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A study of dietary iodine intake and its relationship with scholastic performance

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Abstract

Children all over the world continue to receive top priorities in the field of health and family welfare and nutrition because of their importance to the future human race and also as they contribute to the most vulnerable group due to their tender ages. School going children, who are our future citizens, form an important segment of India's population. They contribute to the vital human potential and import strength to the national economy and its development. The progress of a nation depends largely upon the efficiency of the education imparted to the children in school. A healthy development of the mind can be promoted in children of school going age.

There are many factors, which are related to the mental growth of a child, e.g., proper nourishment, climatic conditions, hygiene, educational facilities etc. Out of these, the most important factor is food and proper nourishment. Most foods fulfil more than one function, as they consist of a number of nutrients, one is macronutrient and second one is micronutrients. Micronutrients include only three nutrients such as vitamin A, iron and iodine, which are required by the body in tiny quantities. Iodine is a micronutrient which is essential to human life. Some of the most vital functions of the human body and maintenance of body temperature depend upon steady supply of iodine.

Keywords: dietary iodine intake, relationship, scholastic performance

Introduction

Children are an important asset to the country hence it is essential that they should have good physical and mental health it is in the hence of the parents that they should provide proper nourishment and hygienic conditions to their children so that they may develop good brains and they may develop into citizens with good intellectual capital capability.

The term iodine deficiency is of relatively recent provenance, having been introduced by Hetzel (1987). It is a term that appropriately covers the tragic spectrum of mental and physical disability resulting from an inadequate dietary iodine intake and supply of iodine to the developing brain of the foetus, infant and young child. At the begin end of the spectrum is the widely prevalent, while at other end is the relatively uncommon syndrome of cretinism. Between these poles is a broad range of impaired mental physical functions of varying severity.

Therefore, iodine deficiency poses a serious threat to the health and quality of human resources. Millions in our country suffer from this form of iodine deficiency and it affects social and economic progress in iodine deficient regions. Its deficiency leads to a host of physical and neurological abnormalities the severity of which depends upon the degree and time of the deficiency. These abnormalities are collectively referred to as iodine deficiency disorders (WHO, 2001).

Iodine deficiency has been narrowly thought of in terms of goitre, which is the most common and immediately recognizable symptom and cretinism, a tragic but relatively rare manifestation. Goitre is only one of the many consequences of iodine deficiency. The most visible and easily recognizable sign of iodine deficiency is goitre. Goitre is an enlarged thyroid gland; the size can range from an invisible swelling to a monstrous growth. Not all goitres are visible.

Iodine deficiency in children lowers intelligence Quotient (IQ) by as many as 10 to 15 points and impairs mental and cognitive function leading to poor school performance, it retards growth dulls motivation and curiosity, reduces play and exploratory activities, results in

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muscular disorders, speech and hearing defects, impairs coordination and leads to sluggishness. (Govt. of UP, 1999). This mental deficiency has an immediate effect on the child's learning capacity, women's health, and quality of life of communities. Infant and young children exposed to iodine deficiency may also suffer from irreversible brain damage. Hypothyroid children are intellectually subnormal and may also suffer from physical impairment. They lack the aptitude of normal children of similar age and are often incapable of completing school.

In the state of UP, eastern area is geologically an Iodine deficient zone in state of UP Gonda district is one of them. The prevalence of goitre is found 65-69% in Gonda district (Govt. of India, 1982). In specific terms, the present study proposes to investigate the dietary iodine Intake and its relationship with scholastic performance and intelligence quotient. The precise statement of the problem is as follows:

A Study of Dietary Iodine Intake and Its Relationship with Scholastic Performance of School Children

The present study was conducted in district Gonda that comes under Sub-Himalayan Tarai belt, which is known for high endemicity of iodine deficiency disorders. Gonda district has 25 community development blocks and they have considerably homogeneity among themselves. Study done by Kochupillai (1991) also reported 50-80% prevalence of iodine deficiency disorders in this district. Stratified random sampling method has been used for the selection of sample. There are 25 blocks in district Gonda. First of all, list of these blocks was prepared in alphabetical order and one block was selected at randomly. It came out to be Colonel Ganj block. The second task in drawing the sample was to get the list of schools of Colonel Ganj block. For this After preparing the list of all the schools, only four schools were selected using random number table. In four primary schools, 200 school children were selected; a sample size consisted of 200 school children belonging to the age group 6-12 years, both boys and girls. The basis of the final sample for the present study is as follows:

Table 1: In four primary schools, 200 school children were selected; a sample size consisted of 200 school children belonging to the age group 6-12 years, both boys and girls. The basis of the final sample for the present study is as follows

S. No.	Name of the school	Total No. of Children	No. of Children studied
1	Primary school, Katra	110	55
2	Primary school, Narayanpur	94	47
3	Primary School, Sakrotta	106	53
4	Primary School, Sahabajpur	90	45
	Total	400	200

The investigator prepared the interview schedule for this study. In all there were thirty-five questions in the interview schedule (e.g., general information, socioeconomic status and food habits etc.) iodine dietary intake was measured of the children and parents by examination of goitre and urinary iodine excretion level.

Estimation of Urinary Iodine Level

Goitre and urinary iodine estimation of school age children are recommended by WHO/UNICE/ICCIDD as an important parameter to assess the iodine status of the body (WHO/UNICE/CCIDD, 1996).

Goitre prevalence of the school age children indicates the correct status of iodine deficiency of that population while urinary iodine level indicates the average iodine consumption, (Stantury, 1987). Urine iodine determination is the biochemical indicator of iodine deficiency because determining thyroid size by palpation is difficult when size is not large. Thus, the iodine level in urine reflects the subject's intake. Iodine in urine is stable can withstand collection and transport even under field conditions. Urine excretion level of fifty percent children had been done in the lab of King George Medical College, Lucknow.

Measurement of Intelligence Quotient

The level of intelligence of children was tested by Ravens coloured progressive matrices (1947) revised in 1956, The coloured progressive matrices, sets A, AB and B are designed to assess as accurately as possible a person's development. Each of the three sets A, AB and B of coloured matrices of 12 problems.

Measurement of Scholastic Performance

Scholastic achievement of the children was measured using by some tests that were obtained from State Council of Education Research and Training. These tests were based on questions from the Math and Hindi syllabus of children from class II to class V. The tests prepared using the syllabus of one class was applied on children of the next higher grade such as, tests prepared using the syllabus of one class II was used for children studying in class III. Each test carried 40 marks. The marks obtained by each child were classified as follows:

Table 2: Measurement of Scholastic Performance

Scholastic Grade	Performance Marks of Tests (Hindi and Math) MM = 80
Good	75 percent and above
Medium	60 to 74 Percent
Below Medium	45 to 59 Percent
Poor	33 to 44 Percent

Subjects (children and teachers) were approached and were explained the purpose of the present study. In this way a good rapport was established with the children. The data were collected with the help of class teacher. The questions related to their families were asked to visit their home.

Observations of the Study

Table 3: Distribution of School Children by Age and Sex

Age (Years)	Males		Females		Total	
	No	%	No	%	No	%
8	16	15.23	9	9.47	25	12.5
9	10	9.52	15	15.78	25	12.5
10	37	35.23	23	24.21	60	30.0
11	29	27.61	23	24.21	52	26.0
12	13	12.38	25	26.31	38	19.0
Total	105	52.5	95	47.5	200	100.0

Study comprised of children of 8 to 12 years of age. Out of the total children, 52.5 percent were males and 47.5 percent were female children. Maximum children (30.0%) were 10 years of age (30.0%) followed by 11 years (26.0%) and 12 years (19.0%) of age and minimum children were 8 years

(12.5%) and 9 years (12.5%) of age. Male children were more found at all ages except the age of 9 and 12 years.)

Table 4: Distribution of Children by Class and Sex

Class	Males		Females		Total	
	No	%	No	%	No	%
III	25	23.8	10	10.5	35	17.5
IV	36	34.3	32	33.7	68	34.0
V	44	41.9	53	55.8	97	48.5
Total	105	52.5	95	47.5	200	100.0

Schools that taken for the study were had the education of class 1st to Class V. The educational status of school children examined ranged from 111 to Vth standard. Maximum children were in (48.5%) Vth standard and minimum were in IIIrd standard that was 17.5 percent.

Table 5: Socio-demographic Characteristics of School Children

Socio-demographic Characteristics	Number	Percentage
Religion		
Hindu	140	70.0
Muslim	60	30.0
Caste		
Upper	73	36.5
Backward	103	51.5
Schedule	24	12.0
Educational status of Children's Mother		
Illiterate	129	64.5
Literate	38	19.0
Primary	33	16.5
Educational status of Children's Father		
Illiterate	56	28.0
Literate	33	16.5
Primary	91	45.5
High School and above	20	10.0
Occupation of Children's Mother		
Housewife	97	48.5
Labourer	40	20.0
Farmer	51	25.5
Skilled worker	6	3.0
Unskilled worker	6	3.0
Occupation of Children's Father		
Labourer	60	30.0
Farmer	54	27.0
Skilled worker	37	18.5
Business	30	15.0
Service	19	9.5
Socio-economic Status		
Class I (Upper)	-	-
Class II (Upper)	2	1.0
Class III (Upper)	8	4.0
Class IV (Upper)	159	79.5
Class V (Upper)	31	15.5
Type of family		
Joint	44	22.0
Nuclear	156	78.0

Religion and Caste

Mainly two religions were encountered in this study. Majority of the children (70.0%) were Hindus and rest were Muslims (30.0%). Maximum children belonged to backward caste (50.0%) followed by upper caste (36.5%) and schedule caste (12.0%).

Educational status of parent

Educational status of parent to only literate to high school quotient. Literate means a person who can read and write only. In majority of the children (64.5%), mothers were illiterate. Only among 16.5 percent of children, mother had education up to primary with none being educated above primary. However, percentage of illiterate fathers was 28 percent. Maximum children's father (45.5%) was educated up to primary followed by illiterate (28.0%) and literate (16.5%).

Occupation of Parents

Nearly half number of children's mother were housewives and rests were engaged in some gainful occupation like farmer (25.5%) labourer (22.5%) skilled worker (3.0%) and businessman (0.5%). Majority of children's father (30.0%) were labourer and others were farmer (27.0%) skilled worker (18.5%) businessman (15.0%) and serviceman (9.5%).

Socio-economic Status

A majority of the children belonged to lower socio-economic class. 79.5 percent and 15.5 percent of families belonged upper lower class and lower class respectively. None of one belonged to upper class, hence in subsequent observations this class has not been described.

Type of family

A majority (78%) of children belonged to nuclear family and only 22 percent children belonged to joint family.

Table 6: Knowledge, Attitude and Practices about type of Salt consumed by Families of School Children

Salt Practices	Number	Percentage
Knowledge about type of benefits of iodized salt		
Tasty	23	31.1
Physical energy	17	23.0
No goitre	34	45.9
Knowledge about purchasing iodized salt		
Yes	64	32.0
No	136	68.0
Source of Knowledge about iodized salt		
Television	11	17.2
Radio	15	23.4
Neighbour	5	7.8
Advertisements	33	51.6
Practices of storage of salt		
Polythene	25	12.5
Open container	59	29.5
Closed container	92	46.0
Matki	24	12.0
Practices of washing of salt before use		
Yes	108	54.0
No	92	46.0
Iodine content in the Salt		
Nil	101	50.5
7 ppm	87	43.5
15 ppm and above	12	6.0

Main cheap and easily available source of iodine of human being is iodized salt. Maximum families (79.5%) used crystallized salt followed by powdered salt 13.5 percent. Only 7 percent families used both type of salt. Brand of salt

purchased by families revealed that only 5 percent families took Tata salt while other were purchased Tara (12.0%) and Taaza (3.5%). 40.5 percent families had knowledge about iodized salt whereas only 11.5 percent families purchased iodized salt. Maximum families (35.5%) did not purchase iodized salt due to cost. And an equal proportion family (22.0%) did not prefer powdered salt due to cost and due to impurity (22.0%). 48 percent families of children did not have knowledge about benefits of Iodized salt and 15 percent families responded that there were no benefits of iodized salt Families who had the knowledge about benefits (no goitre) of iodized salt were found to be 45.9 percent. The sources of knowledge about benefits of iodized salt were seen advertisement in majority of families (55.0%) followed by radio (23.4%) and television (17.2%) and from neighbour (7.8%). Maximum families (46.0%) stored salt in closed container while other were used open container (29.5%), polythene (12.5%) and *matki* (12.0%). Washing of salt have so much importance in order to iodine content of salt. Because from washing of crystallized salt before use iodine content reduced. Nearly equal proportion of family's 54.5 percent and 46.0 percent were washed salt and did not wash before use respectively. Iodine content of salt should be above 15 ppm. Nearly half (50.5%) of children were using the salt having no iodine content and in 43.5 percent of salt samples were 7 ppm whereas only 6 percent children were consuming salt containing iodine content of 15 ppm and above.

Table 7: Distribution of School with Iodine Deficiency Disorders (IDD)

Effect of iodine Deficiency	School Children			
	Presence		Absence	
	No.	%	No.	%
Goitre	106	53.0	94	47.0
Cretinism	-	-	-	-
Others	-	-	-	-
Total	106	53.0	94	47.0

Iodine Deficiency includes so many disorders like goitre, cretinism and other but in present study only goitre was observed in fifty percent children. Hence, in subsequent interpretation of this chapter, the term prevalence of IDD was place in terms of goitre. Goitre is the most common clinical manifestation of iodine deficiency and its prevalence rate is used as an indicator to evaluate iodine nutritional status of the body. Because the prevalence of goitre indicates the past iodine status of the body.

Table 8: Scholastic Performance of School Children and Relationship with Iodine Deficiency Disorders

Scholastic Performance	School Children					
	Male		Female		Total	
	No.	%	No.	%	No.	%
Above Average	40	38.0	34	35.7	74	37.0
Below Average	65	61.9	61	64.2	126	63.0
Total	105	52.	95	47.5	200	100.00

$\chi^2 = .114$ $df = 1$ $p > 0.05$

Majority of school children had below average (63.0%) scholastic performance whereas above average scholastic performance was found in 37 percent children. Female

children were observed to be more below average (64.2%) than male children (61.9%). There was not statistically significant difference between male and female children in relation to scholastic performance ($p > 0.05$).

Table 9: Scholastic Performance of Children with Iodine content of Salt

Iodine Content of Salt	Total Number of Samples	Scholastic Performance			
		Above Average		Below Average	
		No.	%	No.	%
Nil	101	16	15.8	85	84.1
7 ppm	77	47	61.0	40	85.1
15 ppm & above	12	11	91.6	1	8.3
Total	200	68	37.0	126	67.0

The Scholastic performance of school children with consumption of salt having Iodine content above 15 ppm was found to more above average (91.6%) than children who were consuming salt with nil iodine content (15.8%) and these children were performed below average scholastic performance. The association between iodine content of salt used by Camille and scholastic performance of school children was observed to be highly statistically significant ($p < 0.001$).

Table 10: Intelligence Quotient of School Children and Relationship with Iodine Deficiency Disorders

Intelligence Quotient	Total number of children	Number	Percentage
Border line	10	9	90.0
Poor	76	54	71.1
Below average	65	32	49.2
Average	32	11	34.3
Above average	17	-	-

Intelligence Quotient of School Children and Relationship with Iodine Deficiency Disorders

The prevalence of iodine deficiency disorder was observed maximum with borderline intelligence quotients 990,0%) followed by poor IQ (71%) and below average IQ (49.2\$). However, prevalence of IDD was nil among children having average intelligence quotient. As the prevalence of iodine deficiency decreased, the level of iodine deficiency disorders increased. The association between prevalence of IDD and intelligence quotient proved to be statistically significant.

Prevalence of iodine deficiency disorders was found maximum in children (77.0%) who performed below average scholastic performance as compared in children (12.2%) who performed above average Scholastic performance and prevalence of course iodine deficiency disorders was observed to be highly statistically.

A majority of the families had no knowledge about iodized salt and they did not purchase the salt the salt after checking of its iodized nature. Very few families (15.0%) had knowledge about the benefits of iodized salt. Practices about salt was also not satisfactory Maximum salt samples (50.5%) were of nil iodine content

Conclusions of Study

The concluding points of the study are as below-

- A total of two hundred school in the age group of 8-12 years were females studied of which 105 (52,5%)

children were males and 95 (47.5%) were females. The maximum number of children was 10 years of age.

- The children predominately belonged to upper lower class (79.5%) lower (15.5%) and 4 percent belonged to middle class.
- Majority of families (59.5%) had no knowledge about iodized salt and only 11.5% families purchased salt keeping in mind it was iodized or not.
- Main reasons for not purchasing iodized salt were costly than crystal (35.5%) than powdered salt, tasty (22.0%) and due to purity (22.0%).
- Overall prevalence of goitre was 53 percent. Goitre was seen more at 11-12 years of age (63%) than 8 years of age (36%).
- Mean urinary iodine excretion level was 7.52mcg/dl. According to urinary iodine level, Iodine deficiency disorders were observed in children as mild (0.3%), moderate (10.3%) and severe (40%).
- Prevalence of iodine deficiency disorders was not inversely proportional to religion, caste and socio-economic status.
- Prevalence of iodine deficiency disorders was more in children having intelligence quotient of border line (90%) followed by poor (71%) below average (77%) and minimum in children was statistically significant.
- Prevalence of iodine deficiency disorders was maximum in the children having Scholastic in the performance below average (77%) and minimum in children performing above average (12.2%). Scholastic is performance of children in relation to prevalence of iodine deficiency disorders was highly significant.
- It was seen in this study, the prevalence of iodine deficiency disorders among school children, was quite high (53.0%) in the form of goitre which was maximum in the age of 11-12 years.
- The study showed that the intelligence Quotient and scholastic performance of school children was found below average (63%) and rest were above average (37%), Maximum children were found in the level of poor (38%) and below average (16.5%) IQ. Very few children were seen in the IQ level of above average (16.5%). A highly statistically significant relationship was observed between Scholastic performance and Intelligence Quotient among school children with Iodine deficiency disorders.

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