Original Article www.pimr.org.in

DOI: 10.47799/pimr.1303.25.36

Household Salt Iodine Content Estimation and its Association with Salt Storage and Usage Practices

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Date of Submission: 04/07/2025 Date of Review: 31/07/2025 Date of Acceptance: 25/10/2025

ABSTRACT

Introduction: Iodine plays a vital role in human growth and development. Iodine deficiency remains a significant public health issue worldwide. Although India has implemented universal salt iodization, inadequate iodine intake may still occur due to poor storage and handling practices at the household level. **Objectives:** To estimate the iodine content in household salt, examine its association with storage and usage practices, and assess awareness about iodized salt among women of reproductive age. **Methods:** A community-based cross-sectional study was conducted between August 2015 and September 2017 in 15 villages of Udupi Taluk, Karnataka, India. Using stratified sampling, 1,200 households were selected. Information on salt storage and usage was gathered through interviews. Salt samples were tested on-site using spot iodine testing kits. Awareness was assessed among 1,478 women of reproductive age. **Results:** All households reported using iodized salt, and 96% had salt with adequate iodine levels ($\geq$15 ppm). Inadequate iodine content was significantly associated with exposure to heat ($p<0.001$), use of non-plastic containers for storage ($p=0.008$), and soggy salt texture ($p<0.001$). Only 58.2% of women had heard of iodized salt, and among them, 68.3% were confident they used it. The public distribution system was identified as a source of inadequately iodized salt in some households. **Conclusion:** While the use of iodized salt was nearly universal, improper storage practices compromised iodine retention. Public health efforts should focus on promoting proper storage at the household level and strengthening quality assurance in salt distribution systems to ensure consistent iodine intake across the population.

KEYWORDS: Iodized salt, Iodine deficiency disorders, Household salt storage and handling

INTRODUCTION

Iodine is a vital micronutrient necessary for normal human growth and development. Iodine, with a Recommended Dietary Allowance of iodine is 150μg, is a key element in the synthesis of thyroid hormones. [1] Globally, Iodine deficiency is one of the most common micronutrient deficiencies and a major contributor to preventable cognitive disabilities during childhood. [2] Iodine Deficiency Disorders (IDD) encompass a range of conditions, including endemic goiter, hypothyroidism, cretinism, reduced fertility rate, mental retardation and increased infant mortality. [3] These disorders arise from impaired thyroid hormone synthesis due to iodine deficiency. [4]

According to the World Health Organization (WHO), an estimated 37% of school-aged children and nearly 2 billion people globally have inadequate iodine intake. [2] This places around 1.5 billion individuals at risk of developing IDDs, a leading preventable cause of impaired neurodevelopment. [1]

As the soil in India is deficient in iodine, the foods derived from this soil are also deficient in this micronutrient. Given the widespread iodine deficiency across various regions, the entire population of India remains at risk of inadequate iodine intake. The prevalence of IDD is above 10 per cent in the population of the districts surveyed so far. [5] In India, Uttar Pradesh tops the list in Iodine deficiency disorder with 13.270 million people suffering from this disorder. Karnataka has a burden of 2.7 million people suffering from Iodine deficiency disorders. [6] Recognizing the IDDs as a major public health concern, the Government of India

launched the National Goiter Control Program in 1962, which was later renamed the National Iodine Deficiency Disorders Control Program (NIDDCP). The Program adopted universal salt iodization as the most cost-effective and practical strategy to prevent iodine deficiency by promoting the daily consumption of adequately iodized salt. Although this initiative has significantly reduced the burden of IDDs, the issue persists. [7] One contributing factor is that nearly 22% of Indian households still consumes salt with insufficient iodine content. [8]

Iodine content in the salt is affected by the storage practices as iodine sublimes on exposure to moisture. Even after universal salt iodization some household sending up in consuming salt with inadequate iodine might be due to faulty storage practices. This study was carried out with the aim to estimate the salt iodine content among the households and to assess the usage and storage practices of salt and their effect on slat iodine content. To assess the knowledge about iodized salt among the women of reproductive age of the household.

METHODOLOGY

A cross-sectional community based study was undertaken between August 2015 to September 2017 in the designated field practice area of Kasturba Medical College, Manipal. The population comprising of around 40,000 individuals across 15 villages in Udupi Taluk, was selected due to its homogeneity in livelihood, socioeconomic status and nutritional habits. There are five outreach centres which provides primary health care to this area and are located at Maple, Kadekar, Kaup, Alevoor and Udyavara.

Anticipating the proportion of salt samples with adequate iodine level (≥15ppm) to be 77%, [9] with the relative precision of 3.5% and 10% non-response rate of 10% sample size was calculated to be 1094. Stratified sampling design was used. Outreach centres under the field practice area of the department were treated as a stratum. The number of households selected from each stratum was determined proportionally to the stratum's share of the total household population within the study area. Within each stratum, households were chosen using a convenient sampling method.

Approval for the study was obtained from the institutional ethics committee before initiating field work. Data collection was conducted through household visits, during which the purpose of the visit was explained and informed consent was secured. A semi-structured questionnaire was administered by the investigator to gather information on socio-demographic profiles, and practices related to salt storage and usage. Data regarding salt storage and usage practices was collected from 1200 families and awareness about iodized salt was assessed in 1478 women from those families.

From each household, a cooking salt sample (approximately one teaspoon) was obtained and tested on-site for iodine content using spot iodine testing kits (MBI KITS). Adding a drop of starch iodide solution from the kit to the salt sample violet color appears. Salt iodine concentration was classified based on the colour intensity observed during testing, with categories of 0 ppm, 15 ppm, 30 ppm. Salt iodine levels of 15ppm or higher were deemed sufficient in accordance with WHO standards.

Data collected was compiled and analyzed by Statistical Package for Social Science (SPSS) version 15. Results were expressed in frequencies and percentages. Associations between categorical variables were analyzed using the Chi-square test, with statistical significance set at p value <0.05.

RESULTS

Variable	Frequency	Percentage
Type of salt		
Crystalline	358	29.8
Table salt	842	70.2
Type of container		
Plastic	1140	95.0
Ceramic	34	2.8
Glass	19	1.6
Others	7	0.6
Salt exposed to heat		
Yes	129	10.8
No	1071	89.3
Container of salt		
Closed	1189	99.1
Opened	11	0.9
Texture of the salt		
Dry	1143	95.3
Soggy	57	4.7

Table 1: Salt storage and usage practices among the households (N=1200)

Total of 1200 households were interviewed for storage and usage practices of cooking salt. All the families were found to be using iodized salt. On estimation of slat iodine content, it was found that 96% of the households were consuming salt with adequate iodine content (≥15ppm). With 70.8% of salt samples with 30ppm followed by 25.3% of samples with 15ppm.

Variable	Total	Salt iodine		p value
		<15ppm; n (%)	≥15ppm; n (%)	
Type of Salt				
Crystalline	358	15(4.2)	343(95.8)	0.82
Table salt	842	33(3.9)	809(96.1)	
Type of container				
Plastic	1140	45(3.9)	1095(96.1)	**0.008**
Glass	19	0	19(100)	
Ceramic	34	1(2.9)	33(97.1)	
Others	7	2(28.6)	5(71.4)	
Salt exposed to heat				
Yes	163	21(12.9)	142(87.1)	**<0.001**
No	1315	36(2.7)	1279(97.3)	
Container of salt				
Closed	1189	46(3.9)	1143(96.1)	0.06
Opened	11	2(18.2)	9(81.8)	
Texture of Salt				
Dry	1143	39(3.4)	1104(96.6)	**<0.001**
Soggy	57	9(15.8)	48(84.2)	

Table 2: Association between salt storage practices and salt iodine level among the households (N=1200)

Variable	Number	Percentage
Heard of Iodized Salt (n=1478)		
Yes	860	58.2
No	618	41.8
Buy Iodized salt (n=860)		
Yes	587	68.3
Not sure	273	31.7
Reasons for buying (n=587)		
Healthy	385	65.6
Other kinds are not available	120	20.4
Health worker advised	30	5.1
Shop keeper advised	1	0.2
Family members advised	13	2.2
Neighbours advised	7	1.2
TV	31	5.3
Iodine affects taste of salt (n=587)		
Yes	2	0.3
No	327	55.7
Not sure	258	44.0

Table 3: Knowledge about iodized salt (N=1478)

Among 4% samples with inadequate iodine, 3.4% had 7ppm of iodine and seven households (0.6%) with eight individuals were consuming iodized salt with no iodine. Surprisingly, among the seven salt samples with no iodine, six samples were of the salt distributed as iodized salt in the public distribution system at subsidized rates. Table 1 shows the salt usage and storage practices among the households. All the families reported that they were purchasing packaged salt. More than two third (70.2%) of the families were found to be using table salt and plastic container was used by most (95%) of the households for storage of cooking salt. When interviewed about the exposure of salt to heat 10.8 of the households reported that the salt is being exposed to heat. Only 1% of the households reported the storage of salt in containers without lid. When the salt in the containers was observed, salt of 4.7% of households was found to be soggy which indicate the exposure of the salt to moisture.

Table 2 shows that 4.2% of the crystalline salt samples have inadequate iodine as compared to 3.9% of table salt samples but this difference was not statistically significant.

Statistically significant (p=0.008) association was observed in the salt iodine levels among different categories of salt storage containers with the category "others" which included polythene cover, earthenware and steel containers showing the maximum iodine deficiency.

Results of the present study have shown that 12.9% of the salt samples which were exposed to heat had inadequate iodine compared to only 2.7% of samples which were not exposed to heat and this difference was statistically significant (p<0.001). It was also seen that, 18.2% of salt samples which are stored in open containers had inadequate iodine content when compared to only 3.9% which are stored in closed containers. However, there is no statistically significant difference between the two (p=0.06).

There was a statistically significant association (p<0.001) between the texture of salt and iodine levels with soggy salt revealing a larger proportion (15.8%) of inadequate iodine content. Even though all the participants were using iodized salt, only 58.2% of the study participants had heard about iodized salt of which one third (31.7%) were not sure that they were using iodized salt. As shown in Table 3, most common reason for buying iodized salt has been cited as "it is healthy" (65. 6%). More than half of these participants (55.7%) agreed that the iodine did not affect the taste of salt.

DISCUSSION

In the present study all the families found to be using iodized salt. This can be a result of effective implementation of universal salt iodization and the availability of iodized salt in the public distribution system. [10]

National Family Health Survey 4 (NFHS-4) [11] conducted during 2015-16 in the study district showed the usage of iodized salt by 85.5% households which is lower compared to study area. In various studies conducted by Atul Singh et al, Rupali Roy et al, Kamath et al it was found that 42%, 62.5%, 77% of the households surveyed were found to be consuming adequately iodized salt respectively. [12–14] which is lesser compared to the present study.

A study conducted by Imtiaz A Bhat et al [15] revealed that 74.4% were consuming powdered salt and 24.43% were consuming crystal salt which is nearer to the present study.

A study conducted by Rashmin Singh et al [16] showed that only 27% of households were storing the salt in plastic container which contrasted the present study. Similar study conducted by Renu Verma et al [17] reported that the most commonly (31.5%) used container for storage of salt was glass container in contrast to what was observed in present study.

A study conducted by Ramachandra Kamath et al [18] in the year 2005 in Karnataka revealed an exposure of salt to heat is as high as 56% among the households surveyed which was much higher than the present study. The lower exposure of salt to heat in this study can be because of improved awareness over the storage practices in these years.

In a study done by Dhrubajyothy Chaudhary et al [19] it was observed that 3.3% of households were storing the salt in a container without lid. Other studies carried out by Ansuman Panigrahi, et al [20] and Abedi, A.J. et al [21] have shown that proportion of households storing the salt in open containers were 20.7% and 20.8% respectively.

Various studies done in India has shown the proportion of households consuming salt with adequate iodine was ranging from 42% to 93.3% (Atul Kumar, [12] Rupali roy, [13] Kumar sen, Dhrubajyothi, [14] Lalith Kumar [22], Ansuman Panigrahi [20])

In a study done by Ansuman Panigrahi et al, [20] a significant difference ($p<0.001$) was observed in the proportion of inadequate iodine salt samples among open (79.3%) and closed (31.6%) containers. A study conducted by Rashmi Singh et al [12] had shown that average percent iodine loss was higher in the samples kept at 1-2 ft. than at 5-6 ft. and 10-12 ft. distance from cooking place and lowest from glass jar followed by plastic jar, polybag and masaldan (wooden) jar in agreement with the findings of the present study that salts samples with inadequate iodine were more among the samples exposed to heat and stored in earthenware and polythene bags and none among the glass containers. In a study done by Zosya GED et al [23] it was found that, 93.4% of the participants were aware of iodized salt. Results from another study carried out by Atul Kumar Singh [12] showed that 55.2% had heard about iodized salt which is nearly similar to the results of the present study.

Lalith Kumar et al [20] assessed the knowledge and benefits of iodized salt where they found that 70% of household respondents had heard about iodized salt and 36% responded that its good for health.

CONCLUSION

All the households have access and were using iodized salt and most of them were using salt with adequate iodine content. Quality should be maintained in the salt supplied through public distribution system

Conflicts of Interest:

There are no conflicts of interest in this study.

REFERENCES

1. 1.National Rural Health Mission IDD & Nutrition Cell Revised Policy Guidelines on National Iodine Deficiency Disorders Control Programme ; October 2006. Available from: http://nrhm.gov.in/images/pdf/programmes/ndcp/niddcp/revised_guidelines.pdf.
2. World Health Organization. Effect and safety of salt iodization to prevent iodine deficiency disorders: a systematic review with meta-analyses; 2014. Available from: http://apps.who.int/iris/bitstream/10665/148175/1/9789241508285_eng.pdf.
3. Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers, 3rd ed; 2007. Available from: https://www.who.int/publications/i/item/9789241595827.
4. Zimmermann MB, Jooste PL, Pandav CS. Iodine-deficiency disorders. The Lancet. 2008;372:1251–1262. Available from: https://dx.doi.org/10.1016/s0140-6736(08)61005-3.
5. Pandav CS, Yadav K, Srivastava R, Pandav R, Karmarkar MG. Iodine deficiency disorders (IDD) control in India. Indian Journal of Medical Research. 2013;138(3):418–433. Available from: https://pubmed.ncbi.nlm.nih.gov/24135192/.
6. Ministry of Health and Family Welfare. Annexure referred to in reply to lok sabha unstarred, question no. 3306 for answer on 01.08.2014;. Available from: http://164.100.47.132/Annexture_New/lsq16/2/au3306.htm.
7. Indian National Science Academy. Micro-nutrient security for India– Priorities for research and action; 2011. Available from: http://insaindia.res.in/pdf/Micronutrient-Complete.pdf.

8. Knowles JM, Garrett GS, Gorstein J, Kupka R, Situma R, Yadav K et al. Household Coverage with Adequately Iodized Salt Varies Greatly between Countries and by Residence Type and Socioeconomic Status within Countries: Results from 10 National Coverage Surveys. The Journal of Nutrition. 2017;147(5):1004S–1014S. Available from: https://dx.doi.org/10.3945/jn.116.242586.

9. Kamath VG, Jacob GP, Agrawal A, Kamath A, Shenoy RP. Prevalence of goitre and its associated factors in a coastal district of Karnataka. Indian Journal of Community Health. 2015;27(Supp 1):1–6. Available from: https://www.iapsmupuk.org/journal/index.php/IJCH/article/view/626.

10. Salt Commissioner, Government of India. Salt Iodisation Program in India ;. Available from: http://www.saltcomindia.gov.in/nidccp_iodised_program.html.

11. National Family Health Survey-4. District fact sheet, Udupi, Karnataka; 2015-16. Available from: http://rchiips.org/NFHS/FCTS/KA/Udupi.pdf.

12. Singh AK, Gupta SB, Maheshwari S, Agrawal N. Status of Consumption of Iodized Salt in Rural Population in District Bareilly, UP India. International Journal of Current Microbiology and Applied Sciences. 2015;4(7):585–592. Available from: https://www.ijcmas.com/vol-4-7/Atul%20Kumar%20Singh,%20et%20al.pdf.

13. Roy R, Chaturvedi M, Agrawal D, Ali H. Household use of iodized salt in rural area. Journal of Family Medicine and Primary Care. 2016;5(1):77. Available from: https://dx.doi.org/10.4103/2249-4863.184628.

14. Sen TK, Das DK, Biswas AB, Chakrabarty I, Mukhopadhyay S, Roy R. Limited access to iodized salt among the poor and disadvantaged in North 24 Parganas district of West Bengal, India. Journal of Health, Population and Nutrition. 2010;28(4):369–374. Available from: https://doi.org/10.3329/jhpn.v28i4.6043.

15. Bhat IA, Pandit IM, Mudassar S. Study on prevalence of iodine deficiency disorder and salt consumption patterns in Jammu region. Indian Journal of Community Medicine. 2008;33(1):11. Available from: https://dx.doi.org/10.4103/0970-0218.39236.

16. Singh R, Raghuvanshi RS. Effect of household storage practices on iodine content of iodized salt. Asian Journal of Home Science. 2014;9(2):481–483. Available from: https://dx.doi.org/10.15740/has/ajhs/9.2/481-483.

17. Verma R, Singh S, Yadav A. Iodine content of salt samples collected from rural households of Gonda and Barabanki districts of Eastern U.P. International Journal of Home Science . 2016;2(3):417–419. Available from: https://www.homesciencejournal.com/archives/2016/vol2issue3/PartG/2-3-21.pdf.

18. Ganesh KS, Kamath R, Bhat V, Rao RSP, Das A, Kamath A. Prevalence of Goiter in rural area of Belgaum district, Karnataka. Indian Journal of Community Medicine. 2009;34(1):48. Available from: https://dx.doi.org/10.4103/0970-0218.45373.

19. Choudhury D, Baruah R. Knowledge and practices regarding use of iodised salt and iodine deficiency disorder among the population of Rani, Kamrup(R), Assam . Indian Journal of Basic and Applied Medical Research. 2016;5(4):467–474. Available from: https://www.ijbamr.com/assets/images/issues/pdf/September%202016%20467-474.pdf.pdf.

20. Panigrahi A, Mishra K, Mohapatra B. Status of iodized salt coverage in urban slums of Cuttack City, Orissa. Indian Journal of Community Medicine. 2009;34(2):145–147. Available from: https://dx.doi.org/10.4103/0970-0218.51228.

21. Abedi AJ, Srivastava JP, Mathur KP, Zaidi ZH, Ansari MA. A Study of Consumption of Iodized Salt among Households of District Lucknow, India. Indian Journal of Public Health Research & Development. 2014;5(2):186. Available from: https://dx.doi.org/10.5958/j.0976-5506.5.2.101.

22. Sharma LK, Hossen S. Knowledge, Attitude and Practices of Households on Iodized Salt at Urban Slums in Dhaka City. PIBM research journal. 2016;1(1):39–60. Available from: http://himachalcampus.pibm.in/research-journals/research-paper-4.html.

23. De Zoysa GED, Hettiarachchi M, Jayathilaka KAPW, Liyanage KDCE. Knowledge and practices of iodized salt consumption among pregnant women in Galle district. Galle Medical Journal. 2015;20(1):10–16. Available from: https://dx.doi.org/10.4038/gmj.v20i1.7921.

How to cite this article: Wassey MA, Reddy TSK, Afreen I. Household Salt Iodine Content Estimation and its Association with Salt Storage and Usage Practices. Perspectives in Medical Research. 2025;13(3):152-156 DOI: 10.47799/pimr.1303.25.36