashpur, Durg, Gariyabandh, Raipur, Balod, Surajpur, Bemetara, Rajnandgaon, Raigarh, Kondagaon, Narayanpur, Janjgir - Champa, Kabirdham, Kanker, Surguja, Bilaspur, Bijapur, Dhamtari, Sukma
8	Dadra and Nagar Haveli and Daman and Diu (UT)	1	Dadra Nagar Haveli
9	Goa	2	North Goa, South Goa
10	Gujarat	17	Ahmedabad, Amreli, Anand, Bharuch, Bhavnagar, Dahod, The Dangs, Junagadh, Kachch, Kheda, Narmaad, Navsari, Panchmahal, Sabarkantha, Surat, Vadodara, Valsad
11	Haryana	10	Ambala, Faridabad, Gurugram, Hisar, Jind, Karnal, Panchkula, Panipat, Rohtak, Sonepat
12	Himachal Pradesh	12	Bilaspur, Chamba, Hamirpur, Kangra, Kinnaur, Kullu, Lahaul, Mandi, Shimla, Sirmour, Solan, Una
13	Jharkhand	8	Deoghar, Dumka, Godda, Gumla, Lohardaga, Palamu, Ranchi, Sahebganj
14	Jammu & Kashmir (UT)	11	Anantnag, Baramulla, Budgam, Doda, Jammu, Kathua, Kupwara, Poonch, Pulwama, Rajouri, Udhampur
15	Karnataka	9	Bengaluru Rural, Bengaluru Urban, Ballari, Chikmagaluru, Dakshin Kannada, Kodagu, Shivamogga,

			Uttara Kannada, Vijayanagara
16	Kerala	12	Wayanad, Alapuzha, Thiruvananthapuram, Pathanamthitta, Kottayam, Ernakulam, Idukki, Thrissur, Malappuram, Kozhikode, Kannur, Kasargode
17	Ladakh (UT)	2	Kargil, Leh Ladakh
18	Lakshadweep (UT)	1	Lakshadweep
19	Madhya Pradesh	14	Balaghat, Chhindwara, Damoh, Betul, Chattarpur, Hoshangabad, Jabalpur, Khandwa, Khargone, Mandla, Sagar, Shahdol, Sidhi, Tikamgarh
20	Maharashtra	21	Ahmednagar, Jalna, Dhule, Akola, Amravati, Aurangabad, Bhandara, Buldhana, Chandrapur, Kolhapur, Nanded, Parbhani, Pune, Raigad, Ratnagiri, Sangli, Satara, Sindhudurg, Solapur, Thane, Wardha
21	Manipur	16	Bishnupur, Chandel, Churachandpur, Imphal East, Imphal West, Jiribam, Kakching, Kamjong, Kangpokpi, Noney, Pherzawl, Senapati, Tamenglong, Tengnoupal, Thoubal, Ukhrul
22	Meghalaya	11	East Khasi Hills, West Khasi Hills, South-West Khasi Hills, East Jaintia Hills, West Jaintia Hills, Ri-Bhoi, East Garo Hills, West Garo Hills, South-West Garo Hills, North Garo Hills, South Garo Hills
23	Mizoram	9	Aizwal East, Aizwal West, Lunglei, Kolasib, Serchhip, Mamit, Champhai, Saiha, Lawngtlai
24	Nagaland	10	Mon, Kohima, Zunheboto, Mokokchung, Noklak, Phek, Shamator, Tseminyu, Tuensang, Wokha
25	Odisha	17	Angul, Bargarh, Cuttack, Dhenkanal, Gajapati, Ganjam, Kandhamal, Keonjhar, Khordha, Koraput, Malkangiri, Nawarangpur, Nuapada, Puri, Rayagada, Sambalpur, Sundargarh
26	Puducherry (UT)	4	Puducherry, Karaikal (TN), Mahe (Kerala), Yanam (AP)
27	Punjab	6	Gurdaspur, Hoshiarpur, Mohali, Pathankot, Patiala, Ropar
28	Rajasthan	6	Bharatpur, Bikaner, Deeg, Kota, Salumber, Udaipur
29	Sikkim	6	Gangtok, Pakyong, Mangan, Namchi, Soreng, Gayzing
30	Tamil Nadu	21	Chennai, Coimbatore, Cuddalore, Dharmapuri, Dindigul, Erode, Kanniyakumari, Madurai, Nagapattinam, Namakkal, Nilgiris, Perambalur, Pudukkottai, Ramanathapuram, Salem, Thanjavur, Thiruvarur, Trichirappalli, Tuticorin, Villupuram, Virudhunagar
31	Telangana	20	Adilabad, Asifabad, Bhupalapally, Hanumakonda, Janagaon, Jogulamba Gadwal, Khammam, Kothagudem, Mahabubabad, Mahabubnagar, Manchiryal, Medchal Malkangiri, Mulugu, Nagarkurnool, Narayanapet, Nirmal, Rangareddy, Vikarabad, Wanaparthy, Warangal

32	Tripura	8	Dhalai, Gomati, Khowai, North Tripura, Sepahijala, South Tripura, Unakoti, West Tripura
33	Uttarakhand	9	Almora, Chamoli, Dehradun, Haridwar, Nainital, Pauri, Rudraprayag, Tehri, Uttarkashi
34	Uttar Pradesh	24	Agra, Aligarh, Ayodhya, Azamgarh, Bahraich, Bareilly, Basti, Bijnor, Bulandsahar, Deoria, Ghaziabad, Gonda, Gorakhpur, Jaunpur, Lakhimpur Khiri, Mathura, Muzaffarnagar, Pilibhit, Raebareli, Rampur, Saharanpur, Shahjahanpur, Sultanpur, Varanasi
35	West Bengal	12	Alipurduar, Bashirhat HD, Birbhum, Coochbehar, Dakshin Dinajpur, Darjeeling (SMP), Howrah, Jalpaiguri, Malda, North 24 Pargana, Rampurhat HD, Uttar Dinajpur
	TOTAL	370	

Source: *Dte. GHS, Ministry of Health & Family Welfare and State Govt. reports.*

आयोडीन नमक

CHAPTER- 3

ANALYSIS OF IODINE CONTENT OF IODATED SALT

Introduction / Method: The Iodine content of Iodated salt is estimated by a process called Iodometric Titration. Iodometry deals with the titration of iodine liberated in a chemical reaction.

Principle: The principle is that iodine is liberated by adding sulphuric acid to a solution of iodated salt. Potassium iodide solution is added to keep the iodine in a dissolved state. Iodine liberated is then titrated with sodium thiosulphate. Starch is used as an internal indicator.

Reaction steps for Iodometric titration of Iodate

$KIO_3 + 5KI + 3H_2SO_4 \text{----------} > 3K_2SO4 + H_2O + 31_2$

$KI + I_2 \text{----------} > KI_3$

$2Na_2S_2O_3 + I_3 \text{----------} > 2NaI + Na_2S_4O_6$

Apparatus and consumables Required

- Analytical weighing balance
- Burette stand
- Burette
- Conical flask
- Reagent Bottles
- Measuring cylinder of 100 ml volume
- Spatula
- Butter paper
- Heater/Hot Plate
- Micropipette, Micropipette tips

Reagents Preparation

The preferred water for this method should be double-distilled water.

- ***0.005 N Sodium thiosulfate ($Na_2S_2O_3$):*** Dissolve 1.24 g $Na_2S_2O_3.5H_2O$ in 1000 ml double-distilled water. Store in a cool, dark place. This volume is sufficient for 100-200 samples, depending on their iodine content. The solution is stable for at least one month, if stored properly.

- ***0.005 N Potassium Iodate (KIO_3):*** Dissolve 0.0446 g of KIO_3 in 250 ml of double-distilled water. Store in a dark Bottle.

- ***2 N Sulfuric acid (H_2SO_4):*** Slowly add 5.56 ml concentrated H_2SO_4 to double-distilled water slowly. Make up the Solution to 100 ml. This volume is sufficient for 100 samples. The solution is stable indefinitely. Always add acid to water, not water to acid, to avoid excess heat formation and spitting of acid. Stir solution while adding acid.

- ***10% Potassium iodide (KI):*** Dissolve 100 g KI in 1000 ml double-distilled water. Store in a cool, dark place. This volume is sufficient for 200 samples. Properly stored solution is stable for 6 months, provided no change occurs in the colour of the solution.

- ***Starch indicator solution:*** Dissolve reagent-grade Sodium Chloride (NaCl) in 100 ml double-distilled water. While stirring, add NaCl until no more dissolves. Heat the contents of the beaker until excess salt dissolves. While cooling, NaCl crystals will form on the sides of the beaker. When it is completely cooled, decant the supernatant into clean bottle. This solution is stable for 6-12 months. Dissolve 1 g chemical Starch in 10 ml boiling double-distilled water and mix till the Starch completely dissolves. Add to it, the saturated NaCl solution to make 100 ml Starch Solution. This volume is sufficient for testing 20-45 samples. Prepare fresh Starch Solution every day, since Starch Solution cannot be stored.

Standardization of Sodium Thiosulphate Solution:

1. Sodium Thiosulphate Solution is to be standardized with Standard Potassium Iodate Solution to determine its exact Normality.
2. Take 0.005 N Sodium Thiosulphate ($Na_2S_2O_3$) solution in a burette.
3. Pipette out 25 ml of 0.005 N standard Potassium Iodate (KIO_3) solution in a conical flask.
4. Add 2 ml of 2N Sulfuric acid (H_2SO_4) and 5 ml of 10% Potassium Iodide (KI) solution.
5. Titrate the Solution against Sodium Thiosulphate till the solution becomes pale yellow in colour.
6. To this, add 1 ml Starch. The solution turns deep purple. Add Sodium Thiosulphate solution drop by drop from the burette till the purple colour completely disappears.

Normality of Sodium Thiosulphate is calculated as follows:

Volume of KIO_3 (V1) x Normality of KIO_3 (N1) = Volume of $Na_2S_2O_3$ (V2) x Normality of $Na_2S_2O_3$ (N2)

$$\textbf{Normality of Sodium Thiosulphate} = \frac{V1 \times N1}{V2}$$

Determination of Iodine Content:

1. Take 10 g of iodated salt and dissolve it in 50 ml of hot double-distilled water taken in a 250 ml conical flask.
2. Add to this solution 1 ml of 2N Sulphuric acid and 5 ml of 10% Potassium Iodide solution. The solution turns yellow in colour.
3. Close the flask with the stopper. Keep the flask in dark (i.e. in a closed cupboard) for about 10 minutes.
4. Titrate this solution with Sodium Thiosulphate taken in the burette till the solution becomes pale yellow in colour.
5. To this, add about 5 ml of starch. The solution now turns deep purple.
6. Add Sodium Thiosulphate drop by drop from the burette till the purple colour completely disappears.
7. The number of ppm of iodine in the salt samples is **calculated** as follows:

$$\text{Iodine ppm} = \frac{R \times 100 \times 1000 \times 0.127 \times N}{6}$$

where,

R - The Volume of Thiosulphate used (burette reading)

100 - For converting burette reading for 1000gm of salt

10^3 - For converting gms of iodine to milligrams

0.127 - The weight of Iodine equivalent to 1ml of normal sodium thiosulphate solution

N - Normality of sodium thiosulphate solution

6 - To arrive at the value of 1 atom of iodine liberated

If the value is not divided by 6, the 5 atoms of iodine liberated from the KI added will also be included in the final result.

To convert the iodine in terms of KIO_3 (Potassium Iodate) multiply the iodine ppm with 1.685.
To simplify the calculations, multiplying the constant factors, we can express the potassium iodate content in the salt by the following formula:

$$KIO_3 \text{ ppm} = \frac{R \times N \times 100 \times 1000 \times 0.127 \times 1.685}{6}$$

$$= R \times N \times 3566.6$$

For further easy reference, a ready reckoner is prepared to show the iodine content (in ppm) corresponding to the burette reading of $Na_2S_2O_3$ solution. This ready reckoner is given in the Table provided on the next page:

Table: Calculation of Iodine Content of Salt in Parts per Million (ppm) from Burette Reading			
Burette reading	**PPM**	**Burette reading**	**PPM**
0.0	0.0	5.1	54.0
0.1	1.1	5.2	55.0
0.2	2.1	5.3	56.1
0.3	3.2	5.4	57.1
0.4	4.2	5.5	58.2
0.5	5.3	5.6	59.2
0.6	6.3	5.7	60.3
0.7	7.4	5.8	61.4
0.8	8.5	5.9	62.4
0.9	9.5	6.0	63.5
1.0	10.6	6.1	64.5
1.1	11.6	6.2	65.6
1.2	12.7	6.3	66.7
1.3	13.8	6.4	67.7
1.4	14.8	6.5	68.8
1.5	15.9	6.6	69.8
1.6	16.9	6.7	70.9
1.7	18.0	6.8	71.9
1.8	19.0	6.9	73.0
1.9	20.1	7.0	74.1
2.0	21.2	7.1	75.1
2.1	22.2	7.2	76.2
2.2	23.3	7.3	77.2
2.3	24.3	7.4	78.3
2.4	25.4	7.5	79.4
2.5	26.5	7.6	80.4
2.6	27.5	7.7	81.5
2.7	28.6	7.8	82.5
2.8	29.6	7.9	83.6
2.9	30.7	8.0	84.6
3.0	31.7	8.1	85.7
3.1	32.8	8.2	86.8
3.2	33.9	8.3	87.8
3.3	33.9	8.4	88.9
3.4	36.0	8.5	89.9
3.5	37.0	8.6	91.0
3.6	38.1	8.7	92.0
3.7	39.1	8.8	93.1
3.8	40.2	8.9	94.2
3.9	41.3	9.0	95.2
4.0	42.3	9.1	96.3
4.1	43.4	9.2	97.3
4.2	44.4	9.3	98.4
4.3	45.5	9.4	99.5
4.4	46.6	9.5	100.5
4.5	47.6	9.6	101.6
4.6	48.7	9.7	102.6
4.7	49.7	9.8	103.7
4.8	50.8	9.9	104.7
4.9	51.9	10.0	105.8
5.0	52.9		

Precautions:

1. The Starch solution must be added near the end point of the titration, when very little Iodine is left and the solution turns to faint yellow colour. If starch is added earlier, the iodine starch complex becomes very strong and reacts too slowly with Sodium Thiosulphate resulting in false reading.
2. The titration should be done in a comfortably cool room because iodine is volatile and sensitivity of the starch solution indicator diminishes as the temperature rises.
3. Potassium Iodide is used because of low solubility of Iodine. The liberated Iodine forms an unstable complex KI_3. A few minutes should be allowed before titration since the rate of reaction between iodine ions and the oxidant is slow.
4. The reaction mixture should be kept in dark before titration because light accelerates a side reaction in which iodine ions are oxidized to iodine by atmosphere oxygen.
5. Starch solution should be prepared fresh every day because it cannot be stored.
6. Sodium Thiosulphate if stored for more than a week should be standardized using potassium Iodate.

Collection, Dispatch and Analysis of Iodated Salt Samples:

- 50 salt samples to be collected per month per District.
- Out of 50 samples, 25 samples from rural households, 15 samples from urban households, 7 samples from rural retailers and 3 samples from urban retailers should be collected with proper label.
- The amount of an iodated salt samples should be about 100 gms for loose iodated salt kept in polythene pouch and a whole packet for packed Iodated salt.
- These samples will be brought to the District level monitoring lab (if any) for analysis of iodine content.
- Out of the 50 samples collected, the Medical Officer will send 10% samples to the State level IDD Monitoring Lab for quality control.
- A compiled monthly report of analysis of Iodated salt by District IDD Monitoring Laboratory and State IDD Laboratory shall be prepared and sent to Central Nutrition & IDD Cell, Dte.G.H.S, New Delhi through State/UT Programme Officer (NIDDCP). In addition, each Food Inspector at the District level, under Prevention of Food Adulteration Act, will collect at least two samples of iodated salt every month for detailed analysis under the Act and take appropriate measures as desired therein.

Monthly reporting proforma for analysis of salt samples:

By Quantitative Test (Titration Method)

Number of salt samples analyzed and outcome			
Total No. of Salt samples tested	Salt samples >15PPM	Salt samples <15PPM	Nil Iodine content

Salt Testing by using Salt Testing Kit (STKs):

Use of Spot Testing Kit (STK):

A simple kit has been developed for on-the-spot estimation of iodine content. In the spot testing method, estimation of iodine content in salt is done with the help of a standard starch solution provided in the Spot Testing Kit (STK). The STK has been advocated as a method for quantitative estimation of iodine in salt.

Procedure for use of Spot Testing Kit:

1) A few spoons of the salt for testing is filled a small cup and spread flat.
2) The test solution ampoule is opened by piercing it with a pin and the test solution is dropped on the salt surface till the surface is flooded.
3) The reaction liberates the iodine in the salt, and depending on the content of iodine, the solution changes the colour of the salt.
4) The intensity of the colour varies with the amount of iodine and by matching it with the colour chart the range of iodine can be ascertained.
5) In the absence of the colour formation, a few drops of the recheck solution is to be spread on the salt surface before using the test solution.

The Field Test Kit consists of:



1) 2-3 Ampoules of 10ml each containing test solution
2) In some cases, 1 red Ampoule containing recheck solution
3) A detailed instruction sheet in the local language
4) A Colour Chart with circular colour spots
5) One small container

*All fitting into a handy pocket size kit

Observation:

Iodine Test colour Chart

No change in colour: Iodine absent

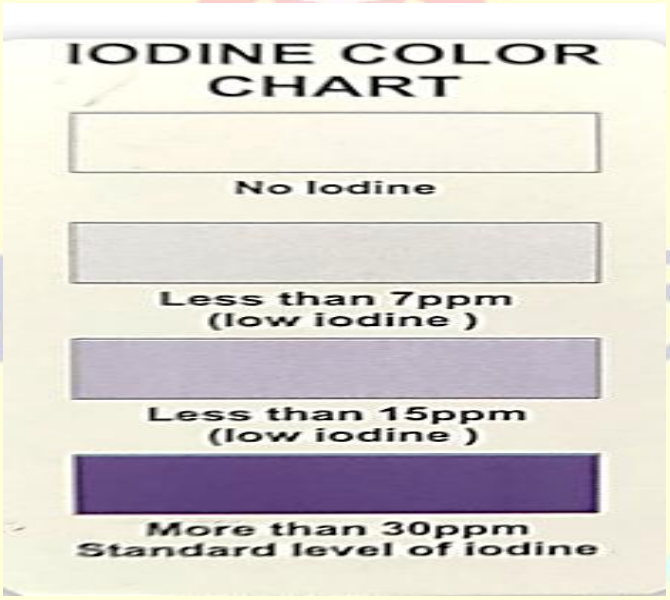
Low Iodine (Less than 15 ppm)

Appearance of intense blue-black colour: **Iodine present.**

***Adequate level of Iodine (more than 15 ppm)**

Recording:

Iodine: - Record ppm (mg/kg) of Iodine is obtained by standard colour comparison.



Picture showing an Iodine Colour Comparison Chart

CHAPTER-4

URINARY IODINE ESTIMATION (UIE)

Introduction: - Iodine is ingested in food in a variety of chemical forms. Most of it is broken in the gut and absorbed into the blood stream where it circulates as Plasma Inorganic Iodide (PII). PII is either taken up by thyroid gland or kidney. Only a fraction of PII goes into thyroid gland and 90-98% of PII comes out in the urine. Thus, urinary iodide excretion reflects iodine intake of an individual and is used an indicator of iodine nutrition of an individual. In epidemiological surveys, urinary iodine excretion pattern indicates the iodine nutrition in the population and has been effectively used to decide whether iodine deficiency exists in the population or not.

Recent awareness that several hundred million people, mainly in developing countries are affected by iodine deficiency has greatly increased the demand for evaluating its severity in a given population. Such evaluation can be done by measuring thyroidal radioactive iodine uptake in the field but this approach cannot be used in the field for reason of equipment safety, cost, standardization and availability of isotope. Another suitable method is the measurement of iodine in urine sample.

Available Methods:

Available methods of Urine Iodine estimations are:

(1) Titration by thiosulphate and
(2) The Sandell Kolthoff reaction.

The former lacks sensitivity and is inadequate for the measurement of iodine in urine. The latter is the method of choice.

Principle

There are two major steps in the estimation of urinary iodine. The first step involves the destruction of the organic content in the sample by either alkaline fusion (dry ashing) at high temperatures or by digestion with mixture of strong acids (wet digestion) at relatively low temperature. In the second step, the inorganic iodine left over in the ashed/digested material is estimated by a suitable method. The most common method used for the micro determination of iodine is based on its catalytic property in a cerate-arsenite mixture. Briefly the reduction of Ce^{4+} to Ce^{3+} changes the optical absorbance, and the progress of the reaction is monitored by discolouration of Ceric ammonium sulphate. The rate of this colour change depends upon the amount of iodine present and is in inverse ratio. It can be measured by a colorimeter, and the amount of iodine in the urine analysis can be calculated by comparison with a standard solution of known iodine content.

The proposed mechanism of the above reaction is as follows:

$2\,Ce^{++++} + 2I \longrightarrow I_2 + 2Ce^{+++}$
(Ceric) (Cerus)

$I_2 + As^{3+} \longrightarrow As^{5+} + 2I$

The catalytic co-efficient of the reaction is dependent on the concentration of H_2SO_4, concentration of iodide, concentration of chloride in the reaction mixture, temperature and the reaction time.

The process of mineralising iodine to perform the Sandell- Kolthoff reaction is a must. There are two ways of mineralising iodine:

(1) Dry ashing and (2) Wet digestion.

Dry ashing requires a muffle furnace, is done in an alkaline medium and is very expensive while wet digestion is done in a strong acid medium. The temperature of the former is around 600°C and of the latter is around 150°C. The loss of iodine and the cost of the instruments are low in the wet digestion method.

Urinary Iodine Estimation by the Wet Digestion Method (Sandell-Kolthoff)
There are many methods available for the destruction of the organic component of the sample, but the one described here is used commonly for its simplicity and convenience.

Method for measuring urinary iodine using Ammonium Persulfate Method:

Principle:

Urine is digested with ammonium persulfate. Iodide acts as the catalyst in the reduction of ceric ammonium sulfate (yellow) to cerous form (colourless) in the presence of Arsenious acid and is detected by rate of colour disappearance (Sandell- Kolthoff reaction).

Apparatus & consumables Required:

1. Hot air oven (vented fume hood not necessary)
2. Spectrophotometer/Spectrocolorimeter/Microplate Reader
3. Microplates (if using Microplate Reader)
4. Cuvetts (if using spectrophotometr/spectrocolorimeter)
5. Analytical Weighing balance
6. Stop watch (digital)
7. Reagent flasks and Bottles
8. Conical flasks
9. Glass Pipettes, Micropipette and micropipette tips
10. Measuring cylinder
11. Test Tubes and Test Tubes Stand
12. Wash Bottle
13. Glass stirring rod
14. Butter paper
15. Tissue paper

Reagents:

1. Ammonium Persulfate $(NH_4)_2S_2O_8$ (Analytical Grade)
2. Arsenic Trioxide
3. Sodium Chloride
4. Sulphuric Acid
5. Ceric Ammonium Sulphate
6. Potassium Iodate
7. Sodium Hydroxide
8. Hydrochloric acid
9. Deionized H_2O

Preparation of Solutions:

1M Ammonium Persulfate:

Dissolve 114.1 g $(NH_4)_2S_2O_8$ in Double distilled water and make up to 500 ml with DD water. Store away from Light. Stable for at least one month.

5N H_2SO_4:

Slowly add 139 ml concentrated (36N) H_2SO_4 to about 700 ml deionized water (careful – this generates Heat). When cool, adjust with deionized water to a final volume of 1 L.

3.5N H_2SO_4:

Slowly add 97 ml concentrated (36 N) H_2SO_4 to about 800 ml deionized water (careful - this generates heat) when cool, adjust with deionized water to a final volume of 1 litre.

Arsenious Acid Solution:

In a 2000 ml Erlenmeyer flask, place 20 g As_2O_3 and 50 g NaCl, then slowly add 400 ml 5N H_2SO_4. Add water to about 1 litre, heat gently to dissolve, cool to room temperature, dilute with water to 2 litres, filter, store in a dark bottle away from light at room temperature. The solution is stable for months. (NIDDCP Guidelines)

OR

Dissolve 0.986 g As_2O_3 in 10 ml 0.5N NaOH (Hot). Add to it, 750 ml chilled Double Distilled Water. Further add 20 ml concentrated HCl and 39.6 ml concentrated H_2SO_4 slowly to the Solution. Make up the final volume to 1 L. (Laboratory Method)

Ceric Ammonium Sulfate Solution:

Dissolve 48 g ceric Ammonium Sulphate in 1 litre 3.5N H_2SO_4. Store in a dark bottle away from light at room temperature. The solution is stable for months. (NIDDCP Guidelines)

OR

Add 6 g Ceric Ammonium Sulphate in 500 ml 3.5N H_2SO_4. Store in a dark Bottle away from light at Room Temperature. The Solution is stable for months. (Laboratory Method)

Stock Iodine Standard solution (A): (100 mg % of iodine) Dissolve 168.5 mg of KIO_3 in 100 ml of double distilled water in a volumetric flask. 168.5 mg KIO_3 contains 100 mg Iodine (Formula weight of KIO3 = 214; Formula weight of Iodine = 127 & 1 mg of Iodine = 214/127 = 1.68 mg of KIO_3). On subsequent dilutions stock solution **(A)** gives 100 µg % of iodine stock solution **(C).**

Stock (A) 168.5 mg % KIO_3

Or

100 mg % of Iodine

↓ x 10 times diluted

Stock (B) 10 mg % of Iodine (9 ml H_20) + 1 ml of Stock A)

↓ x 100 times diluted

Stock (C) 0.1 mg% of Iodine (9.9 ml H_2O + 100µl of Stock B)

Or

100 µg % of Iodine

Working Standard: (5 µg/dl, 10 g/dl, 15 µg/dl, 20 µg/dl) Stock solutions were diluted to prepare working standard solutions.

mL of stock std (C) (100 µg %)	mL of water to be added	Working Std.	
		Total Volume (ml)	Iodine concentration (I µg/dl)

Procedure:

1. Mix urine to suspend sediment
2. Pipette 100 µl of urine sample and standard in glass tubes.
3. Add 1 ml 1 M ammonium persulfate to each tube.
4. Heat all tubes for 60 minutes at 100° C.
5. Cool tubes to room temperature.
6. Add 2.5 ml arsenious acid solution. Mix by inversion or vortex. Let stand for 15 min. (NIDDCP Guidelines)

OR

Add 50 µl digested urine samples in a microplate and add 100 ul Arsenious acid afterwards to the microplate wells. (Laboratory Method)

7. Add 300 µl of ceric ammonium sulfate solution to each tube (quickly mixing) at 30 second intervals between successive tubes. A stopwatch should be used for this. With practice, a 15 sec interval is convenient. (NIDDCP Guidelines)

OR

Add 50 µl of ceric ammonium sulphate solution in each well. (Laboratory Method)

8. Allow to sit at room temperature. Exactly 30 minutes after addition of ceric ammonium sulfate to the first tube, read its absorbance at 420 nm. Read successive tubes at the same interval as when adding the ceric ammonium sulfate. (NIDDCP Guidelines)

OR

15 min. after addition of ceric ammonium sulphate in micro wells, read the absorbance at 420 nm in a Microplate Reader. (Laboratory Method)

Note: The assay time is 25 minutes, so a maximum of only 50 tubes can be run in one assay. (in test tube Method)

Calculation of results:

Construct a standard graph on a centimeter graph paper by plotting iodine concentration of each standard on the abscissa against its optical density on the ordinate. For each sample find its optical density on the standard curve and then locate the corresponding iodine concentration on the abscissa. This is the urinary iodine concentration of the sample.

PREPARATION OF CHROMIC ACID: Take 500 ml of deionized water in a 1000 ml conical flask. Dissolve potassium dichromate ($Kr_2C_2O_7$) till the saturation point. Then 250 ml of concentrated sulfuric acid is to be added drop wise in chilled condition.

Precautions: As the method adopted is very sticky, the following precautions are a must:

1. All water and glassware used should be iodine free.
2. Glassware to be used should be kept in **chromic acid** for 24 hours, then thoroughly rinsed with tap water and then with double distilled H_2O (while distilling, $KMnO_4$ is added in the distillation flask). Final rinsing is done with methanol.
3. Reagents used should be iodine free and also mercury free as these interfere with Sandell-Kolthoff reaction.
4. Use only electronic graded H_2SO_4.

Collection, Dispatch and Analysis of Urine Samples

- 25 Urine samples are to be collected and dispatched to the State level IDD monitoring lab per District per month.
- The samples to be collected from 25 children of 6-12 years age group (both sexes) in cleaned, screw-capped bottles of 15-20 ml capacity.
- From each individual, single casual urine sample (3-5 ml) are to be collected on the spot for estimation of UIE.
- After collecting the sample, few drops of Toluene (A.R. Grade) should be added to make a complete layer.
- These samples should preferably be dispatched to the lab on the same day.
- Each sample should be numbered together with relevant details.
- A monthly report of the analysis will be made available to the Central Nutrition & IDD Cell, Dte.G.H.S, New Delhi through the State Programme Officer (NIDDCP).

Monthly reporting proforma for analysis of Urine Samples:

Number of Urine Samples analyzed for Iodine Excretion and outcome					
Total Urine samples tested	Samples >100 µg/L	Samples 50-100µg/L	Samples 20-50µg/L	Samples <20µg/L	Nil Iodine content

CHAPTER-5

DISTRICT IDD SURVEY GUIDELINES OF NIDDCP

One of the Goals of NIDDCP is to bring down prevalence of IDDs to below 5% in the entire Country. District IDD Surveys are conducted to assess the magnitude of the Iodine Deficiency Disorders (IDDs) and Re-surveys to assess the present extent of Iodine Deficiency Disorders and the impact of Iodated Salt after every 5 years. A Total Budget of Rs 50,000/- for District IDD Survey is provided to States/UTs.

Survey Method: The IDD Survey at the District is conducted by using the method of Population Proportionate to Size (PPS) sampling in the age group of 6-12 years children.

Table: Tabulation by PPS Sampling

S.NO	NAME OF VILLAGE/WARDS	POPULATION	CUMULATIVE POPULATION
1			
2			
3			
4			
5			

Survey parameters:

1) Clinical examination of Goitre.
2) Testing of household salt samples for Iodine content.
3) Estimation of Urinary Iodine Excretion (UIE).

Methodology:

Sample Size:

- 30 villages/wards selected depending on enrolment rate.
- 90 children (45 boys + 45 girls) 6-12 years, in/out of school from selected village /ward included for survey.

Sampling Interval:

- Total population of villages or wards /30= K.
- Total number of children to be examined in district is: 90x30=2700

- Number of salt samples taken 20%=540* (Household of every 5th child is selected for salt sample).
- Number of urine samples taken 10% =270* (every 10th child is selected for urine sample).

Selection of Random Samples:

- Selection of random Starts from 1 to K, say R.
- First random number will be: R
- Second random number will be: R+K
- 30th random number will be: R+29K.

Selection of children for sampling:

- 90 children (45 boys & 45 girls) of 6-12 years age from and out of school in each village/ward selected, based on enrolment rate.
- Suppose in the selected village, enrolment rates are:
    - Boys = 70%
    - Girls = 60%

Allocation of sample would be as under

	Boys	**Girls**
SCHOOL	32(70%)	27 (60%)
Out of School	13(30%)	18(40%)
TOTAL	**45**	**45**

<u>Technique of Clinical examination</u>

- Examination of Goitre is based entirely on inspection and palpation of neck.
- Examiner may palpate from front or back side of neck.
- Examiner palpates the isthmus & lobes with two thumbs/two fingers/fingers of both hands being separated around lateral side of neck.
- Palpation is done with 1st or 1st & 2nd fingers.
- Eyes of examiner at level of subject's neck.
- In people with short neck thyroid gland may be hidden by sternum. This may make difficult to diagnose.
- Nodules if present are noted and be recorded separately.

Classification of Goitre: Three types of Goitre are:

Grade 0: No palpable or visible goitre.

Grade 1: Mass in neck consistent with enlarged thyroid that is palpable but not visible.

Grade 2: Swelling in neck visible when the neck is in normal position and is consistent with enlarged thyroid when it is palpated.

Table: Statement showing prevalence rate of Goitre among male/female of all age group

Age Group (Years)	Sex	Total Examined	Grades Of Goitre			Total Goitre Cases (1^{st} + 2^{nd})	(%)
			0 GRADE	1^{ST} GRADE	2^{ND} GRADE		
6	MALE						
TO	FEMALE						
7	TOTAL						
8	MALE						
TO	FEMALE						
9	TOTAL						
10	MALE						
TO	FEMALE						
11	TOTAL						
12	MALE						
	FEMALE						
	TOTAL						

Table: Classification of IDD as public health problem

INDICATOR	MILD	MODERATE	SEVERE
Goitre grade (1+2)	**5 - 19.9%**	**20 - 29.9%**	**>_30%**
Median UIE (Micrograms per litre)	**50 - 99**	**20 – 49**	**<_20**

ENDEMIC DISTRICTS

If Total Goitre Rate in children of 6-12 yrs age in a District is above 5%, the District is declared Endemic to IDD which is a Public Health problem

CHAPTER- 6

COLLECTION, PREPARATION & TRANSPORTATION OF URINE SAMPLES

1. COLLECTION OF URINE SAMPLE

- At least 50 ml non-first void urine should be collected in screw capped polypropylene bottles (first-void samples may underestimate Iodine levels).
- Few (4-5) drops of Toluene (AR grade) should be added to form a uniform top layer so as to prevent microbial growth.
- Urine samples can be stored at room temperature for maximum 2h followed by storage at 2-8ºC till delivered.
- Mouth of bottles should be properly sealed using parafilm to avoid leakage during transportation.

2. LABELLING OF URINE SAMPLE

- Sample bottles should be labeled with following information in English/Hindi in indelible ink:

    a. Patient Name
    b. Patient's Age and Sex
    c. Location, Date and Time of collection

3. TRANSPORTATION

- Transportation of urine samples should be done at 2-8ºC on the same day, preferably within 4 -6 h of collection.

COLLECTION, PREPARATION & TRANSPORTATION OF SALT SAMPLES

1. COLLECTION OF SALT SAMPLE

- At least 50 grams of the salt sample should be collected in a plastic ziploc Bag in a cool, dry and dark location.
- The ziploc bags containing salt samples should be stored in an air tight container, away from the heat and moisture, till the samples are delivered.

2. LABELLING OF SALT SAMPLE

- Sample Pouches should be labeled with following information in English/Hindi in indelible ink:

    a. Patient Name
    b. Patient's Age and Sex
    c. Location, Date and Time of collection

3. TRANSPORTATION

- Transportation of the ziploc bags containing salt samples should be done in an airtight container, in cool, dry, and dark conditions.

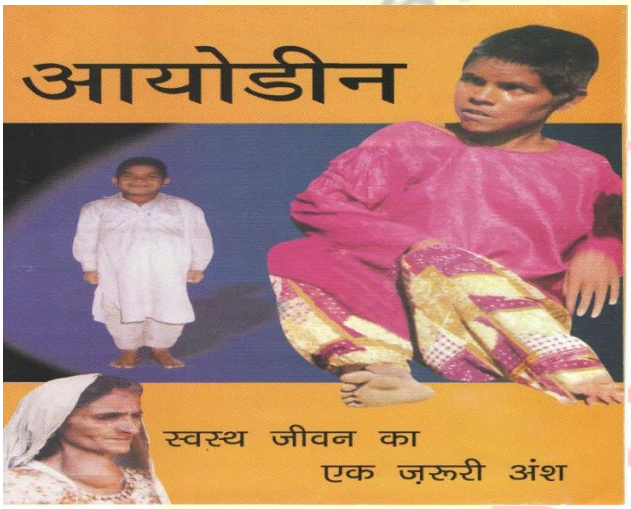
आयोडीन नमक

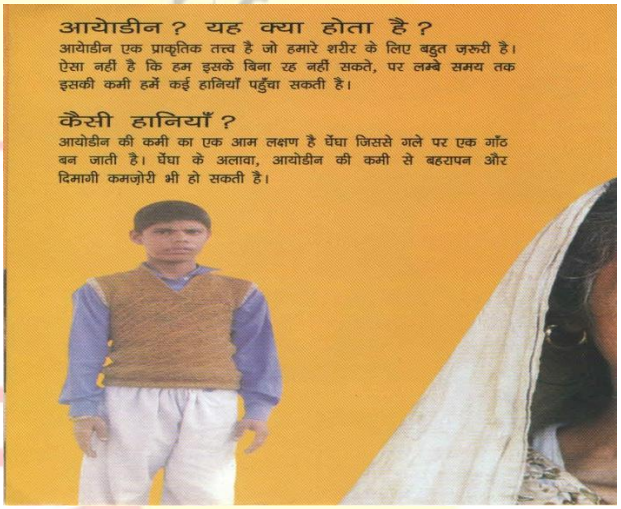
CHAPTER- 7

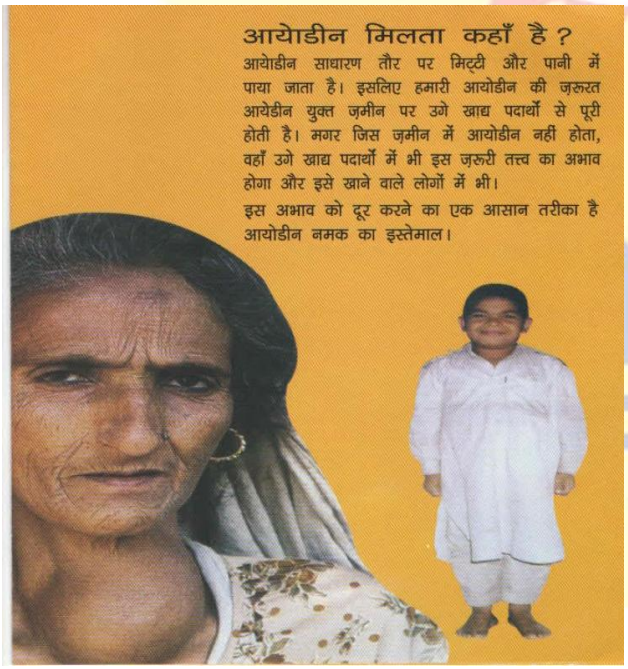
ROLE OF IEC IN NIDDCP

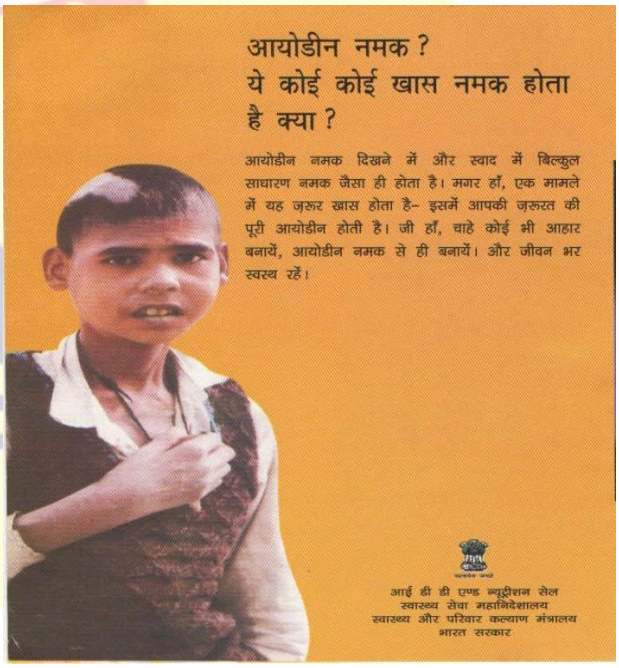
Health Education is an important component of NIDDCP for raising awareness about IDDs and promoting consumption of Iodated Salt. In backdrop of above scenario, effective Health Communication is an important tool for control of IDDs. Effective Health Communication leads to Behaviour Change Communication.

Communication Materials available under NIDDCP

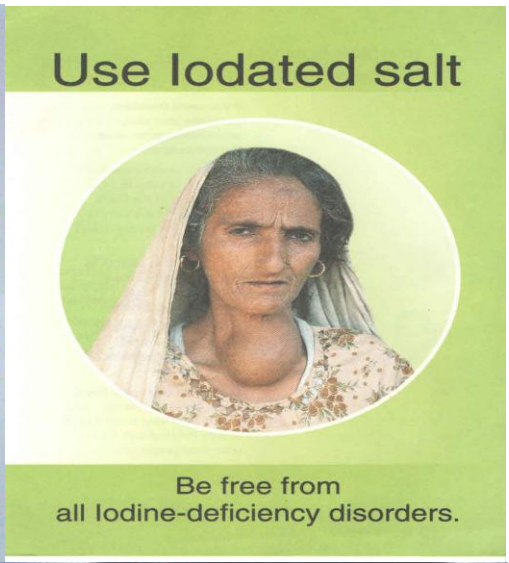









सदैव आयोडीनयुक्त नमक का
ही सेवन करें
आयोडीनयुक्त नमक का ही यदि करें सेवन
घेंघा, बहरापन, मंदबुद्धि से मुक्त रहे जीवन
आयोडीनयुक्त नमक आसानी से हर जगह उपलब्ध है।


Use Iodated salt
Be free from
all Iodine-deficiency disorders.


आयोडीन नमक
आपके बच्चे का
स्वास्थ्य रक्षक


हर माँ का सपना है
एक सुन्दर एवं स्वस्थ बच्चा।
लेकिन क्या आप जानते हैं कि
जीवन भर उसका स्वास्थ्य सुनिश्चित
करने में मदद करता है आयोडीन?
जी हाँ, हर गर्भवती माँ को अपने
आहार में आयोडीन युक्त नमक
ज़रूर लेना चाहिए। इससे आपका
बच्चा घेंघा, बहरापन और दिमागी
कमज़ोरी से बचा रहेगा।
आयोडीन एक प्राकृतिक तत्त्व है
जो आपके और आपके होने वाले
बच्चे के शारिरिक और मानसिक
विकास के लिए बहुत ज़रूरी है। इसकी
कमी से आपको और आपके बच्चे
को कई हानियाँ पहुँच सकती हैं।
आयोडीन नमक बहुत ही सस्ता है
महीने भर के आयोडीन नमक
की कीमत दो वक्त की सब्ज़ी
की कीमत से भी कम है।

CHAPTER-8

Preventing Iodine Deficiency: A Practical Guide for Households

Iodine is an essential nutrient that keeps the **brain sharp, body active, and children growing well**. Without enough iodine, people can suffer from **goitre (neck swelling), memory problems, tiredness, weight gain, and poor growth in children**. Pregnant women and young children are especially at risk.

1. **Buy only iodized salt** – Check the packaging for labels like **"Iodized Salt" or "Fortified with Iodine."**
2. **Store properly** – Keep salt in an **airtight container away from sunlight, moisture, and heat** to prevent iodine loss.
3. **Use fresh stock** – Avoid storing salt for too long, as iodine content may reduce over time.
4. **Add salt after cooking** – Do not expose iodized salt to long cooking times at high heat, as this can destroy iodine.
5. Along with iodized salt, include iodine-rich foods in daily meals (eggs, fish and seafood, milk and dairy products, bananas, potatoes, etc)
6. **Avoid overboiling** iodine-rich foods like fish, milk, and vegetables to retain their nutrients.
7. **Use less water when cooking vegetables** – If possible, use the cooking water in soups or dals to preserve iodine.
8. **Limit raw goitrogenic foods** like cabbage, cauliflower, and soy products, as they can block iodine absorption. Cooking them reduces this effect.
9. Organize **awareness programs** about iodine-rich foods and proper salt usage.
10. Encourage **school meals to include iodine-rich ingredients**.
11. Report **non-iodized salt sales** to local health authorities.

Identifying Signs of Iodine Deficiency

Look out for these **warning signs** in yourself or family members:

- **Swelling in the neck (Goitre)** – Due to thyroid gland enlargement.
- **Constant tiredness & weakness** – A sign of slow metabolism caused by low iodine levels.
- **Weight gain without any reason** – Could indicate an underactive thyroid.

- **Children with learning problems, delayed growth, or low energy** – May be due to iodine deficiency affecting brain development.

If any of these symptoms appear, visit a doctor for a thyroid function test.

Household & Community Action

- Ensure **all family members** use iodized salt.
- Educate **children about the importance of iodine** in food.
- Organize **awareness programs** about iodine-rich foods and proper salt usage.
- Encourage **school meals to include iodine-rich ingredients**.
- Report **non-iodized salt sales** to local health authorities.

CONCLUSION

The training program will equip participants with essential knowledge and skills in iodine deficiency disorders, laboratory analysis of iodated salt and urinary iodine estimation, and the implementation of the National Iodine Deficiency Disorders Control Programme (NIDDCP). With a strong foundation in these areas, participants will now be prepared to apply their expertise in real-world scenarios to ensure effective monitoring and control of iodine deficiency. The post-training evaluation will assess their understanding and retention of key concepts covered during the training.

POST-TRAINING EVALUATION OF THE PARTICIPANTS

After completion of the Training programme, it is essential to evaluate the knowledge gained from the Training. In this regard, at least 20 Multiple Choice Questions (MCQs) consisting of four options are to be given to the participants by the Training Organization at the end of the Training.

आयोडीन नमक


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DISEASE CONTROL
DELHI
दिल्ली-११००५४


NATIONAL HEALTH MISSION
राष्ट्रीय स्वास्थ्य मिशन