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Types of Salt and Their Iodine Content in Rural Areas of Eastern Nepal: Is Consumption of Crystal Salt Still Prevalent?

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ABSTRACT

Introduction: Iodine deficiency disorder (IDD) is a global public health problem. It has many adverse effects on growth and development. Improper transportation facilities, lack of awareness, cultural preferences, and low socioeconomic status are some of the major contributors that determine the type of salt intake in Nepal.
Aims: This study aimed to find out the types of salt intake and their iodine content in rural areas of eastern Nepal.
Methods: This community based cross-sectional study was carried in three village development committees (VDCs) of Udayapur district, Nepal. Five schools were randomly selected and a total of 317 salt samples were collected from school children. Their types along with salt iodine content (SIC) were estimated in department of Biochemistry of BPKIHS, Dharan. Data were expressed in frequency and Chi-square analysis was performed to see the association between groups. P-value ≤ 0.05 was considered to be statistically significant.
Results: A total of 79.5% consumed packet salt while 20.5% still had crystal salt. Out of total, 97.6% of packet salts were adequately iodized (>15 ppm), whereas 67.70% of the crystal salts had nil (0 ppm) iodine. Majority of the SIC were > 15 ppm (246, 77.6%), followed by 0 ppm (44, 13.88%) and <15 ppm (27, 8.5%). Among the VDCs, Katunjebawala had poor iodized salt intake and SIC status. SIC was significantly different between the types of salt and among the VDCs.
Conclusions: Although there is a substantial improvement in the intake of adequate iodized packet salt, but people of rural area are still consuming crystal salt with low iodine intake which is definitely a matter of concern.

Keywords: crystal salt, eastern Nepal, packet salt, salt iodine content,

INTRODUCTION

Iodine deficiency disorder (IDD) is a global public health problem. It has many adverse effects on growth and development due to inadequate production of thyroid hormones, termed as iodine deficiency disorders (IDD). It also increases the risk of spontaneous abortion, stillbirths, and congenital abnormalities in pregnancy. [1,2] The efficient and reliable way to make the iodine available to general population is to fortify table salt with it.[3]

The 43rd World Health Organization (WHO) assembly held at Geneva, in May 1990 recognized IDD elimination as a major priority.[4] WHO has launched the universal salt iodization (USI) program since 1993 to control IDD in the developing countries.[5]A new wave was initiated in Nepal too by implementing a five-year national plan for the elimination of IDD for the period

between July 1997 and June 2002 AD. Consumption of adequately iodized salts remarkably improved over the years as shown by the national surveys conducted in 1998 (55.2%), 2005 (57.7%), 2007 (77%), and 2011 (80%).[6-9] However, the coverage of adequate household iodized salt was substantially higher in urban areas (94%) than rural areas (78%), and also in Terai regions (81%) compared to mountainous regions (73%).[9] Many common vegetables are consumed only after cooking due to which iodine, being volatile, can be easily lost. Another problem is inefficient storage leading to loss of iodine, as it sublimes easily at room temperature. [10-13]

There are still many rural areas in our country where people may not have proper access to adequately iodized salt. Hence, this study aimed to find out the types of salt intake and their SIC in rural VDCs of Udayapur district, eastern Nepal.

MATERIALS AND METHODS

This community based cross-sectional study was carried out by the department of Biochemistry of B. P. Koirala Institute of Health Sciences (BPKIHS), Dharan, Nepal. After a preliminary field visit, we selected three VDCs (Katunjebawala, Siddhipur and Chaudandi) of the Udayapur district, province number.1 as our study area. Five schools were randomly selected from the three different VDCs. Before the collection of samples, a brief interactive program was conducted in the school to highlight the roles of iodine on the overall development of children's physical and mental growth through posters, pamphlets, and oral presentations. The benefits of consuming properly refined salt and effective ways to prevent the loss of iodine during the storage of salt at home were also discussed with school authorities, children, and guardians.

After completion of the interactive session, children were provided a clean, moisture-free plastic pouch to bring their household salt samples on the following day. The salt samples were collected and labeled properly which were then transported to the Biochemistry lab of BPKIHS, Dharan.

The salt samples were classified as crystal and packet type.[2] SIC was tested by MBI rapid test kit (RTK) following manufacturer's instruction.[14] The color developed after addition of test solution on the salt sample was compared with the color chart of the RTK to determine SIC. It was then categorized into three groups: 0 ppm (no color, nil iodine), <15 ppm (light blue color, inadequate iodine), and >15 ppm (dark blue color, adequate iodine). Ethical approval for the study was taken from the institutional review committee (IRC), B.P. Koirala Institute of Health Sciences (BPKIHS), Dharan (IRC/655/015). Both written and verbal consents were taken from the school principal, children, and their guardians before sample collection. Those who were unable to get permission, or denied to participate were excluded.

Statistical Methods

The data were entered in MS Excel 2007 and analyzed by SPSS version 16. Chi-squared test was used for comparison of salt types and SIC between the groups. P-value ≤ 0.05 was taken as statistically significant.

RESULTS

A total of 317 school-going children (boys=158 and girls=159) were enrolled and the salt samples were collected from them. Most of them were from the Chaudandi (124) followed by the Katunjebawala (102) and Siddhipur (91) VDC. Due to the weak trend of sending children to school in the studied areas, we could not enroll many children for our study and hence sample size was not too large.

The consumption of packet salt (about 80%) was more compared to crystal salt (about 20%) as depicted in figure 1. The intake of crystal salt was more in Katunjebawala (38.24%) than other two VDCs (Table 1). There was a significant difference in both salt types as well as SIC

among the VDCs but not between the gender (Tables 1 and 2). The majority of the salt contained adequate iodine content (>15 ppm, 77.6%) followed by nil (0 ppm, 13.88%), and inadequate (<15 ppm, 8.51%) as indicated in figure 2. The study showed a remarkable difference in the SIC between the types of salt (Table 2). Furthermore, 97.6% of the packet salts were adequately iodized while none of the crystal salts were that signifies the importance of having packet salt over crystal. On the other hand, the majority of crystal salt (67.70%) had nil iodine which was not seen even in a single packet salt (Table 2) reflecting to as a poor source of iodine nutrients.

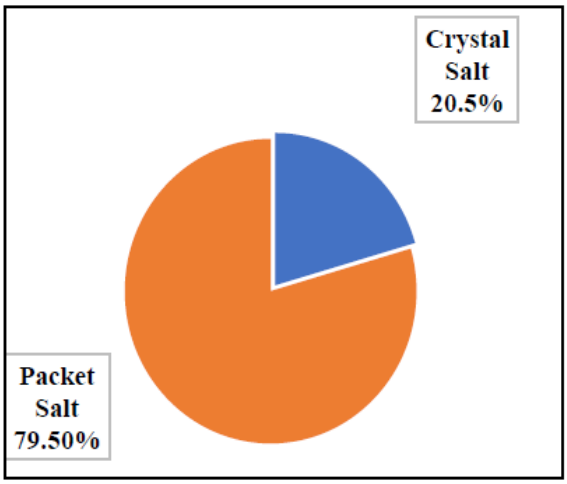

Figure 1: Types of salt samples collected from study population

Table 1: Types of salt consumed among gender and VDCs

Category	Types of Salt			P-Value*
	Sub types	Crystal	Packet	
Gender	Boys (n=158)	37(23.42%)	121(76.58%)	0.200
	Girls (n=159)	28(17.61%)	131(82.39%)	
VDCs	Chaudandi (n=124)	20(16.13%)	104(83.87%)	**<0.001**
	Katunjebawala (n=102)	39(38.24%)	63(61.76%)	
	Siddhipur (n=91)	6(6.60%)	85(93.40%)	

**Chi-square test, p value ≤ 0.05*

Table 2: Salt iodine content in between gender, types of salt and VDCs.

Category	Sub types	SALT IODINE CONTENT			p-value*
		0 ppm	<15ppm	>15ppm	
Gender	Boys (n=158)	26(16.45%)	12(7.60%)	120(75.95%)	0.381
	Girls (n=159)	18(11.32%)	15(9.43%)	126(79.25%)	
Type of salt	Crystal (n=65)	44(67.70%)	21(32.30%)	0	**<0.001**
	Packet (n=252)	0	6(2.38%)	246(97.62%)	
VDCs	Chaudandi (n=124)	18(14.52%)	3(2.42%)	103(83.06%)	**<0.001**
	Katunjebawala (n=102)	23(22.55%)	20(19.61%)	59(57.84%)	
	Siddhipur (n=91)	3(3.30%)	4(4.40%)	84(92.30%)	

**Chi-square test, p value ≤ 0.05*

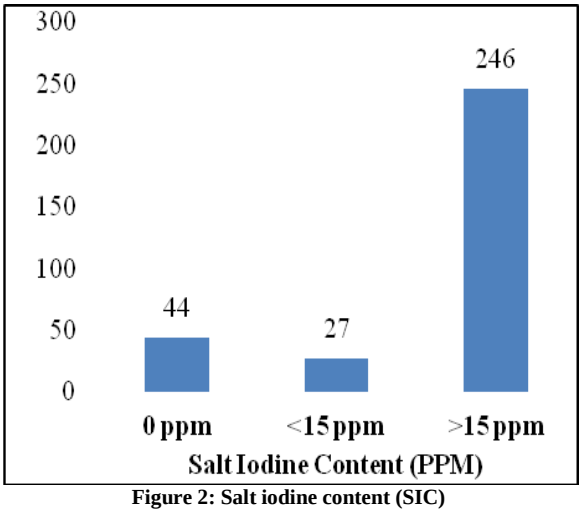

Figure 2: Salt iodine content (SIC)

DISCUSSION

Nepal mainly depends upon India for the import of household salts. Under the act of universal salt iodization (USI), the Nepal government had launched various strategies to increase the rate of consumption of adequately iodized salt throughout the nation.[9] In our study that was conducted in three rural VDCs of eastern Nepal, the majority of the participants preferred packet salt over crystal salt. This is supported by other studies of Gelal B et al (2010) and Nepal AK et al (2013) which show significant improvement in the quality of salt consumption. [5,15] However, one fifth of the children participated in this study still consumed crystal salt which is definitely a matter of concern. Among the three VDCs, salt iodine nutrient status of Katunjebawala

was significantly poorer which may be due to various factors such as socio-economic status, cultural preferences, lack of awareness, geographical challenges, etc. Although crystal salt was mainly purchased for livestock consumption, also been consumed by people which was known during preliminary visit to that area.

In the present study, most of the population (77.6%) consumed salt with adequate iodine content (> 15 ppm) followed by nil (0 ppm) and inadequate (<15ppm) iodine concentration. Most of the crystal salt contained no iodine at all while none of the packet salts had nil iodine. This signifies the importance of consuming packet salt to get sufficient iodine. At the same time, few packet salts with <15 ppm SIC warn us to adopt standard ways to prevent the loss of fortified iodine. Similar types of studies were done focusing on the consumption of packet salt and its iodine content**.** **[16-18]** In a community-based cross-sectional study carried by Srivastava et al, 2012 in Ballabargh, Haryana, Northern India, adequately iodized salt was 65.2% which was lower than ours. The inadequate salt consumers in our study (8.51%) were satisfying in comparison to theirs (21.5%). Surprisingly, the nil iodized salt consumers of our study were similar with theirs at 13.88% and 14% respectively.**[16]** Pandav CS et al (1999) also reported a result in concordance with ours where 76.7% of government school going children in Delhi had iodized salt and the trend of taking it was further increased with span of time.**[17]** An experimental study was carried out in Bangladesh, 2019 by collecting equal numbers of packet and crystal salt samples which showed that only 42% of those samples were adequately iodized which is far less than ours. A relatively lower percentage (75%) of packet salts was adequately iodized than ours (97.62%). In their study, at least 8% of crystal salts were adequately iodized while none of ours were as such.**[18]**

A study carried by Pieter L. Jooste et al in South Africa showed that the people of low socioeconomic spectrum consumed inadequate iodized salts.**[19]** The children of those areas who are being exposed to low-iodized salt are regarded as a vulnerable group and the situation is further aggravated by the habit of consuming less salt by the low socioeconomic strata people of that area, thereby lessening the potential iodine intake via salt. Buying adequately iodized salt is only not enough to supply sufficient iodine in our body, the consumption pattern and other multiple factors influencing its stability should also be taken into consideration. The duration, temperature, sunlight exposure, humidity, the moisture of storage, and closed container should also be taken into consideration**.** **[3,5,13]** In a study done by Joshi et al (2007) in the mid-western region of Nepal, the consumption rate of adequate iodized salt was higher than the present study which showed discrepancies for salt intake pattern in between the different regions within a country itself**.** **[20]**

Another study of Schulze et al in 2003 done three rural communities in the southeastern plain of Nepal found that both the urinary iodine and salt iodine covaried significantly by the season. Their value was highest during hot, dry, pre monsoon months and lowest during and following the humid monsoon season. Also, the consumption percentage of adequately iodized salt was plunged from 85% to 44% from hot, dry season to humid season respectively.**[21]** Since, our studied areas are just few kilometers away from Schulze's studied area, a similar kind of analysis can also be done to assess the effect of various seasons on iodine nutrient status of those VDCs too. In another study done in the eastern part of Nepal, by Shakya et al (2011), the consumption of the crystal salt was comparatively higher in school going children of Tehrathum (hilly area) than Morang (terai area) i.e. 36.9% and 4.1 % respectively. Due to the challenging road facilities and geographical difficulties in the hilly area, it is not so easy to buy and use household stuff on a daily basis. So, people

usually buy crystal type of salt in the winter season and store it for the whole year as household salt for consumption which will affect the stability of iodine in it.[22]

CONCLUSION

Although our study showed the substantial improvement of iodized and packet salt intake in rural areas as well, it is just a snapshot and should be surveyed in a bigger frame to assess the real scenario of many poverty-stricken rural villages of Nepal. Because of noticeable prevalence of crystal salt consumption, proper law enforcement should be practiced and if possible, the selling of crystal salt should be banned from retailers' shops. Overall, there is an increasing trend of in taking adequate iodized and packet salt in the last few decades in our land but some rural areas are still consuming crystal salt; which is a definitely a matter of concern.

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