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DETERMINING THE IODINE CONTENT IN SALT AND FACTORS AFFECTING ITS UTILIZATION AT THE HOUSEHOLD LEVEL IN THE URBAN FIELD PRACTICE AREA OF A MEDICAL COLLEGE, GANGTOK

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ABSTRACT **Background:** Iodine is an essential micronutrient normal human growth and development and the most efficacious long term public intervention for attaining ideal iodine nutrition is salt iodization. Effective salt iodization is a pre-requisite for the sustainable elimination of iodine deficiency disorders. The study aimed to determine the iodine content of salt used in households utilizing the rapid iodine testing kit with a view to determine number of households using adequately iodized salt i.e. ≥ 15 PPM and assess the practices of people in households with respect to storage and utilization of adequately iodized salt. **Methods:** This community based cross sectional study was conducted at urban field practice area where a total of 200 households were surveyed. Pretested semi-structured questionnaire was administered and salt was tested for iodine content using MBI kit. The respondents were asked questions regarding salt purchasing, awareness of iodized salt, consumption habits, salt storage, and iodine deficiency diseases. **Result:** 88.5% are covered with adequately iodized salt. 26.5% salt was not stored in closed containers in the household, so exposing it to moisture, heat & sunlight. Family size (P value=0.036), type of salt bought (P=0.035), exposure of salt to sunlight (Chi-square value-10.87, P<0.001) place (Chi-square value-25.5, P<0.001), and type of container used for storage of salt (Chi-square value-13.83 P <0.001) were significantly associated with the poor content of iodized salt at home.91% households used packed salt however 28.5% had not heard about packed salt. **Conclusion:** There should be regulatory enforcement of salt iodization and regular quality control at household level.

KEYWORDS : households; iodine content; iodized salt; MBI test kit

INTRODUCTION

Iodine is an essential micronutrient required daily at 100-150 micrograms for normal human growth and development [1]. Out of 414 districts surveyed in all the 29 States and 7 Union Territories, 337 districts are endemic [2] Sikkim, the small hilly state in the eastern Himalayas lies in the zone of iodine deficiency. [3] In 1994, Universal Salt Iodization(USI) was recommended as a safe, cost-effective and sustainable approach to ensure adequate intake of iodine by all individuals. [4] At the consumer level, the level of iodization is fixed at 15 parts per million(PPM) according to National Iodine Deficiency Disorders Control Programme (NIDDCP) in India. [5]. Edible salt is an ideal vehicle for iodine fortification because everyone consumes salt, thus easily distributable to the entire population in an inexpensive way. More than all added iodine does not affect the appearance and taste of salt and is well accepted at the consumer level [6]. Salt iodization is considered the most effective long term public intervention for achieving optimal iodine nutrition and staving off iodine deficiency programmes. [4] Despite its stability, losses are imminent because of transportation, storage, weather conditions like moisture and heat and cooking in households.

MBI kit is used to test the iodine content at household level briskly and effectively. In addition to monitoring, these kits are powerful tools for advocating and educating consumers about health. [8]
In a study conducted in North India, 80% of salt samples were found to contain less than the minimum recommended level set by the government i.e. >90%. A compelling need for accurate monitoring of iodine content at different stages i.e. production, distribution, storage, and wholesale was implicated so as to warrant a minimum recommended level at the households. [9]

In this background this study was conducted to assess the iodine content of salt and practices of people used at the household in the east district of Sikkim, India. No other study has been carried out on the utilization of adequately iodized saltin this study area which is subject to diverse climates.

Hence this study was undertaken to impart information regarding the current utilization of adequately iodized salt at the consumer level in the urban field practice area and how we can utilize this information in prevention of iodine deficiency disorders

MATERIALS AND METHODS

The study was a descriptive, community-based cross sectional study conducted at urban field practice area of a medical college at Gangtok under the Department of Community Medicine for over 2 months with a sample size of 200. Two areas were selected using lottery method and households were identified by using purposive sampling**.** All consenting adults above 18 years and member of the house who is responsible for buying food items and engaged in preparation of food were included in the study.

After requisite clearances, preliminary to the administration of the questionnaire, the test MBI rapid iodine test kit was pre-tested in around 20 households in nearby areas not selected for the study. Just before the interview and salt testing, informed consent was taken from both, head of the house and respondent. Institutional Ethics Committee clearance was obtained before initiating the study.

Data was collected using a pretested and a semi-structured questionnaire. The questionnaire was developed employing some questions from a similar study conducted in Kazakhstan. [10] The proforma and questionnaire sought information on socio-demographic characteristics, educational status, income environmental factors, salt purchasing, consumption habits and utilization of iodized salt. To assess the content of iodine in salt, the respondent was asked to bring a teaspoon of salt used for cooking. The salt was tested for iodine using the starch-based iodine rapid test kit (MBI Kit). The kit gave a semi-quantitative estimation to measure iodine in salt at 0,7,15 and 30 PPM depending on the strength of colour obtained.

The cut-off proportion of 15 PPM and above was considered as adequately iodized salt.[11]

The analysis was done using Microsoft Word Excel 2016. The association of the iodine content of salt by rapid iodine testing kits and household habits was tested by using the Chi-square test. A p-value of <0.05(two-tailed) was used as cut off point for statistical significance at the 95% confidence intervals.

RESULTS

The households for the study were selected from two areas, namely, Gairigaon (41.4%) and Daragaon (58.6%) from Gangtok, East Sikkim. About 91% of the respondents were women. Most of them (72%) were between the age of 20–40 years. The respondents' mean age(SD) was 30.2 (7.3) years.

The percentage of adequate iodized salt found in households is demonstrated in Figure 1. 53(26.5%) households who did not use a closed container for the storage of their salt, 20(10%) of the samples

were tested for <15 PPM iodine content in their salt. Of the 9% of the households that did not buy packed salt from the market showed iodine, 3.5% of them had content of <15PPM in their salt.

The household practices regarding use of salt and household factors associated with availability of adequately iodized salt are depicted in Table 1.

34% of the population is employed whereas 66% are housewives. Of the 200 households, 182(91%) respondents proclaimed that they buy packed salt from local shops and supermarkets. Rest 18(9%) of the respondents who did not report of buying packaged salt attributed it to inadequate information, costs and taste. 157(78.5%) stated they added salt early or in between the cooking process while 20(10%) reported adding salt at the end of cooking.

From the Chi-square test and statistical analysis, the association between the family size and presence of adequately iodized salt at home was statistically significant (Chi-square=4.38, P=0.03). Packaged salt (Chi-square=4.4, P=0.03), not exposing salt to sunlight (Chi-square=10.87, P<0.001), storing salt in a dry place (Chi-square=25.513, P<0.001) and storing in a closed container (Chi-square=13.83, P<0.001) were significantly associated with the presence of adequately iodized salt at home. However, variables such as educational status, occupation and duration of storage of salt were not associated with presence of adequately iodized salt at home.

Among the 200 households surveyed for this study, 143(71.5%) people had adequate knowledge about iodized salt. Majority of the people remarked that television was the major source of knowledge. (Figure 2) A high proportion 114(57%) of the respondents realized that the iodine content of iodized salt reduces if not stored in closed containers, attributable to its volatile characteristic.

More than 70% of respondents replied that iodine deficiency disorder is preventable. In regard to the dietary sources of iodine, 28% of the participants knew the various food sources that contain iodine.

There is no association between knowledge and presence of adequately iodized salt at home. (Chi square=0.21, P=0.64)

DISCUSSION

The percentage of households consuming adequately iodized salt should be >90% as determined by a Joint WHO/UNICEF/ICCIDD Working Group which is one of the goals for assessment and monitoring of Iodine Deficiency Disorders.[12]

Twenty-four years following the enforcement of a national programme for the control and elimination of iodine deficiency disorders (NIDDCP) through universal salt iodization[13], there was a positive shift in the process indicator on iodine status, which was evident in this study from the percentage of households that used iodized salt (88.5%) and knowledge the respondent who was responsible for cooking meals had about iodized salt (71.5%), which falls in to the majority group. This highlights that a substantial proportion of the salt samples tested in this study was clearly iodized in accordance with the NIDDCP requirement. There was a survey conducted in 2007 in Ghana, which revealed that 78.1% of households consumed iodized salt in the region.[14] The adequacy of iodized salt in this study was higher than results from Eastern Nepal (82.6%)[15] and Telangana, India (79%).[16]

However, 11.5% of salt examined in households in this study was not adequately iodized (<15 PPM) i.e. not in compliance with the legal requirement as laid during salt iodization program in India under National Iodine Deficiency Disorders Control Program (NIDDCP).[17] The explanation for this might be due to loss of iodine because of exposure to moisture, heat, and sunlight during storage at home or elsewhere in the supply chain.[18][19]. In this study, 26.5% salt was not stored in closed containers in the household, thereby exposing it to moisture, heat, and sunlight. Majority, 73.5% of the respondents stored their salt in the recommended way in closed containers. For the 16% who stored salt in containers without a lid and another 10.5% who stored it in open rubber sachets, there is the likelihood that the iodine content in the salt might drop by virtue of its volatile characteristic. 17% of the respondents stated that they kept their household salt in an area which got direct sunlight and the rest 83% knowingly or knowingly didn't expose their household salt to sunlight.

Studies show that improper storage, buying non iodized salt, illiteracy, poor socioeconomic status poor handling practices such as careless utilization are some of the causes at household level, for low iodine content of edible salt.[20][21][22] The findings of another study indicated that iodine losses occurred leading to a reduction in the iodine content of the salt before it is consumed when iodized salt was not stored in sealed waterproof materials or closed containers.[23] Studies from Ethiopia, Gondar, London and India confirmed that exposure to heat can contribute the highest share for iodine loss. Sunlight exposure speeds up the oxidation of iodide to elemental iodine and this is highly unstable.[24][25] In support of the previous finding, a study conducted in India showed loss of 31% of iodine from iodized salt as a consequence of exposing it to sunlight.[26]

However, there was an accelerating trend to use packet salt for household consumption, which was supported by the findings in this study and several other studies.[8][27][28]

This study also shed light on the fact that place of salt storage was significantly associated with presence of adequately iodized salt at household level. In this study, 10% of households preparing food were adding iodized salt at the end of cooking. However, in order to serve its purpose, iodized salt must be stored in a place away from moisture and sunlight and added to a meal at the end of cooking.[4][12]

Type of containers used to store salt exhibited a significant association with presence of adequately iodized salt at home. The attitude of storage of salts in closed containers could be attributed to the high knowledge that the respondents had about iodized salt.

This study identifies knowledge as an important variable. Whilst majority of people knew, out of the 28.5% who had not heard of iodized salt, 4% of them had <15 PPM iodine content in their salt.

The study had a following limitation that the iodine level was determined by taking sample only from the salt, which did not include urinary testing of iodine or titration level of iodine in the salt to determine body iodine level.

CONCLUSION

The following study demonstrated that the knowledge on iodized salt among people in the urban field practice area was high, as most of them knew or had heard about iodized salt. The consumption of adequately iodized salt in the areas studied is still less than the goal of the program and there is an incongruity between the awareness of the benefits of iodized salt and its consumption per se.The results suggest the need to increase awareness generation activities among households for consumption and proper storage of iodized salt should be taken up especially targeting women groups and organizations as majority of women are only involved in meal preparation and the findings in this study corroborated that institutionalizing regular salt testing could be used as a beneficial method for rapid and regular assessment of the salt situation in a topographical area and as a valuable technique for assessing progress towards reaching the USI goal.

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Conflict of Interest- None

TABLE 1: Consumer practices of households associated with the presence of adequately iodized salt at home

Variables	Salt titration result ≥15 PPM n (%)	Salt titration result <15PPM n (%)	Chi square value	P value
Type of Salt bought				
Packaged	66(83)	16(8)	4.4254	0.035
Open	11(5.5)	7(3.5)		
Exposure of salt to sunlight				
Yes	24(12)	10(5)	10.879	<0.001
no	153(76.5)	13(6.5)		

Place of storage of salt dry place moist place	 148(74) 29(14.5)	 8(4) 15(7.5)	25.513	<0.001
Storage of salt Closed container Containers without lid/open packet	 138(69) 39(19.5)	 9(4.5) 14(7)	13.830	<0.001
Duration of storage 1-3 weeks >1 month	 143(71.5) 34(17)	 15(7.5) 8(4)	2.111	0.146

Figure 1: Iodine content of salt tested in 200 households

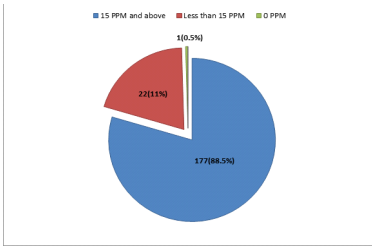
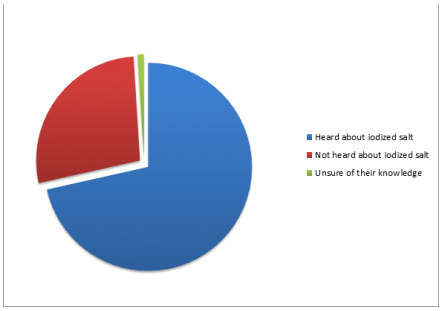


Figure 2: Knowledge of participants concerning iodized salt



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