Section: Biochemistry

Original Research Article

HOUSEHOLD SALT IODINE CONTENT AND ASSESSMENT OF IODINE STATUS AMONG PREGNANT MOTHERS ATTENDING TERTIARY CARE HOSPITAL IN NORTH 24 PARGANAS

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ABSTRACT

Background: Iodine deficiency remains a major public health concern, particularly among pregnant women, due to its critical role in fetal neurodevelopment and maternal thyroid function. Despite universal salt iodization programs, inadequate iodine intake persists in many regions, largely influenced by variability in household salt iodine content and storage practices.
Aims: To assess household salt iodine content and determine iodine status among pregnant mothers.
Materials and Methods: This was a community-based cross-sectional observational study conducted in the Department of Biochemistry, Community-Oriented Medical and Social Determinants of Health (COMSDH). The study was carried out over a period of 12 months. The study population included pregnant women residing in the selected study area who were attending antenatal clinics or were identified through community health workers during the study period. A total of 100 pregnant women were included as the sample size for assessment of household salt iodine content and iodine status.
Results: The association between household salt iodine content and iodine status was assessed among a total of 100 pregnant mothers. Among those using adequately iodized salt (≥15 ppm), 46 mothers (85.2%) had normal iodine status, while 16 mothers (34.8%) were iodine deficient. In contrast, among mothers using inadequately iodized salt (<15 ppm), only 8 mothers (14.8%) had normal iodine status, whereas a higher proportion, 30 mothers (65.2%), were found to be iodine deficient. There was a highly statistically significant association between household salt iodine content and iodine status ($p < 0.001$).
Conclusion: Assessment of household salt iodine content and maternal iodine status is essential for evaluating iodine nutrition during pregnancy. Regular monitoring, nutritional counselling, and proper iodized salt practices may help prevent iodine deficiency and promote optimal maternal and fetal health outcomes.

Keywords: Iodine deficiency, pregnant women, household salt, iodized salt, urinary iodine concentration, maternal nutrition, thyroid function, public health.

INTRODUCTION

Iodine is an essential micronutrient required for the synthesis of thyroid hormones, which play a critical role in regulating metabolism, growth, and neurodevelopment. Adequate iodine intake is particularly crucial during pregnancy, as maternal thyroid hormones are vital for fetal brain development, especially during the first trimester when the fetal thyroid gland is not fully functional. Deficiency of iodine during pregnancy can lead to a spectrum of disorders collectively known as iodine

deficiency disorders (IDD), including miscarriage, stillbirth, congenital anomalies, cretinism, and irreversible cognitive impairment in children.[1,2].

Despite global public health efforts, iodine deficiency remains a significant nutritional problem in many developing and even some developed countries. The World Health Organization (WHO) has identified iodine deficiency as the leading preventable cause of intellectual disability worldwide.[3] Universal salt iodization (USI) has been implemented as the most cost-effective strategy to eliminate iodine deficiency, ensuring that all edible salt contains adequate iodine levels. However, the effectiveness of this intervention depends not only on iodization at the production level but also on proper storage, distribution, and household-level handling practices.[4]

In many low- and middle-income settings, variability in iodine content at the household level is commonly observed due to factors such as exposure of salt to moisture, heat, and sunlight, as well as prolonged storage or use of non-iodized or inadequately iodized salt. These factors can significantly reduce iodine content before consumption, thereby limiting the effectiveness of USI programs.[5] Studies have shown that even when iodized salt is available in the market, improper storage practices at the household level can lead to substantial iodine loss, contributing to persistent iodine deficiency among vulnerable populations, particularly pregnant women.[6]

Pregnant women constitute a high-risk group for iodine deficiency due to increased physiological requirements. During pregnancy, iodine requirement increases to support enhanced maternal thyroid hormone production and fetal needs. The WHO recommends a daily iodine intake of 250 µg for pregnant women, and urinary iodine concentration (UIC) is widely used as a population-level indicator of iodine status.[7] However, inadequate dietary intake remains common in several regions, especially where awareness about iodine nutrition is limited or where access to adequately iodized salt is inconsistent.

In India and similar South Asian contexts, iodine deficiency has historically been a major public health issue. Although USI programs have significantly reduced the prevalence of severe IDD, mild to moderate iodine deficiency continues to exist in certain populations, particularly in rural and socioeconomically disadvantaged groups.[8] Studies have demonstrated that household salt iodine content varies widely across regions, and inadequate iodine intake among pregnant women is still reported despite national iodization policies.[9]

Assessment of iodine status among pregnant women is essential for understanding the effectiveness of iodine supplementation strategies and identifying at-risk populations. Urinary iodine concentration remains the most reliable biomarker for recent iodine intake at the population level, while household salt iodine testing provides insight into the primary dietary source of iodine.[10] Combining these two assessments allows for a comprehensive evaluation of iodine nutrition status and helps in identifying gaps in program implementation.

This study aims to assess household salt iodine content and evaluate iodine status among pregnant mothers. Understanding the relationship between household salt iodine levels and maternal iodine status will provide important evidence for strengthening public health interventions aimed at eliminating iodine deficiency disorders in vulnerable populations.

MATERIALS AND METHODS

Study Design: A community-based cross-sectional observational study

Study Place: Department of Biochemistry, Community-Oriented Medical and Social Determinants of Health (COMSDH)

Study Duration: The study was conducted over a period of 12 months.

Study Population: The study population consisted of pregnant women residing in the selected study area who were attending antenatal clinics or identified through community health workers during the study period.

Sample Size: A total of 100 pregnant women

Study variables

- Adequacy of Household Salt Iodine Content
- Urinary Iodine Status Among Pregnant Mothers
- Association Between Salt Iodine Content and Iodine Status
- Storage Practices of Household Salt
- Association of Iodine Status with Trimester of Pregnancy

Inclusion Criteria

- Pregnant women of any trimester registered in the study area
- Women who provided informed consent to participate
- Residents of the selected study area for at least 6 months
- Women willing to provide household salt samples for iodine testing
- Pregnant women aged 18–45 years

Exclusion Criteria

- Women with known thyroid disorders on treatment
- Pregnant women taking iodine supplementation or multivitamin therapy containing iodine
- Critically ill patients or those with severe pregnancy complications
- Women who did not consent to participate
- Women not available for urine sample collection or follow-up assessment

Statistical Analysis: For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard

deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate.

Explicit expressions that can be used to carry out various t-tests are given below. In each case, the formula for a test statistic that either exactly follows or closely approximates a t-distribution under the null hypothesis is given. Also, the appropriate degrees of freedom are given in each case. Each of these statistics can be used to carry out either a one-tailed test or a two-tailed test.

Once a t value is determined, a p-value can be found using a table of values from Student's t-distribution .If the calculated p-value is below the threshold chosen for statistical significance (usually the 0.10, the 0.05, or 0.01 level), then the null hypothesis is rejected in favour of the alternative hypothesis.

P-value $\leq$ 0.05 was considered for statistically significant.

RESULTS

Table 1: Adequacy of Household Salt Iodine Content (n = 100)

Salt iodine level	Number of patients	Percentage (%)
Adequate (≥15 ppm)	62	62%
Inadequate (<15 ppm)	38	38%
Total	100	100%

Table 2: Urinary Iodine Status Among Pregnant Mothers (n = 100)

Iodine status	Number of patients	Percentage (%)
Normal (150–249 µg/L)	54	54%
Mild deficiency (100–149 µg/L)	28	28%
Moderate deficiency (<100 µg/L)	18	18%
Total	100	100%

Table 3: Association Between Salt Iodine Content and Iodine Status (n = 100)

Salt iodine content	Normal iodine status (n=54)	Deficient iodine status (n=46)	Total	P value
Adequate (≥15 ppm)	46 (85.2%)	16 (34.8%)	62	< 0.001
Inadequate (<15 ppm)	8 (14.8%)	30 (65.2%)	38	
Total	54 (100%)	46 (100 %)	100	

Table 4: Storage Practices of Household Salt (n = 100)

Storage method	Number of patients	Percentage (%)
Airtight container	41	41%
Open container	36	36%
Exposed to moisture/sunlight	23	23%
Total	100	100%

Table 5: Association of Iodine Status with Trimester of Pregnancy (n = 100)

Trimester of pregnancy	Normal iodine status (n=54)	Deficient iodine status (n=46)	Total	P value
1st trimester	20 (37%)	10 (21.7%)	30	0.085
2nd trimester	22 (40.7%)	18 (39.1%)	40	
3rd trimester	12 (22.3%)	18 (39.2%)	30	
Total	54 (100 %)	46 (100 %)	100	

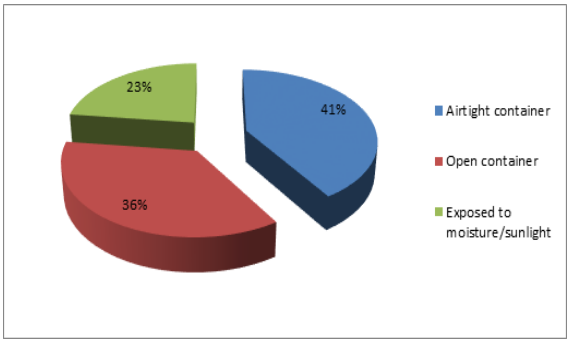


Figure 1: Storage Practices of Household Salt (n = 100)

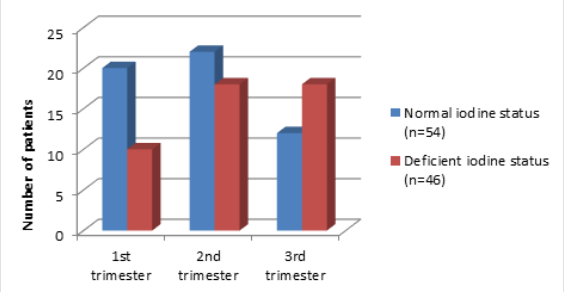


Figure 2: Association of Iodine Status with Trimester of Pregnancy (n = 100)

The study included a total of 100 pregnant mothers for assessment of household salt iodine content. Among them, 62 mothers (62%) were found to be using adequately iodized salt with iodine content ≥15 ppm, whereas 38 mothers (38%) were using inadequately iodized salt with iodine content <15 ppm.

The study assessed iodine status among a total of 100 pregnant mothers using urinary iodine concentration. Among them, 54 mothers (54%) had normal iodine status with urinary iodine levels ranging from 150–249 µg/L. 28 mothers (28%) were found to have mild iodine deficiency with urinary iodine levels between 100–149 µg/L, while 18 mothers (18%) had moderate iodine deficiency with urinary iodine levels below 100 µg/L.

The association between household salt iodine content and iodine status was assessed among a total of 100 pregnant mothers. Among those using adequately iodized salt (≥15 ppm), 46 mothers (85.2%) had normal iodine status, while 16 mothers (34.8%) were iodine deficient. In contrast, among mothers using inadequately iodized salt (<15 ppm), only 8 mothers (14.8%) had normal iodine status, whereas a higher proportion, 30 mothers (65.2%), were found to be iodine deficient.There was a highly statistically significant association between household salt iodine content and iodine status ($p < 0.001$).

The study assessed the household salt storage practices among a total of 100 pregnant mothers. It was observed that 41 mothers (41%) stored salt in airtight containers, while 36 mothers (36%) used open containers for salt storage. Additionally, 23 mothers (23%) stored salt in conditions where it was exposed to moisture and sunlight.

The association between iodine status and trimester of pregnancy was assessed among a total of 100 pregnant mothers. Among mothers with normal iodine status (n = 54), 20 (37%) were in the 1st trimester, 22 (40.7%) were in the 2nd trimester, and 12 (22.3%) were in the 3rd trimester. Among mothers with iodine deficiency (n = 46), 10 (21.7%) were in the 1st trimester, 18 (39.1%) were in the 2nd trimester, and 18 (39.2%) were in the 3rd trimester. the association between iodine status and trimester of pregnancy was found to be not statistically significant ($p = 0.085$).

DISCUSSION

The present study assessed household salt iodine content and iodine status among 100 pregnant mothers and demonstrated that 62% of households used adequately iodized salt (≥15 ppm) while 38% used inadequately iodized salt (<15 ppm). This finding indicates that despite ongoing universal salt iodization programs, a significant proportion of pregnant women are still exposed to insufficient iodine intake at the household level. Similar observations were reported by Singh H et al,.[11] who found persistent gaps in iodized salt coverage in India, particularly in rural and semi-urban populations, where inadequate iodine content in household salt remained a major contributor to iodine deficiency disorders.

In the present study, iodine status assessment showed that 54% of pregnant mothers had normal iodine levels, while 46% were iodine deficient (28% mild and 18% moderate deficiency). This suggests that nearly half of the study population had suboptimal iodine nutrition during pregnancy. Comparable results were reported by Yadav K et al,.[12] who highlighted that iodine deficiency among pregnant women in India continues to exist at mild-to-moderate levels despite national elimination efforts. Similarly, Eastman CJ et al,.[13] reported that urinary iodine concentration remains below optimal levels in a substantial proportion of pregnant women in developing countries, emphasizing ongoing public health concern.

A significant finding of the present study was the strong association between household salt iodine content and maternal iodine status ($p < 0.001$). Mothers consuming adequately iodized salt were significantly more likely to have normal iodine status compared to those consuming inadequately iodized salt. This is consistent with the findings of Sáez-Ramírez DM et al,.[14] who demonstrated that iodized salt consumption is a key determinant of iodine sufficiency at the population level, and inadequate iodized salt usage directly correlates with iodine deficiency in vulnerable groups such as pregnant women . Similarly, Zimmermann MB et al,.[15] emphasized that universal salt iodization remains the most effective strategy to prevent iodine deficiency disorders globally, provided iodine content is maintained throughout the supply chain and household handling .

The present study also observed that 36% of mothers used open containers and 23% exposed salt to moisture and sunlight, indicating improper storage practices. Such conditions are known to accelerate iodine loss from iodized salt. Tadesse S et al,.[16] has reported that improper household storage is a major reason for reduced iodine intake even in regions with adequate iodization policies. Likewise, WHO guidelines stress that iodine stability is highly dependent on protection from heat, humidity, and light exposure.

Regarding trimester-wise analysis, the present study found no statistically significant association between iodine status and trimester of pregnancy ($p = 0.085$), although a slightly higher proportion of deficiency was noted in the third trimester. Similar findings were reported by Kerver JM et al,.[17] who noted that while iodine requirement increases with gestation, trimester alone is not always a strong independent predictor of urinary iodine status in population studies, especially where dietary intake remains consistently inadequate Overall, the findings of the present study highlight that iodine deficiency among pregnant women is still a relevant public health issue, primarily influenced by

inadequate household salt iodization and improper storage practices. Strengthening community awareness, improving quality monitoring of iodized salt, and reinforcing antenatal nutritional counseling are essential strategies to ensure optimal iodine nutrition during pregnancy.

CONCLUSION

The present study highlights the importance of assessing household salt iodine content and iodine status among pregnant mothers to evaluate the adequacy of iodine nutrition during pregnancy. Adequate iodine intake is essential for maintaining maternal thyroid function and supporting normal fetal growth and neurodevelopment. Assessment of iodine content in household salt provides an important measure of the availability and use of adequately iodized salt, whereas assessment of iodine status provides an indication of iodine nutrition among pregnant women. Regular monitoring of both household salt iodine content and maternal iodine status, supported by appropriate nutritional counselling and awareness regarding the correct storage and handling of iodized salt, is essential for preventing iodine deficiency during pregnancy. Strengthening iodine nutrition surveillance and existing preventive strategies may help ensure adequate iodine intake and contribute to improved maternal and fetal health outcomes.

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