International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Urinary Iodine Status among the Subjects of Autoimmune and Non-Autoimmune Thyroid Disease in Coastal Odisha, India

Dr. Kishore Kumar Behera[1], Dr. Suchanda Sahu[2], Dr. Debasish Hota[3], Dr. Madhusmita Sahu[4]

[1]Assistant Professor, Department of Endocrinology, AIIMS, Bhubaneswar
[2]Associate Professor, Department of Biochemistry, AIIMS, Bhubaneswar
[3]Professor and HOD, Department of Pharmacology, AIIMS, Bhubaneswar
[4]Senior Resident, Department of Endocrinology, AIIMS, Bhubaneswar

Corresponding Author: Dr. Suchanda Sahu

ABSTRACT

Background: With universal iodine fortification of table salt, there as been a decrease in the incidence of goitre due to its deficiency. There is an increase in the iodine excretion in urine and this is associated with autoimmune thyroiditis. However the reports are controversial hence this study was designed to see the urine iodine excretion in different groups of thyroid diseases- autoimmune (AITD) and non-autoimmune (NAITD) and compared with euthyroid controls.
Methodology: The study included subjects with autoimmune thyroid disorder (AITD) group 1 (n= 95), non-autoimmune thyroid disorder (NAITD) group 2 (n=31) and compared with age and sex matched healthy euthyroid controls group 3 (n=29). Serum free thyroxine (FT4), thyroid peroxidase antibody (TPO Ab), thyroid stimulating hormone (TSH) and median urinary iodine concentration (UIC) in urine were estimated.
Results: A statistically significantly higher median UIC was observed in group 1 and 3 as compared to group 2 (p=0.001). According to iodine nutrition status, in group 1, 51 subjects (53.68%) were in moderate iodine deficit state which was statistically significant when compared between group 2, 08(25.80%) p=0.01 and group 3, 10(34.48%) p=0.003. The NAITD group 2 subjects were more iodine deficit than the groups 1 and 3. There was positive correlation between median UIC and TSH (r = 0.36, P = 0.326) and with TPO (r = 116, P=0.075).
Conclusion: NAITD subjects are more iodine deficient than the AITD subjects or the euthyroid controls. The UIC was significantly more in AITD than NAITD (p=0.001). We observed a positive correlation between UIC and TPO Ab titres. In adults the incidence of thyroid diseases has increased which may not be directly caused by iodine excess as our study reveals.

Keywords: Urine iodine concentration, autoimmune, non-autoimmune, thyroid diseases.

INTRODUCTION

Iodine is a micronutrient, an essential component of the thyroid hormones. Leaching from the glaciations, erosion and flooding have depleted surface soil iodine content .[1]Therefore, most iodine (iodide) are found in large oceans (50mcg/l), and iodide ions in seawater are oxidized to elemental iodine, which volatilizes into the atmosphere and is returned to the soil by rain, completing the cycle. However, iodine cycling in many regions is slow and incomplete, and soils and ground water become deficient in

iodine. Crops grown in these iodine deficit soils have low iodine content, therefore humans and animals consuming food grown in these soils become iodine deficient. [1]

Iodine is ingested in various chemical forms. Iodide is rapidly and completely absorbed from stomach and duodenum. In normal individuals, 90% of ingested iodide is absorbed. It is mainly cleared by kidneys and thyroid gland which depends upon iodine intake. Plasma half-life of iodine is 10 hrs but it shortens in increased thyroid activity state as in thyrotoxicosis and iodine deficiency. The iodine content of thyroid gland is about 10.5 to 16gms which constitute 70 to 80% total iodine content of a healthy individual. In iodine-sufficient areas, 60 g of iodine per day is trapped by the thyroid gland but iodine trapping may fall to 20 g in chronic iodine deficiency state to balance iodine loss due to hormone synthesis from thyroid gland. [1]

Iodine deficiency has multiple adverse effects in humans, termed iodine deficiency disorders, due to inadequate thyroid hormone production. Globally, it is estimated that 2 billion individuals have an insufficient iodine intake, and South Asia and sub-Saharan Africa are particularly affected. However, about 50% of Europe remains mildly iodine deficient, and iodine intakes in other industrialized countries, including the United States and Australia, have fallen in recent years. In most countries, the best strategy to control iodine deficiency in populations is carefully monitored universal salt iodization, one of the most cost-effective ways to contribute to economic and social development.

The NIS (sodium iodine symporter) a transmembrane protein located in basolateral membrane of thyroid follicular cell concentrates iodine by active transport process. At the apical membrane of thyrocyte, thyroperoxidase (TPO) and hydrogen peroxide oxidise the iodide then attach it to the tyrosyl residues on thyroglobolin (Tg) molecule to generate monoidotyrosine (MIT) and di-idotyrosine (DIT). Two molecule DIT and one molecule of MIT & one molecule of DIT coupling are catalysed by TPO enzyme producing T4 and T3 respectively which are stored extracellularly in luminal colloid of thyroid follicle. By the process of endocytosis, endosomal and lysosomal proteases digest Tg and release T4 and T3 into the circulation. The half-life of circulating T4 is 5–8 d, and for T3, 1.5 to 3 d- which releases iodine that enters the plasma iodine pool and can be taken up by the thyroid or excreted by the kidney. [1]

To estimate the requirement for iodine in an individual with adequate iodine status and euthyroid, daily uptake and turnover of radioiodine can be used safely. The WHO recommendation for adequate daily iodine intake for men and non-pregnant, non-lactating women is 150g/day. A daily dietary iodine intake of approximately 150-200µg is considered normal and sufficient to maintain a plasma iodide concentration of 0.5µg/dl and a urinary excretion greater than 100µg/g creatinine (Cr). [2]

Four methods are generally recommended for assessment of iodine nutrition in populations: urinary iodine excretion (UIE), the goitre rate, serum TSH, and serum Tg. As 90% of ingested dietary iodine is appear in urine, [1] measurement of urinary iodine concentration is an excellent indicator of recent iodine intake. For population survey 24hr urinary iodine estimation is impractical, therefore measurement of median UI is ideal to know the adequacy of iodine status in that particular population.

The association between the UIE and autoimmune thyroiditis is unequivocal. The association between increased UIE and JAT (juvenile autoimmune thyroiditis) [2] and in all age groups [3,4] has been supported by some but has been refuted by others. [5,6] *In India two separate studies done* from south India [7] and North India [8] *have shown positive association between increased UIE and autoimmune thyroiditis.* A similar study done found a high prevalence of goitre in

young children despite iodine repletion and low thyroid autoimmunity. [9]

It has been postulated that Iodine intake and the pattern of thyroid disease are broadly divided into three distinct subsets; iodine induced hyperthyroidism (IIH) (thyrotoxicosis), autoimmune thyroiditis (AIT), and thyroid carcinoma. [10] AIT is a disease of multifactorial cause which includes genetic susceptibility, environmental factors and endogenous factors. Recent available evidence is inconclusive regarding the association between the iodine exposure and development of AIT. Due to controversial reports we designed this study to assess the UIE and different groups of hypothyroidism with autoimmune and non-autoimmune cause.

Objective-

The objective of the study was to assess the iodine nutrition status among the subjects of autoimmune and Non-Autoimmune thyroid patient by using median urinary iodine concentration.

MATERIALS AND METHODS

The study was conducted in subjects with autoimmune thyroid disorder (AITD) group 1 (n= 95), subjects with non-autoimmune thyroid disorder (NAITD) group 2 (n=31) and compared with age and sex matched healthy euthyroid controls group 3 (n=29) attending Endocrinology out patients' department in our tertiary care hospital and medical college. Serum free thyroxine (FT4), thyroid peroxidase antibody (TPO Ab) and thyroid stimulating hormone (TSH) were estimated by Chemiluminescent immunoassay (CLIA). The median urinary iodine concentration (UIC) in urine was estimated by ammonium persulfate digestion method recommended by the WHO. [11] Statistical analysis was done using SPSS 20.0

RESULTS

A total of 155 subjects were included in the study. The subjects were divided into three groups, Auto immune thyroid disorder (AITD)- group 1 (n=95); Non-auto immune thyroid disorders (NAITD) -group 2 (n=31) and normal euthyroid control-group 3 (n=29).

There was no statistically significant difference in the age, height, body weight or body mass index (BMI) among the 3 groups (Table 1).

Diagnosis of Thyroid disorder:

In AITD there were 25 patients having overt hypothyroidism TSH > 10μIU/ml , 46 subjects were having TSH (>5.5 <μIU/ml) and 24 subjects were euthyroid. In NAITD there were 18 subjects were overt hypothyroid and 15 were subclinical hypothyroid state.

Biochemical Parameters: The median urinary iodine (UI) (**Table 2)** was 42.68 ± 20.06, 23.16 ± 20.16 mcg/l and 57.55± 20.66 and in AITD, NAITD and controls respectively. There was significant difference in the mean UI between and within the three groups.

The mean TPO Ab (**Table 2)** was 584± 441.0, 20.85 ± 15.01 U/ml and 21.56± 16.21 and in AITD, NAITD and controls respectively. There was significant difference in the mean TPO Ab among the three groups. On Post HOC Bonferroni analysis, the difference in the TPO Ab between AITD and NAITD; between AITD and control achieved statistically significant. The mean TSH was 13.73± 24.18, 32.82 ± 46.92 and4.16±2.00 in AITD, NAITD and controls respectively. There was significant difference in the mean TSH among the three groups (P=0.001). On Post HOC Bonferroni analysis, the difference in the TSH in AITD and controls; between NAITD and controls achieved statistically significant. The mean FT4 was 1.19± 1.08, 1.09± 0.20 and 0.89 ±0.31 in group 1, group 2 and group 3 respectively. There was no significant difference in the mean FT4 among three groups.

A statistically significantly higher median urinary iodine concentration (UIC) (Table 3) was observed in group 1 (42.68 ± 20.06) μg/l and group 3 (57.55 ± 20.66) μg/l as compared to group 2 (23.16 ± 20.16) μg/l

(p=0.001). According to iodine nutrition status, in group 1, 51 subjects (53.68%) were in moderate iodine deficit state which was statistically significant when compared between group 2, 08(25.80%) p=0.01 and group 3, 10(34.48%) p=0.003. Group 2, 20(64.51%) had a statistically significant severely iodine deficit between group1, 15(15.78%) p=0.01.The NAITD group 2 subjects were more iodine deficit than the groups 1 and 3.

Nutritional iodine status- According to UIE (64.51%) 20, (25.80%) 08,(9.67%) 03 NAITDS subjects were severely, moderately and mildly iodine deficient. Subjects with AITDS 15(15.78%), 51 (53.68%), 29 (30.52%) were also severely, moderately and mildly iodine deficient respectively and 34.48 %(10),65.51%(19) of healthy euthyroid control were moderately and mildly iodine deficiency state . But none of the three groups had optimal iodine state **(Table 3)**.

There was positive correlation **(Table 4)** between median UIC and TSH (r = 0.36, P = 0.326), TPO (r = 116, P=0.075), diastolic pressure BP (R0.013, P==0.438); sex (r= .024, p =708); age (r = .024 , p= .772). There was negative correlation between median UIC and weight (r= -.103, p=.101); BMI (r = -.086, p=.144) and SBP (r = -0.070 , p =0.193).

Table 1: Demographic data

Characteristic	AITD (N=95) Mean ± SD Group-1	NAITD(n=31) Mean ± SD Group-2	CONTROL N=29 Mean ± SD Group-3	P value
Age (years)	35.32 ± 10.70	33.63 ± 13.47	37.48 ±14.48	0.481
Height (meters)	155.47± 5.7	157.18 ± 6.85	155.71± 6.68	0.441

Table 2: Biochemical parameters

Parameters	AITD(n=95) Mean ± SD	NAITD (N=31) Mean ± SD	controls (n=29) Mean ± SD	p
Urinary Iodine Conc (µg/L)	42.68 ± 20.06	23.16 ± 20.16	57.55 ±20.66	0.001
TPO	584 ± 414.01	20.85± 15.01	21.56± 16.21	0.001
TSH(µIU/ml)	13.73±24.18	32.82±46.92	4.16 ±2.00	0.001
FT4 (ng/dl)	1.19±1.08	0.89±3031	1.09 ±0.20	0.248

Table 3: Iodine nutrition status in euthyroid controls, AITD Subjects and NAITD based on urinary Iodine excretion

Iodine status	AITD	NAITD	CONTROLS
Severe deficiency (20 mcg/l)	15(15.78%)	20 (64.51%)	0
Moderate deficiency(20-49mcg/l)	51(53.68%)	08 (25.80%)	10(34.48)
Mild deficiency (50-99mcg/l)	29(30.52%)	03 (9.67%)	19 (65.51%)
Optimal (100-199mcg/l)	0	0	0
More and adequate (200-299mcg/l)	0	0	0
Excessive iodine uptake (>300mcg/l)	0	0	0

Table 4: Pearson correlation urinary iodine level with different parameters

Variable	r	p
Age	0.030	0.708
Sex	0.024	0.772
weight	-0.103	0.101
BMI	-0.086	0.144
TSH	0.036	0.326
FT4	-0.024	0.380
TPO	0.116	0.075
SBP	-0.070	0.193
DBP	0.013	0.438

TABLE -5 The level of iodine was defined according to the WHO/UNICEF/ICCIDD (11) criteria which are as follows

MUI	IODINE INTAKE	IODINE STATUS
<20	Insufficient	Severe iodine deficiency
20-49	Insufficient	Moderate iodine deficiency
50-99	Insufficient	Mild iodine deficiency
100-199	Adequate	Adequate iodine nutrition
200 -299	Above requirement	Likely to provide adequate intake for pregnant / lactating women but may pose a slight risk of more than adequate intake in overall population

DISCUSSION

In our study severe iodine deficiency Median urine Iodine concentration (MUIC) (20mcg/l) was observed 16% (15) of AITD subjects and 64.51% (20) of NAITD but

none in the controls. This was observed that even in severe iodine nutrition state thyroid autoimmunity can occur indicating multifactorial nature of origin. In AITD subjects about 54% (51) &30% (29) were observed to be moderately MUIC (20-49mcg/l) and mildly MUIC (50-99mcg/l) iodine deficient state respectively. In summary NAITD subjects are more iodine deficient state than the AITD subjects. The MIUC was significantly more in AITD than NAITD (p=0.001). We observed a positive correlation between UIC and TPO Ab titres (R= 0.116; p=0.075).

Our study population did not achieve optimal iodine status which was reported by several authors in Odisha. [10,12] A study by Moorthy et al [13] in Odisha had shown that the MUIE was 85.4 mcg/L. and almost 30% of these samples were having moderate iodine deficient state with UIE (less than 50 mcg/L) and 60% had a mild iodine deficient state UIE of (less than 100 mcg/). Sethy et al [14] who conducted a study in the slums of Bhubaneswar had reported median urinary iodine concentration was 50.0 µg/l with 85.7% of children having values less than 100 µg/l, indicating as biochemical iodine deficiency. Another recent study done by Kshatri et al [15] in Odisha had shown that the median UIE in coastal district was found to be 126.4 mcg/L, whereas it was 73.0 mcg/L in the hilly areas. This indicates that moderate to mild iodine deficiency do exist in our population, despite a mandatory salt iodization programme in Odisha that has been in force since 1989.

Though there is iodine deficiency in our study population as MUIC from a mid-morning spot sample, it does not depict the actual deficiency as their diet and water intake in the past few hours affect the same. We have not found about the table salt they consume. As with screening for congenital hypothyroidism and its management, the incidence of the same has decreased. However, in adults the incidence of thyroid diseases has increased which may not be directly caused by iodine excess as our study reveals. It may be due deficiency iron or selenium or vitamin A or due to infections like H. pylori. [1]

- Source(s) of support in the form of grants, equipment, drugs, or all of these-
- Non- funded- This research was self funded by the authors and we have not received any financial grant from any institute, private or government funding agencies.

ACKNOWLEDGEMENT

We, the authors acknowledge the support of our institute in allowing us to conduct the study and specially the help rendered by Dr Simi Das in sample collection and processing.

- Criteria for inclusion in the authors'/ contributors' list

The research was conceived and conducted by Drs KKB, SS and DH. Drs KKB and MS participated in the patient selection, data collection and compilation. All of us have participated in the preparation of the manuscript.

REFERENCES

1. Zimmermann MB. Iodine deficiency. Endocr Rev. 2009 Jun;30(4):376–408.
2. Kang MJ, Hwang IT, Chung HR. Excessive Iodine Intake and Subclinical Hypothyroidism in Children and Adolescents Aged 6-19 Years: Results of the Sixth Korean National Health and Nutrition Examination Survey, 2013-2015. Thyroid Off J Am Thyroid Assoc. 2018; 28(6):773–9.
3. Kotwal A, Kotwal J, Prakash R, Kotwal N. Does iodine excess lead to hypothyroidism? Evidence from a case-control study in India. Arch Med Res. 2015 Aug;46(6):490–4.
4. Teng X, Shan Z, Chen Y, Lai Y, Yu J, Shan L, et al. More than adequate iodine intake may increase subclinical hypothyroidism and autoimmune thyroiditis: a cross-sectional study based on two Chinese communities with different iodine intake levels. Eur J Endocrinol. 2011 Jun; 164(6):943–50.
5. Zimmermann MB. Iodine deficiency. Endocr Rev. 2009 Jun;30(4):376–408.
6. Ergür AT, Evliyaoğlu O, Şıklar Z, Bilir P, Öcal G, Berberoğlu M. Evaluation of thyroid functions with respect to iodine status and TRH test in chronic autoimmune

thyroiditis. J Clin Res Pediatr Endocrinol. 2011;3(1):18–21.
7. Palaniappan S, Shanmughavelu L, Prasad H, Subramaniam S, Krishnamoorthy N, Lakkappa L. Improving iodine nutritional status and increasing prevalence of autoimmune thyroiditis in children. Indian J Endocrinol Metab [Internet]. 2017 [cited 2019 Aug 7];21(1):85. Available from: http://www.ijem.in/text.asp?2017/21/1/85/195996
8. Gopalakrishnan S, Singh SP, Prasad WR, Jain SK, Ambardar VK, Sankar R. Prevalence of goitre and autoimmune thyroiditis in schoolchildren in Delhi, India, after two decades of salt iodisation. J Pediatr Endocrinol Metab JPEM. 2006 Jul;19(7): 889–93.
9. Das S, Bhansali A, Dutta P, Aggarwal A, Bansal MP, Garg D, et al. Persistence of goitre in the post-iodization phase: micronutrient deficiency or thyroid autoimmunity? Indian J Med Res. 2011 Jan; 133:103–9.
10. Pandav CS, Yadav K, Srivastava R, Pandav R, Karmarkar MG. Iodine deficiency disorders (IDD) control in India. Indian J Med Res. 2013 Sep;138(3):418–33.
11. International Council for Control of Iodine Deficiency Disorders, UNICEF, World Health Organization. Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers. Geneva: World Health Organization; 2007.
12. Kaur G, Anand T, Bhatnagar N, Kumar A, Jha D, Grover S. Past, present, and future of iodine deficiency disorders in India: Need to look outside the blinkers. J Fam Med Prim Care. 2017 Jun;6(2):182–90.
13. Moorthy D, Patro BK, Das BC, Sankar R, Karmakar MG, Pandav CS. Tracking progress towards sustainable elimination of iodine deficiency disorders in Orissa. Indian J Public Health. 2007 Dec;51(4):211–5.
14. Sethy PGS, Bulliyya G, Mallick G, Swain BK, Kar SK. Iodine deficiency in urban slums of Bhubaneswar. Indian J Pediatr. 2007 Oct;74(10):917–21.
15. Kshatri JS, Karmee N, Tripathy RM. Prevalence and predictors of poor iodine nutrition in rural South Odisha: a comparative study between coastal and hilly districts. Natl J Community Med. 2017;8(8): 41-6.

How to cite this article: Behera KK, Sahu S, Hota D et.al. Urinary iodine status among the subjects of autoimmune and non-autoimmune thyroid disease in coastal Odisha, India. Int J Health Sci Res. 2019; 9(10):19-24.

******