IODINE DEFICIENCY DISORDER

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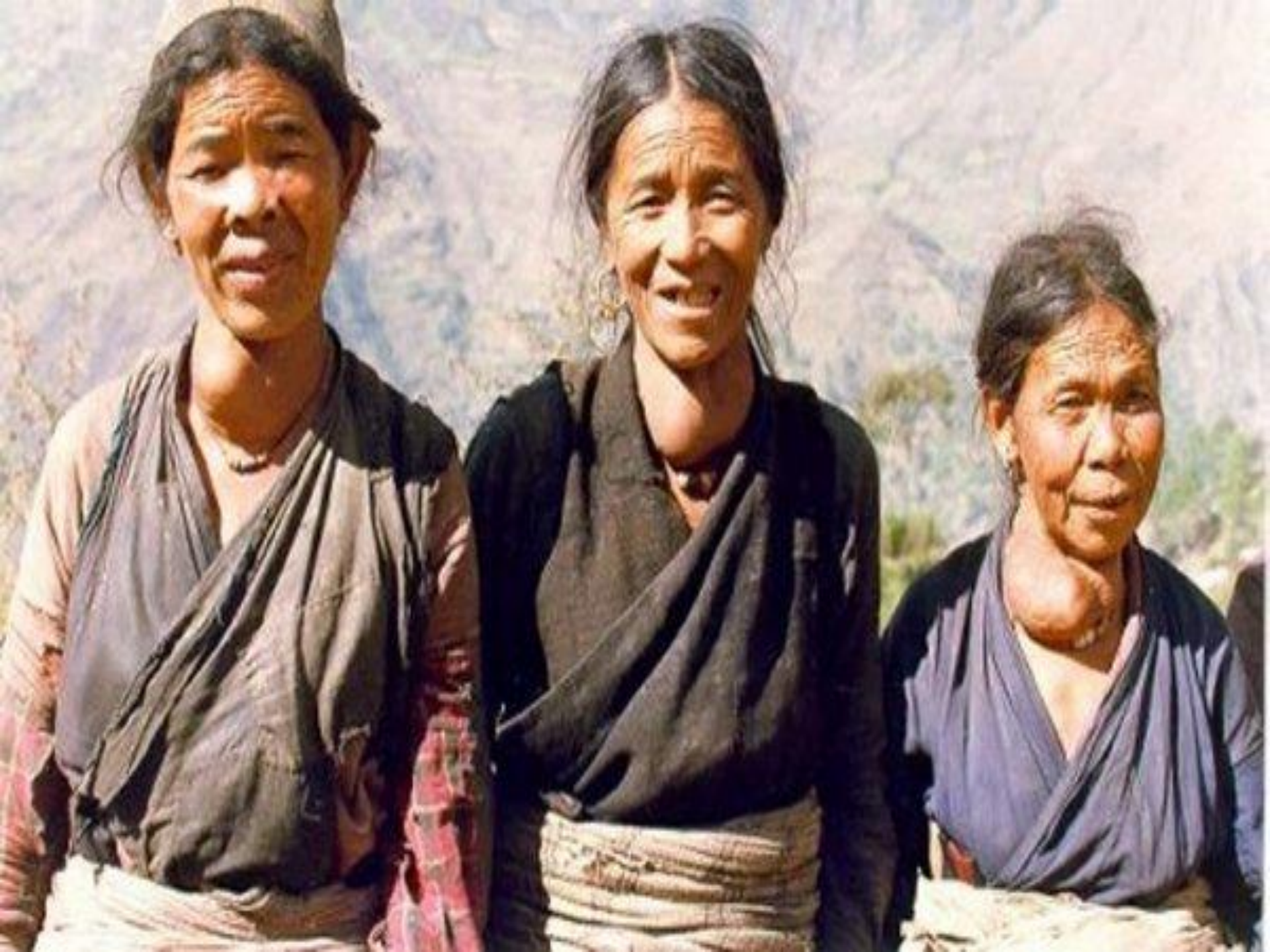


INTRODUCTION

- Essential Micronutrient
- Different forms
- Sources
- Deficiency REGION WISE

SOURCES OF IODINE

- Food is the main source of Iodine
  - Meat, fish and dairy products
  - Vegetables, cereals

- High amounts in sea food.....sea fish & seaweed

Food containing Goitrogens

- Cruciferous vegetables :
  - Brocoli, Brussel sprouts, Cabbage, Cauliflower, Kale, Mustard, Turnip, Rutabaga
- Millets
- Peaches
- Peanuts
- Radishes
- Soyabean and Soy products
- Spinach
- Strawberries

FUNCTIONS OF IODINE

- **Chemical structure :**
  - Two hormones (thyroxine (T4) & tri-iodothyronine (T3)).

- Thyroid hormones → bloodstream → target organs (liver, kidneys, muscles, heart & developing brain)

- **Extra thyroidal fn** : Anti oxidant, detoxify chemical & biological toxins, suppress auto immunity, increase immunity

NEED OF IODINE

- Mental and Physical growth and development
- Regulation of body metabolism

DAILY REQUIREMENT

- **WHO, UNICEF & ICCIDD** recommend the following daily amounts:

Age group	Requirement (microgram per day)
0-11 months	50
12 to 59 months	90
5 to 12 years	120
>= 12 years	**150**
Pregnant & Lactating mother	**200**

CURRENT SCENARIO

- **Children** with IDD : stunted, apathetic, mentally retarded & incapable of normal movements, speech, or hearing.
- Leading cause of **preventable brain damage** worldwide, leading to learning disabilities and psychomotor impairment and a loss of 10-15 IQ points per child.
- Globally, **1.9 billion** people are suffering from IDDs.
- SE Asia : India, Indonesia, Bangladesh, Bhutan, Burma , Nepal, Sri lanka, Thailand
- In India, more than 200 million are at risk of IDD while 71 million people are suffering from goitre or other iodine deficiency disorders.

CURRENT SCENARIO

- **India** : Sub Himalayan region (2400km) extending from Kashmir to Naga Hills k/a **Himalaya Goiter Belt**...biggest belt in world
- **No state in India**...Goiter free
- Prevalence of**" Total goiter rate**" : **7.3%**
- Silent epidemic ...affects children...unnoticed
- **Endemicity : Total Goiter rate (prevalence) > 5 % , Prevalence of Cretinism, Prevalence of neonatal hypothyroidism**

What happens if we get too much iodine?

- Most people who have previously been iodine sufficient can safely tolerate large amounts e.g.

  1 mg (1000 mcg) of iodine/day without adverse effects.

- Excess dietary iodine intake--- excess thyroid hormone production ---- Iodine-induced hyperthyroidism.

- Iodine excess ---- block the thyroid's ability to make hormone---- thyroid under-activity

- >90% of the iodine ingested eventually excreted in the urine ---- **good marker** for iodine nutrition.

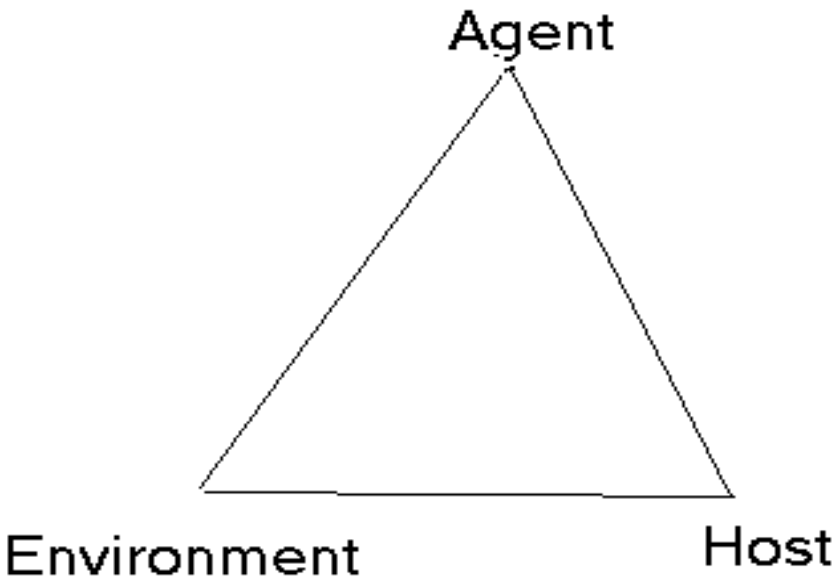
- Urine iodine concentration varies with fluid intake, have limited use for casual samples from an individual, but they are good for **assessing a population group**

- A median urinary iodine concentration between **100 and 200 mcg/l** is ideal.

URINARY IODINE EXCRETION (WHO)

Median urinary Iodine concentration(mcg/l)	Corresponding approximate Iodine intake(mcg/day)	Iodine nutrition
<20	<30	Severe deficiency
20-49	30-74	Moderate deficiency
50-99	75-149	Mild deficiency
100-199	**150-299**	**Optimal**
200-299	300-499	More than adequate
>299	>499	Possible excess

EPIDEMIOLOGY



AGENT FACTOR (Iodine)

- **Normal amount in body**: 15 to 20 mg
- **Blood level**: 8-12 ug/dl
- **Sources**: 90% food and 10% water
- Depends upon level in soil (Highest in sea foods)

Sources of Iodine

Item	Content
Sea Foods	300-3000 ug / kg
Fresh Fruits	20 ug / kg
Leafy and Root Vegetables	30 ug / kg
Cereals, Meat, Milk and Products	40 ug / kg
Eggs	50 ug / 100 gm
Sorghum	75 ug / 100 gm
Mustard	55 ug / 100 gm
Black gram	48 ug / 100 gm
Iodized table salt	76,000 ug / kg

HOST

- All age group are prone to IDD……more during **fetal period**
- **Girls** more than boys
- **Pregnancy**
- **Post menopausal period**

Distribution of IDD by Gender and Age

- Goitre is more prevalent in females than males.
- Starting at age 10, F>M
- It is highest during puberty and child bearing age.

Environmental Factors

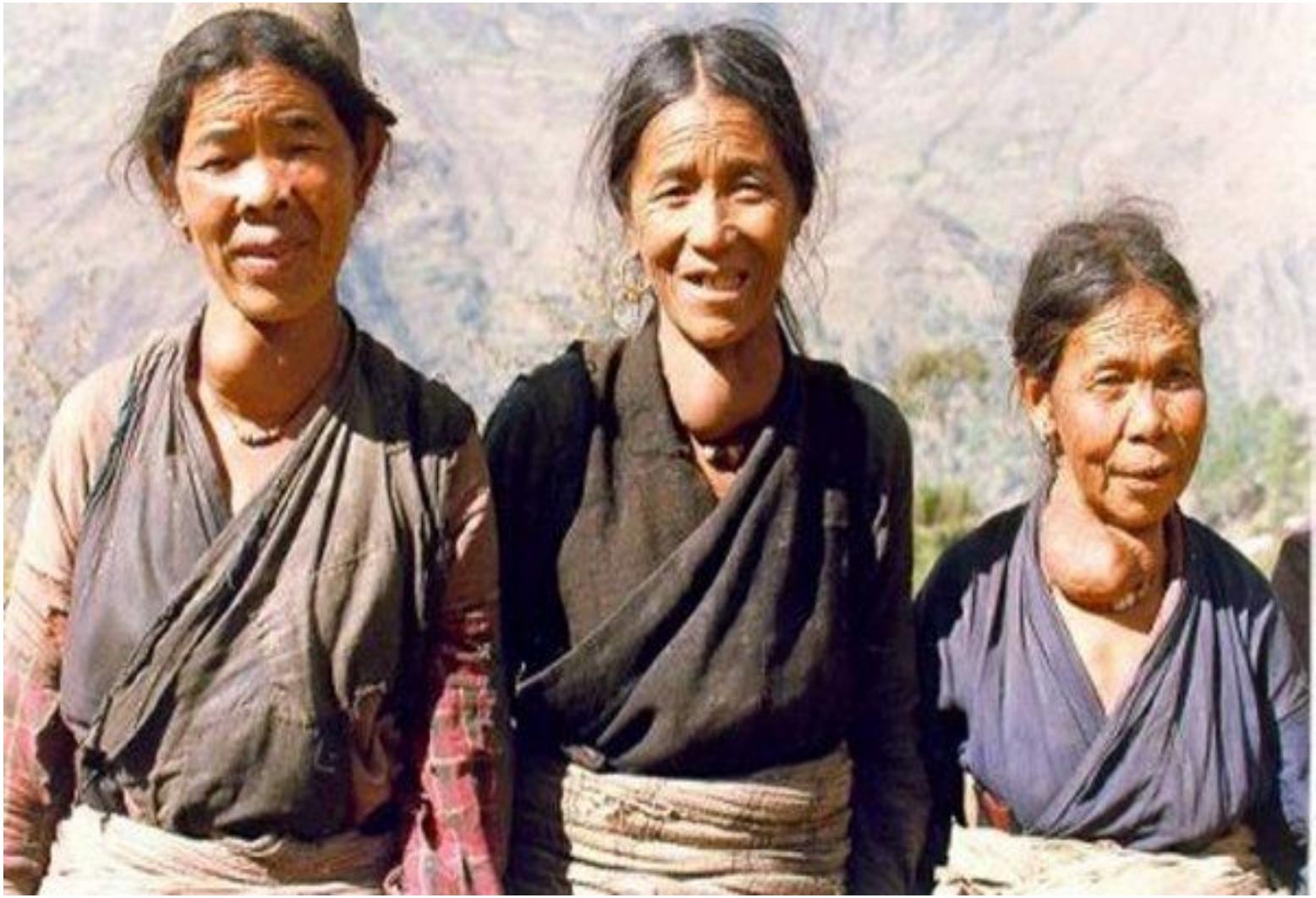
IODINE CYCLE IN NATURE

- Problem of IDD is Geo-Chemical in nature
- Iodine concentration in **Sea water** – 50 µg/l
- Iodine concentration in **Air** – 0.7 µg/ cubic meter
- Atmospheric iodine concentration returned to **soil** by rain – 1.8 to 8.5 µg/l
- **Iodine content of plants grown on deficient area is 10 mcg/kg compared to 1000 mcg/kg for non-deficient area**

Also known as.. disease of soil

- Soil erosion → Water, Soil →Env. Deficiency I_2
- Low availability of I_2 → Plants → Feed, fodder poor in I_2
- Effect on animals → Livestock→ Clinical & reproductive disorders, decreased productivity
- Effect on humans → Health & socio economic impact
- Floods, Drought, Irrigation of Soil all affect it

Women of the Himalayas with stage II goiters



Causes of Iodine Deficiency

- **Residence**: Area where soil lacks Iodine
- **Eating practice**
- **Cooking Practices**: 30-70% Iodine loss occur
  -occurs during boiling or frying

(According to one survey… highest loss in Gujarati food
: Raw food- 336 ug, Cooked- 133 ug)

- **Storage** of Iodised salt

CONSEQUENCES OF IODINE DEFICIENCY

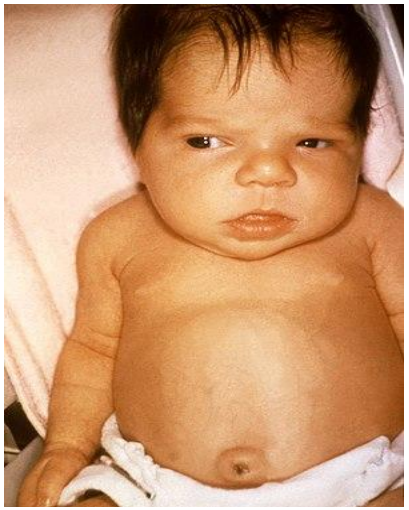
- Mental retardation
- Other defects in development of nervous system
- Goitre
- Physical sluggishness
- Growth retardation
- Reproductive failure
- Childhood morbidity & mortality

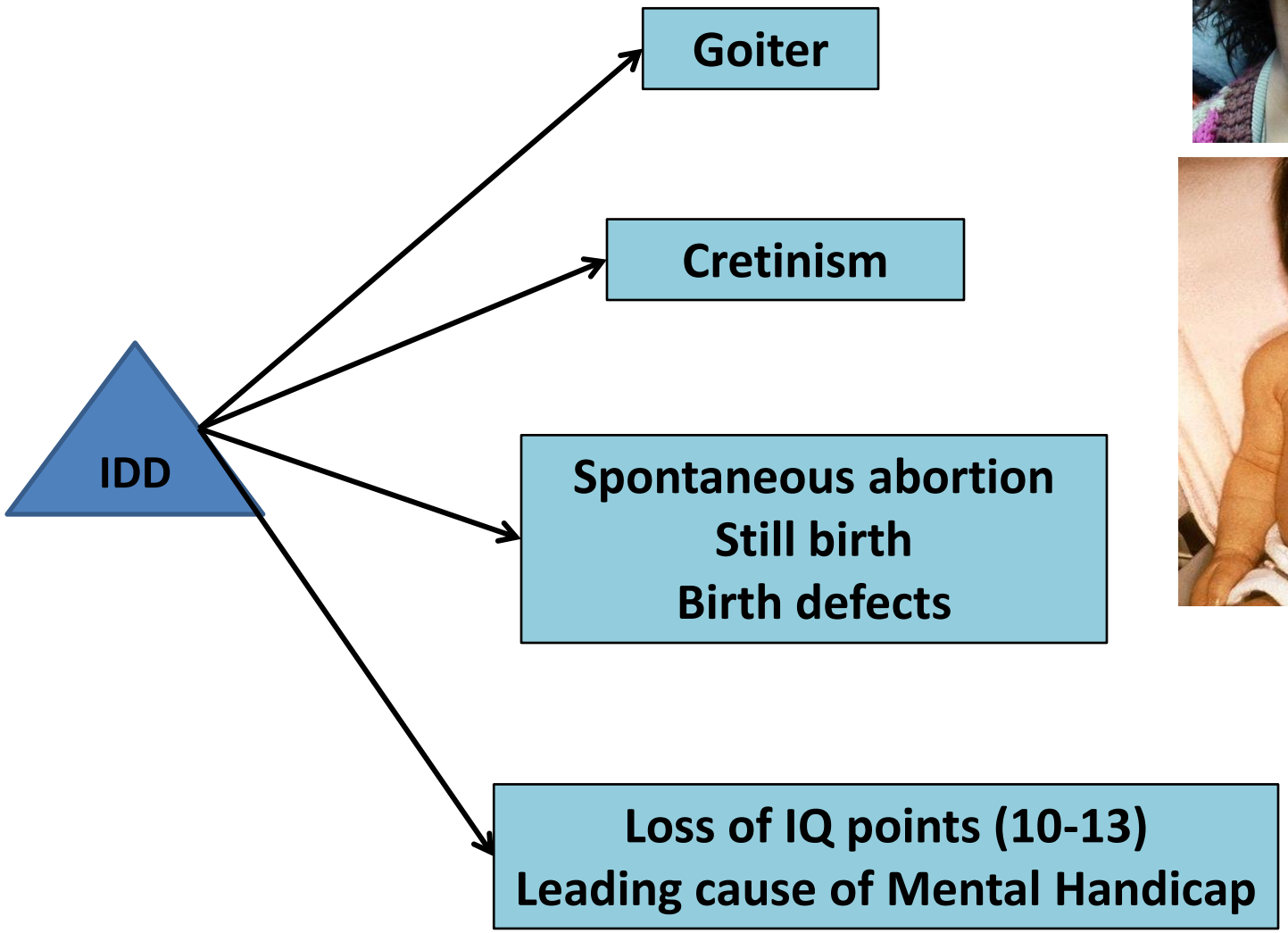
Ultimately……Economic & social

Importance of iodine in brain development

- 50,000 brain cells produced per second in developing fetal brain
- One million billion connections between these brain cells determine IQ
- 90% of brain development…..
- Finally the role of IODINE…..

SPECTRUM OF IDD

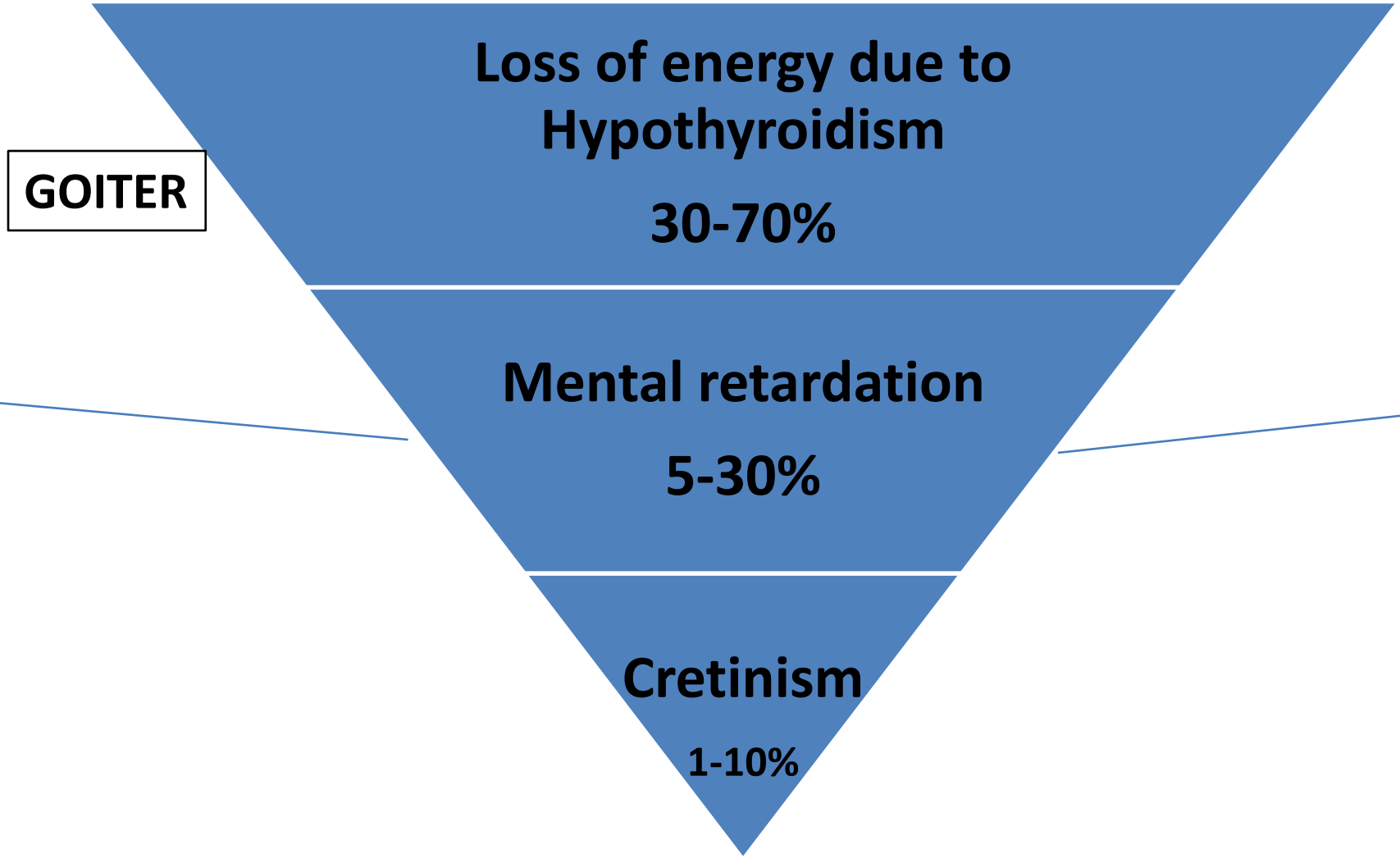




SPECTRUM OF DISEASE

Fetus	- Abortions - Stillbirths - Congenital Anomalies - Increased **perinatal** mortality
Neonate	-Neonatal Cretinism : Mental def.,deaf-mutism, diplegia, squint, psychomotor defect - Neonatal hypothyroidism
Children / Adolescent	-Goiter - Adolescent hypothyroidism - Impaired mental function (low IQ) - Educational backwardness - Personality problems
Adult	- Goiter - Hypothyroidism - Impaired mental function

IODINE DEFICIENCY DISORDER ICEBERG



CLASSIFICATION OF GOITRE

Classification	Description(WHO/UNICEF/NIDDCP)
Grade 0	**No palpable or visible goiter**
Grade 1	A mass in the neck which is **palpable** but not visible when the neck is in the normal position (ie the thyroid gland is not visibly large). Thyroid nodules in a thyroid which is otherwise not enlarged fall into this category.
Grade 2	A swelling which is **palpable & visible** when the neck is in the normal position & consistent with enlarged thyroid gland when neck is palpated.

ENDEMIC AREA FOR GOITRE

"**Total goitre rate**" is **more than 5 % in children 6 to 12 years** (School going children)

Mild	: 5 to 19.9 %
Moderate	: 20 to 29.9%
Severe	: ≥ 30 %

Classification of Goitre (WHO)

- **Grade 0 *(not enlarged)*:**
  - No palpable or visible Goitre

- **Grade 1 *(enlarged and detectable by palpation)***
  - A mass in the neck which is consistent with an enlarged thyroid and is palpable but not visible when the neck is in neutral position. On clinical inspection , the mass is visible when the neck is extended and it moves upward in the neck during swallowing.

Grade I is seen only when neck is extended

Classification of Goitre

- **Grade III :**

(enlarged and visible)

  - A mass in the neck that is consistent with and enlarged thyroid and is visible when the neck is in normal position

OTHER METHODS OF DETECTION

- **Urinary Iodine excretion (community based) (Sensitive marker…screening)**
- Ultrasound thyroid (Clinical)
- Serum TSH, T3, T4 (Both)
- Radioactive iodine uptake

Thyroid Stimulating Hormone (TSH)

- TSH is ⇧ in chronic severe iodine deficiency
- ⇧ TSH in whole blood or serum in neonates & infants indicates insufficient thyroid hormone during brain development in early life.
- TSH levels are used to
  - Identify Congenital hypothyroidism in neonatal screening programs
  - Differentiate primary from secondary hypothyroidism
- It can be measured by Immunoassay techniques.

Serum T3 and T4

- Increased level of serum T3 and decreased level of T4 indicates IDD.
- Synthesis of T3 &T4 is dependent on the availability of Iodine.
- T4 is used in neonatal screening for Hypothyroidism.

PROGRAMME

- **1962** : Goitre control programme
- **1992 (August)** : National Iodine Deficiency Disorders Control Programme (**NIDDCP**) (Iodised salt)
- **2001** : Ban on non-iodised salt
- **2006** : Ban removed then again they banned

- As per the surveys conducted by the Directorate General of Health Services, Indian Council of Medical Research, Health Institutions and the State Health Directorates, it has been found that out of **414 districts surveyed** in all the 29 States and 7 UTs, **337 districts are endemic** i.e where the prevalence of Iodine Deficiency Disorders (IDDs) is **more than 5%.**

NIDDCP

GOAL

1. To bring the prevalence of IDD to below 5% in the country

2. To ensure 100% consumption of adequately iodated salt (15ppm) at the household level.

OBJECTIVES

1. Surveys to **assess the magnitude** of IDDs in the districts.

2. **Supply of iodated salt** in place of common salt.

3. **Resurveys** to assess iodine deficiency disorders & 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 **(IEC)**

COMPONENTS OF NIDDP

- Iodised salt
- Monitoring & surveillance
- Man power training
- IEC & BCC

Recommended Dietary Allowance (RDA) for Iodine

- As per Government of India recommendations, the level of **salt** iodization (quantity of iodine added to **salt**) should provide a minimum of **150 mcg of iodine per day** at the consumption level.

PREVENTION & CONTROL

1. Health education
2. Environment modification (fertilizers)
3. Food fortification (Salt, Oil)
4. Eating habit (Iodine rich food, Goitrogenic food, Cooking, Storing)
5. Supplementation
6. Early diagnosis and Treatment

Salt Iodization

- First intervention done in the United States of America and Switzerland in **1920s.**

- The landmark **study in the Kangra valley** in Himachal Pradesh from **1956 to 1972** successfully demonstrated the effectiveness of salt iodization in reducing goitre rates.

- But in India...in 1962 iodization of salt was started in endemic districts.

Fortification of Salt

- Most widely used **measure** for public health as prophylaxis against IDD.
- Level of iodization under PFA act is 30ppm at production level and 15ppm at consumer level.
- Approximately 20% of iodine is lost between production and household, 20% during cooking and rest due to method of storing Salt.

DOUBLE FORTIFIED SALT

- Double Fortified Salt (DFS) is adequately iodized salt further fortifies with iron either in the form for **Ferrous sulphate (by NIN, Hyderabad)** or encapsulated Ferrous fumerate (by MI and University of Torranto)

- (Approved by Food Safety and Standard Authority of India (FSSAI)

Why Salt is chosen for iodization ??

- It is consumed by everyone.
- Its production is generally centralized.
- It can be implemented at reasonable cost.
- Color, taste and odor of salt is not affected after iodization.

Process of iodization

(Salt + Potassium iodide)

- Dry mixing
- Spray mixing
- Submersion

IODIZED OIL (IM)

- Criteria for selection of areas for iodized oil :
  - Prevalence of endemic goiter >30%
  - Prevalence of endemic cretinism ≥1%
  - Incidence of neonatal hypothyroidism ≥1%
  - Mean estimated excretion of <50 µg per gram of Iodine / gram of creatinine in fair sample of population.
- Major groups requiring Iodized oil

  - Most widely available commercial preparation – Lipiodol – poppy seed oil with 38% of its weight as Iodine.
- Advantages
- Disadvantages

IODIZED OIL (IM)

- Intramuscular injection of Iodized oil (Poppy seed oil)
- National Institute of Nutrition (NIN) had developed Iodized oil from Safflower and Saffola oil.
- One ml provides protection for about 4 years
- Less practicable in community
- More expensive

IODIZED oil (Oral) supplementation

- Oral supplementation is simpler and acceptable

- But it is more costly than intramuscular injections.

Epidemiological assessment of iodine deficiency (INDICATORS)

- Prevalence of goitre
- Prevalence of cretinism
- Urinary iodine excretion
- Measurement of thyroid function – **T4 & TSH**
- Prevalence of neonatal hypothyroidism

  (It is an indicator of Environmental Iodine deficiency)

- Iodine concentration in Salt
- Iodine concentration in water, food and soil

MBI kit

- **Field Monitoring**
- **Level of iodine content in** SALT.
- **How to use??**
- **Observation**

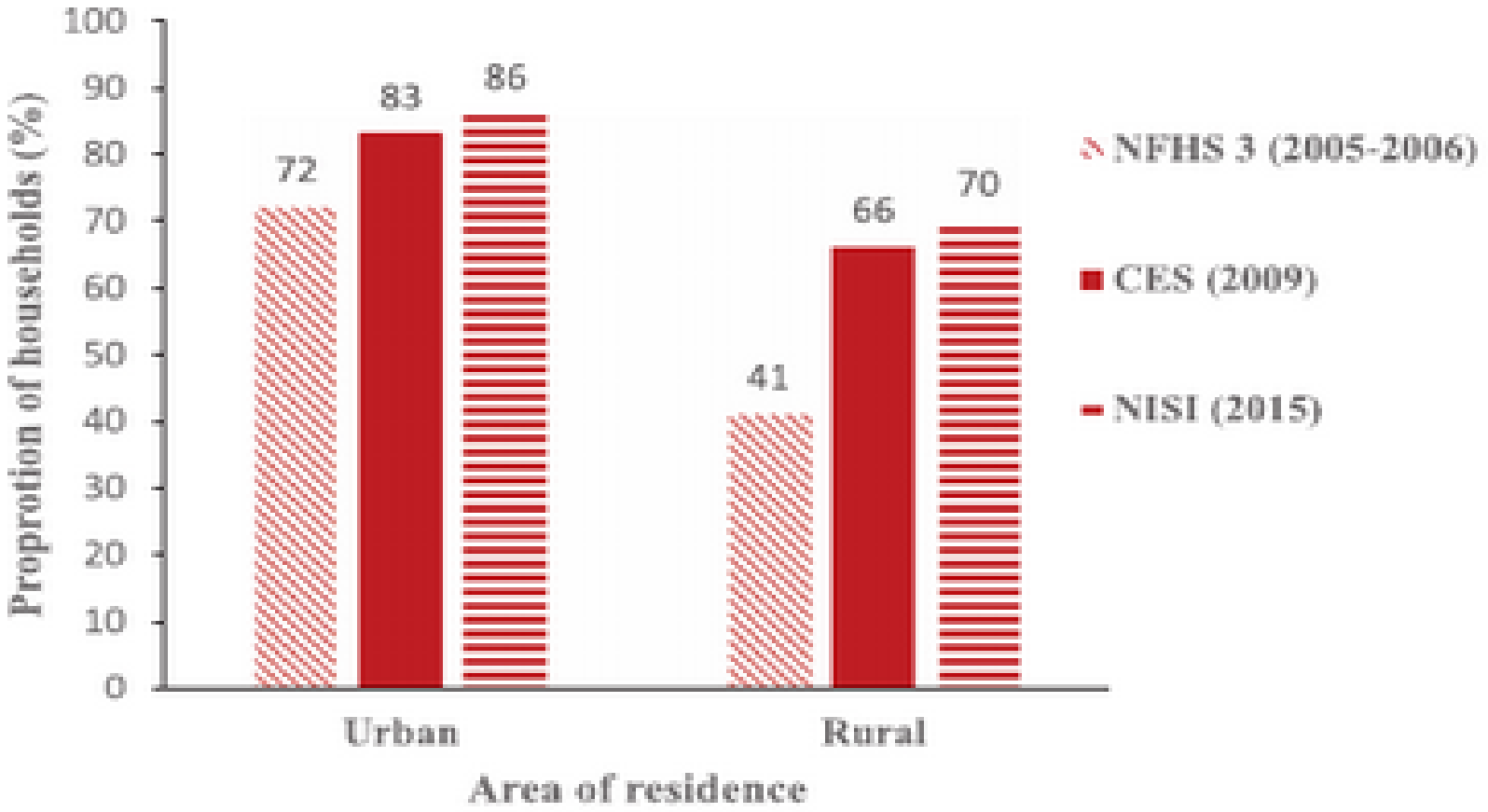


Fig. 1. Trends in use of adequately iodized salt use at national level across urban and rural areas. NFHS 3, National Family Health Survey 3; CES,Coverage Evaluation Survey;NISI, National Iodineand Salt Intake Survey, 2015.
Source: Refs 14, 26, 38.

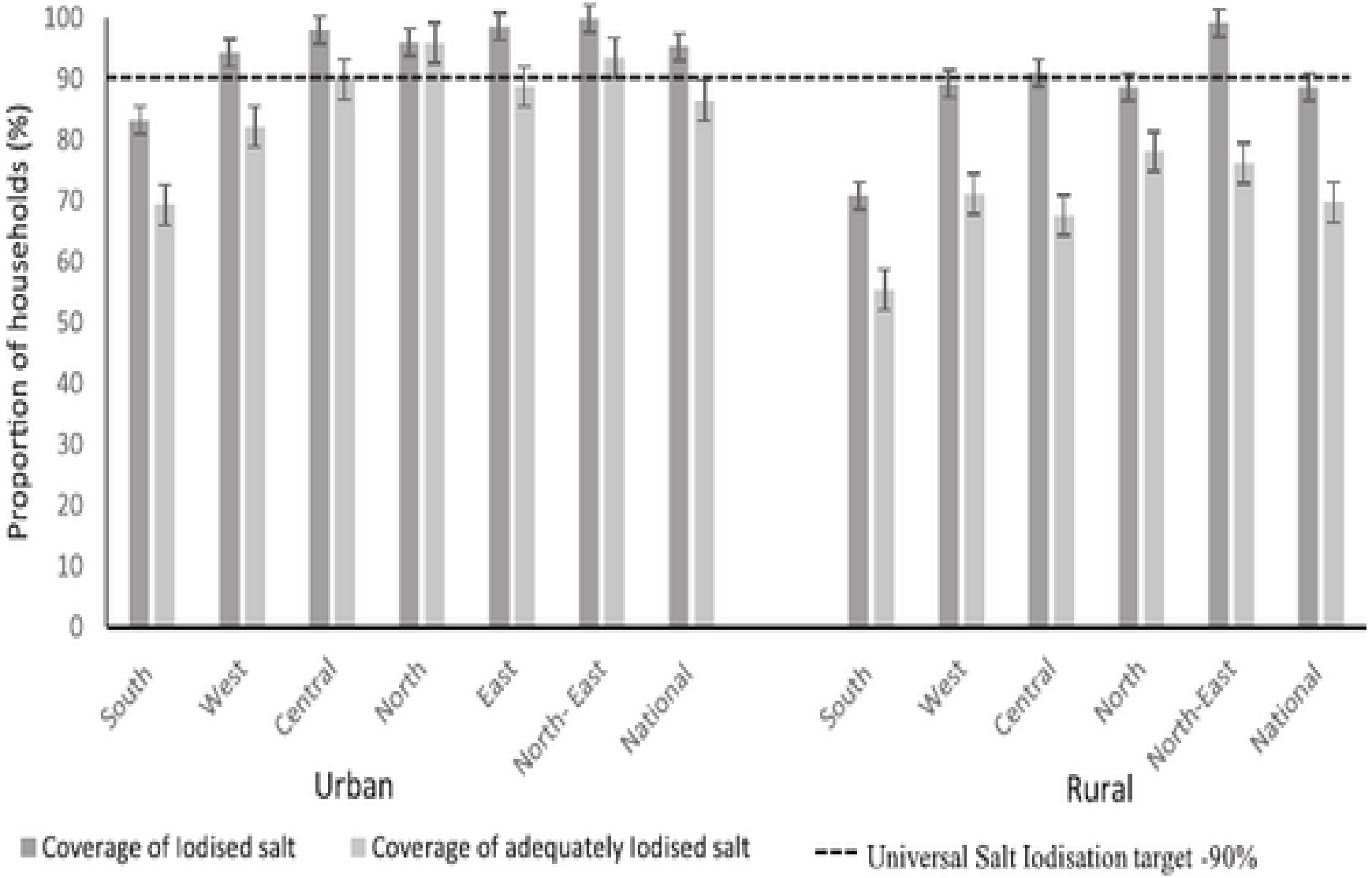


Fig. 2. National and sub-national iodized salt coverage in urban and rural strata. *Source*: Ref. 23.

Manpower Training
Information Education Communication (IEC)

- **BLOCK LEVEL**
  - BEE /HE / Supervisor & NGO / Teachers

- **VILLAGE LEVEL**
  - Training of ASHA/ANM/PRI/AWW/NGO & village health & sanitation committee.

IEC

- One Monthly **Health Day** – IEC/ Demo.
- Village Health & Nutrition Day **(Mamta divas)**
- Immunization& ANC-display of posters, distribution of leaflets, salt demo as focus area under NRHM.
- **Poster & wall painting** with key messages.
- Advocacy with **press/mass media/ TV/ salt traders.**
- **School Health Activities** –lecture & demo on salt to students involving them

THANK YOU