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Utilisation of adequately Iodised salt and its determinants at household level among the tribal population of Yercaud hills in South India – A Community Based Cross Sectional Study

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ABSTRACT

Background

Most cost effective and sustainable intervention to address iodine deficiency is the Universal Salt Iodization (USI). According to the National Family Health Survey 5 (NFHS 5) data, 94.3% of the households in India were consuming adequately Iodised salt.

Objectives

1. To estimate the prevalence of Iodised salt utilisation at the household level using a Rapid Diagnostic Test (RDT).
2. To determine the factors influencing Iodised salt utilisation at the household level.
3. To estimate the Urinary Iodine Excretion (UIE) among the tribal population.

Materials and Methods

This is a community based cross sectional analytical study, conducted among 320 head of the household residing in the in the tribal villages of Semmanatham, Kovilmedu and Kottachedu of Yercaud hills using simple random sampling method. Data was collected using a pre tested semi-structured questionnaire Categorical variables were described using frequency and percentage and Continuous variables were described using mean and standard deviation. Statistical significance was tested using Chi Square test and p value < 0.05 was considered significant.

Results

In this study, the mean age of the study participants was 38.29±14.26 years. Nearly 94.4% were using packed salt. Nearly 66.9% of the households were utilizing adequately Iodised salt. Mean Urine Iodine Concentration was 121.75±72.61 (µg/L) in this study. Utilisation of adequately Iodised salt was significantly associated with usage of powdered salt, use of packed salt, salt storage in dry area, non-exposure to sunlight and storage of salt for a duration of < 2 months.

Conclusion

In this study, utilisation of adequately iodised salt was lower than the Universal Salt Iodization target of 90%. Iodised salt levels should be regularly monitored through regular visit to the shops and markets by concerned legal authorities.

Key-words: Iodine, Salt, Malnutrition, Goiter.

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INTRODUCTION

As per World Health Organisation (WHO) iodine is considered as the most important and essential micronutrient responsible for the normal growth, development and thyroid function of mankind.[1] Inadequate consumption of iodine leads to a condition known as Iodine Deficiency Disorder (IDD) which is very much devastating public health issue in the early part of life (First 1000 days). The vulnerable groups are the children, pregnant woman and the lactating mothers.[2] According to the recent global estimates nearly 2 billion suffer from iodine deficiency and among which 25% (50 million) present with clinical manifestations.[3] Also nearly 241 million children have insufficient iodine intake and South East Asian regions and Africa were home to 50% of children with iodine deficiency.[4]

Most cost effective and sustainable intervention to address iodine deficiency at nation level is the Universal Salt Iodization (USI).[5] When about 90% of the households in the country consume adequately Iodised salt (≥ 15 ppm) they are said to have achieved Universal Salt Iodization.[6] As per the recent UNICEF estimate globally 88.7% of the households are consuming adequately Iodised salt and 92% were from East Asia and Pacific regions.[7]

India is one of the front runners in the iodine deficiency control program as the National Goiter Control Program (NGCP) was launched in 1962 concentrating on Iodised salt supplementation for individuals with goiter. Since the inception, NGCP program had many ups and down and the current National Iodine Deficiency Disorder Control Program (NIDDCP) is committed to USI.[8] According to the National Family Health Survey 5 (NFHS 5) data, 94.3% (96.9% in Urban and 93% in Rural) of the households in India were consuming adequately Iodised salt which is higher than the NFHS 4 estimate of 93.1%.[9] Whereas in Tamilnadu, around 92% of the households were consuming adequately Iodised salt (95% in Urban and 89.3% in Rural).[10]

IDD is still a burning issue in Tamilnadu that too among the tribal population who have limited access and as only fewer studies have been undertaken in the Tribal population of India, this study was planned to assess the utilisation of adequately Iodised salt and its determinants among the tribal population in Yercaud hills of Salem district, Tamilnadu.

METHODOLOGY

Study design:

It was a community based cross-sectional, analytical study.

Study area:

The study was conducted in the tribal villages of Semmanatham, Kovilmedu and Kottachedu of Yercaud hills in Salem district of Tamilnadu. .

Study population:

The study populations identified were, head of the household residing in the Study area permanently at the time of the study.

Study period:

The study was carried out for a period of 6 months from June 1st 2022-November 31st 2022 after approval from the Institutional ethical committee.

Sample size:

The sample size was calculated based on a previous study conducted by Deepika PS et al in Andhra Pradesh in the year 2019. Adequate Iodised salt utilisation was found to be 75% and this was taken as the reference value for the sample size calculation for this study.[11] The sample size was calculated using the formula: N = Zpq / [L] 2 (where p-75, q-25, L-5) Adding 10% non-response rate to the above obtained sample size, the final sample size is rounded off to 320.

Sampling method:

In Yercaud hills, 3 tribal villages Semmanatham, Kovilmedu and Kottachedu were selected randomly. All the households in those villages were numbered serially and there were 375 households in the study area which form the sampling frame for the study. Individual households were chosen by Simple random sampling method using computer generated random numbers.

Inclusion criteria:
Head of the household above 18 years of age who consented for the study was included for the study.
Exclusion criteria:
Samples who did not prepare the food in their household and those who did not give consent were excluded from the study.
Study tool:
Data was collected using a pre tested semi-structured questionnaire. The questionnaire consisted of the following sections namely Socio-demographic characteristics of the study population, Details pertaining to use of Iodised salt, Clinical Examination findings and Salt utilisation and Urinary Iodine Excretion (UIE). From each household few spoons of salt samples were obtained and Rapid Diagnostic Kit (MBI Kit) was used to measure the level of iodine present in the salt sample. If the salt sample turns dark blue it indicates that the salt is adequately iodised (≥ 15 ppm). Urine samples were collected (3 to 5ml) from the head of the household to estimate the Urinary Iodine Excretion (UIE) using Sandell Kolthoff Reaction method.
Statistical analysis:
Data was entered in MS Excel and analysed using SPSS Version 22. Categorical variables were described using frequency and percentage and Continuous variables were described using mean and standard deviation. Chi-Square test and odds ratio estimation was used to test the association and p value < 0.05 was considered as statistical significance.
Informed consent:
It was obtained from the mothers of under five children prior to conduction of the study.
Ethical clearance:
The study was carried out after proper approval from the Institutional ethical Committee.
Operational definitions:
1. *Head of Household:* The person who is responsible for purchasing and cooking food.[12]
2. *Adequately Iodized Salt:* When the sample salt were tested using the rapid iodine test kit, if deep blue color change was seen the iodine content of the household salt sample was considered to be ≥15 parts per million (ppm) and this salt sample was called as adequately iodized salt.[13]
3. *Urinary Iodine Excretion (UIE):* Urine samples were tested for iodine concentration using Sandell Kolthoff Reaction method and based on the iodine concentration they were graded as given below [14]

Median Urinary Iodine concentration (µg/L)	Severity of Iodine deficiency
20-49	Moderate deficiency
50-99	Mild deficiency
100-199	Optimal
200-299	More than adequate

RESULTS

In this study, the mean age of the study participants was 38.29±14.26 years. About 13.1% were only males and responsible for purchasing salt and cooking in this study. Majority 29.4% had middle school education and 17.5% had education > high school. Nearly 37.5% were unemployed and only 11.9% were involved in skilled occupation. Majority 87.5% were from nuclear family and only 12.5% were from joint family (Table 1).

Table 1 Sociodemographic characteristics of the study participants (N - 320)

SNO	Socio-Demographic characteristic	Frequency	Percentage (%)
1.	*Mean age (Years)*	38.29±14.26	
2.	*Sex*		
	Male	42	13.1
	Female	278	86.9
3.	*Education*		
	Illiterate	42	13.1
	Primary School	48	15
	Middle School	94	29.4
	High School	80	25
	> High School	56	17.5
4.	*Occupation*		
	Unemployed	120	37.5
	Unskilled	70	21.8
	Semiskilled	78	24.4
	Skilled	38	11.9
	> Skilled	14	4.4
5.	*Socio Economic Status*		
	Upper	28	8.8
	Upper Middle	50	15.6
	Lower Middle	86	26.8
	Upper Lower	90	28.1
	Lower	66	20.6
6.	*Type of Family*		
	Nuclear Family	280	87.5
	Joint Family	40	12.5

Nearly more than half 56.9% of the households were using powdered salt and 78.7% of the households were purchasing salt from the nearby shop. Almost 94.4% were using packed salt. Around 39.4% and 33.7% look for brand and cost respectively while purchasing the salt. Around 95% of the household store salt in a dry area and only 24.4% of them read the package while purchasing the salt.

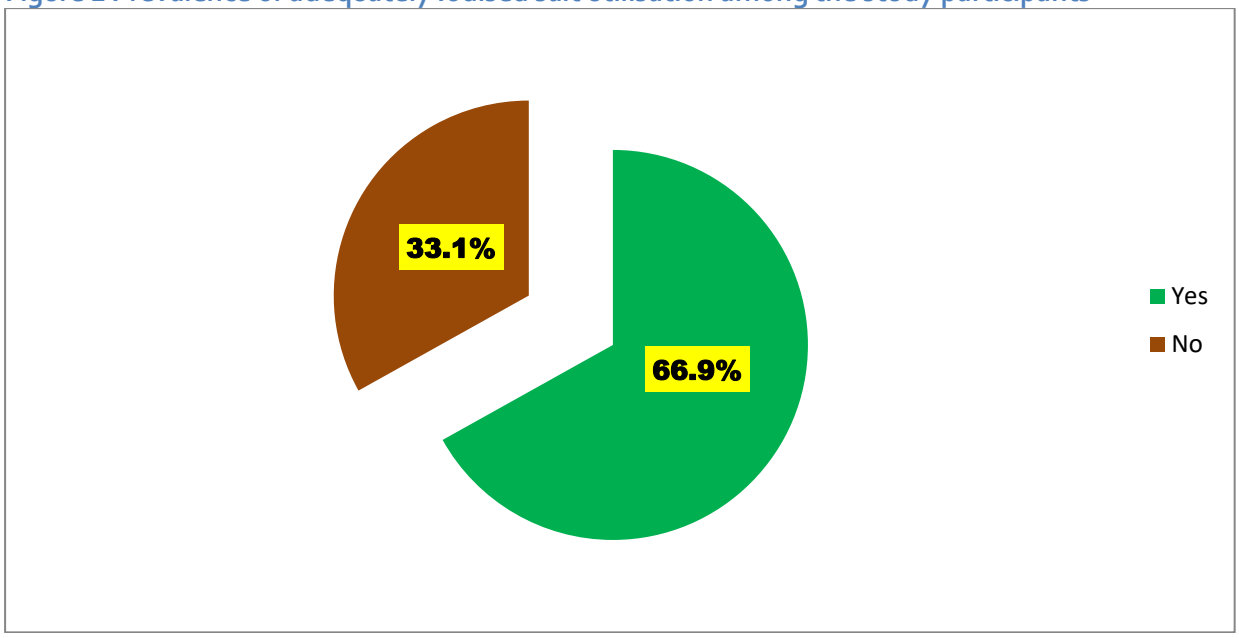
About 94% of the households store salt in a container with lid and 66.9% of the households take salt for usage using hands. In 38.1% of the households, salt storage area is exposed to sunlight. About 68.1% of households store salt for < 2 months and in 76.9% of the households the time travelled to purchase salt is < 10 minutes. Nearly 41.9% and 30.6% of the households respectively add salt late and early while cooking (Table 2).

Table 2Characteristics related to salt usage among the study participants (N - 320)

Sno	Salt usage characteristic	Frequency	Percentage (%)
1.	*Type of salt used*		
	Rock salt	138	43.1
	Powdered salt	182	56.9
2.	*Source of purchase of salt*		
	Weekly market	64	20
	Supermarket	4	1.3
	Nearby shop	252	78.7
3.	*Use packed salt*		
	Yes	302	94.4
	No	18	5.6
4.	*While purchasing salt you look for*		
	Brand	126	39.4
	Cost	108	33.7
	Packaging	14	4.4
	Iodised	72	22.5
5.	*Do you read the package of the salt while purchasing*		
	Yes	78	24.4
	No	242	75.6
6.	*Place of salt storage*		
	Dry area	272	85
	Wet area	48	15
7.	*Salt storage equipment*		
	Container with lid	301	94
	Container without lid	19	6
8.	*Take salt for usage using*		
	Hands	214	66.9
	Spoon	106	33.1
9.	*Salt storage area is exposed to sunlight*		
	Yes	122	38.1
	No	198	61.9
10.	*Duration of salt storage in the house*		
	< 2 months	218	68.1
	≥ 2 months	102	31.9
11.	*Time travelled from house to obtain salt*		
	< 10 minutes	246	76.9
	≥ 10 minutes	74	23.1
12.	*At what time salt is added while cooking*		
	Early	98	30.6
	Middle	84	26.2
	Late	134	41.9
	End	4	1.3

Nearly 66.9% of the households were utilizing adequately Iodised salt (> 15 ppm) in this study (Figure 1) and 28.1% had goiter (Figure 1).

Figure 1 Prevalence of adequately Iodised salt utilisation among the study participants



In this study, utilisation of adequately Iodised salt was significantly associated with usage of powdered salt (p value - < 0.0001, Odds ratio – 11.31), use of packed salt (p value – 0.0003, Odds ratio – 7.98), salt storage in dry area (p value - < 0.0001, Odds ratio – 6.74), non-exposure to sunlight (p value – 0.0002 , Odds ratio – 2.51) and storage of salt for a duration of < 2 months (p value – 0.0003, Odds ratio – 2.45) . All the other variables were found to be insignificant (Table 3).

Table 3 Determinants of utilisation of adequately Iodised salt among the study participants (N:320)

Sno	Variable	Utilisation of adequately Iodised salt		P value	Odds ratio (Confidence Interval)
		Yes (214)	No (106)		
1.	Sex of the head of the household				
	Male	26	16	0.463	0.77 (0.39-1.52)
	Female	188	90		
2.	Education of the head of the household				
	< High school	122	62	0.800	0.94 (0.58-1.50)
	≥ High school	92	44		
3.	Socioeconomic status of the family				
	Upper and Middle class	95	59	0.129	0.69 (0.43-1.11)
	Lower class	109	47		
4.	Type of salt used				
	Powdered salt	160	22	< 0.0001**	11.31 (6.45-19.83)
	Rock salt	54	84		
5.	Use of packed salt				
	Yes	210	92	0.0003**	7.98

	No	4	14		(2.56-24.92)
6.	Exposure of the salt to sunlight				
	No	148	50	0.0002**	2.51
	Yes	66	56		(1.55-4.05)
7.	Salt storage area				
	Dry area	200	72	< 0.0001**	6.74
	Wet area	14	34		(3.42-13.29)
8.	Salt storage equipment				
	Container with lid	194	101	0.154	0.48
	Container without lid	20	5		(0.17-1.31)
9.	Duration of salt storage in the house				
	< 2 months	160	58	0.0003**	2.45
	≥ 2 months	54	48		(1.50-4.00)

** p value< 0.05 is considered as significant and **p value < 0.01 is considered as highly significant*

In this study, the Mean Urine Iodine Concentration was 121.75±72.61 (µg/L). Severity of Iodine deficiency was graded based on the Urine Iodine Concentration in this study. Nearly 22.5% and 15.6% respectively had mild and moderate iodine deficiency (Table 4).

Table 4: Urine Iodine Excretion among the study participants (N - 320)

Urine Iodine Concentration (µg/L)	Severity of Iodine deficiency	Frequency	Percentage (%)
20-49	Moderate deficiency	50	15.6
50-99	Mild deficiency	72	22.5
100-199	Optimal	146	46.3
200-299	More than adequate	50	15.6
Mean Urine Iodine Concentration (µg/L)		*121.75±72.61*	

DISCUSSION

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

Age

In our study majority 51.2% of the study participants belonged to 21-40 years of age and the mean age was 38.29±14.26 years. Whereas 68.5% belonged to 25-50 years of age and 23.9% were above 50 years of age in Deepika PS et al study.[11] About 48.9% of the study participants were above 30 years of age in study by Konda S et al.[15] Mean age of the study participants was 39.46 ± 17.51 years in Ganie MA et al study.[16] In Karmakar N et al study 30.4% were between 31–40 years, 27% were between 21–30 years and mean age of 38.6 ± 13.8 years.[17] Nearly 48.6% were between 34-44 years of age and the mean age was 33.36±9.08 years in Mamo W et al.[18]

Sex

About 13.1% were only males and 86.9% were females in this study. Whereas 65.8% were females in Konda S et al study.[15] Majority 91.3% were females in Tariku WB et al study conducted in Ethiopia.[12] About 56.3% were females and 43.7% were males in Ganie MA et al study.[16] In Mamo W et al study, majority 82.7% of the study population were females.[18]

Education

In our study, majority 29.4% had middle school education and 17.5% had education > high school. Most of them 77.4% were literate, 33% had completed secondary level education, and only 2.6% were graduated and above in Karmakar N et al.[17] In Konda S et al study, only 67% had atleast secondary school education.[15] About 51.4% were illiterates and 36.9% had completed schooling in study by Deepika PS et al.[11] Nearly 47.1% had attended primary school and 10.2% were degree holders in Banumathi G.et al.[19]

Occupation

Nearly 37.5% were unemployed and only 11.9% were involved in skilled occupation in our study. About 43.1% were labours and 17.2% were farmers in Deepika PS et al study.[11] Majority 74% were housewives and 13.7% were government employees in Tariku WB et al study conducted in Ethiopia.[12] Nearly 57.1% were housewives by occupation in study by Mamo W et al.[18] Karmakar et al study recorded that 9.6% were daily labours, 4.1% were farmers and 77.4% were homemaker.[17]

Socio-economic status

In this study 28.1% of the participants belong to upper lower class and 20.6% belonged to lower socioeconomic status. About 34.6% were in lower class, 22,3% were in lower middle class and 30.4% were in upper lower class in Karmakar N et al study.[17] Whereas in Deepika PS et al study 40% were from lower middle class and 26% of households belong to lower class.[11] Only 6% were lower middle and 49% were from upper middle socioeconomic status in Roy R et al stusy.[20]

CHARACTERISTICS RELATED TO IODISED SALT USAGE

In this study, nearly more than half 56.9% of the households were using powdered salt and 78.7% of the households were purchasing salt from the nearby shop. Almost 94.4% were using packed salt. Around 95% of the household store salt in a dry area and 94% of the households store salt in a container with lid in 38.1% of the households, salt storage area is exposed to sunlight. Similar to our study, 83.6% were using packed salt, 50% were using coarse salt and 97.1% store salt in dry areas, 96.% preserving the salt in closed and tight lid containers 13% households placed the salt in sunlight exposure areas and 85.5% households were keeping in house for upto 30 days in Deepika PS et al study.[11] Nearly 22.7% families store salt in areas exposed to sunlight and salt is stored for a duration of < 2 months in 92.3% in Gebremariam HG et al study.[21] Karmakar N et al study noticed that 98.9% use packed salt, 96.3% store salt in dry area, 95.6% used covered container to store salt, 8.9% reported sunlight exposure to salt and 52.6%) stored salt for as long as 15 days to 1 month.[17]

On the other hand a study by Regassa et al in Ethiopia only 47.4% preserve salt in closed tight container, 70.89% families keep salt in dry places and 6.2% of the families expos the salt to sunlight [22] In Mamo W et al study, 56.2% and 77.8% of the households purchased salt from retail shop and use packed salt respectively.[18] About 91.9% were purchasing salt from nearby salt and 66.4% of them expose salt to sunlight in Tariku WB et al study.[12]

ADEQUATELY IODISED SALT USAGE AMONG THE STUDY POPULATION

Nearly 66.9% of the households were utilizing adequately Iodised salt in this study. Similar to our study 63.3% of the household had adequately iodised salt and 25.7% had proper utilisation of adequately iodised salt in Tariku

WB et al study.[12] Roy R et al study recorded that 62.5% of households had adequate iodised salt utilisation. [20] UNICEF Coverage Evaluation Survey results (66.1%) were also similar to our study.[23] In Mathur N et al study 55.7% were using salt which was adequately iodised. In urban area 60.8% and 51.9% in rural area consume adequately iodised salt.[24] Nearly, 40.2% households were using adequately iodized salts in Bnumathi G et al study.[19]

Adequately iodised salt levels were 72.9%, 75%, 75.6% and 79.9% respectively in studies done by Sen TK et al, Deepika PS et al, Agarwal S et al and Das DK et al. [25,11,26,27] Adequately Iodised salt levels very much less than our study in studies by Gidey B et al, Dida N et al, Gebremariam HG and Regassa et al in these respectively 33%, 32.7% 28.9 and 8.7% was the adequate iodised salt utilisation percentages.[28,29,21,22] Changes in the adequate iodised salt utilisation percentages might be due to availability of iodised salt, education of the head of the household, level of knowledge about iodised salt and differences in the sociocultural habits in the study settings.

DETERMINANTS OF ADEQUATELY IODISED SALT USAGE AMONG THE STUDY POPULATION

In this study, utilisation of adequately Iodised salt was significantly associated with usage of powdered salt, use of packed salt, salt storage in dry area, non-exposure to sunlight and storage of salt for a duration of < 2 months. Similar to our study, Residence of respondents, using packed salt, storing salt in dry place and storing salt in container with a lid not exposing salt to sunlight were significantly associated with utilization of adequately iodized salt in Regassa et al study.[22] Mamo W et al study observed that variables significantly associated with adequate iodised salt utilisation were exposing salt to sunlight, keeping salt in a covered container, good knowledge about iodised salt and IDD, buying packed salt and keeping salt away from fire in kitchen.[18] Packaging, education and knowledge towards iodised salt were significantly associated with utilisation of iodised salt Tariku WB et al.[12]

Roy R et al study observed that type of salt used, use of packaged iodized salt, storing salt in closed containers and awareness about iodised salt were found significant.[20] Das DK study noticed that place of residence and religion were significantly associated with iodised salt utilisation.[27] Based on the results of Multivariate Regression Analysis, illiteracy, non-availability of iodised salt, no knowledge about iodised salt and lack of awareness about the advantages of iodised salt were the factors associated with iodised salt in Khan GN et al study.[30]. Adequate iodized salt at household level was associated with good knowledge about Iodised salt and IDD, education of the mothers and storage of salt for short duration in the household in Gebremariam HG et al study [21]

URINE IODINE EXCRETION (UIC) AND IODINE DEFICIENCY AMONG THE STUDY PARTICIPANTS

Mean Urine Iodine Concentration was 121.75±72.61 (µg/L) in this study. Nearly 22.5% and 15.6% respectively had mild and moderate iodine deficiency. Similarly, In Ganie MA et al study 154.50 (135) µg/L was the median [interquartile range (IQR)] of UIC. and about 28.4% had iodine deficiency with UIC < 100 µg/L and 14.8% had mild iodine deficiency.[16] In Kim HI et al study 293.9 µg/L was the median Urine Iodine Concentration (UIC). Nearly 14% of the samples had iodine deficiency based on the UIC and 13.4% had excess iodine.[31] Median UIC was > 100 µg/L in 97.5% of the study participants in Chaudhary C et al study.[32] In Bulliyya G et al study the median UIC was < 100 µg/L in 51.7% of children and visible goitre was seen in 6.9% of the individuals.[33]

CONCLUSION

In this study, 66.9% of the households were utilizing adequately Iodised salt which is lower than the Universal Salt Iodization (USI) target of 90% proposed by the World Health Organisation. Iodised salt levels should be regularly monitored through visit to the shops and markets by concerned authorities. Strict legal actions have to be taken if prescribed iodisation standards were not met and non-iodised salts haveto be removed from the market.

Level of knowledge regarding iodised salt and IDD have to be improved through health education campaigns focusing mainly on behavioural change communication involving females of the households who are responsible for purchasing of salt and cooking using all the available media. Proper utilisation of iodised salt can be attained by creating awareness among the general public through sensitization programs emphasizing on salt handling habits, duration of salt storage in the households, proper salt storage and cooking.

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