

Original Research Article

A cross-sectional study on iodine status among pregnant and non-pregnant women of Tripura: a North-Eastern state of India

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ABSTRACT

Background: Due to excess metabolic demand of iodine in pregnancy, pregnant women and lactating mother and their neonates are most vulnerable of iodine deficiency disorder. Urinary iodine excretion is a good marker of recent dietary iodine intake. Thus, present study was conducted to assess the iodine status and median urinary iodine excretion (UIE µg/lit) among pregnant and non-pregnant women of Tripura.

Methods: Tribal and Bengali pregnant and non-pregnant women from Bokafa and Jolaibari Block of South Tripura district were included in the study. Urinary iodine excretion was done using simple micro plate method. Salt iodine was estimated using iodometric titration. All the tests were performed at CNRT Lab, ICMR, India.

Results: Total number of subjects included in this study was 1071. Total number of urine samples collected from pregnant and non-pregnant women was 538 and 533 respectively. Median value of UIE in pregnant and non-pregnant women of Tripura was 155.0µg/L and 130.0µg/L. In pregnant women percentage prevalence of severe (<20µg/L), moderate (20-49µg/L) and mild iodine deficiency (50-149µg/L) was found in 4.1%, 15.1% and 29.6% subjects. In case of non-pregnant women severe (<20µg/L), moderate (20-49µg/L) and mild iodine deficiency (50-99µg/L) was found in 0.6%, 9.6%, 27.8% subjects respectively. The overall prevalence of iodine deficiency was found in 48.8% pregnant women, compared to 38.0% non-pregnant subjects.

Conclusions: Efforts towards universal salt iodization need to be stepped-up in Sub-Himalayan region (NE part of India) and pregnant and lactating mothers may be targeted with alternate iodine supplements (Colloidal Iodine).

Keywords: Iodine status, Pregnancy, Urinary iodine excretion

INTRODUCTION

The evaluation of micronutrient status at population level remains important, and particular focus needs to be paid to most vulnerable populations particularly to women of reproductive age, pregnant women, and growing children.¹ Iodine plays an important role in the biosynthesis of thyroid hormone which further exerts its effects on different body organ and is ultimately essential

in the development of the central nervous system (CNS) during embryonic and foetal stage.² This, therefore suggests that iodine is an essential micronutrient during pregnancy.

It is well known, that the pregnancy is known to be linked with parallel increase in both iodine, and thyroid hormone demand, possibly due to the physiological changes emanating from the transfer of iodine and the

thyroid hormone to the foetus.³ Body requirements of iodine are increased from 150µg/day in adolescents and adulthood, to 250µg/day in pregnancy.⁴ Abnormalities of iodine metabolism are in two-folds: iodine excess or iodine deficiency. However, the deficiency of iodine is more important compared to iodine sufficiency.⁵ This demonstrates the need for additional iodine intake during pregnancy to prevent possible iodine insufficiency to this particular group of population.⁶

The elementary pathology emanating from iodine deficiency had rested on endemic goitre, but studies in recent times have demonstrated a wide spectrum of disorders caused by iodine deficiency during pregnancy.^{6,7} These include stillbirth, increased number of spontaneous abortion, hearing defect in infants, congenital abnormalities, attention-deficit syndrome, irreversible mental retardation, impaired psychomotor development, and behavioural disorders.^{8,9} In spite of these adverse consequences, recent studies have revealed that iodine intake during gestation is low.⁷⁻¹⁰ Consequently, the last decade has witnessed a substantial global progress in research relating to population iodine status, but information on iodine status among pregnant women in India especially north-eastern part of India (sub-Himalayan range) is scarce, possibly because routine screening and monitoring of this micronutrient in these individuals is lacking. Therefore, this study was aimed at identifying the status of iodine levels during pregnancy so as to generate data that would subsequently inform health policy makers about the effectiveness of the universal salt iodization (USI) program in India.

METHODS

A cross-sectional study was conducted from June 2017 through to June 2018 among pregnant women (third trimester) from ethnic tribal and non-tribal Bengali population residing in Bokafa and Jolaibari block of South Tripura district of north-eastern state of Tripura, India. Subjects from non-pregnant women were also included for comparative analysis of iodine status between pregnant and non-pregnant women subjects.

Consented pregnant women (third trimester of pregnancy) and non-pregnant women of age group between 15-47 years were recruited for the study. Subjects with conditions or diseases that may affect urine iodine levels were excluded.

A pre-validated questionnaire was administered to the participants to obtain demographic information, obstetric data and information on type of salt use.

Collection and determination of urine iodine levels

Subjects were provided with clean appendorf tube (2ml centrifuge tube) into which they provided on-the-spot urine for the measurement of urine iodine concentration (UIC). UIC was estimated by the Ammonium persulfate

method.¹¹ All the tests were performed at CNRT Lab at Indian Council of Medical Research, New Delhi, India. As a quality control measure, the interval between the time of addition of ceric Ammonium sulphate and reading the absorbance were all the same for all samples, standards, and blanks so to rule out any systematic or random biases. In pregnant women, median urinary iodine levels of <150µg/L was considered as insufficient, 150-249µg/L as adequate and >250µg/L as more than adequate.¹¹

Statistical analysis

Data were analysed using SPSS version 16.0. and analyzed using simple descriptive statistics such as frequency and percentages. Maternal UIC during pregnancy was then determined in all analyses. Median was used to assess the difference between demographic characteristics and the levels of the iodine concentrations with $p < 0.05$ considered as statistically significant.

RESULTS

Total number of pregnant and non-pregnant subjects included in the present study was 1071. Total number of urine samples collected from pregnant and non-pregnant women was 538 and 533 respectively (Table 1).

Table 1: Distribution of study subjects according to pregnancy status and study area (n=1071).

	Frequency (n)	Percentage (%)
Pregnant women	538	50.23
Non-pregnant women	533	49.77
Bokafa Block	522	48.74
Jolaibari Block	549	51.26

Median value of UIE in pregnant and non-pregnant women of Tripura was 155.0µg/L and 130.0µg/L respectively (Table 2, 3).

Table 2: Urinary iodine level (µg/L) in pregnant women (n=538).

	Frequency (n)	%
Severe iodine deficiency (<20µg/L)	22	4.1
Moderate iodine deficiency (20-49µg/L)	81	15.1
Mild iodine deficiency (50-149µg/L)	159	29.6
Iodine sufficient (150-249µg/L)	115	21.4
Above requirement (250-499µg/L)	155	28.8
Excessive iodine (≥500µg/L)	6	1.1

Median (IQR) = 155.0 (µg/L), IQR = Inter-quartile range

In pregnant women percentage prevalence of severe (<20µg/L), moderate (20-49µg/L) and mild iodine

deficiency (50-149µg/L) was found in 4.1%, 15.1% and 29.6% subjects respectively. However, iodine sufficient (150-249µg/L), above requirement (250-499µg/L) and excessive iodine ($\geq 500\mu\text{g/L}$) was found in 21.4%, 28.8% and 1.1% subjects respectively (Table 2).

Table 3: Urinary iodine level (µg/L) in non-pregnant women (n=533).

	Frequency (n)	%
Severe iodine deficiency (<20µg/L)	3	0.6
Moderate iodine deficiency (20-49µg/L)	51	9.6
Mild iodine deficiency (50-99µg/L)	148	27.8
Adequate iodine nutrition (100-199µg/L)	192	36.0
Above requirement (200-299µg/L)	73	13.7
Excessive iodine ($\geq 300\mu\text{g/L}$)	66	12.4

Median (IQR) = 130.0 (µg/L), IQR = Inter-quartile range

In non-pregnant women severe (<20µg/L), moderate (20-49µg/L) and mild iodine deficiency (50-99µg/L) was found in 0.6%, 9.6% and 27.8% subjects respectively. However, adequate iodine nutrition (100-199µg/L), above requirement (200-299µg/L) and excessive iodine ($\geq 300\mu\text{g/L}$) was found in 36.0%, 13.7%, and 12.4% subjects respectively (Table 3).

The overall prevalence of iodine deficiency in pregnant women was found in 48.8% cases, whereas in non-pregnant women it was found in 38.0% subjects (Table 2, 3).

It was found that overall 68.6% household had salt iodine concentration with iodine content of 15 ppm and more. The median of per capita per day salt consumption (gm) of pregnant and non-pregnant women of Tripura were 20.1 (Table 4). Distribution of urinary iodine concentration (UIE µg/L) levels by household salt iodine concentration revealed non-significant difference $p < 0.08$ between group (Table 5).

Table 4: Household salt iodine concentration (ppm) in pregnant (n=545) and non pregnant (n=529) women of Tripura.

	Pregnant, N (%)	Non-pregnant, N (%)	Total N (%)
0-4.9	10 (1.9)	11 (2.1)	21 (2.0)
5.0-14.9	152 (28.3)	163 (30.6)	315 (29.4)
≥ 15	376 (69.9)	359 (67.4)	735 (68.6)
Per capita per day salt consumption (g), Median (IQR)	20.1		

IQR = Inter-quartile range

Table 5: Distribution of urinary iodine concentration levels by household salt iodine concentration.

Household salt iodine concentration (in ppm)	Median (IQR) UIC levels (µg/L)	p (Kruskal-Wallis test)
0-4.9	243 (167-301)	0.08
5-14.9	286 (216-344)	
≥ 15	259 (312-333)	

DISCUSSION

The measurement of urinary iodine provides an accurate estimation of dietary iodine intake in view of the fact that the majority of iodine ingested is excreted via the urine. Concentration of urinary iodine is thus a reliable estimate of the amount of iodine intake and by extension of iodine deficiency.¹²

Generally, the median UIE obtained in the present study (155µg/L in pregnant women and 130µg/L in non-pregnant women) indicates adequate iodine intake according to WHO criteria.¹³ However, of the 538 pregnant women recruited, only 115 (21.4%) subjects had sufficient iodine (UIE>150µg/L-249µg/L), and 262 (48.8%) had iodine deficiency (UIE<150µg/L) as

estimated by urinary iodine concentration. A recent study conducted among pregnant women in the Central Region of Ghana reported similar finding, where 42.5% of pregnant women were iodine deficient by the same method.¹⁴ Our study suggests that pregnant women of Tripura are still not meeting the higher iodine requirements during pregnancy; this may lead to a negative effect on foetal brain development and thus a general survey of iodine nutritional status in pregnancy is recommended.¹⁵

In our study, the figures for sufficient iodine nutrition decreased from 36.02% in non-pregnant women to 21.4% in pregnant women. It was also observed that out of 538 pregnant women, a total of 48.8% subjects exhibited insufficient iodine excretion (UIE <150µg/L); and out of the 533 non-pregnant mother, 38% exhibited insufficient

iodine excretion ($UIE < 100 \mu\text{g/L}$). Hence, it appears that the salt iodination program adopted by the Indian Government is adequate for general population but insufficient for pregnant and lactating mothers. The recommended dietary intake of iodine during pregnancy and the cut-off values for UIE concentration were revised by the Technical Consultation convened by WHO Secretariat in 2007 and were later endorsed by WHO/ICCIDD/UNICEF.^{16,17} The standards of salt iodization in India require an iodine content of 30ppm at the time of manufacture, so as to deliver 15ppm at the retail level (due to loss during transportation). The iodine content of the packaged salt was tested from household women at random in our study and found consistent with package description.

Therefore, salt consumption of 10gm/day will provide only $150 \mu\text{g/day}$ of iodine with current level of iodine supplementation, which may not be sufficient to meet the increased requirement of pregnancy and lactation. Also, the increase in UIE cut-offs will lead to greater proportion of pregnant women being classified as iodine deficient. Though, the majority of pregnant women have access to adequately iodized salt, pregnant Indian women are likely to remain iodine deficient due to increase in demand during pregnancy.¹⁴ It appears that iodine status of pregnant women in India will be adequate if the salt iodine content raised to 60ppm so as to deliver 30ppm at the retail level and a salt consumption of 10gm/day will ensure $300 \mu\text{g/day}$ of iodine intake.¹⁸

Very few studies from India has been reported the low prevalence of iodine deficiency in pregnant women and 2% iodine deficiency among 150 pregnant women was found in a recent Indian study but most of the studies across India reported wide spread iodine deficiency among pregnant and lactating mothers.^{19,20} Yadav et al, reviewed nine different hospital based and community based Indian studies from 1993 to 2008, and found that majority of pregnant women had low median UIE (value ranged from $95 \mu\text{g/l}$ to $178 \mu\text{g/l}$).²¹ The authors reported that available studies from India showed a significant iodine deficiency in pregnant women. The median UIC progressively changes with the changes of consumption of household salt iodine concentration among the subjects of our study, indicating that household salt iodine consumption is important for both pregnant and non-pregnant subject.²² The prevalence of IDD in the pregnant women has also been reported from other parts of the country like Delhi, Uttaranchal, and West Bengal, indicating widespread iodine deficiency among the pregnant women.²³⁻²⁵

CONCLUSION

The findings of our study may not be generalizable to all pregnant women in India as it was a study based on sampling in rural setting of Tripura, north-Eastern part of India. However, similar data have been reported from most parts of India as discussed above, from community

based as well as hospital based studies. This data suggests that unless the levels of universal salt iodization are stepped-up, pregnant and lactation women as a group needs to be targeted with iodine supplements throughout pregnancy and lactation with collosol iodine oral (colloidal iodine).

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