

Status of Iodine Nutrition among Pregnant Women Attending Antenatal Clinic of a Secondary Care Hospital: A Cross-sectional Study from Northern India

Shashi Kant, Partha Haldar, Ayush Lohiya, Kapil Yadav, Chandrakant S. Pandav
Centre for Community Medicine, All India Institute of Medical Sciences, New Delhi, India

Abstract

Background: Daily requirement of iodine increases during pregnancy making pregnant women a high-risk group for iodine deficiency disorders. The limited available literature shows that even in iodine sufficient population, pregnant women are iodine deficient. **Objective:** The objective of this study is to assess the current iodine nutrition status among pregnant women in Ballabgarh, district Faridabad, Haryana. **Materials and Methods:** Pregnant women were recruited from antenatal clinic (ANC) of subdistrict hospital (SDH), Ballabgarh, Haryana. Consecutive sampling strategy was followed to recruit pregnant women, and women of all trimesters were included in the study. Urinary iodine estimation was done using simple microplate method, and salt iodine was estimated using iodometric titration. The study was approved by Institute Ethics Committee, All India Institute of Medical Sciences (AIIMS), New Delhi. **Results:** Out of the total 1031 pregnant women, 90.9% were using adequately iodized salt. Median (interquartile range [IQR]) salt consumption by the pregnant women was 8.3 (6.7, 11.1) g/day. Median (IQR) urinary iodine concentration (UIC) for the pregnant women was 260 (199, 323) $\mu\text{g/L}$. Only 13.5% of pregnant women had insufficient iodine intake (UIC $<150 \mu\text{g/L}$). There was no significant difference in median UIC values by household salt iodine content and across three trimesters of pregnancy. **Conclusion:** Iodine nutrition status of the pregnant women attending ANC clinic of SDH Ballabgarh was adequate with attainment of universal salt iodization goal of $>90\%$ adequately iodized salt coverage in the study population.

Keywords: India, iodine, iodized salt, nutrition, pregnancy

INTRODUCTION

Iodine, a trace element, is critical in synthesis of thyroid hormones in humans. The latter is essential for vital functions of human body, including normal growth and development. Deficiency of iodine leads to inadequate synthesis of thyroid hormones, eventually resulting in disease conditions that are collectively known as iodine deficiency disorders (IDDs). Iodine deficiency is the single most important preventable cause of brain damage globally.^[1] As per the most recent estimates, almost 1.88 billion people were at the risk of iodine deficiency because of insufficient iodine intake, (Urinary Iodine Concentration [UIC] cutoff of $<100 \mu\text{g/L}$).^[2] In India, 335 out of 386 surveyed districts were endemic for IDD (total goiter rate $>5\%$).^[3]

Daily demand for iodine during pregnancy increases to $250 \mu\text{gm}$ as compared to $150 \mu\text{gm}$ for nonpregnant women.^[4] Failure to meet this increased iodine demand, results in the

insufficient supply of thyroid hormones to the developing brain,^[5] resulting in mental retardation in the newborn.^[6]

As per the recent study done in Himachal Pradesh, it was found that two of the three districts surveyed had iodine deficiency among pregnant women (median UIC $<150 \mu\text{g/L}$). Percentage of pregnant women consuming adequately iodized salt was less than the universal salt iodization (USI) target of 90% in all the three districts surveyed.^[7] Generating local evidence on status of iodine nutrition specifically among pregnant women as a risk group is important since it has been shown in earlier studies

Address for correspondence: Dr. Shashi Kant,
Room No. 11, Centre for Community Medicine, All India Institute of Medical
Sciences, Ansari Nagar, New Delhi - 110 029, India.
E-mail: skant76@gmail.com

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Kant S, Haldar P, Lohiya A, Yadav K, Pandav CS. Status of iodine nutrition among pregnant women attending antenatal clinic of a secondary care hospital: A cross-sectional study from Northern India. Indian J Community Med 2017;42:226-9.

Received: 02-09-16, **Accepted:** 17-07-17

Access this article online

Quick Response Code:



Website:
www.ijcm.org.in

DOI:
10.4103/ijcm.IJCM_312_16

that pregnant women may continue to be iodine deficient even when the general population, otherwise is iodine sufficient.^[5,8]

In most of the studies previously done to estimate the iodine nutrition status of general population, school children had been used as a surrogate population.^[9-11] There is a need to explore the feasibility of ascertaining iodine nutrition status of pregnant women as they constitute the main priority high-risk group for iodine deficiency prevention.

In India, few studies have focused on the status of iodine nutrition among pregnant women.^[5] The median UIC among pregnant women has been included as one of the key indicators to monitor progress toward sustainable elimination of IDD in the country as per the guidelines of the WHO/UNICEF/ICCIDD.^[1] Our objective was to assess the iodine nutrition status among pregnant women who were attending a secondary care subdistrict hospital (SDH) in the district of Faridabad, Haryana.

MATERIALS AND METHODS

This study was done in an SDH in Ballabgarh, district Faridabad, Haryana, India.^[12] The antenatal care (ANC) clinic is held thrice a week from 2 to 5 PM. The study was done among antenatal women attending ANC clinic of SDH, Ballabgarh. The study period was from March to May 2015.

Sample size was calculated as 1175 on the basis of assumption of the prevalence of iodine deficiency among pregnant women as 38%, relative precision of 7.5%, and nonresponse rate of 10%.^[13]

Consecutive sampling strategy was adopted at the ANC clinic to recruit pregnant women. All pregnant women attending the ANC clinic, irrespective of the period of gestation, were eligible to participate. Pregnant women who reported consuming medicines affecting absorption of iodine, were too ill to respond, or, unable to understand or respond to the question were excluded from the study.

The eligible pregnant women were invited to join the study and were given the participation information sheet in Hindi. On signing of the written informed consent, a pretested semi-structured interview schedule was administered. Spot urine sample and household salt samples were collected from all the participants. Urine sample was collected in sterile screw-capped, wide mouth plastic container (approximately 10 ml), and stored at 4 degree Celsius in the laboratory of SDH, Ballabgarh. Urinary iodine estimation was done within 15 days of sample collection. Salt consumption was assessed using monthly edible salt procurement method. Pregnant women were given a zip lock pouches for bringing the salt used at home for cooking purposes (approximately 50 g). Salt samples were stored at a cool, dry place, away from sunlight. Salt samples were analyzed within 15 days of collection.

The stored urine samples were transported under cold chain to ICCIDD laboratory in New Delhi, where iodine estimation of urine and salt samples was done. ICCIDD laboratory is the

regional reference laboratory of South Asia Regional Office of ICCIDD Global Network. Salt iodine estimation was done using iodometric titration, and urinary iodine estimation was done using simple microplate method using Sandell-Kolthoff reaction.^[1]

Both urinary and salt iodine estimation were done by the same persons in the same laboratory. However, to avoid bias, personal identifiers were removed from both urine and salt samples. Each urine sample was given a unique ID which was different from the ID given to the salt sample of that person. The unique IDs were decoded at the time of final data analysis. In addition, the result of UIC was not available with the laboratory personnel while estimating the salt iodine content.

Standard operating procedures for laboratory quality control procedures, including internal and external quality assurance were at place at the ICCIDD laboratory in New Delhi. ICCIDD laboratory is also a participating laboratory of the ensuring quality of urinary iodine procedures (EQUIP) program of the Centers for Disease Control and Prevention, Atlanta, for quality assurance under which EQUIP proficiency samples are sent, and Q scores are compared. Levy-Jennings charts were plotted to ensure that the tests remain stable, and due corrective actions were taken whenever required.

Data were entered in EpiInfo 7 (Centre for Disease Control and Prevention, Atlanta, Georgia, USA) and analyzed in SPSS version 17 (SPSS Statistics for Windows, Version 17.0., SPSS Inc., Chicago, Illinois, USA). For comparison of median UIC across different categories of household salt iodine content and across three trimesters, Kruskal–Wallis test was used. Multivariate logistic regression was used to determine the independent predictors of UIC and salt iodine concentration. For categorization of pregnant women on the basis of urinary iodine and salt iodine levels, WHO/UNICEF/ICCIDD criterion was used.^[1]

The study was approved by the Institute Ethics Committee of the All India Institute of Medical Sciences, New Delhi (vide letter no. IEC/NP-278/2013 and RP-07/05.08.2013, OP-10/05.06.2015, RP-38/2015, dated 04.08.2015).

RESULTS

A total of 1,031 pregnant women took part in the study, and most of them (96.4%) were between age group 18–30 years. As per the modified Kuppuswamy scale,^[14] almost half of the pregnant women belonged to the upper lower (48.0%) socioeconomic status. Majority were Hindu (91.8%) by religion and homemaker (93.7%) by occupation. While one-fifth of the pregnant women attended school till 10th grade, another similar proportion were illiterate. Three-fifth of all the pregnant women were in the second trimester of pregnancy, and almost one-fourth were in third trimester of pregnancy. More than one-third (38.0%) of the pregnant women were primigravida.

Based on monthly household edible salt procurement, median (interquartile range [IQR]) salt consumption by the pregnant women was 8.3 (6.7, 11.1) g/day. The majority of the pregnant women (89.4%) had made no changes to their usual salt consumption pattern after conception. Seven percentage of women had decreased the amount of salt consumption after getting pregnant. More than 90.0% of pregnant women were using adequately iodized salt (≥ 15 ppm iodine).

Median (IQR) urinary-iodine concentration among pregnant women was 260 (IQR-199, 323) $\mu\text{g/L}$. Overall, 13.5% pregnant women had insufficient iodine intake (median UIC < 150 $\mu\text{g/L}$). Almost 55% of women had UIC 250 or more $\mu\text{g/L}$ which reflected of more than adequate iodine [Table 1]. There was no significant difference in the median UIC levels across three categories of the household salt iodine content [Table 2]. Similarly, there was no difference in the median UIC levels across three trimesters of pregnancy [Table 2]. UIC levels were found to be significantly associated with per capita per day salt consumption ($p = 0.04$).

Table 1: Iodine status among pregnant women (n=1031)

Per capita per day salt consumption (g)	
Median (IQR)	8.3 (6.7-11.1)
Household salt iodine concentration (ppm), n (%)	
0-4.9	9 (0.9)
5.0-14.9	85 (8.2)
≥ 15.0	937 (90.9)
Urinary iodine concentration ($\mu\text{g/L}$)	
Median (IQR)	260 (199-323)
Urinary iodine concentration ($\mu\text{g/L}$), n (%)	
< 150 (insufficient)	139 (13.5)
150-249 (adequate)	322 (31.2)
250-499 (above requirement)	563 (54.6)
500 or more (excessive)	7 (0.7)

IQR: Interquartile range

Table 2: Distribution of urinary iodine concentration levels by household salt iodine concentration and trimester of pregnancy

UIC levels across various categories of household salt iodine concentration	Median (IQR) UIC levels (mg/L)	P (Kruskal-Wallis test)
Household salt iodine concentration (in ppm)		
0-4.9	243 (167-301)	0.07
5.0-14.9	286 (216-344)	
≥ 15.0	259 (198-321)	
UIC levels across three trimesters of pregnancy		
Trimester of pregnancy		
First (n=139)	251 (205-311)	0.54
Second (n=619)	264 (198-326)	
Third (n=273)	263 (201-322)	

UIC: Urinary iodine concentration, IQR: Interquartile range

DISCUSSION

The median per capita per day salt consumption among pregnant women in the study area was more than the recommended value of salt intake of 5 g/day. The proportion of pregnant women using salt having iodine ≥ 15 ppm was more than 90%. The majority of pregnant women had not made any change in the salt consumption after conception. The median urinary iodine among pregnant women was 260 (199, 323) $\mu\text{g/L}$. There was no difference in iodine nutrition status across three trimesters of pregnancy.

In this study, pregnant women were recruited from ANC clinic. Dietary habits of the women attending ANC could be different from those not availing the services from this hospital. Hence, the findings may not be generalizable to those women who do not attend antenatal clinic (ANC) of the hospital.

The median per capita per day salt consumption among pregnant women was more than the recommended salt intake of 5 g per day. Per capita, salt consumption calculation was a crude method that assumed that the consumption of salt was uniform among all members of the household. In the absence of a more accurate method of estimation of salt consumption at individual level, one would have to rely on UIC as a marker of dietary iodine nutrition. However, the need to assess iodine content of salt at consumption point remains undiminished.

The proportion of pregnant women using salt having iodine ≥ 15 ppm was more than 90%. This was higher as compared to the previous studies done in rural areas of Haryana and Rajasthan.^[8,13,15] The difference could be due to increase in availability of better-packed salt and refined salt after better implementation of the Food Safety and Standards Act, 2006. Hence, it can be concluded that the target of USI had been achieved in this particular study setting.

The median urinary iodine among pregnant women was more than 150 $\mu\text{g/L}$ implying that IDD was not a public health problem in this community. This finding is similar to the previous study reported from the same area. In fact, there had been gradual increase in the median UIC from 178 $\mu\text{g/L}$ in 2004–260 $\mu\text{g/L}$ in 2015 among women attending ANC of a secondary care hospital.^[13] Most of the previous studies done in other parts of the country have shown lower median UIC levels among pregnant women.^[16,17,18] One possible reason could be the increase in the iodine nutrition of the population over the period. Yet, almost 14% of all the women had UIC < 150 $\mu\text{g/L}$, posing their fetuses at the risk of IDD.

One could argue that dietary pattern over the entire period of gestation may vary resulting in different UIC values at different gestational period for the same women. We had recruited women irrespective of their period of gestation. We did not find any difference in median UIC levels across three trimesters of pregnancy. Thus, one could assume the UIC values observed are true representative of pregnant women as a whole. This in turn would be surrogate marker of community level iodine nutrition status. However, it would be advisable

that future studies are done with sufficient sample size for each of the three trimester of gestation so as to validate the assumption made in this study.

We found that median UIC levels were not affected by the household salt iodine content. Median UIC level among pregnant women has already been accepted as a reliable indicator to monitor the iodine deficiency at population level.

Pregnant women and their fetus are likely to suffer more serious consequence of iodine deficiency as compared to other age groups in the population. Hence, there is a need to establish surveillance mechanism for monitoring the iodine nutrition status of pregnant women. In recent years, utilization of ANC has improved significantly.^[19,20] Spot test for UIC at facility level could be a good option for surveillance for iodine nutrition status of the population at large. Currently, iodine nutrition status of the population is assessed using school children as proxy for general population. Pregnant antenatal attendee could serve as a more useful alternative as they constitute the primary target group for iodine nutrition programs.

The present study had large sample size as compared to the previous studies. Hence, the estimates are more precise. In addition, the study was done using standard quantitative methods of iodine estimation which provided valid estimate of iodine nutrition among pregnant women. The study, however, had following limitations as follows: (i) Since women were recruited from hospital setting, the findings may not be generalizable to those women who do not attend ANC of a hospital and (ii) Salt intake estimates were based on household salt purchase which may not reflect actual individual level salt consumption.

CONCLUSION

The average iodine intake of the pregnant women attending ANC OPD of SDH, Ballabgarh, was adequate as per the UIC levels. In addition, USI goal of greater than 90% adequately iodized salt coverage has been achieved in the study population.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. World Health Organisation. Assessment of Iodine Deficiency Disorders and Monitoring their Elimination : A Guide for Programme Managers. 3rd ed. Geneva: World Health Organisation; 2007. Available from: http://www.apps.who.int/iris/bitstream/10665/43781/1/9789241595827_eng.pdf. [Last accessed on 2016 Feb 29].
2. Andersson M, Karumbunathan V, Zimmermann MB. Global iodine status in 2011 and trends over the past decade. *J Nutr* 2012;142:744-50.
3. Ministry of Health and Family Welfare. Annual Report 2014-15. New Delhi: Ministry of Health and Family Welfare, Government of India; 2012. p. 126.
4. WHO | Recommended Iodine Levels in Salt and Guidelines for Monitoring their Adequacy and Effectiveness. WHO. Available from: http://www.who.int/nutrition/publications/micronutrients/iodine_deficiency/WHO_NUT_96.13/en/. [Last accessed on 2016 Feb 29].
5. Yadav K, Srivastava R, Badhal S, Palanivel C, Pandav CS, Karmarkar MG. Iodine nutrition of pregnant women in India: Evidence of significant iodine deficiency. *Indian J Med Spec* 2012;3:49-54.
6. Bath SC, Steer CD, Golding J, Emmett P, Rayman MP. Effect of inadequate iodine status in UK pregnant women on cognitive outcomes in their children: Results from the Avon Longitudinal Study of Parents and Children (ALSPAC). *Lancet* 2013;382:331-7.
7. Kapil U, Prakash S, Sareen N, Bhadoria AS, Khenduja P, Nigam S, *et al.* Status of iodine deficiency among pregnant mothers in Himachal Pradesh, India. *Public Health Nutr* 2014;17:1971-4.
8. Ategbo EA, Sankar R, Schultink W, van der Haar F, Pandav CS. An assessment of progress toward universal salt iodization in Rajasthan, India, using iodine nutrition indicators in school-aged children and pregnant women from the same households. *Asia Pac J Clin Nutr* 2008;17:56-62.
9. Kapil U. Urinary iodine excretion levels amongst schoolchildren in Haryana. *Indian Pediatr* 2009;46:57-9.
10. Kapil U, Sharma TD, Singh P, Dwivedi SN, Kaur S. Thirty years of a ban on the sale of noniodized salt: Impact on iodine nutrition in children in Himachal Pradesh, India. *Food Nutr Bull* 2005;26:255-8.
11. Mallik AK, Pandav CS, Achar DP, Anand K, Lobo J, Karmarkar MG, *et al.* Iodine deficiency disorders in car Nicobar (Andaman and Nicobar Islands). *Natl Med J India* 1998;11:9-11.
12. Kant S, Misra P, Gupta S, Goswami K, Krishnan A, Nongkynrih B, *et al.* The ballabgarh health and demographic surveillance system (CRHSP-AIIMS). *Int J Epidemiol* 2013;42:758-68.
13. Srinath S. Iodine Status of Pregnant Women Attending Antenatal Care Clinic at Comprehensive Rural Health Services Project (C.R.H.S.P.), Ballabgarh, Haryana, North India. (MD Dissertation Submitted to Faculty of All India Institute of Medical Sciences, New Delhi, India). Submitted in; 2004.
14. Oberoi SS. Updating income ranges for Kuppuswamy's socio-economic status scale for the year 2014. *Indian J Public Health* 2015;59:156-7.
15. Singh MB, Fotedar R, Lakshminarayana J. Micronutrient deficiency status among women of desert areas of Western Rajasthan, India. *Public Health Nutr* 2009;12:624-9.
16. Pathak P, Singh P, Kapil U. Prevalence of iron, Vitamin A, iodine deficiencies amongst adolescent pregnant mothers. *Indian J Pediatr* 2003;70:299-301.
17. Kant S, Misra P, Baridalyne N, Goswami A, Pandav CS, Kumarkar M. Iodine status of pregnant women residing in an urban resettlement colony of Delhi. *Obstet Gynecol* 2003;53:554-7.
18. Chakraborty I, Chatterjee S, Bhadra D, Mukhopadhyaya B, Dasgupta A, Purkait B. Iodine deficiency disorders among the pregnant women in a rural hospital of West Bengal. *Indian J Med Res* 2006;123:825-9.
19. UNICEF, Ministry of Health and Family Welfare, Government of India. Coverage Evaluation Survey 2009 All India Report. New Delhi: UNICEF; 2010. Available from: http://www.unicef.org/India/1_-_CES_2009_All_India_Report.pdf. [Last accessed on 2016 Jan 12].
20. Roy MP, Mohan U, Singh SK, Singh VK, Srivastava AK. Determinants of utilization of antenatal care services in rural Lucknow, India. *J Family Med Prim Care* 2013;2:55-9.