Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Der Pharmacia Lettre, 2015, 7 (7):271-280
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0975-5071
USA CODEN: DPLEB4

Iodine and nutritional status of primary school children in a Nigerian Community Okpuje, in Nsukka LGA, Enugu State, Nigeria

[1]Nwamarah, Joy Ugo[*], [2]Otitoju Olawale, Otitoju Grace Taiwo Olawale and [3]Emewulu, Chidinma Uju Doris

[1,3]Department of Home Science, Nutrition and Dietetics, University of Nigeria, Nsukka,
[2]Department of Biochemistry, Federal University Wukari, Taraba State

---

ABSTRACT

This study was designed to assess iodine levels and nutritional status of primary school children in a Nigerian community, Okpuje, using recommended quantifiable indicators. A total of 395 school children, 6-12 years (204 males and 191 females) were selected through a multistage random sampling procedure. Structured administered questionnaire was used to obtain information on socioeconomic anddietary status of respondents using 24hr dietary recall. Heights and weights of the children were measured using standard methods. The WHO Z score system was used to classify stunting, wasting and underweight among the children. Goiter was assessed clinically using the standard palpation method. Salt samples were collected from Okpuje market and pupils' homes to test for iodine content. Twenty percent sub-sample urinary iodine excretion (UIE) levels were analyzed using the Sandell-Koltholf reaction forits determination. Data obtained were analyzed using descriptive statistics and chi-square analysis. The result shows that majority of the children consumed cereals and cassava based diets for breakfast, lunch and supper. There was no child found with goiter; prevalence of stunting, wasting and underweight were 19.5%, 8.9% and 8.5% respectively. Wasting was more in male children, while under weight and stunting were more in females. The median UIE was 124.7µg/L. About 96.2% of the children had UIE value consistent with adequate intake (UIE > 100µg/L). A total of 3.8% of the children had mean UIE less than 100µg/L. Iodine content of 395 home salt samples tested with spot testing kit revealed that 94.2% had iodine greater than15ppm. The entire market salt sample had iodine greater than 15ppm. The median urinary excretion of 124.7µg/L obtained for this study suggests that there no iodine deficiency in majority of the respondents and indicates that Okpuje in Nsukka LGA is in the transition phase of iodine deficiency to iodine sufficiency.

Key words: urinary iodine, nutritional status, children, underweight, goiter, nutrition,

---

INTRODUCTION

Iodine deficiency disorders (IDD) is a serious public health problem in developing countries. It is one of the oldest and most insidious of human health problems. WHO (2011) estimated that two billion people worldwide including 285 million children of school age have iodine deficiency despite major national and international efforts to increase iodine intake, mainly through voluntary or mandatory intake of salt (WHO, 2011). Recent estimates by the World Health Organization (WHO, 2011) indicate that 54 countries are still affected by iodine deficiency and nearly 2 billion individuals worldwide are iodine-deficient. A large percentage of the world population is at risk of iodine deficiency disorder (IDD) (Delange&Hetzel, 2003).

Poor nutrition remains a global epidemic contributing to more than half of all children's mortality, about 5.6 million per year. It has been reported that as severity of iodine deficiency increases, the occurrence of poor pregnancy outcome such as miscarriage, still birth, and increased infant mortality is more likely (Bruno & Maria, 2004). Several parts of Nigeria have been identified with goiterendemicity and labeled the "goitre belt" (Abua et al.,

2008;Isichie et al., 1987). In 1993, a National goitre rate of 20% was reported and 20 million Nigerians were estimated to be affected by IDD (UNICEF, 1993). 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 south-west, and 43% in the north-west of Nigeria. Less than a decade later, national surveyshowed that goiter prevalence among 30 states in Nigeria dropped from 40 million in 1990 to less than 11 million in 1999 (IDD Newsletter, 2000). There has been several intervention initiatives rolled out by the government and other international agencies to combat the menace of IDD in Nigeria(Madukosiri,2011)

Iodine Deficiency Disorder (IDD) is a major global cause of morbidity, mortality and impaired development in children (Madukosiri,2011; Heydarian et al., 2007). It has substantial effects on growth and development and is the most common cause of preventable mental impairment worldwide. Mild iodine deficiency impairs cognition in children, and moderate to severe iodine deficiency in a population reduces intelligent quotient (IQ) by 10-15 points (Zimmermann, 2009). Iodine deficiency still constitutes the single greatest cause of preventable brain damage and mental retardation (Delange, 2000a & 2001). All degrees of iodine deficiency affect the thyroid function of the neonate, and the mental development of the child (Delange 2000b). The resulting mental deficiency has an immediate effect on child learning capacity, the quality of life of communities and economic production (WHO, 2015). Other consequences of iodine deficiency and subsequent inadequate thyroid hormone production include goitre, hypothyroidism, cretinism, congenital anomalies, increased prenatal mortality, still births and abortions. Much has been achieved in the area of universal salt iodization (UNICEF 2003, Egbuta et al., 2003; NAFDAC, 2003) in the sub-Saharan Africa and Nigeria in particular. Nevertheless iodine deficiency continues to be of public health importance (UN/SCN 1993, SCN 2004) in some communities.

Enugu State in southeast and Kogi state in south western Nigeria has long been identified as a goiter endemic area with a goiter prevalence rate of 16-40% (Egbuta*et al.,* 2003). Nwamarah and Okeke (2012) reported an iodine deficiency prevalence of 58.3% among school children in Obukpa, a community in Nsukka, Enugu state. The objectives of this study were to determine the relationship between the children's iodine status,quantities of iodized salt consumed and its effects on some anthropometric indices of Okpuje children.

MATERIALS AND METHODS

Study area: This study was carried out in Okpuje, a community located at the north-western end of Nsukka Local Government area of Enugu State, Nigeria. It is located between longitude 6^0 18′ and 7^0 06′North and latitude 6^0 52′and 7^0 54′East (Oke, 2013). The town has an estimated land area of about 65sqkm. Okpuje lies between the savannah vegetation and the rain forest belt of the south. The area through, continuous cultivation, has virtually lost its rain forest features. Generally, Okpuje people practice agriculture at subsistence level. The climate is made up of two seasons namely: dry and wet seasons. The dry season lasts from November to mid-April, while the wet season lasts from mid-April to October.

Study population: The target population consisted of school age children (6-12yrs) in Okpuje, Nsukka, LGA, Enugu State. Okpuje has a sizable population of 16,598 (Nigerian census, 2006). A total of seven (7) primary schools can be found in Okpuje, (three public schools, two missions and two migrant farmers children school (MFCS) with a population of 940 pupils.

*Research design:*This study adopted a cross sectional survey design and laboratory work.

Sample size calculation: The sample size was calculated using 40% of the study population.

In order to make up for drop outs, this figure was approximated to 395 (5% increase). The sub-sample for determining urine iodine excretion was obtained using 20% of the total sample as follows:

Sampling procedure: All the seven primary schools in Okpuje were used for the study. The names of all the primary schools in Okpuje were collected from the local government area education authority. A multistage sampling technique was used in selecting participants for the study. The first stage employed stratified proportionate sampling: to determine the share of each school from the sample size (395) while the second stage involved a systematic sampling method in which a sampling interval of 1:2 was employed to select 395 pupils from all the schools. The third stage involved a simple random sampling technique of balloting without replacement to select 79 pupils for the sub sample population (that will provide specimen for urinary iodine excretion (UIE)) from the sample size following the calculation above.

Method of data collection and analysis:
Approach to the community: Ethical clearance was obtained from Ministry of Health ethical Committee, Enugu State. A letter of introduction from the Department of Home Science, Nutrition and Dietetics, University of Nigeria Nsukka was presented to the chief of Okpuje to obtain approval to carry out the study; this letter was also presented to the heads of each school.

Questionnaire: A structured questionnaire was used to collect information on socio-economic status (name, age, class, sex, parent's occupation and family size), anthropometric measurements and indices, clinical examinations, dietary pattern using 24hr dietary recall. The questionnaire was validated by four experts in the Department of Home Science, Nutrition and Dietetics, University of Nigeria, Nsukka. The questionnaires were administered to the children by interview and retrieved immediately after completion.

Anthropometry: Anthropometric measurement involving height and weight were carried out and WHO Z score system was used to assess the anthropometric indices of the children. The ages of the children were determined using the school records.

Height: The heights of the children were measured using a microtoise meter rule in centimeters (cm) and was read immediately from the tape to the nearest 0.1 centimetre.

Weight: The weight was measured using Hanson's scale of 120kg capacity. Each child was weighed with minimum clothing. The measurement was taken to the nearest 0.1 kilogram.

Determination of Z scores: The WHO (2007) reference data was used as a standard to determine the Z score for height-for-age, BMI for age and weight-for-age. Z scores of < -2 standard deviation (SD) for height-for-age and weight-for-age were used to determine the prevalence of stunting and underweight. The Z-score for wasting was determined using BMI for age under the 5th percentile from the international reference population (De Onis*et al*., 2006). In addition to BMI for age, a Z-score of less than -2standard deviation (SD) for weight –for –height was also used to calculate wasting.

Estimation of iodine in salt: Different samples of salt were collected from Okpuje market stalls for iodine analysis. Also, the children were asked to bring salt samples (ten grams) about one teaspoon full from their homes for iodine analysis. These were labeled and analyzed with the spot test kit from UNICEF Enugu. The WHO (2007) cut-off points for inadequate salt iodine, <15ppm was used as the proxy indicator.

Urinary iodine excretion: Urine samples were collected from the sub sample size of 79 children in 5ml sample bottles. The containers were cap screwed to prevent leakages and evaporation and were properly labeled and transported to the laboratory maintaining a cold box. The urine samples were analyzed for iodine concentration using ammonium persulphate to digest the samples (Ohashi*et al*., 2000), followed by the Sandell-Kolthoff reaction for assessing the severity of IDD. The result was expressed as µg iodine/L.The WHO/ UNICEF& ICCIDD (2001) cut-off points for urinary iodine excretion was used to define iodine status (severe deficiency <20µg/L, moderate deficiency 20-49µg/L, mild deficiency 50-99µg/L, optimal 100-199µg/L, more than adequate 200-299 µg/L, excessive ≥300µg/L and particularly high ≥500µg/L).

Clinical assessment: Clinical assessment involved assessing the hair, face, eyes, lips, glands, tongue, and gums for clinical signs/ disorder among the children.

The thyroid gland size of each child in the sub-sample was visually inspected and palpated by a trained nurse, and was graded according to the WHO/UNICEF/ICCIDD(2007) classification of goiter.

Statistical analysis: All data from the questionnaires were analyzed using the SPSS package version 17 (SPSS, Inc. Chicago, USA). Descriptive statistics: Frequencies, percentages and mean were used to describe all categorical data variables. Chi-square tests were used to determine the differences between categorical variables. ANOVA was used to determine relationships among means. Significant differences were set at $P< 0.05$.

RESULTS AND DISCUSSION

Anthropometry: Growth assessment in this study (Table 1)showed that 19.5% of the children were stunted signifying that it is a public health problem in Okpuje, Enugu state according to WHO criteria (WHO, 2014). The prevalence of stunting in the present study was lower than the findings of Ene-Obong and Ekweagwu (2012) in Ebonyi state Nigeria who reported mild to severe stunting of 42.5% but higher than Olanrele (2014) who reported 14.6%

stunting in Oyo State, Nigeria and Akor et al., (2010) reported 11.1% stunting in Jos, Nigeria. Stunting measures cumulative deficient growth associated with the long term factors, including insufficient dietary intake, frequent infections and poor feeding practices over a sustained period and low socioeconomic status of households (WHO,2007).

Table 1: Distribution of underweight, stunting and wasting among males and females in Okpuje

Variables	Males		Females		Total
	Frequency	Percentages	Frequency	Percentage	
***Weight for age(n=213)**					
<-2SD	7	3.3	11	5.2	18(8.5)
-2SD -+1SD	90	42.3	84	39.3	174(81.6)
>+2SD	14	6.6	7	3.3	21(9.9)
TOTAL	111	52.2	102	47.8	213(100)
HEIGHT FOR AGE (n=395)					
<-2SD	30	7.6	47	11.9	77(19.2)
-2SD -+1SD	149	37.7	131	33.2	280(70.9
>+2SD	25	6.3	13	3.3	38(9.6)
TOTAL	204	51.6	191	48.4	395(100)
BMI FOR AGE					
<-2SD	20	5.1	15	3.8	35(8.9)
-2SD -+1SD	168	42.6	166	42	334(84.6)
>+2SD	16	4	10	2.5	26(6.5)
TOTAL	204	51.7	191	48.2	395(100)

*P= 0.067. *(weight for age (n=213) were for children under 10 years of age)*

Table 2: 24 hour dietary recall of the primary school children

Variable	Breakfast		Lunch		Supper	
	No	%	No	%	No	%
Bambaranut paste *(Okpa)*	62	15.7	16	4.0	22	5.5
Rice	154	39	90	22.8	101	26
Yam with palm oil/stew	28	7.1	72	17.2	42	10.5
Pigeon pea with corn & veg. (*Ayaraya*)	12	3.0	14	3.5	18	4.5
Rice/beans	6	1.5	2	0.5	4	1.0
Yam/beans	4	1.0	18	4.6	14	3.5
Three leaf yam *(Una*)	8	22	4	1.0	8	2.0
Potatoes	6	1.5	4	1.0	2	0.5
Beans & pap	6	1.5	14	3.5	6	1.5
Melon soup&*akpu* (cassava paste)	18	4.6	28	7.1	20	5.0
Cassava-Foofoo&ogbono soup	36	9.1	48	12.2	55	13.8
Black eye pea (*akidi*)&yam	4	1.0	6	1.5	12	3.0
Cassava-*Garri*/okro soup	8	2.0	12	3.0	12	3.0
Bean cake (*Akara*) & pap	2	0.5	-	-	-	-
Beans pudding (*Moimoi)*& pap	6	1.5	-	-	2	0.5
Pigeon pea pottage with cassava (*Igbawara*)	4	1.0	6	1.5	10	2.5
Cassava-*Foofoo*&bitter leaf soup	6	1.5	2	0.5	14	4.0
Yam pottage	4	1.0	6	1.5	4	1.0
Bread &tea	8	2.0	-	-	2	0.5
Beans &plantain	2	0.5	1	0.3	-	-
Spaghetti	2	0.5	4	1.0	-	-
Indomie	4	1.0	4	1.0	4	1.0
Cassava-*Foofoo*/veg. soup	2	0.5	4	1.0	2	0.5
Fried plantain	1	0.3	4	1.0	2	0.5
Soaked *garri*(cassava source)	-	-	4	1.0	2	0.5
Pounded yam/white soup (*nsala*)	-	-	-	-	5	1.3
Corn with vegetable pudding(*igbangwu*)	-	-	-	-	8	2.0
Pigeon pea &yam(*ayarayaji*)	-	-	-	-	4	1.0
Skipped meals	10	2.5	32	9.3	20	5.0
Total	395	100	395	100	395	100

The prevalence of underweight 8.5% among the respondents (Table 1) was lower than 23.3% reported by Ene-Obong and Ekweagwu (2012), andOlanrele (2014) reported 9.8% underweight. Underweight reflects achieved body mass to chronological age and it's the most commonly used nutritional indicator in defining malnutrition (WHO, 2014).

Wasting was prevalent in about 8.9% of the total children in this study (Table 1). Wasting reflects body proportions, is particularly sensitive to acute growth disturbance (WHO, 2014) and is due primarily to insufficient energy intake and repeated infections. This is consistent with Ene-Obong and Ekweagwu (2012), Nwamarah and Okeke (2012) who reported 6.1% and 6.3% wasting respectively. Wasting in this study was found to be higher than Olanlele (2014) who reported 4.0% in Oyo state and Akor *et al.* (2010) where it was 2.4% in Jos, Plateau State.

Table 3 Snack consumption of the children

Variable	Snack 1		Snack 2		Snack 3	
	No	%	No	%	No	%
Sweet	20	5.1	18	4.6	6	1.5
Orange	38	9.6	44	11.1	14	3.5
Biscuits	102	25.8	62	15.7	14	3.5
Palm kernel	6	1.5	14	3.5	2	0.5
Banana	12	3.0	6	1.5	-	-
Pawpaw	2	0.5	15	3.8	11	2.8
Cheese balls	4	1.0	8	2.0	-	-
Pop corn	6	1.5	6	1.5	7	1.8
Mango	-	-	10	2.5	4	1.0
Groundnut	4	1.0	20	5.1	8	2.0
Chewing gum	2	0.5	2	0.5	-	-
Chin chin	2	0.5	2	0.5	-	-
Bread	6	1.5	-	-	22	5.5
Ice cream	2	0.5	6	1.5	-	-
Cake	2	0.5	-	-	-	-
Buns	-	-	2	0.5	2	0.5
Coconut	2	0.5	8	2.0	-	-
Cashew	2	0.5	2	0.5	2	0.5
Fried potatoes	-	-	2	0.5	-	-
Udara	2	0.5	4	1.0	4	1.0
Akara (bean cake)	8	2.0	2	0.5	2	0.5
No snack indication	178	43.5	162	41	297	75.2
Total	395	100	395	100	395	100

NB: Snack1 taken after breakfast, snack 2 taken after lunch, snack 3 taken after supper

Table 4: IDD clinical signs observed in the respondents

Variable	Present		Absent	
	No	%	No	%
Thyroid enlargement	-	-	395	100
Squint	2	0.5	393	99.5
Deafness	-	-	395	100
Muteness	4	1.0	391	99
Congenital anomalies	6	1.5	389	98.5
Crenitism (abnormally short)	6	1.5	389	98.5
Other clinical signs of nutritional deficiency				
Hair: lacks natural shine	10	2.5	385	97.5
Thin and sparse hair	4	1.0	391	99
Face: moon face	4	1.0	391	99
Paleness	2	0.5	393	99.5
Eyes				
Pale conjunctiva (anaemia)	14	3.5	381	96.5
Bitot spot	2	0.5	393	99.5
Conjuctivalxerosis	4	1.0	391	99.0
Lips: angular stomatitis	4	1.0	391	99.0
Cheilosis	2	0.5	393	99.5
Tongue				
Scarlet or raw tongue	0	0	395	100
Swollen tongue	0	0	395	100
Gums				
Spongy bleeding gums	0	0	395	100
Nails : spoon shaped nails	0	0	395	100
Brittle nails	0	0	395	100

Table 5: Relationship between urine iodine and weight for age

Variable	-2sd	-1sd	Median	1sd	2sd	total
50-99ug/l(mild iodine deficiency)						
	0(0)	1 (7.1)	0 (0)	1 (25.0)	0(0)	2 (4.0)
100-199ug/l (optimal urine iodine)						
	4(100)	13(92.9)	25(100)	3(75)	3(100)	48(96)
Total	4(100)	14(100)	25(100)	4(100)	3(100)	50(100)

X2 = 6.287, df =4, P= 0.179

Previous studies had shown gender differential in the prevalence of malnutrition in school children. Sekumade (2013) observed that male children were likely to suffer incidence of stunting and wasting than female children. In the present study, there were marginal differences in the occurrence of wasting. Male children were more affected (5.1%) than female children (3.8%)(Table 1). This was similar to the findings of Dabone et al., (2011) where the occurrence of wasting was 14.2% in boys and 13.2% in girls.

Table 6: Relationship between urine iodine and BMI for age

Variable	-3sd	-2sd	-1sd	Median	1sd	2sd	total
50-99mcg/l (mild iodine deficiency)							
	0(0)	0(0)	1(4.3)	2(6.1)	0(0)	0(0)	3(3.8)
100-199mcg/l (optimal urine iodine)							
	2(100)	9(100)	22(95.7)	31(93.3)	11(100)	1(100)	76(96.2)
	2(100)	9(100)	23(100)	33(100)	11(100)	1(100)	79(100)

X2 = 1.390, df =5, P= 0.925

Table 7: The Relationship between urine iodine and height for age

Variable	-3SD	-2SD	-1SD	MEDIAN	1SD	2SD	3SD	TOTAL
50-99mcg/l (mild iodine deficiency)								
	0(0%)	0(0%)	2(8.3%)	1(3.7%)	0(0%)	0(0%)	0(0%)	3(3.8%)
100-199 mcg/l(normal urine iodine)								
	3(100)	10(100)	22(91.7)	26(96.3)	5(100)	6(100)	6(100)	76(96.2)
Total	3(100)	10(100)	24(100)	27(100)	5(100)	6(100)	4(100)	79(100)

X2 = 2.458, df = 6, P = 0.873

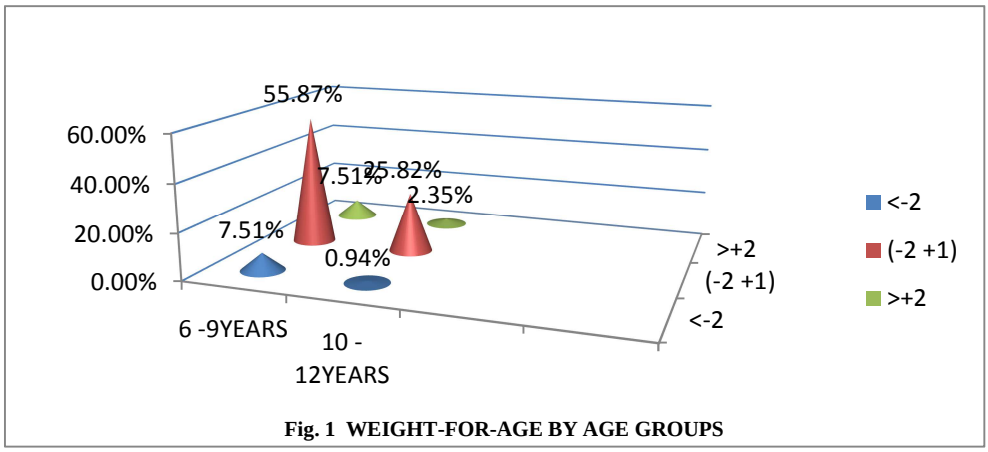


Fig. 1 WEIGHT-FOR-AGE BY AGE GROUPS

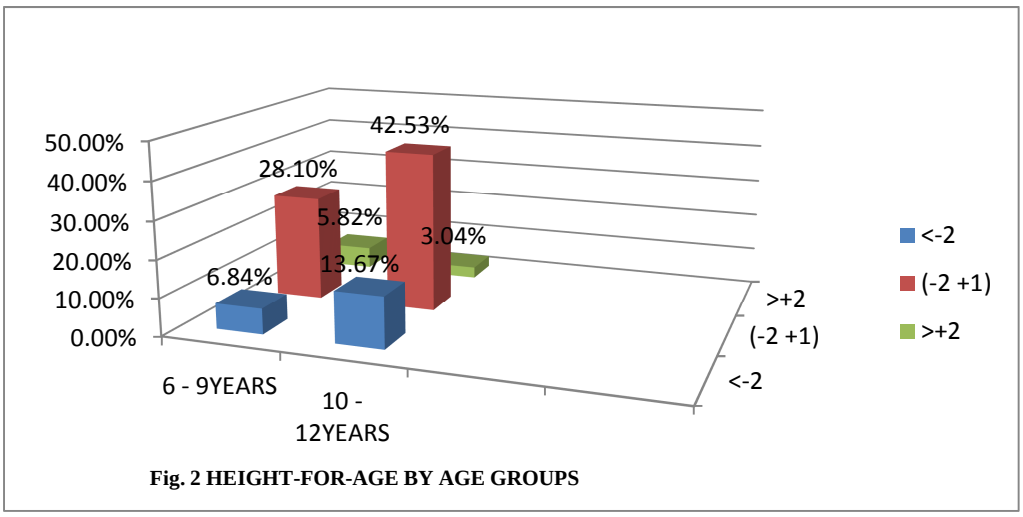


Fig. 2 HEIGHT-FOR-AGE BY AGE GROUPS

In the case of stunting and underweight, there were remarkable differences between male and female children. Higher (11.9%) prevalence of female was stunted and underweight (5.2%) compared to male children 7.6% and 3.3% respectively (Table 1). This is not consistent with the finding of Senbanjo et al., (2011) whereby 18.2% of male and 16.4% of female were stunted. However, Chowhury et al., (2008) observed higher prevalence of stunting in females than males. Meanwhile, Akor*et al.*(2010) observed no gender difference in under-weight; this was contrary to the result of the present study. These variations may be due to the effect of various intervention strategies by the government and consequent increased nutrition awareness among the populace.

This study observed that stunting and wasting (Fig. 2& Fig. 3) were more in older children (10-12 yrs) and underweight (Fig. 1) was more in younger children (6-9yrs). This is compatible with Ene-Obong and Ekweagwu(2012) who observed that stunting was more in older children. Stunting is a cumulative effect of under

nutrition and recurrent infections. The insult starts in-utero and progresses into childhood. The fact that these school children were still stunted, even in its milder form suggests a chronic state of food insecurity, macro and micronutrient deficiencies as well as infection and inadequate care.

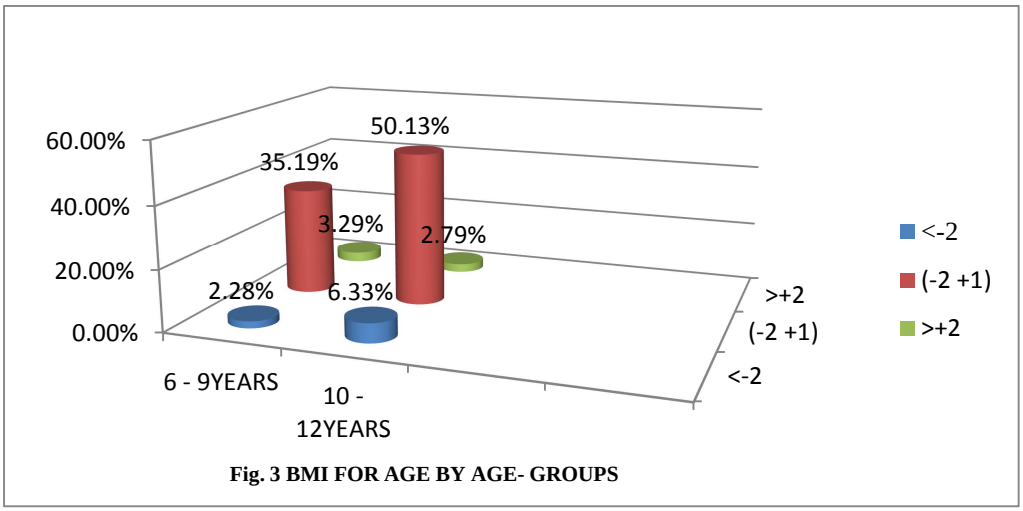


Fig. 3 BMI FOR AGE BY AGE- GROUPS

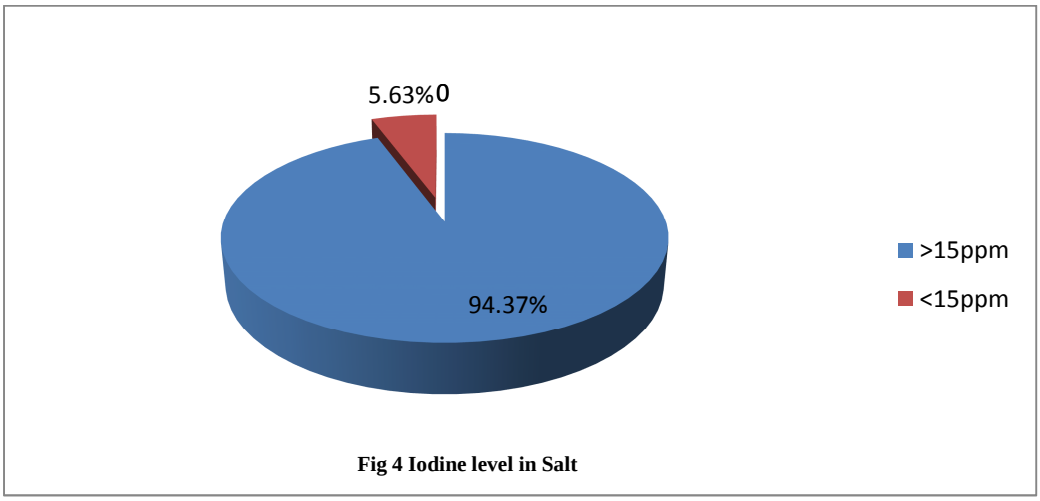
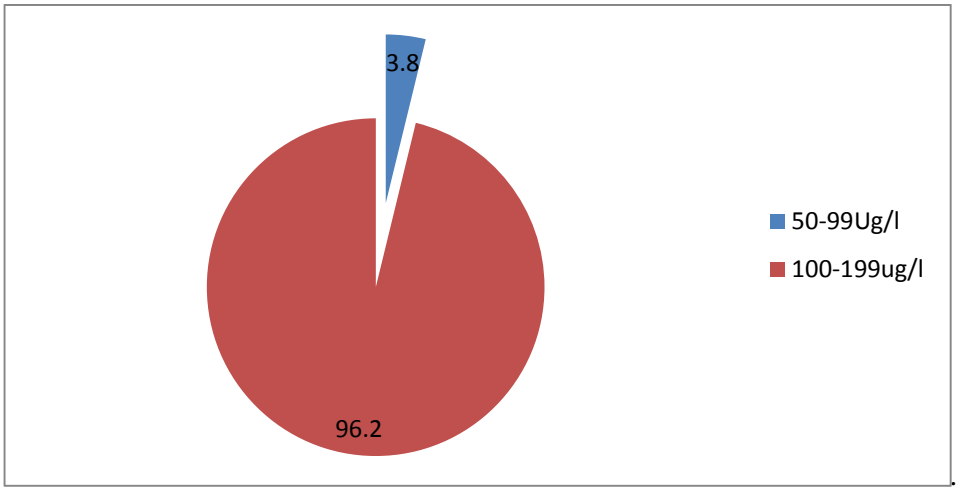


Fig 4 Iodine level in Salt



50-99ug/l (mild iodine deficiency), 100-199 (optimal iodine deficiency)
Fig.5: Median Iodine urinary status of the primary school children

Consumption Pattern: Table 2 shows the 24hr dietary recall revealed that majority of the school children had three meals per day (97.5% for breakfast, 90.7% for lunch and 95% for supper). This is consistent with the study conducted by Olumaikaiye*et al.* (2010) on food consumption patterns of Nigerian children and it showed that

majority of Nigerian children did eat 3 times per day. This is highly commendable and should be encouraged; consumption of breakfast can boost a child's diet by meeting the daily nutrient intake requirement, promoting healthful food choices and it is also associated with better academic performances (Rampersaud, 2009).

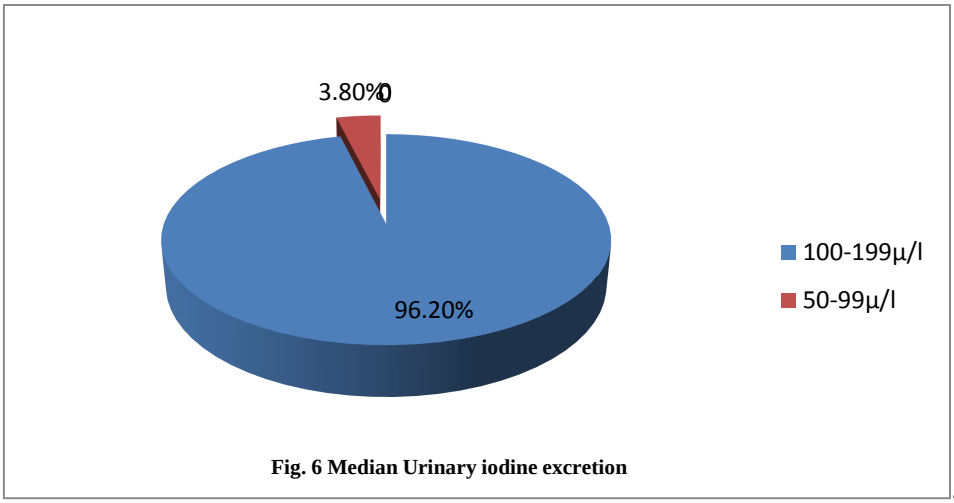


Fig. 6 Median Urinary iodine excretion

Cassava based foods were consumed by the majority of the respondents in the community is probably due to the fact that majority of their fathers were engaged in farming, with cassava as the major food crop cultivated. This type of positive connection between the staple foods commonly consumed by school children and the major agricultural produce of the community has been reported in previous study (Olusanya, 2010). Surprisingly however, rice is the food commonly eaten by the respondents' for breakfast. Lunch of the children comprised of energy providing foods mainly rice (22.8%), yam with palm oil (17.2%), and aribo (foofoomade from cassava and corn) and ogbono (Dika nut) soup, (12.2%). Some children skipped breakfast, lunch and supper owing to a number of factors such as poor socioeconomic status.

Snacks were found to play an important part in the diets of these children. Snacking has been shown to contribute significantly to energy intakes but excessive consumption of fats and sugar in snacks is undesirable (Otitoola, 2014). The most commonly consumed snacks by the (Table 3) children were biscuits (25.8%) and sweets (5.1%).These findings support those from the study conducted by Oogarah-Pratap and Heerah-Booluck (2005) on the children's consumption of snacks at school in Mauritius; they also pointed out that upper primary children (8-12 years) tended to opt for snacks which are loaded with, sugar, energy and fat (Oogarah-Pratap&Heerah-Booluck 2005). The availability of such snacks and their low prices makes it possible for children to obtain them.

Clinical Assessment: Among the respondents observed, hair changes in the form of lack of luster and thin and sparse hair was seen in 2.5% and 1.0% respectively (Table 4). This is consistent with Shivaprakash and Ranjit (2014) who reported lusterless and sparse hair (3.9%) in Mandya district, India. Moon face and paleness was seen in 1.5% of the respondents. And this could be due to the fact that protein consumption was low. The low consumption of protein might lead to protein deficiency diseases. Also there could be high risk of developing pernicious anemia, since vitamin B_{12} is solely from animal source.

Generally, salt is one of the easily available sources of iodine for a population. But the iodine content of salt samples may vary widely dependent on the source, the storage place, the method of packaging and the methods used for processing (in the case of commercial/branded items).The present study (Fig. 4) revealed that as high as 94.37% (which is higher than the recommended goal of 90%) of families were consuming salt with an adequate iodine content (containing iodine level >15 ppm) and 100% of salt from the market contained iodine >15ppm. This could be one of the main reasons for the non presence of goiter and 96.2% optimal mean urine iodine levels in the primary school children. It has been recommended by WHO that 90% of the households in a population should be able to get iodized salt containing iodine level >15 ppm for the effective elimination of IDDs.

This finding shows that the majority (94.2%) of the sampled population consumes iodized salt indicating the success of the universal salt iodization programme in Nigeria. This finding justifies the claim of the NDHS (2004) that almost all households (97%) in Nigeria use adequately iodized salts. The 5.8% of the population that have salt less than 15ppm could be due to exposure to sunlight, length of storage of the salts, method of packaging and processing of the salts. Poor and prolong storage have been shown to be a major factor affecting iodine concentrations of table salt (Egbuta*et al.*, 2003; WHO/ICCIDD/UNICEF, 2007).

Most of the rural women often buy large amounts of salts stored in 25kg porous bags because they are cheaper and can last for longer periods. Salt packaged in sacs have been shown to lose much of their iodine content due to leakages, moisture and higher room temperature (Egbuta *et al.*, 2003). This result supports Nigeria NAFDAC claim that the governmenthad greatly promoted salt iodization using public campaigns (Lantum, 2009) and Nigeria was certified for sustained universal salt iodization (USI) Compliance 95-98% as at year 2005 (Lantum, 2008).

Urinary iodine excretion is a good marker of the dietary intake of iodine, and is the index for evaluating the degree of iodine deficiency, correction and toxicity. Many countries have adopted massive salt iodization as a means of correcting IDD in countries where they were prevalent.The median urinary iodine excretion in this study (Fig.6) was 124.7µg/L. This value is compatible with previous assertion that Nigeria is among the ten African countries with median urinary iodine (UI) concentration of over 100µg/L (Delana, 2001). The median UI in this study is higher than that reported by Abua*et al.* (2008) for school age children (65µg/L) in Cross River state, Nigeria but similar to that of Alozie, Y.,Assi andAlozie, G. (2012) who reported median UI concentration of 185µg/l among school children in AkwaIbom state Nigeria.The results from this study show that none of the pupils had any degree of severe iodine deficiency. This is a welcome development in terms of public health and could attest that lots of families have massively embraced salt iodization. This is not consistent with the findings of Nwamarah and Okeke (2012) in obukpa a community in Nsukka, who reported a prevalence of iodine deficiency of 58.3%. However, the mild iodine deficiency as shown from this study, implies need to investigate other factors. This finding is consistent with the findings of Onyeaghalaet al., (2010) who reported mild to moderate iodine deficiency in school children in Ibadan, Nigeria.There was no presence of goiter found in the population studied which is not consistent with the findings of Sanusi and Ekerette (2009)who reported a goiter prevalence of 42.2% among primary school children in Ibadan, Oyo state Nigeria and also not compatible with Alozie, et al., (2014) who reported a goiter prevalence of 8.3% in school age children in AkwaIbom state Nigeria.

Conclusion: The mean urinary iodine excretion of 124.7µg/L obtained in this study revealed no biochemical iodine deficiency in majority of the respondents while 3.8% of the respondents had mild iodine deficiency. This finding suggests that the population studied was in a phase of iodine deficient to iodine sufficient.

This study also showed that 94.2% of the families consumed iodized salt greater than 15ppm. This finding supports the claim that Nigeria in general terms, has achieved the goal of universal salt iodization and should now focus its attention on constant monitoring in order to sustain this iodization level.

On the basis of the present study, we therefore conclude that through the universal salt iodization, Iodine Deficiency Disorders can be successfully eliminated from our communities. Therefore there is the need to sustain this initiative especially in areas with high prevalence of IDD.

REFERENCES

[1] Abua, S.A., Ajayi O.A. &Sanusi, R.A. (**2008**). *Pakistan journal of Nutrition 7(1): 40-43.*
[2] ACC/SCN (**2000**).Explaining trends in nutrition under weight in the developing world.Fourth report on the world nutrition situation.UN Standing Committee on Nutrition, Geneva.
[3] ACC/SCN (**2001**)Working Group on Nutrition in Emergencies | ENN*www.ennonline.net/fex/13/acc*
[4] Akor, F., Okolo, S. &Okolo, A. (**2010**). *Pakistan journal of nutrition.*9 (12): 1166-1170.
[5] Alozie,Y., Assi, A. and Alozie, G. (**2012**). *Nigerian journal of Nutritional sciences.*Vol 33 No 1. Pp42-45
[6] Bazrafshan HR, Mohammadian S, Ordookhani A, Farhidmehr F, Hedayati M, Abdolahi N, Azizi F, Braveman LE and EN Pearce (**2005**) *Journal Endocrinol invest* 28(8) 727-33
[7] Bruno de B., Maria, A., Ines, E., Bahi, T., Henrietta, A. (**2004**). Iodine status worldwide: WHO global IDD database on iodine deficiency. Geneva
[8] Chowhury, S.D., Chakraborty, T. &Ghosh, T (**2008**). *Indian peadiatrics* (45) 43-46.
[9] Dabone,C., Delisle, H.F &Receveur, O. (**2011**). *Nutrition journal* 10(34): 1-8.
[10] De Onis, M., Onyango, A.W., Borghi, E., Garza, C. & Yang, H. (**2006**). Comparison of the World Health Organization (WHO) Child Growth Standards and the National centre for Health statistics/WHO International growth reference: implications for child health programmes, *Public Health Nutrition* 9(7), 942-974. http://dx.doi.org/10.1017/PHN20062005
[11] Delana, A.A. (**2001**). *South African Journal of clinical Nutrition* pp 19-20.
[12] Delange, F. (**2000a**). The role of iodine in brain development. *Proceedings of the Nutrition Society*, 59 (01): 75-79.
[13] Delange, F. (**2000b**). Iodine deficiency in the thyroid, a fundamental and clinical text.Braverman L.E., Utiger, R.D, eds. Philadelphia: *lippincott public*. pp. 295-316.
[14] Delange , F. (**2001**). *Postgraduate Medical Journal* 77 (906): 217-220

[15] Delange, F., &Hetzel, B.S. (**2003**). The Iodine Deficiency Disorders in: the thyroid and its diseases. Basle Karger, pp 324-44.
[16] Egbuta, J.O., Onyezili, F. Vanormelimgen, K(**2003**). *Public Health Nutrition* 6(2): 169-173.
[17] Ene-Obong, H.N., Ekweagwu, E. (**2012**). *Nigerian journal of Nutritional sciences* vol.33,(1) pp 23-30.
[18] Heydarian P1, Ordookhani A, Azizi F. (**2007**). *J. Endocrinol Invest*. 30(5):404-410.
[19] IDD Newsletter (**2000**).Indicators for assessing iodine deficiency status.(16): number 1.
[20] Ischie, U.P., Das, S.C., Egbuta, J.O., Banwo, A.I., Marimot, I., &Nagataki, S. (**1987**). *Proceedings of Nigeria/ Japan conferences*, Jos. pp: 78-81.
[21] Lantum, N.D. (**2008**). Food and Nutrition Security. Eleventh ECOWAS Nutrition Forum held at Freetown, Sierra Leone, 22–24.
[22] Lantum, D.N. (**2009**). *IDD Newsletter May*, 32(2) 6-7.
[23] Madukosiri C.H. (**2011***). Am. J. Food. Nutr*, 2011, 1(4): 193-200.
[24] Medda E, Olivieri A, Stazi MA, Grandolfo ME, Fazzini C. Baserga M et al (**2005**) *European Journal of Endocrinol* 153(6): 765-73.
[25] NAFDAC (**2003**). Achieving and sustaining universal salt iodization: doing it well through regulation and enforcement. Lessons learned from USI in Nigeria.
[26] Nwamarah, J.U &Okeke, E.C. (**2012**) *Journal of public Health and Epidemiology*. 9 (4): 246-252.
[27] Nwokolo, C., &Ekpechi O.L (**1966**). *Hygiene* 6: 97-108.
[28] Ohashi T, Yamaki M, Pandav CS, Karmarkar MG, Irie M. (**2000**) *Clin Chem*. :46(4):529-36.
[29] Oke, J.U. (**2013**). Power and politics, 1000 years of Okpuje history: 1012AD-2012AD Enugu, Grand-Heritage Global communications. pp 1-6
[30] Olanrele, D.I. (**2014**). *Nigerian Journal of Nutritional sciences vol*35, No: 99-104.
[31] Olumaikaiye, M.F., Afinmo.T. &Olubayo-Fatiregun M.A (**2010**). Food Consumption Patterns Of Nigerian Adolescents And Effect On Body Weight. Retrieved from www.ncbi.nlm.nih.gov/pudmed/20083439.Accessed 25th April 2011.
[32] Olusanya, J.O. **2010**. *Pakistan journal of Nutrition* 2010, 9(2):198-204.
[33] Onyeaghala,A.A., Anetor, J.I., Nurudeen, A. and Oyewole, O.E (**2010**). *Journal of Toxicology and Environmental Health Science*.Vol 2 (7). Pp. 93-96.
[34] Oogarah-Pratap, B. &Heerah-Booluck, B.J. (**2005**). *Nutrition and Food Science* 2005; 35 (1):15-19.
[35] Otitoola, O. &Atinmo, T. (**2008**). *Nigerian journal of Nutritional sciences* 29(2): 221-225.
[36] Rampersaud G.C., (**2009**). *American Journal of lifestyle medicine*: 3(2). 86-103.
[37] Sanusi, R.A. &Ekerette, N.U. (**2009**). *African Journal of Biomedical Research*:12(1).
[38] SCN (**2004**).Nutrition to improve development outcomes.5threporton the world Nutrition situation.UN Standing Committee on Nutrition, Geneva.
[39] Sekumade, A.B. (**2013**). *Journal of Biology Agriculture and Healthcare*. 3(12) No.12: 24-33.
[40] Senbanjo, I.O, Oshikoya, K.A., Odusanya, O.O &Njokanma, O.F (**2011**).. *Journal of Health Population Nutrition.* 29(4): 364-370.
[41] Shivaprakash, N.C. & Joseph, R.B. (**2014**). I*nternational Journal of Scientific Study*: 2 (2)
[42] UN/SCN (**1993**).Second report on the world nutrition situation, country trends, methods and statistics (11): 142
[43] UNICEF (**1993**).Regional goitre survey in school children, Nutrition section, Lagos Nigeria.
[44] World Health Organisation (**2000**). Consultation on obesity: preventing and managing the global epidemic. WHO technical report 894, Geneva
[45] World Health Organization (**2007**). WHO Reference 2007, viewed 16th April 2012 from http://www.who.int/growthref/en/.
[46] World Health Organization (**2011**). Global database on iodine deficiency Geneva, Switzerland: http:/www.who.int/database/iodine/en/.(accessed may 17, 2011)
[47] WHO, UNICEF, and ICCIDD. **2001**. Assessment of the Iodine Deficiency Disorders and monitoring their elimination. Geneva: WHO publ. WHO/NHD/01.1. 1-107 pp.
[48] World Health Organization (**2015**).Micronutrient deficiencies; iodine deficiency disorders.http:/www.who.int/nutrition/topic/idd/en.(accessed June 03, 2015)
[49] WHO/UNICEF/ICCIDD.(**2007**). Assessment of iodine deficiency disorders and monitoring their elimination (3rd.edn).Geneva : WHO
[50] Zimmermann, M.B. (**2009**)..*Endocrinology Review*, 30: 376-408. Cross Res PubMed.