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Assessment of Iodine Deficiency by Analysing Urinary Iodine Levels

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Abstract: Iodine is an essential element required for the body in trace quantities to maintain the body's physiology. Deficiency of this element leads to many disorders like goiter, cretinism & myxoedema etc. Elimination of iodine deficiency disorders can be done by counseling the people about the type of salt that they are using whether iodized or non iodized salt and to educate them about the importance of iodized salt. Thus the study was undertaken to find out the number of families using iodine content of salt, it is done by urine analysis. Urinary iodine determination is the key biochemical indicator in the assessment of iodine deficiency. Samples are easy to obtain and over 90% of dietary iodine eventually appears in urine. Excretion of iodine in the urine of target group of children helps as an indicator on the prevalence of iodine deficiency in 8 – 10 years school children. The iodine levels in the urine were estimated by using Colorimeter. Finally the study revealed that out of 100 samples, 60 from rural area in that mild iodine deficiency(49), moderate iodine deficiency(5), and optimal iodine levels(6). Remaining 40 from urban area mild iodine deficiency (14) and optimal iodine levels (26)
Key Words: Iodine, iodine deficiency, colorimeter, Myxoedema, Thyroid stimulating hormone.

INTRODUCTION

The primary function of iodine(I_2) in the body is to provide a substrate for the synthesis of the thyroid hormones thyroxin(T_4), and triiodothyronine(T_3) which are crucial for normal growth and also promotes healthy hair, nails, skin & teeth. When the iodine deficiency[1,2] occurs then it leads to goiter, cretinism, myxoedema etc. This condition can be tested by the different methods like Thyroid Stimulating Hormone tests, T_4 tests, T_3 tests, Thyroid antibody tests, Fine needle aspiration, Thyroid nuclear scan, Thyroid ultra sound & also analyzed by Urinary iodine levels[3]. Urinary iodine determination is the key biochemical indicator in epidemiologic assessment of iodine deficiency. Samples are easy to obtain and over 90% of dietary iodine eventually appears in urine. International council for the control of Iodine Deficiency Disorders (ICCIDD), World Health Organization (WHO) prepared the following classification of iodine nutrition[5] base on urinary iodine concentration. Table – 1.

Table – 1

Median Urinary Iodine concentration (µg / ml)	Iodine nutrition
<20	Severe deficiency
20 – 49	Moderate deficiency
50 – 99	Mild deficiency
100 – 199	optimal
200 – 299	more than adequate
>299	possible excess

MATERIAL AND METHODS:

Subjects:

Study models used for base line survey [8] were adopted for real comparison and impact assessment. We categorize specified primary schools for boys in and around Thirupathi. Samples were collected randomly from school boys of age group 8-10 years.

Materials used:

Colorimeter, Arsenic trioxide, Sodium hydroxide, Sulphuric acid, Sodium chloride, Cerric ammonium sulphate, Brucine sulphate, Hydrochloric acid & Potassium iodate.

Preparation of standard stock solution:

potassium iodate 168.5 mg was accurately weighed, dissolved in small amount of distilled water, then the final volume was made up to 1L with distilled water(100 µg I/ ml) and again diluted with same solvent to get 1µg I/ml concentration of standard solution. Various working concentrations were made by further dilution with 0.1 M HCl.

Method:

There are 7 methods proposed by the International council for the control of Iodine Deficiency Disorders (ICCIDD) [7] for the estimation of iodine in the urine. In that we select 6^{th} one, method F because it is economical and easy.

In this, urine is subjected for Sandell-Kolthoff reaction [13,14] in which iodine acts as catalyst and yellow colored Cerric ammonium sulphate is reduced to the cerrous sulphate in the presence of arsenious acid. The color change fixed with brucine sulphte. This color change is proportional to the amount of iodine present. Samples are compared with reference samples of known iodine content.

Preparation of basic solutions:

1) Arsenious acid solution:
   In a 2L volumetric flask dissolve 19.6g of arsenic trioxide and 14.0g of sodium hydroxide in 500 ml of distilled water. Add carefully 64 ml of concentrated sulphuric acid, cool and make up the volume with distilled water. Add 50 g of sodium chloride and dissolve.
2) Cerric ammonium sulphate:
   Dissolve 24.0 g cerric ammonium sulphate in a solution of 3.5N sulphuric acid and make up to 1L with the same acid solution.
3) Brucine sulphate solution:
   Dissolve 10.0 g of brucine sulphate in distilled water and make up to 1L with water.
4) Hydrochloric acid(0.1M):
   Dilute 9 ml concentrated hydrochloric acid with distilled water and make to 1L.

Working method:

All the urine samples should be acidified with one drop of concentrated HCl for each 10 ml of urine, and filter the urine samples. Water (150µl) was taken as a blank, like wise standard and sample was taken in different tubes. Added the Arsenious acid solution (2 ml), Cerric ammonium sulphate solution (400µl) and place in water bath. After 5 min 200µl of brucine sulphate solution was added, mixed, and removed from water bath. Brucine stops the reaction, fixes and stables the yellow color of cerric ammonium sulphate at degree of reduction reached in 5 minutes. Read the absorbance of standard (Table - 2) and samples (Tables -3 to 12) in a colorimeter at 410 nm. Then calibration curve of standard iodate solution was constructed (Figure - 1). Then regression equation was calculated, and by using this equation the concentration of iodine was determined in the urine samples.

Table –2: STANDARD READINGS:

Sample	Tube	Working iodine (std ml)	Absorbance at 410 nm	µg I/dL	µg I/L
Blank iodate std solution µg/ml	1	1.25	0.014	1.25	12.5
	2	2.5	0.019	2.5	25.0
	3	5	0.035	5	50.0
	4	7.5	0.06	7.5	75.0
	5	10.0	0.067	10.0	100.0
	6	15.0	0.099	15.0	150.0
	7	20.0	0.12	20.0	200.0
	8	25.0	0.16	25.0	250.0

Table –3: URINE SAMPLES:

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
V.R KANDRIGA	1	150	0.054	8	80
	2	150	0.063	9.5	95
	3	150	0.051	7.5	75
	4	150	0.047	6.83	68.3
	5	150	0.033	4.5	45
	6	150	0.072	11.0	110
	7	150	0.055	8.16	81.6
	8	150	0.049	7.16	71.6
	9	150	0.060	9.0	90
	10	150	0.047	6.83	68.3

Table –4

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
DAMINEDU	1	150	0.066	10	100
	2	150	0.059	8.83	88.3
	3	150	0.045	6.5	65
	4	150	0.052	7.66	76.6
	5	150	0.057	8.5	85
	6	150	0.071	10.8	108
	7	150	0.060	9.0	90
	8	150	0.034	4.6	46
	9	150	0.042	6.0	60
	10	150	0.037	5.16	51.6

Table –5

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
PADIPETA	1	150	0.052	7.66	76.6
	2	150	0.051	7.5	75
	3	150	0.059	8.88	88.8
	4	150	0.06	9	90
	5	150	0.043	6.16	61.6
	6	150	0.037	5.16	51.6
	7	150	0.049	7.16	71.6
	8	150	0.047	6.83	68.3
	9	150	0.052	7.66	76.6
	10	150	0.075	11.5	115.0

Table –6

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
GANGANA GUNTA	1	150	0.061	9.16	91.6
	2	150	0.052	7.66	76.6
	3	150	0.055	8.16	81.6
	4	150	0.053	7.83	78.3
	5	150	0.057	8.5	85
	6	150	0.065	9.83	98.3
	7	150	0.043	6.16	61.6
	8	150	0.047	6.83	68.3
	9	150	0.057	8.5	85
	10	150	0.075	11.5	115

Table –7

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
KOTHURU	1	150	0.033	4.50	45
	2	150	0.034	4.83	48.3
	3	150	0.049	7.16	71.6
	4	150	0.054	8.0	80
	5	150	0.041	5.83	58.3
	6	150	0.061	9.16	91.6
	7	150	0.055	8.16	81.6
	8	150	0.042	6.0	60
	9	150	0.041	5.83	58.3
	10	150	0.037	5.16	51.6

Table –8

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
YOGIMALLA VARAM	1	150	0.039	5.5	55
	2	150	0.042	6.0	60
	3	150	0.031	4.16	41.6
	4	150	0.047	6.83	68.3
	5	150	0.052	7.66	76.6
	6	150	0.059	8.88	88.8
	7	150	0.065	9.83	98.3
	8	150	0.049	7.16	71.6
	9	150	0.070	10.6	106
	10	150	0.064	9.66	96.6

Table –9

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
NGO CIRCLE SCHOOL	1	150	0.070	10.6	106
	2	150	0.065	9.83	98.3
	3	150	0.066	10.0	100
	4	150	0.068	10.3	103
	5	150	0.061	9.16	91.
	6	150	0.068	10.33	103.
	7	150	0.071	10.83	108.3
	8	150	0.069	10.5	105
	9	150	0.059	8.88	88.
	10	150	0.057	8.5	85

Table –10

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
BAVANI NAGAR	1	150	0.059	8.8	88
	2	150	0.057	8.5	85
	3	150	0.065	9.83	98.
	4	150	0.079	12.16	121.
	5	150	0.072	11.0	110
	6	150	0.065	9.83	98.
	7	150	0.069	10.5	105
	8	150	0.068	10.33	103.
	9	150	0.065	9.83	98.
	10	150	0.078	12.0	120

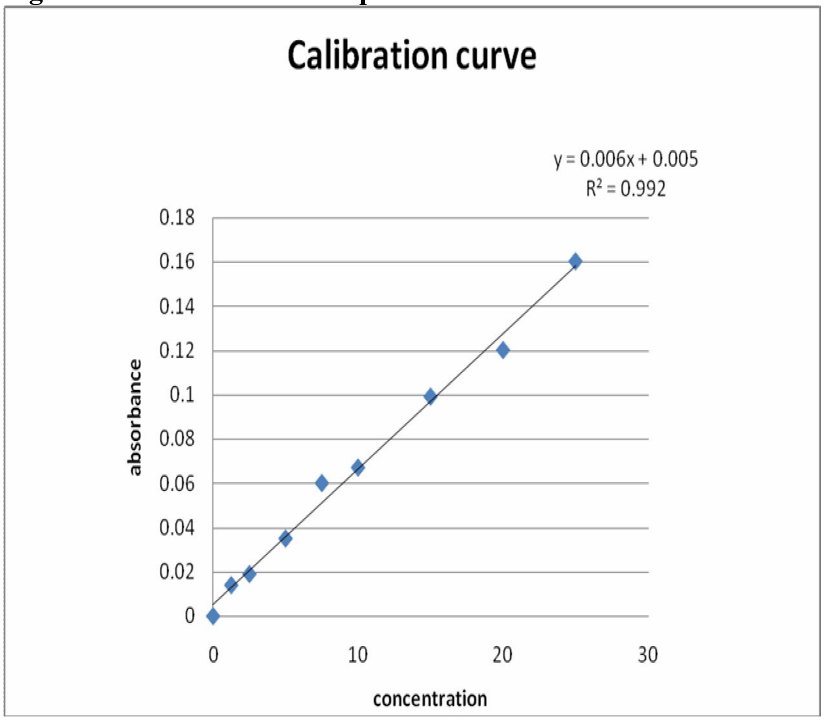
Table –11

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
PADMAVATHI	1	150	0.079	12.15	121.5
	2	150	0.075	11.5	115
	3	150	0.076	11.66	116.6
	4	150	0.070	10.60	106.
	5	150	0.061	9.16	91.6
	6	150	0.065	9.83	98.3
	7	150	0.060	10.33	103.3
	8	150	0.068	10.33	103.3
	9	150	0.059	8.83	88.3
	10	150	0.065	9.83	98.3

Table –12

Name of the area	Tube	Vol of urine µL	Absorbance at 410 nm	µg I/dL	µg I/L
THUMMLA GUNTA	1	150	0.069	10.5	105.0
	2	150	0.068	10.33	103.3
	3	150	0.068	10.33	103.3
	4	150	0.074	11.33	113.3
	5	150	0.075	11.5	115.0
	6	150	0.070	10.60	106.0
	7	150	0.059	8.83	88.3
	8	150	0.058	8.66	86.6
	9	150	0.067	10.16	101.6
	10	150	0.075	11.5	115.0

Figure 1: Standard curve of potassium iodate:



RESULTS:

Out of 100 samples of urine collected from the school children for the assessment of urinary iodine levels, the results obtained as,

Total number of samples – 100

1. Samples collected from rural area – 60
   - Mild iodine deficiency – 49
   - Moderate iodine deficiency – 5
   - Optimal iodine levels – 6
2. Samples collected urban area – 40
   - Mild iodine deficiency – 14
   - Optimal iodine levels – 26

DISSCUSSION:

Iodine is an essential element required for the body in trace quantities to maintain the body's physiology. Deficiency of this element leads to many disorders like goiter, cretinism & myxoedema etc.

Elimination of iodine deficiency disorders can be done by counseling the people about the type of salt that they are using whether iodized or non iodized salt and to educate them about the importance of iodized salt.

Thus the study was undertaken to find out the number of families using iodine content of salt. Excretion of iodine in the urine of target group of children helps as an indicator on the prevalence of iodine deficiency in 8 – 10 years school children.

The present study revealed that 65% of the children residing in urban areas school are consuming salt with stipulated level of iodine. So they are having optimum iodine levels in their urine and 35% of the school children of urban areas are having mild deficiency which indicates that they are consuming Iodine below the required quantity.

The present study also reveals that 82% of children from rural areas are with mild deficiency and 8% with moderate deficiency. Only 10% of children are having optimum iodine levels.

From the result it is known that the children of rural areas are having more iodine deficiency when compared to that of urban children. It may be because of usage of non iodized salt and also it can be presumed that these people will not be aware of importance of iodine. This iodine is highly helpful for the developing brain.

If the iodine deficiency persists without correcting, it leads to impairment of the developing brain. Which in turn disturbs the studying ability of childrens?

CONCLUSION:

The progressed towards prevention of Iodine Deficiency Disorders are monitoring the urinary Iodine excretion (UIE) levels in the community as UIE in an indicator of the current iodine nutrition of the community.

By changing the environment of the political system, government of India should take preventive measures and reinitiate the process of central ban on scale of non iodized salt in country and also government should recommend the following:

- Add 90µg of iodine per day, in a convenient form, to complementary food in diet of children from birth onwards.
- Add 150µg of iodine to the daily diet of women during pregnancy and lactation, achieve most simply as part of vitamin and mineral supplements.
- Install effective monitoring by urine Iodine concentration in the country to permit adjustment of Iodine nutrition to optimal intakes.

Finally, iodine deficiency can be controlled by providing adequate amounts of iodine to the affected individuals can be either by the direct administration of iodine, as with iodized oil or iodide solutions, or by addition of iodine to a suitable vehicle, such as salt or water.

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