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Original Research Article

Exploring iodized salt consumption and storage practices in urban slums of Bhubaneswar: a cross-sectional analysis

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ABSTRACT

Background: Salt iodization is the most effective public health intervention to prevent iodine deficiency disorders. This study aimed to estimate the proportion of households using adequately iodized salt at the consumer level and assess knowledge and practices regarding iodized salt usage and storage. The study also assessed the association between salt storage practices, awareness about iodized salt, and iodine levels in salt.
Methods: A cross-sectional study was conducted in the urban slums of Bhubaneswar from May to July 2022. The required sample size was calculated to be 95 households, selected through systematic random sampling proportionate to the size of each ward. The multibus interface (MBI) kit was used for spot testing of iodine. Data analysis was performed using SPSS version 26.0.
Results: The proportion of households using adequately iodized salt was 91.6%. About 13.7% stored salt in open containers, 65% near the fire/gas, 21.1% stored salt for more than four weeks, and 7.4% had moisture in their salt. About 53% of households added salt in the beginning of cooking and 81% of respondents had poor knowledge about iodized salt. Storing salt in open containers or sacks was significantly associated with inadequate iodine levels in salt (p value: 0.01).
Conclusions: While the consumption of adequately iodized salt meets the target level of 90%, poor awareness and improper storage practices are still prevalent. Education on proper storage, handling, and the importance of iodized salt is crucial to increase community awareness and improve iodine levels in salt.

Keywords: Iodized salt, Salt iodization, Salt storage practices

INTRODUCTION

Iodine is an essential micronutrient required for optimal mental and physical development in human beings. Iodine deficiency disorders (IDD) continue to be a significant nutritional deficiency disorder throughout India.[1] Iodine deficiency disorders (IDD) encompass a range of disabilities and disorders such as goiter, hypothyroidism, cretinism, abortion, stillbirth, mental retardation, and psychomotor defects. A majority of these consequences are invisible and irreversible but are entirely preventable.[2]

As per the surveys conducted by the Directorate General of Health Services, Indian Council of Medical Research, out of 414 districts in India, 337 districts had a prevalence of IDD more than 5%.[1] In Odisha, out of 20 districts surveyed under the National Iodine Deficiency Disorders Control Programme (NIDDCP), 17 are found endemic to goiter with a goiter prevalence of >10%, including the district Khordha. The prevalence rate of goiter in Odisha ranges from 30.18% in central Odisha to 10.8% in western Odisha.[3,4] In a study done in the urban slums of Bhubaneswar, the goiter's prevalence was 23.6%.[5]

Salt iodization is the most effective long-term public health intervention for achieving optimal iodine nutrition and preventing iodine deficiency disorders. Under the NIDDCP, the iodine levels in the salt at the consumer level should be at least 15 parts per million.[3] However, what reaches the consumer is not universal yet, as was seen in the India Iodine Survey 2018-19 report, where Odisha ranked fourth among the states with the lowest household coverage with iodine content (65.8%).[4]

Inadequate iodine in salt at the consumer level occurs due to losses during transportation, storage, weather conditions like moisture and heat, and household cooking practices. The India Iodine survey report evaluated the iodine content in salt, relying on participants to provide samples rather than directly collecting from households. Additionally, they assessed participants' knowledge of iodized salt but did not directly observe storage and cooking practices.

Hence, this study aimed to estimate the proportion of households using adequately iodized salt at the consumer level in the urban slum areas of Bhubaneswar and assess the salt storage, cooking practices, and their knowledge regarding iodized salt. The study also aimed to find the association between salt storage practices with the iodine level in salt.

METHODS

Study design and setting

We did a cross-sectional analysis in the Urban slum pockets of Bhubaneswar in the Khordha District of Odisha from May 2022 to July 2022. All four wards under the field practice area of urban health training centre (UHTC) Nayapalli were selected for the study. The households in the slum pockets of these wards constituted the sampling frame.

Sample size calculation and recruitment of samples

The sample size was determined based on the proportion of households using iodized salt in Odisha, which was reported as 65.8% in the India Iodine Survey 2018-19.[4] Considering a relative precision of 10% and a 95% confidence interval, the required sample size was estimated to be 86. After accounting for a 10% non-response rate, the final sample size was 95 households. The samples taken from each ward were proportionate to their size, and systematic random sampling was done to select the households with a sampling interval of 35.

All households with cooking facilities were included in the study. The person in the household above 18 years who cooks food most often was assessed for their knowledge regarding iodine deficiency. The households not willing to consent to conduct the study at their homes were excluded.

Study tool

Multibus interface (MBI) kit was used for spot testing of Iodine at the household level. A semi-structured questionnaire was used in the study which covers the sociodemographic profile of the family, knowledge regarding iodized salt, and an observational checklist was used for assessing the storage practices of iodized salt.

Procedure of salt iodine estimation

To assess the iodine content in salt, the respondent was asked to bring a teaspoon of salt used for cooking. The salt was then tested for iodine using the starch-based iodine rapid test kit on the spot by adding one to two drops of test solution, which was then gently mixed. The kit gives a semi-quantitative estimation to measure iodine in salt at 0, 5, 15 and 30 ppm depending on the strength of color obtained. The color was matched with the color chart provided with the testing kit. If no color was obtained, another teaspoon of salt was taken, and one to two drops of recheck solution were used, and again, the color was matched with the color chart. Iodine content equal to or more than 15 parts per million (ppm) was considered adequately iodized salt.

Statistical analysis

Data was collected in the Epicollect app using a self-structured questionnaire and exported to MS Excel. Data analysis was done using SPSS version 26.0. Categorical variables were presented as percentages or proportions, and continuous variables were expressed in mean and standard deviation. The association of the iodine content of salt and household salt storage habits were estimated using the Chi-square test.

RESULTS

The study participants' mean age was 38.43±13.36 years. Most participants were aged between 18 to 40 years (60%), followed by 34.7% in the age group 41-60 years and only 5.3% participants were above 60 years. Most participants were Hindus (95.8%), with Muslims and Christians making up smaller proportions (2.1% each). Most of the participants resided in semi-pucca houses (94.7%) and belonged to nuclear families (72.6%). Education levels of Head of the Households varied, with a significant proportion having completed high school (37.9%) or intermediate/diploma (11.6%), while some were illiterate (16.8%). Regarding socioeconomic status, the majority fell into the upper-lower (52.6%) and lower-middle (40%) categories (Table 1).

Table 1: Sociodemographic details of the study participants (n=95).

Parameters	Frequency N (%)
Age (in years)	
18-40	57 (60)
41-60	33 (34.7)
>60	5 (5.3)
Religion	
Hindu	91 (95.8)
Non-Hindu	4 (4.2)
Caste	
General	26 (27.4)
OBC	26 (27.4)
SC/ST	43 (45.2)
Type of house	
Pucca	5 (5.3)
Semi pucca	90 (94.7)
Type of family	
Nuclear	69 (72.6)
Joint	26 (27.4)
Education of the head of the household	
Illiterate	16 (16.8)
Primary school	9 (9.5)
Middle school	20 (21.1)
High school/ intermediate	47 (49.5)
Graduate	3 (3.2)
Occupation of the head of the household	
Skilled workers	50 (52.6)
Unskilled workers	44 (46.3)
Unemployed	1 (1.1)
Socioeconomic status	
Lower	5 (5.3)
Upper lower	50 (52.6)
Lower middle	38 (40)
Upper middle	2 (2.1)

Table 2: Details on salt procurement.

Parameters	Frequency N (%)
Source of procurement of salt	
General store	15 (15.8)
Local market	80 (84.2)
Decision on buying salt	
Head of the household	48 (50.5)
Spouse of the head of the household	33 (34.7)
Other male adult family member	7 (7.4)
Other female adult family member	7 (7.4)
Purchasing salt most often	
Head of the household	57 (60)
Spouse of the head of the household	23 (24.2)
Other male adult family member	8 (8.4)
Other female adult family member	6 (6.3)
Children (<18 years)	1 (1.1)
Factors determining buying of salt	
Price	41 (43.2)
Brand	46 (48.4)
Availability	8 (8.4)

Table 3: Salt storage and cooking practices among the households.

Parameters	Frequency N (%)
Average duration of storing salt	
<4 weeks	75 (78.9)
4-8 weeks	20 (21.1)
Medium of salt storage	
Plastic container with lid	77 (81.1)
Plastic container without lid	8 (8.5)
Glass container with lid	5 (5.2)
In the same pouch/sack/bag	5 (5.2)
Stored near gas/stove	
Yes	62 (65.3)
No	33 (34.7)
Moisture content in salt	
Yes	7 (7.4)
No	88 (92.6)
Time of adding salt	
At the beginning of cooking	50 (53)
In the middle of cooking	32 (34)
Immediately before the end of cooking	11 (11)
After cooking	2 (2)

Table 4: Knowledge regarding iodized salt.

Items	Responses	Frequency N (%)
Ever heard of iodine in salt	Yes	31 (32.6)
	No	64 (67.4)
Benefits of Iodized salt	Prevents thyroid diseases	4 (4.2)
	Improves intelligence	8 (8.4)
	Don't know	83 (87.3)
Source of information on iodized salt	TV/Radio	25 (26.3)
	Social media	5 (5.3)
	Health personnel/educational institution	1 (1.1)
	Don't know	64 (67.4)
Does every salt contain Iodine?	Yes	8 (8.4)
	No	21 (22.1)
	Don't know	66 (69.5)
Do you buy iodized salt?	Yes	44 (46.4)
	No	1 (1.1)
	Don't know	50 (52.6)
How do you know if the salt is iodized?	Name of the brand	21 (22.1)
	Word iodized	16 (16.8)
	Shopkeeper tells me so	2 (2.1)
	Don't know	56 (59)
Taste of iodized salt is different	Yes	4 (4.2)
	No	21 (22.1)
	Don't know	70 (73.7)

The majority of participants procured salt from local markets (84.2%), while 15.8% procured from general stores. In terms of decision-making, the head of the household was primarily responsible for purchasing salt (50.5%), followed by the spouse of the head of the household (34.7%). Factors determining the buying of salt varied. The most common factor influencing was price (43.2%) and brand (48.4%), while availability (8.4%) played a lesser role (Table 2).

The proportion of households using adequately iodized salt was 91.6%. The details of salt storage and cooking

practices among households were surveyed in the present study. Most households stored salt for less than 4 weeks (78.9%). Plastic containers with lids were the most common medium for salt storage (81.1%), followed by plastic containers without lids (8.5%). Fewer households stored salt in the same pouch/sack (5.2%).

A significant number of households stored salt near the gas or stove (65.3%), potentially exposing it to moisture and heat. About 7.4% salt samples were found to have moisture content. Regarding cooking practices, most households added salt in the beginning of cooking (53%) or the middle of cooking (34%) (Table 3).

Table 5: Association of salt storage practices with adequacy of iodine in salt.

	N (%)	Inadequate iodine N (%)	Adequate iodine N (%)	Odds ratio	95% CI	P value
Storage practice						
Container with lid	82 (86.3)	3 (37.5)	8 (9.2)			
Container without lid or in pouch/sack	13 (13.7)	5 (62.5)	79 (90.8)	5.9	0.12-0.30	0.001*
Total	95	8	87			
Near gas/stove						
Not near gas	62 (65.3)	3 (37.5)	59 (67.8)			
Near gas	33 (34.7)	5 (62.5)	28 (32.2)	0.3	0.06-1.28	0.093
Total	95	8	87			
Moisture content						
Absent	88 (92.6)	3 (37.5)	83 (95.4)			
Present	7 (7.4)	5 (62.5)	4 (4.6)	0.03	0.01-0.46	0.012*
Total	95	8	87			
Knowledge regarding iodized salt						
Good	18 (18.9)	0	18 (20.7)			
Poor	77 (81.1)	8 (100)	69 (79.3)	-	0.83-0.97	0.17
Total	95	8	87			

*Statistically significant

Around two-thirds of respondents (67.4%) reported having heard of iodine in salt. When asked about the benefits of iodized salt, only 12.6% correctly identified its benefits. The most common sources of information on iodized salt were television/radio. About 8.4% believed that every salt contains iodine, and the majority (69.5%) were unsure. While majority of the respondents (57.9%) brought the salt without knowing the iodization status, some brought it by seeing the brand names (22.1%), or by seeing the word "iodized" on the packet (16.8%) (Table 4).

The present study found that 81.1% of participants had poor knowledge about iodized salt, and only 18.9% had good knowledge.

The association between salt storage practices and the adequacy of iodine content in salt was assessed. Salt stored in containers without lids or in the original pouch/sack was 5.9 times more likely to have inadequate iodine levels compared to salt stored in containers with lids, and this association was statistically significant (p=0.001) (Table 5).

DISCUSSION

Despite advancements in public health initiatives, there remains a paucity of recent studies on iodized salt usage and storage practices in urban slum settings, particularly in Bhubaneswar city. This highlights the need for updated insights to inform public health strategies. Hence this study was done to address this gap by providing contemporary data on the prevalence of adequately iodized salt usage and associated storage and cooking practices.

The proportion of households using adequately iodized salt in this study was 91.6%, which is higher than the findings of Chauhan et al in the tribal district of Himachal Pradesh (84.7%) but lower than the findings of Konda et al in Telangana (96.3%).[6,7] These variations may be attributed to differences in geographic, socio-economic, and educational contexts, as well as the effectiveness of local health promotion initiatives.

In terms of salt storage practices, this study observed that 86.3% of households stored salt in containers with lids, while 13.7% stored salt without an airtight lid. Improper storage practices can lead to loss of iodine content, underscoring the need for targeted health education. Similar findings were reported by Anwar et al, who identified a significant association between salt storage practices and iodine content (p value <0.001).[8] This aligns with the present study's observation of a significant association between storage practices and iodine retention.

Cooking practices also play a crucial role in determining iodine content retention. In this study, 53% of households added salt at the beginning of cooking, 34% in the middle, 11% just before the end, and only 2% after cooking. These practices are consistent with the findings of Karmakar et al, where the majority (60.4%) added salt in the middle of cooking, 37.4% at the beginning, and only 1.9% at the end.[9] The study by Mukherjee et al also found that very few participants added salt at the end of their cooking.[10] Adding salt earlier during cooking results in greater iodine loss due to prolonged exposure to heat, emphasizing the need for awareness programs to promote better cooking practices.

Awareness of iodine deficiency disorders (IDD) and the benefits of iodized salt was notably low among the study population. Only 32.6% of households were aware of IDD, which is comparable to the findings of Konda et al (26.1%).[7] Similarly, only 13.7% of respondents in this study were aware of the benefits of iodized salt, which is significantly lower than the 30.9% reported by Mukherjee et al.[10] This highlights a critical gap in health literacy and underscores the importance of community-based educational programs in the study region.

A major strength of this study is the direct observation of salt storage behaviour at the household level, which minimizes reporting bias and enhances data accuracy. The use of a validated iodine rapid test kit for on-the-spot testing further ensured reliable field-level estimation and reduced recall bias. Systematic random sampling with proportional allocation improved representativeness and reduced selection bias. However, being cross-sectional, it cannot establish causality between storage practices and iodine adequacy and the findings may not be generalizable beyond the urban slum population studied.

The information provided in this study can be utilized to prevent iodine deficiency disorder in the areas and provide data about the current status of the iodized salt consumption in the urban slum pockets of Bhubaneswar. This study underscores the need for sustained efforts to improve awareness about the importance of iodized salt, promote proper storage and cooking practices, and address gaps in knowledge about IDD. These findings provide a foundation for tailored interventions in slum pockets and emphasize the need for ongoing research to monitor trends and inform public health policy.

CONCLUSION

Consumption of adequately iodized salt in the study area has reached the universal target level. But poor awareness and faulty storage practices regarding iodized salt are still prevalent. Specific education regarding proper storage, handling, and the importance of iodized salt needs to be implemented to increase community awareness.

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