Original Article

Status of salt iodization, related awareness and practice at the household level in slums of Burdwan Municipality, West Bengal

Ananya Mukherjee, Somnath Naskar, Niladri Banerjee, Sutapa Mandal, Dilip K Das

Department of Community Medicine, Burdwan Medical College, West Bengal, India

Abstract

Background: Monitoring adequacy of salt iodization at consumption level and exploring the reasons for inadequacy, especially in marginalized communities, is crucial to achieve the target coverage of universal salt iodization. **Aims:** To assess the iodine content of salt used at household level, related awareness and practice of respondents and their socio demographic correlates. **Settings and Designs:** This cross-sectional descriptive study was conducted in the slums of Burdwan Municipality in 2019. **Methods and Material:** A total of 330 households were selected by cluster sampling. Salt iodine content was estimated at household level semi-quantitatively by Iodine testing kit, following recommended guidelines. One respondent from each household was interviewed to assess their awareness and practice regarding iodized salt. Kruskal Wallis test, Mann Whitney U test and Multivariable logistic regression was used. **Results:** All 330 households were using iodized salt; 77.6% were consuming adequately iodized and 22.4% were consuming inadequately iodized salts. Only 30.9% of the respondents were aware about the importance of iodized salt, few had correct practice despite inadequate knowledge and none, except one, practiced adding salt at the end of cooking. Awareness and practice were associated with caste and age of the respondents, respectively. Keeping salt container near the oven, adjusting for keeping salt in uncovered container, significantly predicted inadequate level of iodization [AOR 6.17 (95% CI: 2.68-14.26)]. **Conclusion:** Inadequate iodization, lack of awareness regarding iodized salt and faulty storing practices amounting to increased risk of inadequate iodization are still prevalent emphasizing the need, in policy, for health education.

Keywords: Adequate iodization, iodine, salt iodization, slums, West Bengal

Introduction

Iodine deficiency disorders (IDD), a lingering public health problem around the world, is produced due to dietary deficiency of iodine, which is essential for normal thyroid function, growth, and development. The spectrum of the disorders ranges from stillbirth, congenital abnormalities, increased perinatal and infant mortality, impaired physical growth, motor function, and cognitive development in children to reduced work productivity in adults. The insidious nature of development of symptoms along with irreversible nature of consequences emphasize the utmost need of primary prevention in controlling the problem of IDD.[1] Among various interventions for primary prevention, universal iodization of salt (USI) is the most cost-effective and sustainable public health measure.[2]

In India, salt iodization was started in as early as the 1960's, recognizing iodine deficiency as a national public health

Address for correspondence: Dr. Niladri Banerjee, Indrakanan, Sripalli, Purba Bardhaman - 713 103, West Bengal, India.
E-mail: nibknock@gmail.com

Received: 02-08-2020 **Revised:** 29-09-2020
Accepted: 28-10-2020 **Published:** 30-01-2021

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_1576_20

How to cite this article: Mukherjee A, Naskar S, Banerjee N, Mandal S, Das DK. Status of salt iodization, related awareness and practice at the household level in slums of Burdwan Municipality, West Bengal. J Family Med Prim Care 2021;10:361-6.

problem.[3] National Goitre Control Programme (NGCP) was launched in 1962, following a landmark study in 1956 in the Kangra Valley, Himachal Pradesh, which established iodine deficiency as the principle cause of endemic goitre and documented a significant decline in goitre prevalence in the areas where iodized salt was used for consumption.[4,5] The USI initiative came as a policy in 1983 and the commercial production of iodized salt was permitted since then.[3,6] In 1992, the programme was renamed as National Iodine Deficiency Disorders Control Programme (NIDDCP) reflecting the government's commitment to eliminate the spectrum of IDDs; and in 1997, a nation-wide ban was enacted on the sale of non-iodized salt for edible purposes, under the Prevention of Food Adulteration (PFA) Act, which further stipulated the minimum iodine content of salt at 30 ppm at the production level and at 15ppm at the consumption level.[7]

The household coverage of adequately iodized salt in India has undergone major variations reflecting major setbacks in programme implementation.[8] Intensified USI activities, have led to a significant improvement in the household consumption of adequately iodized salt and the national coverage rose to 51% in 2005–2006, 71% in 2009, 77.5% in 2014–2015 and again 76.3% in 2018–2019 in 'India Iodine Survey 2018-19' where reproductive age group women were taken as representative of general population.[9-11] Despite these achievements, the household coverage remains well under the target of 90% which is necessary to eliminate IDDs.[12] Studies done in various parts of India and West Bengal, indicate that consumption of adequately iodized salt in different areas is not universal.[13,14] This gap in the utilization of adequately iodized salt may be due to non-availability at affordable cost, poor knowledge of iodine deficiency diseases and/or faulty storage practices.[14] Monitoring of iodization of edible salt at household level is an important tool for assessing the salt iodization status in certain sections of the society and therefore an effective measure to control iodine deficiency disorders. According to National Iodine and Salt Intake (NISI) survey, 2014-2015, a significant percentage of the population were found to consume inadequately iodized salt (14%) or non-iodized salt (8%) which again varies in urban and rural settings.[10] To accelerate the elimination of IDD in India, and to sustain it, household coverage of adequately iodized salt well above the target of 90% is essential in all areas particularly among the underserved and unreached population of the society. The slum population is such a neglected and underserved section of the society who are deprived of various privileges. They live in unhygienic environmental conditions and are already at risk for various health hazards. Few studies have been done on the iodine adequacy status of the edible salt among slum population in India. In this perspective, the present study had been planned in the slums of Burdwan Municipality, West Bengal to assess the adequacy of iodization of the consumed salt at household level and the awareness and practice regarding use of iodized salt.

Materials and Methods

This descriptive cross-sectional study was conducted between August and December 2019 in the slums of Burdwan municipality in Purba Bardhaman District, West Bengal. There are 144 slums across 35 wards in the municipality, with a total 314265 population, of which 67,623 reside in the slums.

Study population

The primary study units were households in that study area to elicit the status of salt iodization at household level; for assessing related awareness and practice, one adult female person from each selected household, who primarily looks after the cooking of the family, was randomly chosen as respondent. Not willing to participate in the study and absence of eligible respondents, who can comprehend and complete the interview, were the only exclusion criteria.

Sample size and sampling

The sample size was calculated using the formula for estimating the population proportion, i.e., $n = Z_{\alpha}^{2}*p*(1-p)/d^{2}$ where prevalence (p) of consumption of adequately iodized salt was taken as 72.9% from the findings of a similar study done in North 24 Parganas of West Bengal.[14] The population estimate was expected to fall within 10 percentage points (d) with 95% confidence ($\alpha = 0.5$). A design effect of 2 had been applied to compensate for the applied sampling technique (cluster sampling). Further adding for an anticipated non-response of 10%, the minimum sample size came to be 315.

To obtain the sample of 315 households, 30 cluster sampling technique was applied. At first, 30 slums (clusters) out of 144 slums in total were identified by Probability Proportion to size sampling (PPS) technique. The cluster size, after rounding off for the whole number, was determined as $315/30 \sim 11$. From the list of all the households in each selected cluster, 11 households were chosen by simple random sampling. Kish selection grid was used to select the respondents randomly; thus, 330 households and 330 respondents were selected as the study population.

Study tools and technique

A pre-designed pretested semi-structured schedule and spot iodine testing kits [Batch no: IC-649;Mfg date: 01/19;Mfg by: Global Biosciences, A-10, Borsi, Durg (CG)] were used for collecting data. Data regarding the socio-demographic characteristics, awareness and practice related variables were collected by interviewing the respondents. For estimating the level of salt iodization, standard operating procedures for spot iodine testing kit was followed. One spoon of edible salt was taken and one to two drops of the mixture from the white container was added to the spoon of salt. The change in colour was compared against the colour chart provided with the kit and categorized as inadequately (<15 ppm) or adequately iodized salt (≥15 ppm), respectively. If no change in colour was

observed after adding the mixture to the salt sample, then a fresh sample of salt was taken and two drops of the re-check solution was added to the sample, along with one to two drops of the mixture from the white container. Salt was considered to be non- iodized (0 ppm), if no colour change was observed after this procedure.

Data collection

Interview and inspection of salt storing practice was done with consent by visiting each selected household. Small amount of salt sample was collected and tested for iodine content by spot iodine testing kit at the household. The test results were communicated to the respondents and other family members. Improper knowledge and practice were addressed as appropriate.

Study variables

The outcome variable was level of salt iodization: 'no iodization', 'inadequate iodization' or 'adequate iodization'. The independent/explanatory variables were socio-demographic characteristics like age, socio-economic status, religion, caste, type of family etc., awareness regarding importance of salt iodization and variables regarding knowledge and practice of using iodized salt properly.

Statistical analysis

Collected data were checked for completeness and consistency and entered in Excel Data Sheets. Data were analyzed using Statistical Package for Social Sciences v. 20. Categorical variables were expressed as proportions; continuous variables were expressed by mean/median and standard deviation/inter quartile range as appropriate. Multivariable logistic regression was used to predict the level of salt iodization from practices of storing salt at households. Cumulative scores for knowledge and practice regarding the importance of iodized salt and its use were calculated by giving the same weight to all the domains, taking their average and expressing it as a score out of hundred. More was the score; more were the number of domains where awareness and practice were adequate. The minimum attainable score was '0' and maximum was 100. These scores were compared across categories of socio-demographic variables and to find significant difference, non-parametric tests, e.g., Kruskal Wallis one way ANOVA or Mann Whitney U test was used as appropriate.

Ethical considerations

Institutional permission and scientific review committee approval was sought and ethical clearance was obtained from the Institutional Ethics Committee of Burdwan Medical College and Hospital (Memo No.: BMC/2783 dated 1/11/2019). During data collection, the nature and the purpose of the study were briefed to the respondents and their written consent was sought, they were affirmed that complete confidentiality and anonymity would be maintained and the sole use of collected data will be in academic purpose.

Results

Background characteristics

Majority of the respondents were in their fourth and fifth decades of life (74.5%); about half of them were illiterate (47.3%) and almost all of them (97.0%) were homemakers. The members of the households were mostly Hindu (59.7%) and belonged to castes other than General caste (77.0%). Nuclear family (72.7%) and Upper lower socio-economic class (99.4%) according to the Modified Kuppuswamy scale, were the predominant features in the studied households [Table 1].

Salt iodization at household level

77.6% (95% CI: 72.7% to 82.0%) of the households were found to be using adequately iodized salt (≥15 ppm) whereas 22.4% (95% CI: 18.3% to 27.2%) were found to be using inadequately iodized salt (<15 ppm). None of the households were found to be consuming non-iodized salt [Table 2].

Awareness and practice regarding iodized salt

About one fourth of the respondents (25.8%) had no buying preference for packet salt over loose salt. Less than one third (30.9%) of them knew that packet salt contains iodine and that deficiency of iodine can cause health hazards. However only 2.7% of them had reliance that iodized salt can prevent from iodine deficiency disorders. Only 8.8% of the respondents were aware about any of the signs of iodization portrayed in the packet of iodized salt. In practice, all the households used only packet salt due to non availability of loose salt from retailers in the area. In about three fourth of the households (75.8%), salt was stored in covered plastic container. However, 60.9% of the respondents did not know about appropriate container to be used to store salt. Despite inadequate knowledge (329/330 did not know) regarding placement of the salt container with respect to source of heat in kitchen, in 31.2% of the households it was practiced to keep the salt container away from the oven. The study population grossly lacked in knowledge regarding correct time to add salt during preparation of food, which was reflected in their practice that only 0.3% (1/330) of them practiced the appropriate method of ensuring maximum use of salt iodine, i.e., addition salt at the end of cooking. The proportion of respondents with appropriate awareness and practice in aforementioned domains are presented in Figure 1.

Relationships between background characteristics and awareness and practice of the respondents

The scores out of hundred reflect the levels of correct awareness and practice at different domains of knowledge and practice (importance of salt iodization, knowledge & practice regarding using the iodized salt). The median overall score attained for awareness was 12.5 (IQR: 12.5-25) and for practice it was 25 (IQR: 25-50); which denotes the study subjects had adequate knowledge in only 12.5% of the domains of awareness and had adequate practice in only 25% of the domains of practice regarding iodized salt. Muslims, compared to Hindus, subjects

Table 1: Calculated scores for awareness and practice regarding salt iodization across categories of socio-demographic characteristics (*n*=330)

Socio-Demographic Characteristics	Frequency (%)	Median score for awareness (IQR)	*P*	Median score for Practice (IQR)	*P*
Overall score		12.5 (12.5-25)	-	25 (25-50)	-
Religion*					
Hinduism	197 (59.7)	13 (13-25)	0.504	25 (25-50)	0.066
Islam	133 (40.3)	25 (13-25)		25 (25-50)	
Caste**					
General	76 (23.0)	25 (13-38)	0.004	25 (25-50)	0.090
Other Backward. Caste	120 (36.4)	13 (13-25)		25 (25-50)	
Scheduled Caste	115 (34.8)	13 (13-25)		25 (25-50)	
Scheduled T	19 (5.8)	0 (0-13)		25 (25-50)	
Type of family*					
Joint	90 (27.3)	13 (13-25)	0.465	25 (25-50)	0.110
Nuclear	240 (72.7)	13 (13-31)		25 (25-50)	
Socio-economic status#,*					
Upper lower	328 (99.4)	13 (13-25)	0.191	25 (25-50)	0.284
Lower	2 (0.6)	6 (0-13)		25 (25-50)	
Educational status of respondent**					
Illiterate	156 (47.3)	13 (13-25)	0.122	25 (25-50)	0.222
Non formal	10 (3.0)	6 (0-13)		25 (25-50)	
Primary	109 (33.1)	25 (13-38)		25 (25-50)	
Middle	40 (12.1)	19 (13-38)		25 (25-50)	
Secondary & above	15 (4.5)	13 (13-38)		50 (25-50)	
Age of the respondent in years**					
21-30	53 (16.1)	25 (13-38)	0.228	25 (25-50)	0.010
31-40	139 (42.1)	13 (13-25)		25 (25-50)	
41-50	107 (32.4)	13 (13-25)		25 (25-50)	
51-60	31 (9.4)	13 (0-38)		25 (25-25)	

#Modified Kuppuswami Scale; *Mann Whitney U test applied; **Kruskal Wallis test applied

Table 2: Association between practice of storing salt and level of iodization (*n*=330)

Practice of storing salt	Categories	Level of salt iodisation		OR* (95% CI)	AOR* (95% CI)	*P*
		Adequate No (%)	Inadequate No (%)			
Place of storing the salt container	Away from oven (*n*1=103)	95 (92.2)	8 (7.8)	Ref.	Ref.	0.000
	Near the oven (*n*2=227)	161 (70.9)	66 (29.1)	4.87 (2.24-10.58)	6.17 (2.68-14.26)	
Type of salt container	Covered (*n*3=275)	214 (77.8)	61 (22.2)	Ref.	Ref.	0.057
	Uncovered (*n*4=55)	42 (76.4)	13 (23.6)	1.09 (0.55-2.15)	2.13 (0.97-4.66)	
Total		256 (77.6)	74 (22.4)			

Hosmer & Lemeshow goodness of fit test *P*: 0.796, Negelkerke R^2 0.096. *OR and AOR for inadequate level of iodization

belonging to General caste compared to other castes, households with upper lower socio-economic status (SES) compared to lower SES and younger respondents were found to attain more scores for awareness; but statistically significant difference was found only in case of caste (p = 0.004). The median scores for practice were almost identical across all socio-demographic strata excepting that respondents of 51-60 years age group had significantly (p = 0.010) lower scores than younger age groups.

Relationships between practice of storing salt and its level of iodization

Inadequate levels of iodization was found in about one third of the households (29.1%) and in less than one tenth (7.8%) of the households where salt was kept near the oven and away from the oven respectively. A multivariable logistic regression model was used to predict inadequate levels of salt iodization at households from 'place of storing salt with respect to the oven in kitchen' and 'type of salt container (covered or uncovered)'. The risk was found to be 6.17 (2.68-14.26) times more in households where salt was kept near the oven than in households where salt was kept away from the oven (p = 0.000). Though the risk was found to be 2.13 (0.97-4.66) times more in households where salt was kept in uncovered containers than in households where salt was kept in covered containers, it did not significantly predict the level of salt iodization (p = 0.057).

Discussion

All the studied households were found to consume iodized salt by the virtue of buying packet salt. However, adequate iodization, i.e., ≥15 ppm, as mandated by the NIDDCP, is found in only 77.6% of households, which is almost identical to the

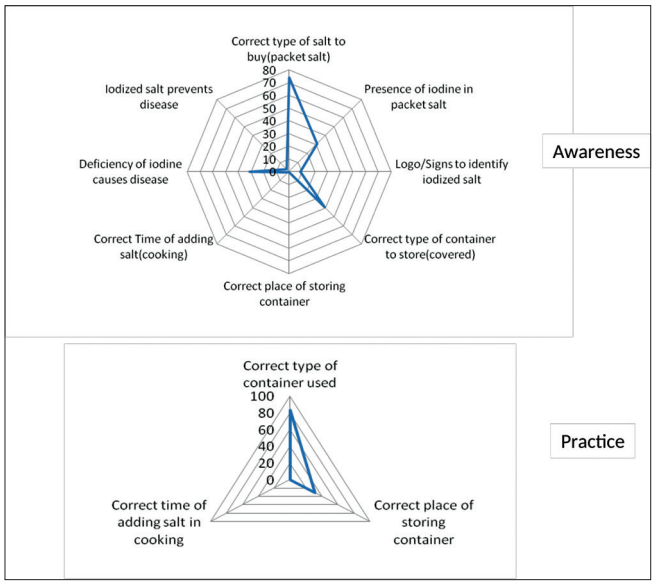

Figure 1: Proportion of the study population with appropriate awareness and practice (n = 330)

national average of 77.5% found in National Iodine and Salt Intake (NISI) survey, 2014-2015 and 76.3% as in India Iodine Study 2018-19.[10,11] Present study, similar to other studies done in various settings of West Bengal reveal a coverage of household consumption of iodized salt, that is still far from the target of 90%.[15-18] Contrary to other studies done in West Bengal and other states of India, where non iodized salt consumption constituted a significant proportion, the present study found no households consuming non iodized salt.[12,13] An improved access to iodized salt of this deprived and poor section of the community is evident from this study, which may be attributed to continued efforts under NIDDCP to provide iodized packet salt at affordable price and a stringent ban on sell of non-iodized loose salt; however the findings also hint that only 'access to iodized salt' is not sufficient to maintain a good level of iodization at consumption.

The lack of adequate iodization of consumed salt despite procuring adequately iodized salt for consumption can be explained by the faulty storage practices at households backed by inadequate and improper knowledge regarding importance of iodization and appropriate methods of using. Interestingly, present study reveals the presence of both, i.e., faulty practices and inadequate knowledge among the respondents. Moreover, the awareness and practice were found poor across all socio-demographic strata with respondents belonging to other than general castes attaining the poorest scores for awareness. Similar results were found in other studies done in various settings of India, where iodine nutrition was especially poor in lower socio-economic groups.[14,19,20,21] Inadequate level of salt iodization was more in households where salt container was stored near the oven and in households where salt was kept in uncovered container. These findings are biologically plausible and corroborated by a similar study in North 24 Parganas, West Bengal where a greater proportion of households with practice of storing salt in the shelf were found to consume adequately iodized salt.[15]

The evidence reflects a lack of authentic sources of information regarding salt iodization, to the community. The five guiding principles, crucial to sustain USI programme success, as identified by UNICEF based on a review of global efforts towards USI and as envisaged by Rah *et al.*,[22] emphasize strengthening the monitoring system and maintaining continuous education and communication. Information Education and Communication activities regarding the importance of salt iodization and proper use of iodized salt should be strengthened under the NIDDCP, otherwise the benefit of 'adequate access to iodized salt' cannot be realized. The primary care physicians have the advantage of catering the vast majority of diverse population in India. Being close to the people, they can also play an important role in achieving the USI targets, particularly emphasizing appropriate storage and use of iodized salt. Moreover, regular within system and independent investigations for estimating the coverage at various geographical and socio-demographic settings are crucial.

The study is limited by the fact that observations of practices on storing salt and adding salt during cooking only reflect practice during data collection and self-reported information.

From the findings and interpretations, it can be summarized and concluded that consumption of adequately iodized salt in the study area is far below the expected level of 90%. Poor awareness and faulty storage practices regarding iodized salt are still prevalent. This study highlighted the magnitude of shortfall (77.6% vs. 90%) in achieving the universal salt iodization target in a marginalized population of a district in West Bengal; and also provided the evidence as well as the effect size for inadequate level of iodization accountable to faulty storage practice near oven [AOR 6.17 (2.68-14.26)], and for storing in uncovered container [AOR 2.13 (0.97- 4.66)]. Regular monitoring of salt iodization at household level and focussed IEC activities, especially on storage practices of edible salt at household level should be emphasized.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Pandav CS, Yadav K, Srivastava R, Pandav R, Karmarkar MG. Iodine deficiency disorders (IDD) control in India. Indian J Med Res 2013;138:418-33.
2. Ministry of Health and Family Welfare. Annual Report 2018-19.New Delhi: Ministry of Health and Family Welfare, Government of India. 2019. p89-90.
3. Pandav CS, Moorthy D, Sankar R, Anand K, Karmarkar MG,

Prakash R. National Iodine Deficiency Disorders Control Programme, National Health Programme Series 5. National Institute of Health and Family Welfare: New Delhi. 2003.

4. Sooch SS, Ramalingaswami V. Preliminary report of an experiment in the Kangara valley for the prevention of Himalayan endemic goitre with iodized salt. Bull World Health Organ 1965;32:299-315.
5. Sooch SS, Deo MG, Karmarkar MG, Kochupillai N, Ramachandran K, Ramalingaswami V. The Kangra valley experiment: Prevention of Himalayan endemic goitre with iodinated salt. Acta Endocrinol Suppl (Copenh) 1973;179:110.
6. The Government of India Report on advocacy policy meeting on iodine deficiency disorders. Ministry of Health and Family Welfare, Government of India: New Delhi. 1994.
7. The Salt Department. Quality of Salt under PFA Act. 2007. Available from: http://saltcomindia.gov.in/. [Last accessed on 2012 Jun 05].
8. International Institute for Population Sciences (IIPS) and Macro International. National Family Health Survey (NFHS-2) 1998–9. IIPS: Mumbai.
9. International Institute for Population Sciences (IIPS) and Macro International (2007) National Family Health Survey (NFHS-3) 2005–6. IIPS: Mumbai. 2000.
10. Pandav CS, Yadav K, Salve HR, Kumar R, Goel AD, Chakrabarty A. High national and sub-national coverage of iodized salt in India: Evidence from the first National Iodine and Salt Intake Survey (NISI) 2014–2015. Public Health Nutr 2018;21:3027-36.
11. Nutrition International, ICCIDD, AIIMS (New Delhi) and Kantar. India Iodine Survey 2018-19 National Report, New Delhi, India. 2019.
12. Mathur M, Pattanaik S, Sayed S, Das BN. Assessment of adequately iodized salt consumption in Telengana state, India. Int J Community Med Public Health 2018;5:3588-91.
13. Biswas AB, Chakraborty I, Das DK, Roy RN, Ray S, Kunti SK. Assessment of Iodine Deficiency Disorders in Purulia District, West Bengal, India. J Trop Pediatr 2006;52:288-92.
14. Karmakar N, Datta A, Nag K, Datta SS, Datta S. Knowledge, attitude and practice regarding household consumption of iodized salt among rural women of Tripura, India: A mixed methods study. J Educ Health Promot 2019;8:21.
15. Sen TK, Das DK, Biswas AB. Limited access to iodized salt among the poor and disadvantaged in North 24 Parganas Distrct of West Bengal. J Health Popul Nutr 2010;28:369-74.
16. Das DK, Chakraborty I, Biswas AB, Saha I, Mazumder P, Saha S. Goitre prevalence, urinary iodine and salt iodisation level in a district of West Bengal, India. J Am Coll Nutr 2008;27:401-5.
17. Chandra AK, Tripathy S, Ghosh D, Debnath A, Mukhopadhyay S. Iodine nutritional status & prevalence of goitre in Sundarban delta of South 24-Parganas, West Bengal. Indian J Med Res 2005;122:419-24.
18. Chandra AK, Tripathy S, Ghosh D, Debnath A, Mukhopadhyay S. Goitre prevalence and the state of iodine nutrition in the Sundarban delta of North 24-Parganas in West Bengal. Asia Pac J Clin Nutr 2006;15:357-61.
19. Deepika PS, Rao BT, Vamsi A, Valleswary K, Sekhar MC. A cross sectional study on proper use of iodized salt in communities of rural areas and its relevant factors in Prakasam district, Andhra Pradesh, India. Int J Community Med Public Health 2019;6:1083.
20. Vasudevan S, Senthilvel S, Sureshbabu J. Knowledge attitude and practice on iodine deficiency disorder and iodine level in salt in retail and vendors among the rural population in south India: A community based observational and descriptive study. Clin Epidemiol Glob Health 2019;7:300-5.
21. Bhattacharya U, Chandra AK. Socioeconomic status of the population–a prime determinant in evaluating iodine nutritional status even in a post salt iodization scenario. J Pediatr Endocrinol Metabol 2019;32:143-9.
22. Rah JH, Anas AM, Chakrabarty A, Sankar R, Pandav CS, Aguayo VM. Towards universal salt iodisation in India: Achievements, challenges and future actions. Matern Child Nutr 2015;11:483-96.