Brief Research Article

Prevalence of Iodine Deficiency among Adult Population Residing in Rural Ballabgarh, District Faridabad, Haryana

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Summary

Community-based surveys are essential to monitor iodine deficiency disorders (IDD) program at both the state and national levels. There is paucity of information on population iodine nutrition status in Haryana state using standard methods. A cross-sectional study was conducted in villages of Comprehensive Rural Health Services Project (CRHSP), Ballabgarh, Haryana, India. A total of 465 randomly selected individuals were assessed for urinary iodine concentration (UIC) by microplate method and household salt iodine content using iodometric titration. Of the interviewed households, 73% were using adequately iodized salt (≥15 ppm). Iodine nutrition was deficient in 17% respondents (UIC <100 μg/L); 20.2% among males and 13.9% among females. Iodine intake of the study population as measured by UIC was adequate but nearly one-fourth of households in the study population were consuming inadequately iodized salt. The availability and access to adequately iodized salt in the study population should be improved by strengthening regulatory monitoring.

Keywords: Haryana, iodine, iodized salt, nutrition

Iodine deficiency disorders (IDD) are the single most important cause of preventable brain damage worldwide. In India, one out of every three individuals has suboptimal iodine nutrition [urinary iodine concentration (UIC) <100 μg/L].[1] Almost 29% of households in India are currently using inadequately iodized salt [<15 parts per million (ppm)].[2]

Haryana, one of the states in the northern part of India, is IDD endemic and 10 of the 11 districts surveyed are reported to be IDD endemic (total goiter rate >10%).[3] However, most surveys previously done in the state used rapid testing kits to assess household coverage by adequately iodized salt. Rapid testing kits provide qualitative assessment of iodine and salt and are known to over- or underestimate the iodine content of salt.[4]

School-aged children are used as a proxy for the general population for the estimation of iodine nutrition because of ease of sampling, and all earlier studies from Haryana done in school-age children are predominantly school-based. Estimates of iodine nutrition status are not available separately for the rural and the urban areas of Haryana. There is a need to generate data on iodine nutrition status using standard methodology for assessment of salt and urine iodine content in the general

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adult population to assess the impact of elimination programs for IDD. The present community-based study was done to assess the iodine nutrition status of the adult population residing in a rural area of Haryana, northern India.

The study was conducted in 28 villages under the Comprehensive Rural Health Services Project (CRHSP), Ballabgarh, Haryana from November 2012 to December 2013. The study design was cross-sectional and all adult (≥18 years) individuals residing in the 28 specified villages under CRHSP were eligible for inclusion in the study. The sample size was calculated as 465 based on the assumption of normal iodine nutrition status (UIC more than 100 μg/L) as 92.6%, absolute precision of 2.7%, and response rate of 80%.[5] Similarly, if we assume the proportion of households consuming adequately iodized salt to be 86.7%, absolute precision 3.6%, and response rate 80%, then the sample size will be 445.[2] Hence, the final sample size required was 465.

Study participants were selected after simple random sampling by computer from the Health Management and Information System (HMIS) database of CRHSP. House-to-house visits were made to collect urine samples and sociodemographic information of the participants. Households of the study participants were selected for the collection of the salt samples. A minimum of three repeat visits were made to contact an individual between 8 AM and 7 PM. If an individual was not present, the likely time of his/her availability was ascertained and a repeat visit was made accordingly.

A structured interview schedule was used to collect detailed information on the socioeconomic and demographic profile of the selected individuals. A 10 mL spot urine sample was collected from each participant in a wide-mouth sterile container. Collected urine samples were transported at room temperature to the CRHSP laboratory, Ballabgarh on the same day and stored at 4°C. Salt used for cooking in the households of the respondents was collected (50 g from each household) and packed in airtight ziplock polythene pouches. Urine samples and salt samples were subsequently transferred to the regional reference laboratory of South Asia Regional Office of the International Council for Control of Iodine Deficiency Disorders (ICCIDD) Global Network at New Delhi.

Urinary iodine was estimated using simple microplate method using Sandell–Kolthoff reaction.[6] The iodine content of salt was measured by iodometric titration.[6]

Quality control of laboratory analysis

The laboratory of the South Asia Regional Office of the ICCIDD Global Network is a reference laboratory and provides external quality assurance to many laboratories of government and nongovernmental organizations. This laboratory is also tasked with the Ensuring the Quality in Urinary Iodine Procedures (EQUIP) program under the Centers for Disease Control and Prevention (CDC), Atlanta, GA, USA. Four control samples were run with all batches of urine samples. Control samples were tested and Levey-Jennings Plots were used every day before starting salt iodine estimation.

Data entry was done in EpiInfo version 3.5.4 (Centre for Disease Control and Prevention, Atlanta, Georgia, United States of America) and statistical analysis was done in Stata version 11 (StataCorp, Texas, United States of America). UIC and household salt iodine coverage were presented as median with interquartile range (IQR) and proportion respectively. For the comparison of the medians of the two groups, the Mann–Whitney *U* test was used. World Health Organization (WHO)/ United Nations Children's Fund (UNICEF)/ICCIDD criteria were used for categorizing individuals into iodine nutrition status-based UIC and household salt iodine content.[6]

Ethical approval for the study was obtained from the institutional ethics committee of All India Institute of Medical Sciences (AIIMS), New Delhi. Written informed consent was obtained from all study participants. Confidentiality of all information was maintained.

Information on all study parameters including urine and salt sample could be obtained for only 399 out of 465 study participants. Thus, the overall response rate for the study was 85.8%. The reasons for nonresponse were insufficient salt sample (<10 g) to estimate iodine content (5.8%), locked house/inability to contact after three repeat visits (5.4%), and refusal to participate in the study (3.0%). The study participants included 204 males (51.1%) and 195 females (48.9%) [Table 1].

The median iodine content (IQR) of salt in the study households was 21.2 (14.8, 29.6) ppm. Most (73.4%) individuals were consuming salt with adequately iodine

Table 1: Distribution of sociodemographic characteristics of study participants

Variable	Frequency (*N* = 399)	
	Males *N* (%)	Females *N* (%)
Sex	204 (51.1)	195 (48.9)
Age		
18-39 years	117 (57.4)	112 (57.4)
40-59 years	60 (29.4)	51 (26.2)
≥60 years	27 (13.2)	32 (16.4)
Mean age		
Mean years (SD)	38.48 (16.2)	39.13 (16.6)
Marital status		
Unmarried	41 (20.1)	15 (7.7)
Married	161 (78.9)	153 (78.5)
Widowed	2 (1.0)	27 (13.8)
Occupation		
Semiprofessional and above	7 (3.4)	0 (0.0)
Clerical, shop owner, farmer	53 (26.0)	0 (0.0)
Skilled/Semiskilled/Unskilled worker	87 (42.7)	7 (3.6)
Unemployed/ Homemaker	57 (27.9)	188 (96.4)
Literacy status		
High school and above	119 (58.3)	50 (25.6)
Less than high school	53 (26.0)	51 (26.2)
Illiterate	32 (15.7)	94 (48.2)

Table 2: Prevalence of iodine deficiency among study participants

Variable	Proportion (95% confidence interval)		
	Males (*N* = 204)	Females (*N* = 195)	Total (*N* = 399)
Iodine content of the household's edible salt (in ppm)			
0-4.9	4.9 (1.9-7.8)	3.6 (1.0-6.2)	4.3 (2.3-6.3)
5-14.9	20.1 (14.6-25.6)	24.6 (18.5-30.6)	22.3 (18.2-26.4)
≥15	75.0 (69.0-81.0)	71.8 (65.5-78.1)	73.4 (69.0-77.8)
UIC (μg/L)			
<50	3.0 (0.7-5.3)	4.2 (1.4-7.0)	4.0 (2.0-5.9)
50-99	17.2 (12.0-22.4)	9.7 (5.5-13.9)	13.5 (10.1-16.8)
100-199	21.1 (15.5-26.7)	24.1 (18.1-30.1)	22.6 (18.5-26.7)
200-299	23.0 (17.2-28.8)	26.7 (20.5-33.0)	24.8 (20.5-29.0)
≥300	34.8 (28.3-41.3)	35.3 (28.6-42.0)	35.1 (30.4-39.8)

concentration (≥15 ppm) [Table 2]. The median UIC (IQR) of the study participants was 240.4 μg/L (133.5, 327.0). The median UIC (IQR) values were 227.4 μg/L (115.6, 323.5) and 249.1 μg/L (150.2, 336.0) for males and females, respectively (*P* value 0.16). The proportion of study participants having UIC less than 100 μg/L was 17.5% (20.2% among males and 13.9% among females. One-third of the study participants (35.1%) had UIC more than 300μg/L [Table 2].

Nearly three-fourth (73.5%) of the study participants were consuming adequately iodized salt, which was below the universal salt iodization (USI) target of >90% adequately iodized salt household coverage. More worryingly, 4.3% of the study participants were consuming salt with nil iodine content (<5 ppm). This points toward lacunae in the regulatory monitoring of iodized salt. To ensure USI attainment in Haryana, it is essential that strict enforcement of mandatory sale of only iodized salt is ensured. The most efficient mechanism to do the same is due implementation of the provisions of the Food Safety and Standards (FSS) Act, 2006 under the leadership of the district administrative head in all the districts of the state. There is also a need for a communication campaign regarding provisions of the FSS Act with respect to mandatory salt iodization focused at consumers and supply chain stakeholders.

The proportion of households using adequately iodized salt in this study was lower than that reported for the state of Haryana in 2009 (86.7%).[2] The difference may be because two different methods were used for salt iodine content estimation in the two surveys. Our study used iodometric titration, while the coverage evaluation survey of 2009 had used rapid test kits. Rapid test kits are known to overestimate the salt iodine content.[4] In addition, our study population was rural, whereas the 2009 survey reported aggregate data for rural and urban, thus partially explaining the difference between the two surveys estimates. The iodine nutrition status of the study population was comparable with other states of the country.[7,8]

The median UIC of the study participants was 240.4 μg/L, though the household level coverage was short of the USI target of >90% adequately iodized salt coverage. Numerous studies have shown that despite adequate iodine intake in children and adult populations, the UIC levels of pregnant and lactating mothers (the primary target for addressing iodine deficiency) continue to be in the deficient range.[8,9] Thus, there is a need to study the iodine nutrition status of pregnant women in this study population. Almost one-third of individuals had UIC in excess range, which needs to be explored in further studies. Recently there have been studies that support the revision of adequate UIC levels from 100-199 μg/L to 100-299 μg/L.[10]

If our findings are extrapolated to the entire state of Haryana (after making an assumption that iodine nutrition status of the whole of the rural Haryana area is similar to the villages of CRHSP), and assuming the same rate of iodine deficiency among pregnant women as in adult women in the general population, then we can

estimate that every year 77,000 newborns in the state of Haryana are not protected from irreversible brain damage due to iodine deficiency. This estimate is based on a birth rate of 21.8 per thousand, the total population of 25.4 million, and 13.9% of the population having UIC less than 100 μg/L. The magnitude of the problem warrants priority action by the health system in the state of Haryana to ensure that every child born in the state has optimal iodine nutrition and thus can attain their fullest developmental potential.

Our study was community-based and done in the adult population, and we feel that our findings are a robust estimate of iodine nutrition among adults residing in our study area. The study had the following limitations: Household selection for estimation of iodine content of salt was not done separately, information pertaining to consumer behavior regarding edible salt was not obtained in the study to understand the reasons for consuming substandard iodized salt, and the nonresponse rate was 14.2%. Therefore the results should be interpreted carefully.

In conclusion, the iodine intake of the study population as measured by UIC was adequate. Despite the mandatory salt iodization in the country including the state of Haryana, nearly one-fourth of the households in the study were consuming inadequately iodized salt. The availability and access to adequately iodized salt in the study population should be improved by strengthening the regulatory monitoring.

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Conflicts of interest

There are no conflicts of interest.

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