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Research Article

Household Coverage with Adequately Iodized Salt in an Endemic District of North India and Their Common Practices Affecting Iodine Content of Salt

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Abstract: Background: Over one and a half billion people worldwide are still not consuming adequately iodized salt and are, at a risk for iodine deficiency disorders. Himachal Pradesh in India is a known endemic region to iodine deficiency. Despite significant progress through the supply of iodized salt, population in this region still continues to suffer from chronic iodine deficiency. Current survey was done to estimate household coverage with adequately iodized salt and to assess common storage and cooking practices affecting iodine content of salt. Methods: A survey was conducted in 402 households of Solan district of Himachal Pradesh. MBI rapid salt iodine testing kits were used to determine iodized salt coverage while a pre tested semi structured questionnaire was used to assess storage and cooking practice affecting iodine content of salt. Observations: Household coverage of adequately iodized salt was found to be 94.03% (95% CI 91.2- 96.1%). Only 3 out of 4 respondents were using air tight, wide base container as the preferred mode for salt storage at household level. Half the respondents were consuming salt within 4 weeks of opening the packet and only one third were keeping salt container beyond appropriate distance from heat source. 3 out of 4 respondents were adding salt at the time of gravy preparation, while only 1 in 10 respondents were adding it at the end of cooking. Conclusion: Despite high iodized salt coverage, faulty storage and cooking practices poses a challenge for elimination of iodine deficiency in this region.

Keywords: Iodized salt, Iodine deficiency, Household coverage, Iodine.

BACKGROUND:

Iodine is an essential micronutrient for humans required in a very small quantity for normal functioning of thyroid gland (WHO. 2017). Daily recommended amount of iodine intake is 150–200 µg/L for adults, 90–120 µg/L for children and 250 µg/L for pregnant & lactating mothers, which if not consumed leads to a diverse variety of health problems popularly described as Iodine Deficiency Disorders (IDDs) (IDD. 2008; WHO.2007). IDDs are associated with many thyroid related diseases including hypothyroidism, hyperthyroidism, goiter and cretinism, and also inherit real risk of coronary artery diseases, autoimmune disorders, psychiatric disorders, cognitive impairment, and cancer. Iodine Deficiency is the also the most common preventable cause of intellectual impairment (Patrick, L. 2008; Verheesen, R.H., & Schweitzer, C.M. 2008; Simone, C. 2010).

IDDs remain a significant public health problem in over 50 countries including India. Over one and a half billion people worldwide are still not consuming adequately iodized salt and are, as a result, not protected against IDDs (Andersson, M. *et al.*, 2012). An estimated 167 million people in India are at risk of IDDs. Of these, 54 million suffer from goiter, 2 million suffer from cretinism, and 6.6 million children have neurological deficits (Yadav, K., & Pandav, C.S. 2018). Various surveys conducted in different part of country had revealed that no state in India is free from IDDs (Kamath, R. *et al.*, 2009).

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Natural iodine content of foods is not adequate enough to meet our daily iodine requirements and iodization of salt is first line measure to prevent and control IDDs. The salt iodization program was introduced in India in 1962 as the National Goitre Control program. In 1992 the program was renamed as the National Iodine Deficiency Disorders Control Program (NIDDCP) to combat the disorders due to iodine deficiency (Tiwari, B.K. *et al.*, 1995). In spite of universal salt iodization which was made mandatory in the country from 2005, only 71% of households were consuming adequately iodized salt as per the Coverage Evaluation Survey, 2009 (UNICEF. 2010). According to the NFHS 4 conducted in 2015 - 2016, 93.1% households (96.5% in urban area and 91.4% in rural area) in the country consumed salt which is iodized. As per the NFHS 4, 99.1% households (99.3% in urban area and 99.1% in rural area) in the state of Himachal Pradesh consumed iodized salt (National Family Health Survey (2015-16).

Iodine content of salt has been shown to be reduced due to personal and environment factors in spite of proper iodization at production level. Exposure to excessive heat and light, faulty storage, poor handling or cooking practices and buying non-iodized salt are some of the cause for low iodine content in salt (Ethiopian Demographic and Health Survey. 2015; Pieter, L.J.M., & Lombard, C.J. 2015; Pan American Health Organization. 2011; Zimmermann, M. 2011). Since iodine readily sublimes in certain environmental conditions, normally the iodine content in salt is fixed at higher level (30–100 µg of iodine in 1 g of salt). This dosage is determined after taking into account anticipated losses during transportation and storage. In India, salt is iodized at a level of 30 µg of iodine in 1 g of salt at production level and it is expected to be 15 µg of iodine in 1 g of salt at consumer level (WHO, UNICEF, ICCIDD. 2008; Government of India. 2019; Rana, R., & Raghuvanshi, R.S. 2013).

Himachal Pradesh in India is a known endemic region to iodine deficiency. The Kangra Valley experiment (1956-1961) that led to initiation of the National Goiter Control Program, in 1962 is also conducted in one of the district of Himachal Pradesh (Kapil, U. 1998). A significant progress has been made in the control of IDDs through the supply of iodized salt. However, recent studies conducted in this region have revealed that the population continues to suffer from chronic iodine insufficiency (Kapil, U. *et al.*, 2000; Kapil, U. *et al.*, 2007; Sohal, K.S. *et al.*, 1999). A study conducted among school age children and pregnant women in year 2012-14 reflect high total goiter rate (15.4%) and low mean urine iodine concentration (<100 µg/L) in district Solan (Kapil, U. *et al.*, 2015).

Keeping in sight all these contrasting results from various agencies Department of Community Medicine, IGMC Shimla and National Health Mission, Himachal Pradesh decided to commission a fresh study in order to estimate consumption of iodized salt in Solan city. The aim of the present survey was to estimate the uptake of adequately iodized salt at the household level. We also tried to assess the knowledge and practices with respect to the storage and use of iodized salt among respondent of survey.

METHODS:

A community based cross sectional survey was conducted in 15 wards of Municipal corporation area of Solan City of Himachal Pradesh located in the south-western ranges of the Himalayas in March 2019.

402 Households were selected using stratified random sampling distributed over 15 wards of city. (Minimum sample size was estimated to be 394, expecting 80% of the household consuming adequately iodized salt with 95% level of confidence, 5% absolute error, design effect of 1.5 and non-response rate of 5%).

The survey team, consisting of medical social workers and residents of department of community medicine, were given training regarding the estimation of iodine in salt with the help of MBI kits and administration of the questionnaire. A semi structured questionnaire containing information on type of salt use, quantity of salt intake, storage practices, cooking practices and knowledge about iodine deficiency was prepared, validated and pre tested in local vicinity of IGMC Shimla. Surveyors after obtaining the consent from the head of family filled this questionnaire by taking information from the member of family most frequently involved in cooking. Respondents were asked questions regarding salt purchasing and consumption habits, benefits of Iodine, and iodized salt awareness etc. After that salt iodine content was tested by using rapid salt iodine testing kit in front of family and the results were conveyed to them.

The collected data was thoroughly screened and entered in Microsoft Excel spreadsheet 2007 for further analysis. Statistical analysis was done by using Epi Info 7 software. Descriptive statistics (frequency, percentages and 95% confidence interval) were determined for categorical variables and were presented in tables or figures.

Observations:

A total 402 households from all 15 wards of municipal corporation area of Solan City had been surveyed for iodized salt coverage, using MBI salt Iodine detection kit. Most of the respondents were female (92.8%) belonging to younger age groups and nuclear family (Table 1). Per capita salt consumption was found to be 9.34 ± 2.12 grams/day. 94.5% (n-380)

of households in Solan city were using iodized salt in current survey.

Table 1: Demographic profile of study participants (n-402)

Age groups (years)	Frequency (n)	Percentage (%)
18-30	140	34.83
31-45	120	29.85
45-60	86	21.39
> 60	66	16.42
Gender		
Female	373	92.79
Male	29	7.21
S.E. Status (According to Modified KS Scale 2019)		
Class I-II	146	36.32
Class III	151	37.56
Class IV-V	105	27.12
Respondents Education		
Illiterate/Primary	62	15.42
High school	32	7.96
Secondary education	93	23.13
Senior secondary	112	27.86
Graduate or above	103	25.62
Respondents occupation		
House maker	262	65.17
Government job	90	22.39
Private job	50	12.44
Type of family		
Nuclear	317	78.86
Joint	85	21.14
Type of salt being used		
Iodized	380	94.53
Non-iodized	22	5.47

Table 2: Results of Rapid Salt Iodine detecting Kit (Household iodized salt coverage):

Iodine content (ppm)	Interpretations	Frequency	Proportion	95% CI
0	No iodine	5	1.24	0.4-2.9
1-15	Inadequate iodine	19	4.73	2.9-7.3
15-30	Adequate iodine	104	25.87	21.7-30.4
> 30	Adequate iodine	274	68.16	63.4-72.7

The present study shows that 94 % (91.2- 96.1%) of households were consuming adequately iodized salt. 6% (4.33 – 9.3%) of the sample had inadequate iodine content (less than 15 ppm) at the time of testing. (Table 2) (Figure I).

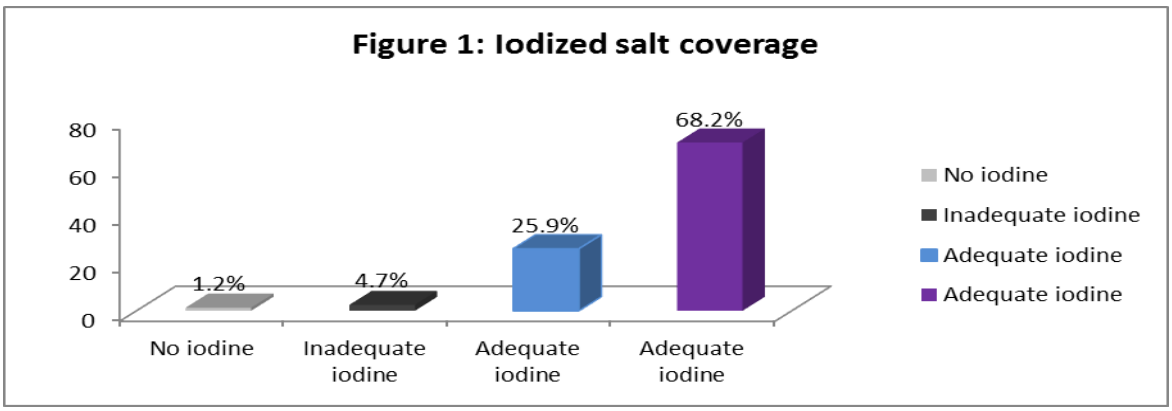

Fig-1

88.3% respondents in Solan city had heard about iodine. Mass media (TV/Radio/Internet) was found the primary source of information in most of the cases. Roughly half to three fourth of the respondents either don't have much knowledge or had wrong knowledge about iodine or iodized salt. (Table 3) Similarly, only half the respondents were aware of importance of iodine / iodized salt and its role in normal growth and prevention of diseases. (Figure II)

Table 3: Knowledge of survey respondents regarding iodized salt:

Heard of Iodized salt	**Yes**	**No**
	355 (88.3%)	47 (11.7%)
Source of information	**Frequency**	**%age**
1. Television /Radio/ Internet	321	90.42
2. Newspaper/ Poster	4	1.13
3. Health personnel	9	2.54
4. Others (Friends, relatives etc.)	21	5.92

Knowledge (n-355)	**Response**		
	Yes	**No**	**Don't Know**
Every salt don't contain iodine	168 (41.8%)	44 (10.9%)	190 (47.3%)
Iodine content ↓ when salt not stored properly	104 (25.87%)	38 (9.45%)	260 (64.7%)
ID cause Mental retardation in children	112 (27.86%)	19 (4.73%)	271 (67.42%)
ID cause Growth retardation in children	131 (32.59%)	17 (4.23%)	254 (63.2%)
Taste of iodized salt is same of common salt	189 (47%)	99 (24.6%)	114 (28.4%)

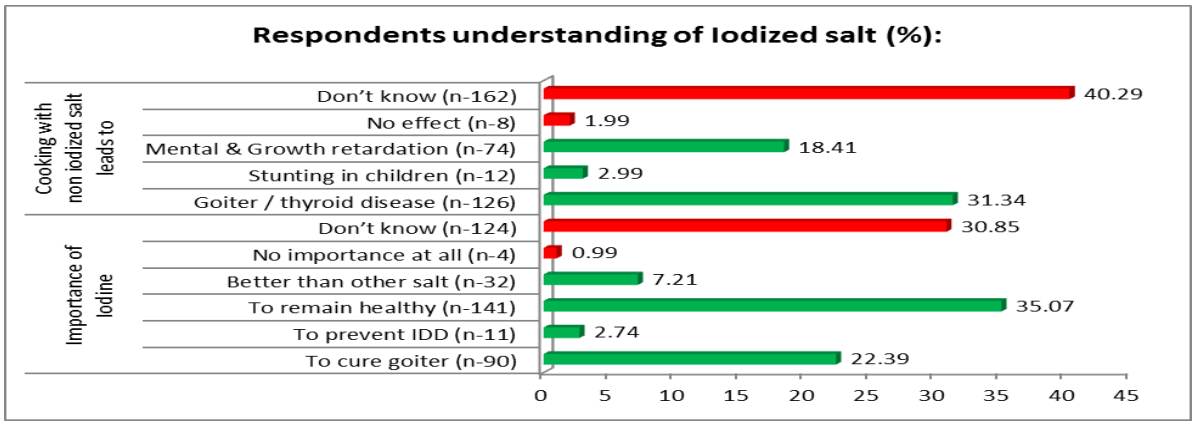

Figure II: Respondents understanding of Iodized salt:

In the present survey 76.12% of respondents were using air tight plastic container for storage of salt. 75% of them were using wide base container for storage of salt. 88.06% respondents never practice exposing salt to heat and light. Almost half the respondents was consuming salt within 4 weeks after opening of packet. 69.15% respondents were keeping salt container within 2-4 feet from stoves/gas chulha (Table 4).

Table 4: Storage practices of salt among survey respondents:

Type of container	Frequency	%age
1. Air tight glass container	35	8.71
2. Open glass container	4	1.00
3. Air tight steel container	16	3.98
4. Open steel container	25	6.22
5. Air tight plastic container	306	76.12
6. Open plastic container	16	3.98
Shape of container		
1. Wide base	305	75.87
2. Narrow base	97	24.13
Dampness/moisture observed in salt		
1. Never	244	60.70
2. Some time	143	35.57
3. Often	15	3.73
Exposing moisturized salt to light or heat		
1. Never	354	88.06
2. Some time	37	9.20
3. Often	11	2.74
Average duration needed to consume salt after opening of packet		
1. Less than 2 weeks	21	5.22
2. 2 – 4 weeks	198	49.25
3. 5 – 8 weeks	160	39.80
4. More than 8 weeks	23	5.72

Distance of salt container from stove/gas chulha		
1. Less than 2 feet	112	27.86
2. 2-4 feet	278	69.15
3. More than 4 feet	12	2.99

Boiling (63.68%) was the most common cooking practice found in the survey followed by frying and steaming. Majority of respondents (80.59%) were adding salt at the start of gravy preparation, followed by during gravy preparation, while only few (9.20%) were adding at the end of cooking (Table: 5).

Table 5: Common cooking practices among survey respondents:

Most common cooking practices	Frequency	Proportions
1. Frying	134	33.33
2. Steaming	12	2.99
3. Boiling	256	63.68
Timing of Salt added to food		
1. At the start	324	80.59
2. During	41	10.19
3. At the end	37	9.20
4. At the time of serving	1	0.24

DISCUSSION:

Household coverage of adequately iodized salt was found to be 94.03% (91.2- 96.1%) in current survey which is slightly less than 99.1% what was reported in NFHS 4 (2015-16) for the same region (National Family Health Survey. 2015-16). Coverage is better than what has been reported by National Iodine and salt intake report 2015 (86.4%) and overall national average value (93.1%). (AIIMS. 2015; National Family Health Survey. 2015-16). According to the WHO and International Council for Control of Iodine Deficiency (ICCIDD) standard, elimination of IDDs will be possible if over 90% of the households consume adequately iodized salt (World Health Organization. 2007). Coverage in current survey reflects an encouraging progress toward achieving elimination of IDDs in this region of country. This further support the claim of IDDs control program as one of the success stories of public health in India (Yadav, K., & Pandav, C.S. 2018).

Daily per capita salt consumption in Solan city was found to be 9.34 ± 2.12 grams which is greater than the 5 grams per day as per the recommendation by W.H.O. Global action plan for the prevention and control of NCDs (Rana, R., & Raghuvanshi, R.S. 2013). Restricting salt intake to less than 5 grams per day is advisable to reduce blood pressure and risk of cardiovascular disease, stroke and coronary heart attack.

Most of respondents (88.3%) had heard about iodine and the major source of information was mass media (TV, Radio & Internet). But more than half of the respondents either didn't have much knowledge or had wrong knowledge about iodine or iodized salt. Similarly half of respondents were unaware of importance of iodine / iodized salt and its role in normal growth and prevention of diseases.

Similarly storage and cooking practices as determined in this survey reflect their poor knowledge of handling the iodized salt before consumption. Only 3 out of 4 respondents were using air tight, wide base container as the preferred mode for salt storage at household level. Most of the respondents (88%) claimed to avoid exposing salt to excessive heat and light. However only half the respondents were consuming salt within 4 weeks after opening of packet and only one third (31%) were keeping salt container beyond appropriate distance from stoves/gas chulha. Boiling was the most common cooking practice found in this survey followed by frying and steaming. 3 out of 4 respondents were adding salt at the time of gravy preparation, while only 1 in 10 respondents were adding it at the end of cooking. Loss of iodine depends upon type of cooking method and time at which salt is added while cooking (Rana, R., & Raghuvanshi, R.S. 2013). Therefore, persistence of IDDs or chronic iodine deficiency as reported by various studies in this region (Kapil, U. *et al.*, 2000, 2015, 2007; Sohal, K.S. *et al.*, 1999) despite of high iodized salt coverage may be due to faulty cooking and to some extent storage practices. To prevent iodine losses, it is advisable to store salt in air tight wide base container and add it to food items as late as possible during cooking rather than at the start as practiced traditionally in this region.

Use of mass media has been recommended as an appropriate strategy for the prevention of IDDs for a number of reasons (Can, G. *et al.*, 2001). The mass media have the potential to reach large proportions of the population which cannot readily be accessed through other channels. The message at present merely asks substituting salt use with iodized salt use which can be further reinforced with the adequate information about storage and cooking practices.

In spite of the fact that IDDs control program is there for almost six decades, still we almost have nil to little data regarding sustainability and impact indicators for monitoring of IDDs nationwide. Further

efforts are required in this direction for ensuring our commitments toward the elimination of IDDs as a public health problem.

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Conflict of interest: None

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