

Insufficient Level of Iodine Content in Household Powder Salt in Nepal

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ABSTRACT

Universal salt iodization (USI) is long term strategy for the control of iodine deficiency disorder (IDD) in Nepal. Standardized periodic testing of the iodine content in salt is a critical part of a salt iodisation programme. To achieve programmatic objective, this study was carried out to estimate the iodine content of household salt in Kavre, Lalitpur and Parsa districts of Nepal. Iodometric titration of 1803 salt samples collected from the households through the students of different schools revealed that 289 (16.0%) had less than 15ppm iodine. Two hundred forty-one powder salt samples without two children logo (14.3% among total powder salt samples) had iodine below 15ppm. It includes 25.8% of total salt samples from Parsa district of Terai ecological region. Among total, the largest proportion of the population accounting for almost 93.0% used powder salt. In total 1803 salt samples, mean and median iodine concentration were 31.8 ppm (95.0% CI= 31.0-32.6) and 29.5 ppm respectively. The mean and median iodine concentration of phoda (dhike) salt were 22.1 ppm (95.0% CI= 19.2-25.1) and 18.9 ppm; powder salt were 32.6 ppm (95.0% CI= 31.7- 33.4) and 30.6 ppm respectively. In the community level, people are still using the non-iodized salt. To eliminate the IDD more efforts are required at program implementation and monitoring level.

Keywords: USI, salt iodine, IDD

INTRODUCTION

Iodized salt is considered as the most appropriate measure for iodine supplementation.¹⁻⁴ The advantage of supplementing with iodized salt is that it is used by all sections of a community irrespective of social and economic status. The daily requirement of iodine is 150 µg per person for adults. The level of iodination of salt has to be sufficient to cover this requirement together with losses from the point of production to the point of consumption including the expected shelf life. It is considered that iodine deficiency has been eliminated from one particular country when the access to iodized salt at household level is at least 90.0%, together with median urinary iodine of at least 100 µg/l and with less than 20.0% of the samples below 50 µg/l.¹

USI is the long-term strategy for the control of IDD in Nepal. Salt iodization is the most effective public health approach for the elimination of IDD without side effects and it is important to assess the knowledge about iodized salt consumption and iodine deficiency disorders.⁵

Standardized periodic testing of the iodine content in salt is a critical part of a salt iodisation programme. Such monitoring is done to ensure adequate iodine levels at all points of the salt distribution system from production to consumption. There are two principal methods for measuring iodine levels in salt, rapid test kits and titration. Rapid test kit method provides a semi-quantitative estimate of the iodine concentration at one of four levels, 0ppm, 7ppm, 15ppm or 30ppm based on the intensity of the colour change. In contrast, titration provides more reliable and precise estimates of the iodine content of salt.² Nepal micro-nutrient status survey, 1998 indicated that about 17.0% of salt samples were found to contain no iodine at all, while approximately 27.7% of the salt samples contained less than 15ppm.^{6,7}

This cross-sectional study was designed to study salt iodine level in three districts Kavre, Parsa and Lalitpur representing different ecological regions of Nepal. The study was conducted during July 2003 to January 2004 with objectives to estimate the salt iodine level among the different salt samples collected from school children; and availability of salt in different geographical locations.

MATERIALS AND METHODS

This study was conducted during July 2003 to January 2004. The districts selected for the study represent different ecological regions, Kavre and Lalitpur from Mid hill and Parsa from Terai region. Convenience sampling technique was used to identify the different schools. Thirteen schools from Kavre, 11 schools from Parsa and 4 schools from Lalitpur were selected for the study. A total of 1803 household salt samples were collected from the students, comprising one sample from each household. Altogether 667 (37.0%) samples from Kavre, 790 (44.0%) samples from Parsa and 346 (19.0%) salt samples from Lalitpur were collected. Attention was given for each school to be selected as a sample representing the rural areas of the respective districts. The schools with 2 hours walking distance from the motorable road were identified as rural schools.

Salt Iodine Estimation

Collection of Salt Samples for Iodine Estimation: About 10gm of salt was collected from the household of each participating student of three study districts. The salt sample was packed into plastic bag and sealed in order to make airtight. The analysis was done in the laboratory of the Institute of Medicine, Tribhuvan University.

Analysis of Salt Iodized with Potassium Iodate: Salt samples were analyzed to find out the iodine content by titration method. The principle is that iodine is liberated by adding sulphuric (orthophosphoric) acid to a solution of iodated salt. Potassium iodide solution is added to keep the iodine in the dissolved state. Iodine liberated is titrated with sodium thiosulphate solution to form sodium iodide and sodium tetrathionate. Starch is used as an external indicator.⁸ Briefly, 10gm of salt sample was weighed and was transferred to a clean conical flask with 50ml of distilled water. Two ml of sulfuric acid (2N) was added followed by addition of 5ml of potassium iodide (10% solution) and shaken to mix. The color of the solution turned deep yellow. The conical flask was covered with watch glass and kept it in dark for 10 minutes. The sodium thiosulfate solution was placed in burette and the salt solution was titrated with sodium thiosulfate until the color turned pale yellow. One ml starch solution was added to the mixture. The color of the mixture turned purple. The titration was continued (this time, sodium thiosulfate was added drop by drop) until the deep blue color completely disappeared. The volume of sodium thiosulfate solution needed for the titration was noted. The iodine content (in ppm) of the salt was calculated using the formula given below:

$$\text{ppm of KIO}_3 = R/V_2 \times 445.825$$

$$\text{ppm of Iodine} = (R/V_2 \times 445.825) \times 0.595$$

Where, $R =$ Volume of thiosulfate consumed by salt solution

$V_2 =$ Volume of thiosulfate consumed by standard KIO_3 (0.005N)

Semi-structured interview

The adult member of the households of near by community of the school were interviewed to collect information regarding salt purchasing behaviour, salt storage practices, knowledge about iodine and iodised salt. 1802 households member were interviewed for this purpose.

Data Management and Analysis

The data were entered into SPSS version 11.5 after coding. The entered data were processed for final analysis and the data analysis was carried out using SPSS version 11.5. The descriptive analysis was done using frequency and proportion. The mean and median values of salt iodine level and 95% confidence intervals were calculated for powder and phoda salt samples.

RESULTS

Among total 667 household salt samples collected from the students of Kavre district, 582 (87.3%) were powder salt and 85 (12.7%) were phoda (dhike) salt. Among 790 household salt samples collected from Parsa included 789 (99.9%) powder and 1 (0.1%) phoda. From Lalitpur, 346 salt samples were 309 (89.3%) powder salt and 37 (10.7%) phoda. In total, 1680 (93.2%) salt samples were powder and 123 (6.8%) salt samples were phoda. The powder salt samples of mid-hill ecological region were salt packets with two children logo where as that of Terai ecological region were packets without two children logo.

(Fig. 1.)

In most of the households salt is stored in plastic bags or in plastic jar. Very little respondents use wooden pot, bora or bamboo to store the salt. Whatever means is used for storage, mostly it is kept covered in most of the households (Data not shown).

Among 1803 salt samples analyzed for iodine estimation, 289 (16.0%) were found to have less than 15ppm iodine and 637 (35.3%) salt samples have 15-30ppm iodine. The iodine level 30-50ppm was found in 649 (36.0%) samples. Of the total, 228 (12.6%) salt samples had iodine level greater than 50ppm.

District-wise data analysis revealed that 61 (9.2%) salt samples had iodine level below 15ppm, in Kavre district. Similarly, in Parsa district 204 (25.8%) salt samples had iodine less than 15ppm. Likewise in Lalitpur, 24 (6.9%) salt samples had iodine less than 15ppm.

Among 289 salt samples having iodine level below 15ppm, 204 (70.6%) were from Parsa. Kavre included 61 (21.1%) and Lalitpur included 24 (8.3%) salt samples below 15ppm iodine.

(Table-1) (Table-2)

Of the total, 241 powder salt samples had iodine below 15ppm. This data includes 204 salt samples from Parsa. This is due to inadequate iodized salt imported from India. Forty-eight (39.0%) phoda salt samples had iodine below 15ppm. However, 75 (61.0%) phoda salt samples had iodine above 15ppm.

Mean and median iodine concentration of powder salt was higher than dhike salt. Mean iodine concentration of dhike salt was 22.1 ± 16.5 ppm (95% CI= 19.2-25.1) and median iodine concentration was 18.9 ppm. Similarly, mean and median iodine concentrations of powder salt were 32.6 ± 17.7 ppm (95.0% CI=31.7-33.4) and 30.6 ppm respectively. There is significant difference in mean iodine concentration of dhike and powder salt (t-calculated at 95.0% CI< 0.05, independent t-test). The mean and median iodine concentration of total salt samples were 31.8 ppm (95.0% CI= 31.0-32.6) and 29.5 ppm respectively. The iodine concentration of salt in rural households was lower than that in urban households.

(Fig. 2.) (Table-3)

The mean and median iodine concentration of salt in rural households were 30.1 ppm (95.0% CI= 29.1-31.1) and 27.5 ppm respectively. Similarly, the mean and median iodine concentration of salt in rural in urban households were 35.9 ppm (95.0% CI= 34.5-37.3) and 34.4 ppm respectively.

DISCUSSION

This study revealed that the powder salt is not safe against the common sense believed in Nepal. The powder salt with two children logo was found to contain sufficient iodine content. The powder salt with two children logo is officially verified that it is iodised. However, powder salt without two children logo was found to contain insufficient iodine content. Two hundred forty-one powder salt samples (14.3 percent among total powder salt samples) had iodine below 15ppm. It includes 25.8 percent of total salt samples from Parsa, a district of Terai ecological region. Iodine variation in the salt found in the Terai is probably associated with the method of salt handling or the procurement of salt outside the official market rather than the process of iodization. Indeed, with its long, difficult to control, border with India, the Terai zone is particularly vulnerable to informal trade of non-iodized salt. Iodine losses during transportation, and during retail and household storage, could also have been partly responsible for the inadequate iodine content in salt, particularly in the hot and humid summer climate of the Terai region. Therefore, geographical variation in the iodine concentration of salt and the availability of iodized salt appear to be a problem in Nepal.

Iodine deficient population of school children was 39.2% in mid-hill district Kavre, 19.1% in lowland district Parsa and 25.9% mid-hill semi-urban area of Lalitpur.⁹ The mountains have long been considered endemic areas of IDD.^{6,9,10}

Among total, the largest proportion of the population accounting for almost 93.0% used powder salt. Only 12.7% population of Kavre and 10.7% population of Lalitpur used dhike salt. The phoda salt was found to contain low amount of iodine content as compared to powder salt. There was significant difference in mean iodine level between powder and phoda salt (t-calculated at 95.0% CI< 0.05, independent t-test). Although 25.8% salt samples from Parsa were powder without two children logo, they contained inadequate iodine. Salt is a very useful carrier of iodine, irrespective of geographical area, educational level, socio-economic category. Therefore, it is important to assure that all household salt is adequately iodized.

Among 1803 salt samples analyzed for iodine estimation, 289 (16.0%) were found to have less than 15ppm iodine. Six hundred thirty seven (35.3%) salt samples were found to have 15-30ppm iodine. The iodine level 30-50ppm was found in 649(40.0%) samples. Two hundred twenty eight (12.6%) salt samples had iodine greater than 50ppm.

Adequately iodized phoda salts in the mountains were also found. The seasonality and salt using practices have also been reported as the contributing factors for varying household salt iodine content in rural southern part of Nepal. Urinary iodine and salt iodine both were lowest in humid monsoon season.¹¹ However, the increase in iodine content of table salt in Switzerland improved the iodine status significantly¹² indicating the value of monitoring and adjustment of salt iodine content.

Universal salt iodization of all edible salt is the primary intervention implemented to control IDD in Nepal. However, salt with iodine below 15ppm was also observed. Iodised salt is usually the best approach to control of iodine deficiency disorders. According to Nepal micronutrient status survey, 1998 the largest proportion of the population (63.0%) used dhike salt. The study also reflected that 17.0% of salt samples were found to contain no iodine at all, while approximately 55.0% of the salt samples contained at least 15ppm iodine.⁷ This study found that most of the populations were using powder salt but some powder salt samples were iodine deficient. This study shows that the progress has been made in Nepal to limit IDD as a public health problem as compared to Nepal micronutrient status survey, 1998, however, its far to reach elimination objectives where at least 90.0% of the population should use adequately iodized salt.¹ It indicates a requirement of more effort for strengthening effective intervention program and other preventive measures because there is still more than one fourth population iodine deficient.⁹ Therefore, this study highlights the need of regular

monitoring of salt iodine content for assessment of salt iodine status, its trend evaluation and ensuring sustainability of salt iodization programme.

In conclusion, this study found that most of the populations were using powder salt; however, more than fourteen percent of study population are still using iodine deficient salt. The progress has been made in Nepal to prevent and control IDD as compared to the past but elimination target of use of iodized salt has not been achieved. Control on import and sale of non-iodized salt is important.

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Table-1: Iodine Level of Salt Samples analyzed in Laboratory

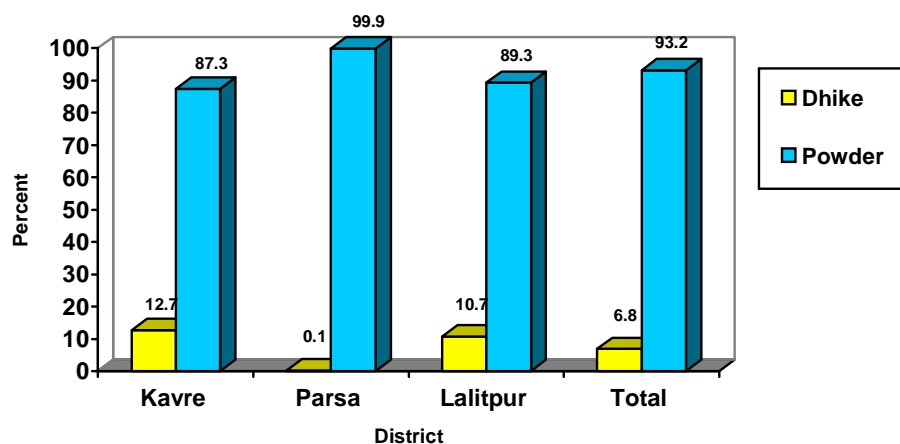
District	Type of salt	Iodine level (ppm)				Total
		<15 (%)	15-30 (%)	30-50 (%)	>50 (%)	
Kavre	Powder	26 (4.5)	174 (29.9)	282 (48.5)	100 (17.2)	582
	Dhike	35 (41.2)	31 (36.5)	14 (16.5)	5 (5.9)	85
Parsa	Powder	204 (25.9)	294 (37.3)	225 (28.5)	66 (8.4)	789
	Dhike	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	1
Lalitpur	Powder	11 (3.6)	121 (39.2)	121 (39.2)	56 (18.1)	309
	Dhike	13 (35.1)	16 (43.2)	7 (18.9)	1 (2.7)	37
Total	Powder	241 (14.3)	589 (35.1)	628 (37.4)	222 (13.2)	1680
	Dhike	48 (39.0)	48 (39.0)	21 (17.1)	6 (4.9)	123

Table-2: Iodine Concentration in Different Salt Type

Type of salt	Sample size	Iodine concentration (PPM)		95 %
		Mean \pm SD	Median	Confidence interval
Dhike	123	22.1 \pm 16.5	18.9	19.2-25.1
Powder	1680	32.6 \pm 17.7	30.6	31.7-33.4
Total	1803	31.8 \pm 17.8	29.5	31.0-32.6

Table-3: Household Location-wise Salt Iodine Concentration

Location	Sample size	Iodine concentration (PPM)		95 %
		Mean \pm SD	Median	Confidence interval
Rural	1244	30.1 \pm 17.9	27.5	29.1-31.1
Urban	559	35.9 \pm 17.1	34.4	34.5-37.3
Total	1803	31.8 \pm 17.8	29.5	31.0-32.6

**Fig. 1.** Type of Salt used in Households of School Children

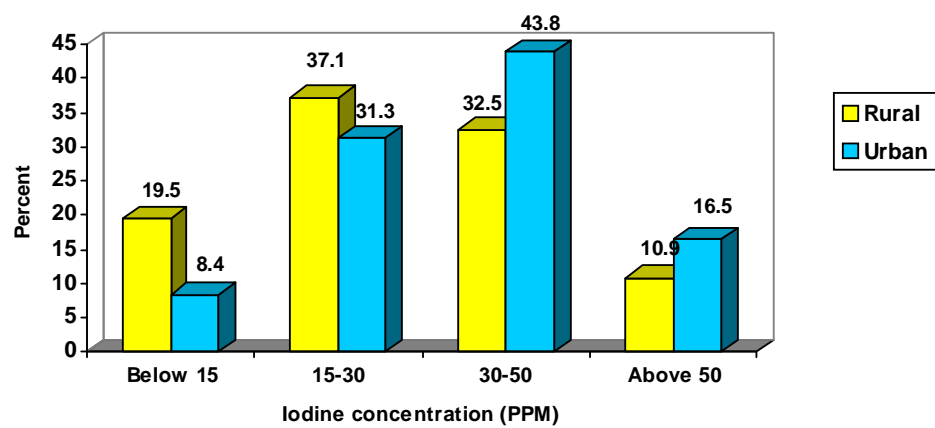


Fig. 2. Household Location wise Salt Iodine Level