Original Article

Prevalence of iodine deficiency among pregnant and lactating women: Experience in Kolkata

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ABSTRACT

Objective: The cross-sectional study was carried out to assess the iodine status of pregnant and lactating mothers, using median urinary iodine excretion (UIE) as the measure of outcome, to document the prevalence of iodine deficiency. **Materials and Methods:** The present study assessed the UIE in the morning urine samples from 237 pregnant women, 73 lactating mothers and 59 healthy non-pregnant female controls. **Results:** Out of 237 pregnant women, 88 (37%) exhibited insufficient iodine nutrition (UIE < 150 μg/l), out of 73 lactating mothers, 24 (33%) exhibited insufficient iodine nutrition (UIE < 100 μg/l) and only 3% female control subjects exhibited insufficient iodine nutrition (UIE < 100μg/l). Additionally, a number (32.3%) of babies born of iodine deficient mothers had respiratory distress at birth. **Conclusion:** It appears that the present salt iodination program is adequate for the general population but insufficient for the pregnant and lactating mothers. They need to be targeted with iodine supplements throughout pregnancy and lactation. Increased incidence of respiratory distress in the new born of iodine deficient mothers merits further study.

Key words: Gestation, iodine deficiency, pregnancy, thyroid, urinary iodine excretion

Introduction

Iodine deficiency disease (IDD) is the most common cause of preventable mental deficiency in the world today[1] as iodine plays a critical role in infant brain development and hence this nutrient has immense importance during pregnancy and lactation. Most of the 1,572 million people worldwide, estimated to be at risk of IDD, live in developing countries of Africa, Asia and Latin America; however, large parts of Europe are also vulnerable.[2] IDD was recognized as a public health problem in India after the pioneering work of Prof. V. Ramalingaswami and others[3-5] and led to the formation of National Goiter Control Program (NGCP) in 1962.[6] The implementation of NGCP continued till 1983 with limited success. In 1984, the Govt. of India decided to adopt the programme of Universal Salt Iodization (USI) under which all salt meant for human consumption was to be fortified with iodine. In 1992, the NGCP was renamed as National Iodine Deficiency Disorder Control Programme (NIDDCP).[7] A ban on the sale of non-iodized salt was lifted in September 2000[8] and the ban was re-imposed on 27th May 2005.[9]

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The factors responsible for a higher requirement of iodine are: (1) increased requirement of Thyroxin (T4) to maintain a normal global metabolism in the mother, (2) transfer loss of T4 and iodide from the mother to the fetus and (3) increased loss of iodide through the kidney due to an increase in the renal clearance of iodide in pregnancy.

The recommended dietary intake of iodine during pregnancy is therefore higher than the value of 100 μg/day, which is recommended for nonpregnant adults and adolescents.[10] Iodine balance is negative during pregnancy below a daily intake of 150 μg/day.[11] The iodine intake of an exclusively breastfed infant is dependent on the iodine intake of the mother during pregnancy and lactation.[12] Pregnant and

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lactating women and neonates are the main targets of the effects of iodine deficiency because of the impact of maternal, fetal and neonatal hypothyroxinemia on neonatal brain development.[13]

Kolkata is conventionally considered as an iodine-replete area because of its proximity to the sea. In this study, we have evaluated the prevalence of iodine deficiency among pregnant and lactating mothers, almost three decades after the adoption of USI program by the Indian Government.

The recommended iodine intake during pregnancy was increased from 200 to 250 μg/day and median UIE concentration cut off was increased from 100 μg/l to 150 μg/l.[12]

Materials and Methods

The reference population comprised pregnant women attending the antenatal clinic of the Vivekananda Institute of Medical Sciences, Kolkata, India. The hospital is a charitable organization serving low socio-economic groups. The controls were selected among the healthy non-pregnant female hospital office employees (nursing staff were not included). The subjects were consecutively selected. This observational study was approved by the Hospital's Ethics Committee and informed consent was obtained from all subjects.

Inclusion criteria

- Age between 20 and 45 years
- Pregnant or lactating mother.

Exclusion criteria

- Any concomitant acute or chronic illness or disease
- Known history of thyroid disorder: present or past
- Ingestion of iodine containing products like cough syrups.

After collecting the basic data (age, gestational age or last childbirth and presence of any exclusion criteria), the subjects were requested to give spot urine samples during a routine clinic visit (between 8.00-10.30 am). Lactating mothers who had recently (less than 10 days) delivered in the hospital were also invited to participate. The urine samples of healthy female hospital employees were collected in morning hours. The urine samples were collected in plastic screw capped and labeled containers. Approximately 20 samples were collected each day. The samples were placed in an ice box and transported to the laboratory.

Finally, 237 pregnant women, 73 lactating mothers and 59 healthy non-pregnant female controls had data suitable for analysis. Perinatal outcome of the babies of 65 mothers who delivered in our institution (others were lost on follow up and must have delivered in some other institution) are also available for analysis.

Median UIE is a key indicator of recent iodine intake among the population as recommended by the World Health Organization (WHO)[14] and this was estimated to evaluate the iodine nutrition status of the study population.

Based on the UIE cutoff values as set by the WHO, the study subjects were categorized as insufficient iodine nutrition and adequate iodine nutrition. Urinary Iodine excretion was assessed by using the ammonium persulfate method as recommended by the WHO.[14]

Results

All the pregnant women, lactating mothers and control group are age matched [Table 1]. Out of 237 pregnant women studied, 88 (37%) pregnant women had insufficient iodine nutrition status based on median urinary iodine excretion (UIE < 150μg/l) [Table 2].

Insufficient iodine nutrition was most prevalent in the 3rd trimester (40%). In our study, the figures for insufficient iodine nutrition increased from 30% in first trimester to 37% in second trimester and to 40% in the third trimester [Table 3].

Out of 73 lactating mothers, 24 (33%) exhibited insufficient iodine nutrition based on median urinary iodine excretion (UIE < 100μg/l) and no significant association was found between the age of the lactating mothers and their iodine nutrition status [Table 4]. As only 2 subjects (3%) out of 59 female control subjects had mild iodine deficiency and the rest had adequate iodine nutrition status [Table 5], it appears that the salt iodination program is adequate for general population.

Table 1: Age of the population

Age (years)	Pregnant women	Lactating mother	Control
20-29 (%)	199 (59)	63 (86)	46 (78)
30-39 (%)	35 (15)	10 (14)	11 (19)
>40 (%)	3 (1)	0	2 (3)
Total	237	73	59

Table 2: Median urinary iodine excretion of pregnant women (*n*=237)

Age (years)	No. of subjects	Insufficient iodine nutrition UIE<150 μg/l	Adequate iodine nutrition UIE>150 μg/l
20-45 (%)	237 (100)	88 (37)	149 (63)

UIE: Urinary iodine excretion

Sixty-five iodine deficient mothers were delivered in our institution. The perinatal outcome of the babies was noted from charts and compared to the chart data of 108 babies born on the same days as these babies, but from non iodine deficient mothers. There was no difference in timing of delivery, birth weight, cesarean section rates, Apgar scores, or stay in the NICU. However, 21 (32.3%) of the 'iodine deficient' babies were noted to have respiratory distress by the Pediatrics resident on duty who was unaware of the iodine status. In contrast, of the 108 babies delivered of non iodine deficient mothers, only 11 (10.1%) had respiratory distress (non significant).

Discussion

The UIE represents recent iodine intake and is widely accepted as a good indicator of iodine nutrition status.[14] Epidemiological criteria for assessing iodine nutrition status of adults is based on median UIEs[15] (severe iodine deficiency <20 μg/l, moderate iodine deficiency between 20-49 μg/l, mild iodine deficiency between 50-99 μg/l and adequate iodine nutrition >100 μg/l).

Table 3: Median urinary iodine excretion of pregnant women (*n*=237) in each trimester

Trimester	No. of subjects	Insufficient iodine nutrition UIE<150 μg/l	Adequate iodine nutrition; UIE>150 μg/l
1st (%)	40 (17)	12 (30)	28 (70)
2nd (%)	110 (46)	41 (37)	69 (63)
3rd (%)	87 (37)	35 (40)	52 (60)
Total	237	88	149
%	(100)	(37)	(63)

UIE: Urinary iodine excretion

Table 4: Median urinary iodine excretion level of lactating women of different age groups (*n*=73)

Age (years)	No. of subjects	Insufficient iodine nutrition; UIE<100 μg/l	Adequate iodine nutrition; UIE ≥ 100 μg/l
Group 1: 20-25 (%)	35 (48)	14 (40)	21 (60)
Group 2: 26-29 (%)	28 (38)	5 (18)	23 (82)
Group 3: 30-35 (%)	10 (14)	5 (50)	5 (50)
Group 4: 36-39	None	-	-
Group 5: 40-45	None	-	-
Total (%)	73 (100)	24 (33)	49 (67)

UIE: Urinary iodine excretion

Table 5: Median urinary iodine excretion of female control subjects (*n*=59)

Age (years)	No. of subjects	Insufficient iodine nutrition; UIE<100 μg/l	Adequate iodine nutrition UIE>100 μg/l
20-45 (%)	59 (100)	2 (3)	57 (97)

UIE: Urinary iodine excretion

The median UIE are used to categorize the iodine nutrition of pregnant women (insufficient iodine nutrition <150 μg/l, adequate iodine nutrition 150-249 μg/l, more than adequate iodine nutrition 250-449 μg/l and no added health benefit >500 μg/l) and lactating women (insufficient iodine nutrition <100 μg/l and adequate iodine nutrition >150 μg/l), based on the epidemiological guidelines advocated by the World Health Organization, UNICEF, and International Council for Control of Iodine Deficiency Disorders.[14]

In our study, the figures for insufficient iodine nutrition increased from 30% in first trimester to 37% in second trimester and to 40% in the third trimester [Table 3]. This is consistent with data showing that the requirement of iodine increases with the progression of pregnancy.[11,16]

In this study, it was observed that out of 237 pregnant women, 88 (37%) exhibited insufficient iodine nutrition (UIE < 150 μg/l) and out of the 73 lactating mothers, 24 (33%) exhibited insufficient iodine nutrition (UIE < 100 μg/l). In contrast, only 3% female control subjects had iodine deficiency (UIE < 100 μg/l) and the rest had adequate iodine nutrition status (UIE > 100 μg/l). Hence, it appears that the salt iodination program adopted by the Indian Government is adequate for general population but insufficient for the vulnerable group of pregnant and lactating mothers. Respiratory distress is a known feature of iodine deficiency in the neonate.[17] It is notable that in this study, a number (32.3%) of babies born from iodine deficient mothers had respiratory distress at birth, although this did not apparently have any deleterious outcome.

The recommended dietary intake of iodine during pregnancy and the cutoff values for UIE concentration were revised by the Technical Consultation convened by WHO Secretariat in 2007[15] and were later endorsed by WHO/ICCIDD/UNICEF.[14] The standards of salt iodization in India require an iodine content of 30 ppm at the time of manufacture, so as to deliver 15 ppm at the retail level (due to loss in transportation). The iodine content of the packaged salt was tested from 10 women at random and found consistent with package description. Therefore, salt consumption of 10 gm/day will provide only 150 μg/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 cutoffs will lead to greater proportion of pregnant women being classified as iodine deficient. Despite the fact that 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.[16] It appears that iodine status of pregnant women in India will be adequate if the salt iodine content raised to 60 ppm,[18] so as to deliver 30 ppm at the retail level and a salt consumption of 10 gm/day will ensure 300 μg/day of iodine intake.

Only limited number of studies reported minimum or low prevalence of iodine deficiency in pregnant Indian women[19,20] and 2% iodine deficiency among 150 pregnant women was found in a recent Indian study,[20] but most of the studies all over India reported widespread iodine deficiency among pregnant and lactating mothers.[18,21] Yadav *et al*., (2010) reviewed nine studies (from Rajasthan, West Bengal, Delhi, Haryana, Uttaranchal, Himachal Pradesh, and Maharashtra) from 1993 to 2008, of which 5 were community based and the majority of pregnant women had low median UIE (value ranged from 95 μg/l to 178 μg/l).[22] The authors concluded that available studies from India showed a significant iodine deficiency in pregnant women.

The median urinary iodine concentration progressively declined (from 106 μg/l at recruitment, to 71 μg/l at the second visit and to 69 μg/l in the postpartum) among the tribal pregnant Indian women, indicating that these women were iodine deficient throughout pregnancy, despite the fact that three quarters of these women had access to iodized salt (i.e. >15 ppm).[16]

The prevalence of IDD in the pregnant women has also been reported from other parts of the country like Delhi.[23] Uttaranchal[24] and West Bengal,[25] indicating widespread iodine deficiency among the pregnant women. The data of these studies were reported as per the old cutoff values.

The results of the present study may not be generalizable to all pregnant women in India as it was a hospital based convenient sampling in urban setting. However, similar data have been reported from most parts of India as discussed above, from hospitals as well as community based studies.

Two trials started in 2008 in areas of low iodine status: one in Bangalore, India (n = 325), and another in Bangkok, Thailand (n = 514), where pregnant women received a daily dose of 200 μg of iodine (as KI) or an identical placebo throughout pregnancy. Both trials are ongoing, and women will be followed up during pregnancy and at delivery. The outcomes of these trials will provide the evidence base for iodine supplementation of pregnant women living in areas of iodine deficiency.[26] However, after iodine supplementation programme, thyroid autoimmunity has been considered as an important cause for persistence of goiter and it is believed that auto immunity has increased following salt iodization.[27,28]

Though, the impact of poor iodine nutrition among pregnant mothers may be far reaching and our small sample size on perinatal outcome lacks statistical significance on this issue. There is a suggestion of inferior perinatal outcome of the babies born out of the mother with insufficient iodine nutrition in respect to respiratory distress.

Our data suggest 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). Our finding of an increased incidence of respiratory distress in the new born of iodine deficient mothers merits further study.

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