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Adequacy of Dietary Iodine in Two Local Government Areas of Cross River State in Nigeria

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Abstract: The Cross River State of Nigeria was in the goiter-endemic or goiter belt of Nigeria before the introduction of Universal Salt Iodization (USI) in 1996. After several years of availability and consumption of iodized salt in Nigeria, it has become necessary to revisit some of these previously goiter endemic areas so as to measure the effect of USI on the iodine nutriture, especially since goiter has not completely disappeared. This study was therefore initiated to assess the current iodine status of the population in relation to the USI programme in The state. Primary school children aged 8-12 years were recruited from ten schools in two Local Government Areas (LGA) in the Cross River State, using a simple random sampling technique. Casual, on the spot urine samples were collected from the children and analyzed for urinary iodine using the ammonium persulphate method. Salt samples were also collected from the households of the children in the study and analyzed for iodine content using titrimetric method. Four hundred school children participated in this study, 200 (50%) were males and 200 (50%) were females. One hundred and eighty-eight (47%) were 12 years old, while 95 (23.8%), were 11 years old, 80 (20%) were 10 years old, 32 (18%) were 9 years old and 5 (1.2%), were 8 years old. Median urinary iodine in these school children was 65µg/l. Ninety-nine (24.75%), had a median urinary iodine of 100-299 µg/l consistent with adequate iodine intake, while 136 (34.0%) had a median urinary iodine of 50-99 µg/l suggesting mild iodine deficiency. Only 92 (23%) of the children had a mean urinary iodine level less than 20 µg/l, which is consistent with severe iodine deficiency, while 73 (18.25%) of them were moderately deficient (20-49 µg/). However, the analysis of the table salt from the households showed that 74% of the households consumed salts with adequate iodine content of greater than 15ppm. In conclusion, the apparent contradiction observed between adequacy of table salt iodization and urinary iodine levels suggests the possible existence of factors such as improper use of table salt, poor handling by the retailers, high goitrogen content in the diets and cooking methods. These are areas of future research.

Key words: Iodine deficiency, table salt, iodization, urinary iodine

Introduction

Iodine is an important micronutrient required for proper brain development. Iodine Deficiency Disorders (IDD) refers to all the ill effects of inadequate iodine nutriture and hence deficiency in populations. Enlargement of the thyroid gland in response to inadequate dietary iodine intake, high rates of still births, neonatal mortality, mental and physical impairments are some of the consequences of IDD (FAO, 1997). The impact of IDD is enormous and it affects all the stages of life (Hetzel, 1983; ICCIDD/UNICEF/WHO, 2001). Iodine deficiency disorders are primarily the result of inadequate amounts of iodine in soil, water and food as well as consumption of foods rich in goitrogenic substances (Aston and Brazier, 1979; Sharma *et al*., 1999; Ene-Obong, 2001).

While a large proportion of the world population is at risk of IDD or are affected in some ways (De Lange and Hetzel, 2003), several parts of Nigeria had been earlier identified with goiter endemicity and hence labeled the "goitre belt" (Nwokolo and Ekpechi, 1966; Olurin, 1975; Isichie *et al*., 1987; Ubom, 1991). A national goitre rate of 20% was reported in 1993 (UNICEF, 1993) and it was then estimated that about 20 million Nigerians were affected by IDD, although a large variation was observed among the various states of Nigeria. The Participatory Information Collection Study (1993), using thyroid hormone concentrations as indicators of iodine status reported an iodine deficiency prevalence of 65.6% in South-East, 41% in the South-West, 43% in the North-West of Nigeria.

As part of the strategies to reduce the prevalence of IDD in Nigeria, the Universal Salt Iodization Programme (USI) was introduced in 1996. The update from the report of the Nigeria Demographic and Health Survey (NDHS, 2003) showed that almost all Nigerian households (97.3%) consumed adequately iodized salt, while about 1.7% consumed unionized salt. The report further showed that 98.0% of households in the South-south zone of Nigeria, where Cross River State is located, consumed adequately iodized salt. After several years of availability and consumption of iodized salt in Nigeria, it has become necessary to revisit some of the goitre endemic areas so as to measure the iodine nutriture of the populations in those areas.

Table 1: Subjects' Characteristics

	N	%
Age (years)		
8	5	1.25
9	32	8.00
10	80	20.00
11	95	23.75
12	188	47.00
Occupation of the father		
Civil servants	191	47.75
Farmers	163	40.75
Traders	44	11.10
Artisans	2	0.50
Sources of drinking water		
Well	109	27.25
Borehole	98	24.50
Tap water	48	12.00
Stream	129	32.25
Rain water	14	3.50
Packaged water	2	0.50
Housing		
One-room apartment	167	41.75
2-3 bedroom flat	138	34.50
Bungalow	66	16.50
Others	29	7.25
Toilet facility		
Water closet	116	29.00
Pit latrine	182	45.50
Open bucket	43	10.75
Bush	59	14.75

Since Cross River State of Nigeria was one of the states known for goitre endemicity, the need for reassessment of the state after at least five years of existence of iodized salt in Nigerian households is essential. This study was therefore designed to assess the prevalence of iodine deficiency among school children (aged 8-12 years) in two local government areas of the State. The Iodine concentration of the table salts from the households was also investigated.

Materials and Methods

Study population: This study was carried out at two Local Government Areas (LGA) in Cross River State of Nigeria. Boki LGA is predominantly rural while Ikom LGA is predominantly urban. The study was a descriptive cross sectional survey. Primary school children of ages between eight and twelve years were the subjects of the study. Using a power calculation, a minimum sample size of 347 subjects was statistically derived, but 400 pupils were recruited from ten schools in the two LGA. The selection of the pupils from each school employed a random sampling procedure. The schools from which the pupils were selected included both public and private primary schools.

Consent and ethics: Consent letters, which explained the objectives and procedure of the research, were sent to the parents and the schools' management. Ethical clearance for the study was obtained from the Ethical review Committee of the University College Hospital and University of Ibadan, Nigeria.

Urinary iodine: Casual urine samples were obtained from each pupil, labeled and preserved. A short questionnaire was interviewer-administered to each pupil. Each of the pupils was also requested to bring on the second day, a sample of the table salt consumed in their respective homes. The salt samples were also labeled and preserved. The laboratory analysis of the urine for urinary iodine was carried out at the chemical pathology laboratory of the University College Hospital (UCH), Ibadan. The analysis employed the Sandell-Kolthoff reaction (ICCIDD/UNICEF/WHO, 2001).

Estimation of iodine in household salt: 10g of table salt collected from each household was labeled and analyzed using iodometric titration method.

Data analysis: All data collected were subjected to statistical analysis using the Statistical Package for the Social Science (SPSS) version 10 to determine the mean, frequencies and relationships. Chi-square was used to test the significance of proportions, with $p<0.05$ taken as significant.

Results

Characteristics of the subjects: The characteristics if the study subjects are shown in Table 1. A total number of 400 pupils in two local government areas of Cross River State participated in this study. The age distribution of the subjects was such that almost half (47%) of the pupils were 12 years old. The least proportions were from those of ages 8 and 9 years.

Pupils whose fathers were civil servants had the highest percentage, followed by farmers and traders. Also, almost half of these pupils resided with their family members in a "one room apartment" while few lived in Bungalows. The living condition of the subjects as described by their sources of water for domestic use showed that majority obtained water from flowing stream while very few of them had access to tap water. The most common sewage disposal method used by subjects was pit latrine, followed by water closet.

Adequacy of Iodine intake: The adequacy of iodine intake as measured by the median urinary iodine and the table salt iodine concentration, is depicted by the Table 2 and 3. The results obtained from the casual urine examination showed that about one-fourth (24.75%) of the pupils had optimal median Urinary Iodine (UI) (100-299 µl), while about three-quarter were iodine deficient ranging from mild to severe deficiency. As shown in Table 2, very high percentages of pupils with optimal iodine intake and severe iodine deficiency

Table 2: Age and Iodine deficiency

Classification of Iodine Nutrition*										
	Severe deficiency Median UI (<20µg/l)		Moderate deficiency Median UI (20-49µg/l)		Mild deficiency Median UI (50-99µg/l)		Optimal Median UI (100-299µg/l)		Excessive Median UI (≥300µg/l)	
Age (yr)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
8	--	2 (0.5)	2	(0.5)	2	(0.5)	1	(0.25)	--	--
9	10	(2.5)	3	(0.75)	8	(2.0)	11	(2.75)	--	--
10	16	(4.0)	17	(4.25)	25	(6.25)	22	(5.5)	--	--
11	14	(3.5)	23	(5.75)	33	(8.25)	25	(6.25)	--	--
12	52	(13.0)	28	(7.0)	68	(17.0)	40	(10.0)	--	--
Total	92	(23.0%)	73	(18.25%)	136	(34.0%)	99	(24.75%)	--	--

*Classification based on standard recommendations (ICCIDD/UNICEF/WHO, 2001)

Table 3: Iodine deficiency by sex

	Male		Female	
Median Urinary Iodine (µg/l)	N	%	N	%
<20	56	28	36	18.0
20-49	36	18	37	18.5
50-99	65	32.5	71	35.5
100-299	43	21.5	56	28.0
Total	200	50.0	200	50.0

Table 4: Iodine content of salt samples from the households

	Boki LGA households		Ikom LGA households	
Level of Iodine in salt (ppm)	N	%	N	%
None (0ppm)	--	--	--	--
Inadequate (<15ppm)	49	24.5	56	28.0
Adequate (≥15ppm)	151	75.5	144	72.0

*parts per million (ppm)

coexisted among the 9 years olds. The median UI excretion in both the males and the females are shown in Table 3. More females (28.0%) than males (21.5%) were in the normal range concerning urinary iodine ($p<0.05$). Thus, the prevalence of iodine deficiency based on median UI, may be relatively higher in males than in females.

As shown in the Fig. 1, the median UI in the two local government areas were significantly ($p<0.05$) different. Ikom LGA had a higher prevalence of iodine deficiency (82.0%) than found in Boki LGA (68.5%).

Salt iodine concentration: The results obtained from the analysis of the salt samples obtained from the households showed that there was no household without iodized salt, but about 35% of the households consumed salt with inadequate iodine concentration. Boki LGA relatively had a higher proportion of households consuming salt with adequate iodine concentration than the households in Ikom LGA (Table 4).

Discussion

Iodine Deficiency Disorders (IDD) has been described as the single most important cause of brain damage on a worldwide basis. Increased demand for micronutrients during growth spurts predisposes school children, adolescents and women of reproductive age to micronutrient deficiencies (McGuire, 1993; ICCCIDD/UNICEF/WHO, 2001). While enlarged thyroid (goiter) gland is a longstanding response to iodine deficiency, urinary iodine excretion measures current iodine status (Dunn, 1993).

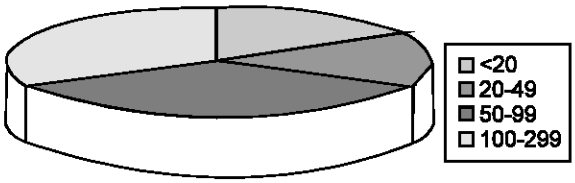

Fig. 1a: Median Urinary Iodine (µg/l) in Boki LGA

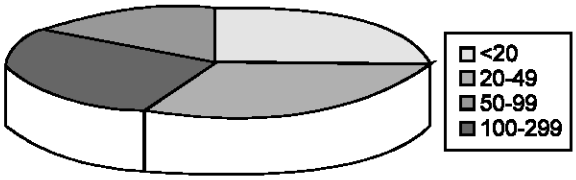

Fig. 1b: Median Urinary Iodine (µg/l) in Ikom LGA

The median urinary iodine excretion in this study was 65 µg/l. This value is incompatible with previous assertion that Nigeria is among the ten African countries with median Urinary Iodine (UI) concentration of over 100 µg/l (Delana, 2001), however, the figure here is not a national figure. The median UI in this study is higher than that reported by Masenkoyela *et al.* (2003) for school-age children in Berea, Lesotho, but similar to that of Egri *et al.* (2006) who reported median UI concentration of 66 µg/L among school children in Turkey. In school age children living in the goiter-endemic areas of Limpopo province of South Africa, Mapa *et al.* (2005) found the prevalence of iodine deficiency to be mild, with median UI levels of 81 µg/L.

In our study, over 70% of the pupils had UI compatible with iodine deficiency. This is far higher than the proportion (38.8%) stated for Nigeria as of 1998 in the 5th Report (SCN, 2004).

The indication of the results obtained from this study is that households in Boki and Ikom communities of Cross

River State have access to and make use of iodized salt for cooking. This finding justifies the claim of the NDHS (2003) that almost all households (97%) in Nigeria use adequately iodized salts. However, the fact that there were some significant proportion (26.25%) of the households in the two communities consuming salt with inadequate iodine concentration (<15ppm) shows the need for a consistent follow up of the iodization programme starting from the sentinel, all through to the retail level till it finally gets to the households. Contrary to the NDHS (2003) report that urban areas had relatively higher proportion of households consuming salt with adequate iodine concentration than the rural areas, our findings showed that Boki LGA, which is rural, had a higher proportion than the Ikom LGA, which is urban. Several factors could be attributed to the level of inadequacy observed with respect to the iodine concentration of the salt consumed in these households. These include: poor storage methods, daily and over-exposure of iodized salt to sunlight by retailers and selling of unpackaged salt.

Conclusion: This study was carried out in the Cross River State, which was in the goitre endemic zone of Nigeria before the introduction of universal salt iodization. The study aimed at knowing the prevalence of iodine deficiency in the state in light of the on-going universal salt iodization programme in the country. The results showed that over 70% of the school age children were iodine deficient and more than 25% of the households consumed salt with inadequate iodine concentration. Several factors could be responsible for the inadequacy in iodine concentration of the household salt. However, these are potential areas for future research. It is therefore necessary that adequate attention be paid to issue of handling and storage of salt both at home and in the market. There is a need for change in the knowledge, attitude and practice of people on the handling and storage of table salt.

References

Aston, S.R. and P.H. Brazier, 1979. Endemic goiter,the factors controlling iodine deficiency in soils. Sci. Total Environ., 11: 99-104.

Delana, A.A., 2001. Childhood Nutrition and Malnutrition in Nigeria. South Af. J. Clin. Nutr., pp: 19-20.

Delange, F. and B.S. Hetzel, 2003. The iodine deficiency disorders. In: The Thyroid and its Diseases. Basle karger, pp: 324-44.

Dunn, J.T., 1993. Measuring iodine in the urine. Joint WHO/UNICEF/ICCIDD Publication, pp: 1-15.

Egri, M., N. Bayraktar, Y. Temel, C. Ercan, M. Ilgar, E. Pehlivan, L. Karaoðlu, G. Güneº and M. Genç, 2006. Prevalence of goiter and urinary iodine status of 7-11-year-old children in Malatya province, Turkey The Turkish J. Ped., 48: 119-123.

Ene-Obong, H.N., 2001. Substances occurring in foods. In: Eating Right (Nutrition Guide). University of Calaber Press, Nigeria, pp: 48.

FAO, 1997. Agriculture, Food and Nutrition for Africa. Malnutrition and micronutrient deficiencies. Food and Nutrition Division. Food and Agri. Organization, Rome, pp: 48-55.

Hetzel, B.S., 1983. Iodine deficiency disorders (iDD) and their eradication, 12: 1126-1129.

ICCIDD/UCICEF/WHO, 2001. Assessment of iodine deficiency disorders and monitoring their elimination. A guide for programme managers; WHO document WHO/NHD/01.1.

Isichie, U.P., S.C. Das, J.O. Egbuta, A.I. Banwo, I. Marimot and S. Nagataki, 1987. Endemic goitre in plateau state, Nigeria; the possible aetiological factor and the establishment of endemic goitre map for the region. Proceedings of Nigeria/Japan Conferences, Jos., pp: 78-81.

Mapa, S.N., X.G. Mbehenyane, P.L. Jooste, L.F. Mustaph and A.K.A. Aney, 2005. The prevalence of Iodine deficiency in Vhembe districy, Limpopo Province, South Africa. Poster presented at the 18th International Congress Nutrition, 19-23 September.

Masenkoyela, L.D.S., D. Andre, L.J. Pieter and J. Gina, 2003. Prevalence of Goitre and Urinary Iodine Status of Primary School children in Lesotho. Bulletin of World Health Organization, 81, 1.

McGuire, J., 1993. Best practice in addressing micronutrient malnutrition. In: SCN News Geneva. No. 9.ACC/SCN, pp: 1-10. Nigeria Demographic and Health Survey, 2003. Infant feeding and children and women nutritional status. National Population Commission, Federal Republic of Nigeria, pp: 160.

Nigeria Demographic and Health Survey (NDHS), 2003. National Planning Commission(NPC) and OCR Macro, Calverton, Maryland USA 2004.

Nwokolo, C. and O.L. Ekpechi, 1966. New foci of endemic goitre in eastern Nigeria. Trans Roy Soc Tropical medicine and hygiene, 6: 97-108.

Olurin, E.O., 1975. The fire of life (The Thyroid Gland). Inaugural lecture. University of Ibadan.

SCN, 2004. Nutrition for improved development outcomes. 5th report on the world nutrition situation, Geneva, Switzerland, pp: 91-99.

Sharma, S.K., P.K. Chelleng and S. Gogoi, 1999. Iodine status of food and drinking water of a sub-Himalayan zone of India. Int. J. Food Sci. Nutr., 50: 95-98.

The Participatory Information Collection Study, 1993.

Ubom, G.A., 1991. The goiter-soil-water-diet relationship: case study in Plateau State, Nigeria. Sci. Total Environ., 107: 1-11, 13: 22-23.

UNICEF, 1993. Regional goitre survey in school children, Nutrition Section, Lagos Nigeria.