

Knowledge and practice of mothers of school-going children regarding iodized salt and its association with the psychology testing of the students

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ABSTRACT

Context: Iodized salt is the mainstay intervention to tackle iodine-related disorders. In spite of the government's efforts to make iodized salt available in more than 90% of the households across the country, there are sketchy details on its use. Since the main propagators of this intervention are the mothers cooking in kitchen, this study was conceived, as a corollary to a larger micronutrient assessment study among school-going children. **Aims:** The aim of this was to assess knowledge, practice of mothers of school-going children (6-16 years) regarding use of iodized salt, and to see any association between the simple psychological testing of the children and the iodine content of the salt used in home kitchen and the contributing factors thereof. **Methods and Materials:** A cross-sectional study was conducted by interviewing mothers of 240 school-going children of age groups 6-11 years and 12-16 years from six schools of Bhubaneswar using a semi-structured questionnaire regarding their knowledge on iodine and its deficiency and the practice of using iodized salt. MBI kit was used to assess the iodine content of salt used at home. The psychology adeptness of students was assessed using the standardized and validated coding, standard progressive matrices, and colored progressive matrices tests. **Statistical Analysis:** Analysis was done using SPSS version 16, wherein the sociodemographic data were shown in proportions, and the iodine content was taken as the dependent continuous variable and means reported. For the sake of associations with intelligence and cognition, a binary logistic regression model was drawn. **Results:** It reports that 47.5% of mothers knew that iodized salt is good for health and iodine content measured using MBI kit was 15 ppm and above for 71.7% of the sample. Further, iodine content in salt is seen as protective for cognition and also for IQ. **Conclusions:** The knowledge of the mothers' needs reinforcement regarding iodine and related disorders and the benefits of iodized salt. The aim of the National Iodine Deficiency Disorders Control Program can only be achieved by generating awareness, regular follow-up, and improving the iodization of salt.

Keywords: Cognition, intelligence quotient, iodized salt, micronutrient, school-going children

Introduction

India banks on a strong public health delivery service and strategies to withstand its several public health problems, owing to its huge load of population and socioeconomic disparity. Iodine deficiency disorders (IDD) is one such public health burden,

which owes its existence to environmental reasons, wherein melting of glaciers, floods, change of river beds, and loss of forest cover have collectively led to the depletion of iodine from the top layers of the soil. The geological loss of iodine is reflected in the low-iodine levels in the plant and animal vegetation and subsequent deficiency in humans, who are dependent on the dietary intake of iodine.^[1]

IDD have caught the eye ever since its deficiency has been associated with serious impact on the brain of developing child

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besides a myriad of health and social problems. Hence, it has a bearing on human resource development and national growth.^[2-4] This is aided by an important statistics that one point increase in a nation's average IQ is associated with a 0.11% annual increase in the gross domestic product (GDP), thus IDD elimination can potentially contribute to 1.5% the GDP growth annually.^[5,6]

Universal iodization of salt is a cost-effective simple strategy that can turnaround the issue, with the country reinstating a ban on the sale of non-iodized salt and consolidation of the sustainable elimination of IDD (Since 2005). Even after this, currently there is 92% household level coverage of iodized salt in India, of which 78% is adequately iodized salt, and the statistics vary from state to state.^[7,8] Some studies have attributed the variations to the lack of knowledge of users, that is, the mothers, regarding iodized salt attributing to the poor iodine reserves in children.^[9,10]

The current study was conducted as a value addition corollary to a much larger pan India study, initiated by King George Medical College, KGMU, Lucknow, with the aim to know the micronutrients intake among school-going children in 6-16 years age group children in 10 cities of the country. Eastern India was represented by Guwahati and Bhubaneswar. Along with the in-depth core protocol of this study, a nested study was planned at Bhubaneswar site to assess the knowledge and practices of mothers of the sampled school children, regarding the use of iodized salt and look for any associations with the psychological testing done for the students as a part of the mandate for the bigger study.

Objectives

The objective of the study was to assess knowledge, practice of mothers of school-going children (6-16 years) regarding the use of iodized salt, and see any association between the simple psychological testing of the children and the iodine content of the salt used in home kitchen.

Methodology

The study as mentioned is an interim analysis for the site Bhubaneswar city, of a bigger project on micronutrients in 10 cities. It was ethically approved by the Institutional ethical committee (Ref No. KIMS/KIIT/IEC/112/2016 dated 29.11.16). The sampling frame comprised of all co-educational schools, inclusive of private and government schools in the city with both secondary and higher secondary classes. Thus, 6 schools, 2 private and 4 government schools, were selected randomly at the central site of Lucknow for accessing the study population of 240 children, stratified for 120 from 6-11 years age group and 120 from 12-16 years age group and also proportionate for gender representation. For this study, taking that the use of iodized salt is appropriate in 65% households in Odisha (Indian salt coverage report 2010), at 95% CI and an acceptable difference of 7%, the optimum sample is calculated at 178, Considering 20% non-response,

the final optimum sample is calculated as 214. The data were collected for 240 students. The sample population were 20 children (proportionate for boys and girls), which were collected from the randomly selected 6 schools as per protocol. The respondents were mothers of the sampled children who were willing to participate in the study.

The study tool was an interview with a semi-structured questionnaire regarding their knowledge on iodine, iodine-related disorders, and the practice of the use of iodized salt. The questionnaire was bilingual, i.e. English and in the local language, Odia. Consent of District Education Officer of Bhubaneswar city, consent of principal of the selected school, written informed consent of parents, and assent for children above 7 years of age were sought before conducting the study.

Rapid iodized salt test kit (MBI kit, Chennai) was used to assess iodine content in salt consumed in the household kitchen. The kit contained a stabilized starch-based solution, which manifests a color change when mixed with the salt. The sample salt was taken in a teaspoon, and after shaking the reagent (test solution) bottle well, a drop of the test solution was poured on the salt which colored up from blue to dark violet depending on the iodine content of the salt. To assess the iodine content, the color of the salt was compared with an accompanying chart (0, 7, 15, and 30 parts/million – ppm). The cut-off proportion of 15 ppm and above was considered as adequately iodized salt using the WHO/UNICEF given standards as a reference for this study. Anthropometric measurements were also done like height, weight to calculate body mass index.

Two types of psychological tests were considered to assess the intelligence and cognition of the sampled child.

Intelligence quotient or IQ was scored using colored progressive matrices (CPM) for age group 6-11 years (Ref: J Raven, JC Raven and J H Court; 1998 Edition) and the use of standard progressive matrices (SPM) for the age group 12-16 years of age (Ref: J Raven, JC Raven and J H Court; 2000 Edition) using the standardized booklets.

The coding test was to test for cognition (Ref: Malin's Intelligence Scale for Indian Children) and scored as per the standard format in reference.

In both cases, the final scoring was extrapolated onto a grading that is easier to comprehend and report, as shown in Figure 1.

The results were analyzed in SPSS version 16, wherein the sociodemographic data were shown in proportions and the iodine content was taken as the dependent continuous variable and means reported. For the sake of associations with intelligence and cognition, a binary logistic regression model was drawn by merging Grades 1, 2, 3 as normal and above and 4, 5 as below average and needing a referral for the sake of bivariate logistics.

Results

Table 1 shows that the mothers' mean age is 35 years, mostly with an average of 10.6 years of schooling, 85.8% are housewives, 74.5% belong to joint family, and nearly equal proportions of lower and upper class were seen as we had a mix of government and private schools representation. Iodine content measured using the MBI kit was 15 ppm and above for 71.7% of the sample.

Table 2 shows that 47.5% of mothers knew that iodized salt is good for health; the knowledge gap is only 4.2%, i.e. 43.3% practiced the same at home. This acceptable gap may be because the study was taken in an urbanized city of the state, which is also the capital of Odisha. So availability and advocacy of the safe use of the iodized salt are better, but the figure may be an iceberg overview of the state statistics. Contrary to the knowledge, other accessory practices to ensure the availability of desired iodine on consumption like storing salt in air-tight containers and adding it towards the end of cooking procedures (as iodine is susceptible to heat) were dismal, i.e. 22.5% and 17.9%, respectively.

In Graph 1, comparing age groups poor IQ is noted in 6-11 years (8.3% vs 1.7% in grade 5), and the ratio is reversed in cognition and memory test, i.e. Coding test (20.8% vs 26.9% in grade 5). Brain development and other accessory familial and peer group pressures may be the reasons, but studying them was beyond the scope of the study.

As can be seen in graphs, poor intellectual levels (Grade V) in both genders are less as can be seen in Graph 2, i.e. nearly 5% while poor cognition (Grade 5) is more in girls (28.1% vs 19.5%). The reasons here off could be anemia, and, in the bigger study, we have a provision to see the hemoglobin and serum iron levels that may validate the reasons, but the results are not available in the current article for reporting.

In the above table, adequate iodine content is seen as protective (adjusted odds: 0.86; SD: 0.41, 1.82) for and cognition and also for IQ (0.98; SD: 0.39, 2.44). The results hint at an inadequate sample due to CIs including integer 0 and the P values > 0.05 ; hence, the results may not be taken as conclusive.

GRADE I	"Intellectually superior", if a score lies at or above the 95th percentile for people of the same age group.
GRADE II	"Definitely above the average in intellectual capacity", if a score lies at or above the 75th percentile. (It may be designated II+ if it lies at or above the 90th percentile.)
GRADE III	"Intellectually average", if a score lies between the 25th and 75th percentiles. (It may be designated as III+, if it is above the 50th percentile, and III-, if it is below it.)
GRADE IV	"Definitely below average in intellectual capacity", if a score lies at or below the 25th percentile. (It may be designated IV-, if it lies at or below the 10th percentile.)
GRADE V	"Intellectually impaired", if a score lies at or below the 5th percentile for that age group.

Figure 1: Final Scoring pf psychological tests used in the study

It calls for a more robust sampling and other restrictive limitations such as the non-availability of serum iron and iodine results, which are the definitive indications of micronutrient deficiency. Moreover, school-going children do not necessarily eat from the home kitchen alone, given the wide choices of junk and packet foods available nowadays. For both the psychological tests, the median years of schooling of the mother were highly significant for iodized salt use and psychological scores.

Discussion

This simple study reiterates the fact that in spite of a ban on unionized salt in India since 2005 its use in Indian kitchens still needs emphasis. Mothers, who usually do the cooking, are the

Table 1: Child and mother characteristics of the sample

Variables	Number=240
Child Characteristics	
Age group (proportionate)	
6-11 yrs	120 (50.0)
12-16 yrs	120 (50.0)
Gender (proportionate)	
Male	119 (49.6)
Female	121 (50.4)
Mean weight in kg (SD)	40.5 (14.6)
Mean body mass index (SD)	18.2 (4.6)
CT (Coding test to test cognition)	
Normal/High (Grades 1,2,3)	149 (62.3)
Impaired (Grades 4,5)	90 (37.7)
Intellectual level (SPM/CPM Test)	
Normal/High (Grades 1,2,3)	200 (83.7)
Impaired (Grades 4,5)	39 (16.2)
Mother's Characteristics	
Mean age of Mother in yrs (SD)	35.1 (4.4)
Education of Mother	
Illiterate	33 (14.2)
Literate	199 (85.8)
Mean years of schooling of mother (SD) (n=199)	10.6 (4.4)
Occupation of Mother (n=200)	
Housewife	171 (85.5)
Working	29 (14.5)
Household characteristics	
Type of family	
Nuclear	61 (25.5)
Joint	178 (74.5)
Median family size (IQR)(range)	4 (4, 5) (2, 15)
Socio-economic status	
Lower (1/2)	87 (38.0)
Middle (3)	59 (29.8)
Upper/upper middle (4/5)	83 (36.2)
Iodine content in the salt in ppm (%)	
Zero	26 (10.8)
Seven	42 (17.5)
Fifteen	156 (65.0)
Thirty	16 (6.7)
Iodine content (among those using at home) (n=104)	
Inadequate	28 (26.9)
Adequate	76 (73.1)

propagators of the practice, and the study which was directed to measure the micronutrient status among school children was used to assess the mothers' knowledge and practice on iodized salt.

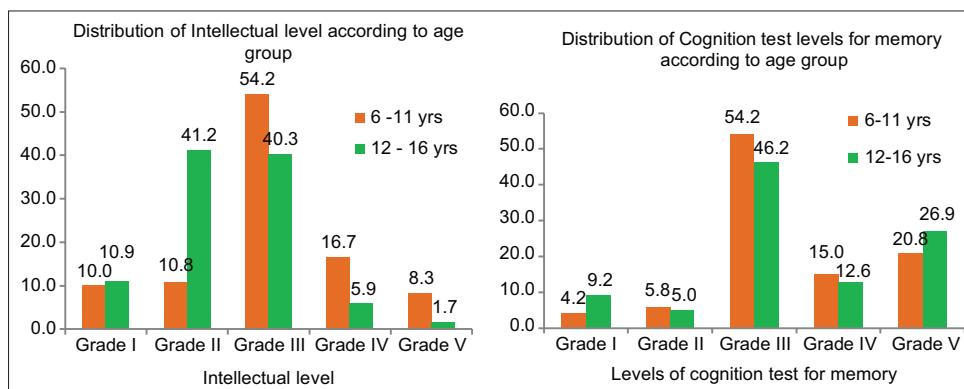
Our study registers 47.4% of the mothers being aware of iodized salt which is the same as reported in the rural women of Tripura (46.7%)^[10] but much less than that reported in Tamil Nadu,^[11] wherein knowledge was 64.6%. Also, contrary to the Tripura study which states that the practices of salt use were better in the study population, in Bhubaneswar, both practices of storing in air-tight containers and adding the salt at end of cooking were dismal at 22.5% and 17.9%, respectively. Though in this study women attributed their knowledge regarding iodized salt to television ads (96%) and 88.5% could say that it led to poor mental development, a disconnect was detected in terms of practice while cooking. Such pertinent information should also be added to the information education communication campaigns done for advocacy for iodized salt as the lack of proper practices undo the benefit of the availability of iodized salt. None of the women named the frontline health workers as their source of information for this public health measure, which means that the antenatal opportunity is not being utilized to propagate the importance of iodine among mothers.

The psychological testing could not be directly linked to the iodine content of the salt as the food habits of school-going children are not limited to their home kitchens. In the public schools, they

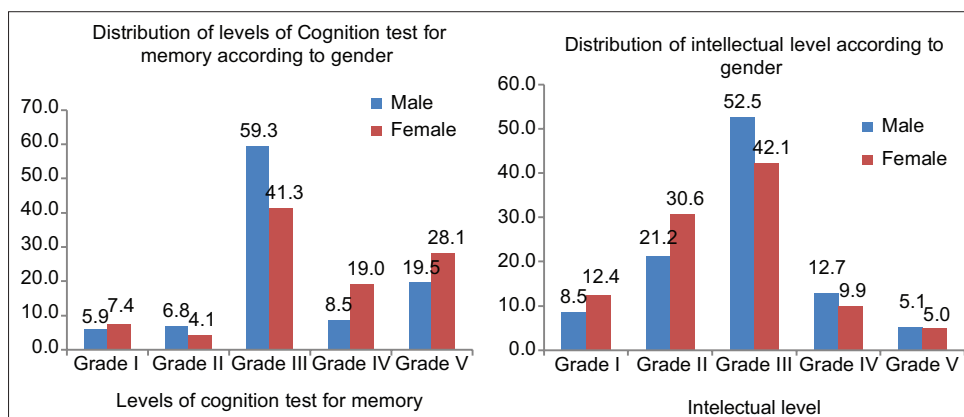
were offered mid-day meals, and even otherwise in private schools, canteen foods and the easily available packet or junk foods also make up the diet of school-going children. Hence, a proper diet survey and serum blood iodine levels are the best ways to ascertain the association with psychological tests. This limitation is cited in the methodology and is the mandate of the bigger umbrella study done in 10 cities of the country. Nevertheless, the small exercise of testing home kitchen iodine and IQ testing offered hands-on

Table 2: Knowledge and practice among mothers for iodized salt

Variables	n=240(%)
Awareness about iodized salt is good for health (%)	114 (47.5)
Meaning of iodized salt (%)	
Ordinary salt with iodine	101 (42.1)
Common salt	8 (3.3)
No response	131 (54.6)
Know about the adequate iodine content in salt (%) (n=104)	34 (32.7)
Source of information regarding iodized salt (n=114)	Television ads 96%
Could name at least one disorder related to iodine deficiency (n=114)	101 (88.5)
Practice of storing salt in tight lid containers	54 (22.5)
Practice of adding salt to food at the end of cooking	43 (17.9)



Graph 1: Variations of IQ and Coding test among the 2 age groups



Graph 2: Variations of IQ and coding test in gender

Table 3: Association between iodine levels and psychological tests

SPM/CPM test	Intellectual	Impaired	Crude OR (95% CI) <i>P</i>	Adjusted OR (95% CI) <i>P</i>
Iodine content in salt (%)				
Inadequate	58 (29.0)	10 (25.6)	1.00	1.00
Adequate	142 (71.0)	29 (74.4)	1.18 (0.54, 2.59) 0.671	0.98 (0.39, 2.44) 0.971
Coding test for cognition	High memory	Impaired memory	Crude OR (95% CI) <i>P</i>	Adjusted OR (95% CI) <i>P</i>
Iodine content in salt (%)				
Inadequate	45 (30.2)	23 (25.6)	1.00	1.00
Adequate	104 (69.8)	67 (74.4)	1.26 (0.70, 2.27) 0.441	0.86 (0.41, 1.82) 0.696

evidence to mothers, regarding the significance of micronutrient and use of iodized salt. Odisha being a coastal state, there is easy availability of crystalline salt, whose use is culturally and popularly ingrained. Also, to keep salt in open containers is a common habit to suit its immediate need in case of hot humid summers. The study was used to educate all mothers regarding the use and importance of iodine in a child's development. The children also cooperated and benefited from the exercise of salt testing and its relevance in a consumer's life. It is scientifically proven that iodine-sufficient children have fine motor skills, information processing, and visual problem solving,^[12,13] and similar results are seen in our study wherein the adequate iodine content in salt was protective for normal and above psychological scores as seen in Table 3. The results are not significant as the sample size is not representative; however, the inferences can be used as a strong proxy educative message to insist on iodized salt use among the mothers of the school children.

Conclusion

The study emphasizes that besides policy-level decisions and legislations like banning uniodized salt, widespread campaigns with full information are essential, especially among target populations like school-going children and their mothers to maximize the health benefits of iodized salt. Psychological tests, which are simple to run like CPM and SPM, can be done for the school children from time to time to generate scientific evidence of the benefits of iodine on memory and IQ.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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