International Scholars Journals

International Journal of Public Health and Epidemiology ISSN 2326-7291 Vol. 15 (2), pp. 001-007, February, 2026. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Iodine Deficiency and Growth Outcomes among Primary School Pupils in Rural Nigeria

Nwamarah, Joy Ugo* and Okeke, Elizabeth Chinwe

Department of Home Science, Nutrition and Dietetics, University of Nigeria Nsukka, Enugu State, Nigeria.

Accepted 26 September, 2025

This study was designed to assess the iodine and the anthropometric status of primary school children in a rural Nigerian community (Obukpa). Stratified random sampling technique was used in selecting the respondents for the study. The sample size was 330 children aged 6 to 12^{+} years. The anthropometric measurements of the children comprising 170 boys and 160 girls were obtained using standard procedures. The urine of a sub-sample of 36 children were subjected to laboratory analysis for iodine using "method H". Data generated from this study were analyzed using Statistical Package for the Social Sciences (SPSS) version 12, means, standard deviation, student t-test, analysis of variance (ANOVA) and correlation coefficient (r) values. Anthropometric measurements of the children showed that 25% were stunted. More boys (13.7%) were stunted than girls (11.3%). Stunted children correlated negatively with wasted children significantly (P < 0.05). Urinary iodine showed that 58.3% of the children had <20 µg/L indicating severe iodine deficiency. Iodine levels in urine correlated with stunting and underweight.

Key words: Urinary iodine status, anthropometric status, primary school children.

INTRODUCTION

Iodine Deficiency and Physical Development: The physiological effects of iodine are realized by the thyroid hormone in human body. Thyroid hormone is one of the most important hormones in the human body. Hence the physiological effects of iodine are: Firstly, it can maintain the metabolism of energy in the body (www.lookchem.com). It breaks down the substances in human body, so as to provide the energy required for basic life activities. What's more, it can promote the production of heat, so as to maintain the normal tempe- rature of human body. Iodine deficiency will decrease the synthesis of thyroid hormone, which may cause damage on the basic life activities and decline physical ability. Secondly, iodine can promote physical development. Iodine can regulate the development of bones and mu- scles for children at the growth and developmental stage. Iodine deficiency can lead to physical retardation, muscle weakness and other symptoms. Thirdly, iodine can promote the development of brain. For the fetuses and infants, the development of their brain is closely related with iodine. As a result, iodine deficiency will greatly affect brain development, and even may lead to mental retardation, while this disorder is essentially irreversible.

Foods that contain a large number of iodine::In general, foods which contain great amounts of iodine are mostly seafood, such as kelp, seaweed, dried scallop, mussel, sea cucumber, jellyfish, lobster, and so on. Seaweed contains the highest content of iodine (one kilogram of fresh kelp contains more than 2000 micrograms of iodine); and followed by marine fish and shellfish. Apart from seafood, other foods such as egg, milk and meat also contain a large number of iodine. Plant food contains the lowest amount of iodine in all the foods.

In addition, iodized salt contains a really small amount of iodine, especially the purified salt. Every one kilogram of sea salt contains about 20 micrograms of iodine. If one person takes in 10 grams of salt every day, he can only take in 2 micrograms of iodine. This can hardly meet the need for the prevention of the disorders caused by iodine deficiency (www.lookchem.com). In many developing countries, however, children hardly grow to their full

*Corresponding author. E-mail: joynwamarah@gmail.com. Tel: +2348038714159.

potential as a result of many environmental factors such as malnutrition and infections (Van de Poel et al., 2008). Children from poor or less privileged families in those countries are the most affected due to food insecurity, inadequate facilities, infection and poor general environmental sanitations.

The causes of child undernutrition are complex, multidimensional, and interrelated, ranging from factors as fundamental as political instability and slow economic growth to those as specific in their manifestation as respiratory infection and diarrhea disease (ACC/SCN, 2000). Lack of progress to combat malnutrition is damaging to children and nations. For every visibly undernourished child, there are several more battling a hidden nutritional crisis. Many are seriously deficient in essential vitamins and minerals such as Iodine, Vitamin A and Iron (Clements, 2006). Poor nutrition remains a global epidemic contributing to more than half of all children's deaths, about 5.6 million per year. UNICEF's charts and progress reports towards the first UN Millennium Development Goal are aimed to eradicate extreme poverty and hunger by 2015. Achieving this goal means halving the proportion of children who are underweight for their age, the most visible sign of malnutrition (Clements, 2006).

Most of the Iodine status monitoring with anthropometric studies was done outside Nsukka has boundary with Kogi state that is endemic of goiter. Thus, there is the inadequate documentation of the Iodine status and anthropometric status of Nsukka school age children. These groups of children are also susceptible to Iodine deficiency disorders.

The general objective of this study was to assess the Iodine status and the anthropometric status of primary school children in rural community- Obukpa in Nigeria.

MATERIALS AND METHODS

The study was carried out in Obukpa in Nsukka Local Government Area of Enugu State, Nigeria. The subjects consisted of primary school children aged 6 to >12 years.

Approach to the local community

A letter from the University introduced the researcher to the Chief of the community. Subsequently, the Chief gave approval that was presented to the Headmaster of each school; permission for the study was obtained.

Design and sampling procedure

3 out of 7 primary schools in the community were randomly selected for this study.

Sample size and sample size calculation

This was calculated using the formula (www.herkimershideaway.org/writings/sizesam.htm) as follows:

$$N = \frac{4P(1-P)}{W^2}$$

where N = total number of children required, P = proportion of the subjects assumed to have subnormal iodine urine excretion and nutritional status. P = 28%.

Maziya-Dixon et al. (2004) reported in International Institute of Tropical Agriculture (IITA) that 27.5% of the children suffered various degrees of Iodine deficiency. W = required precision level or probability level for the study. W = 0.05(5%). In order to make up for drop outs, this figure was approximated to 330. The sub-sample was obtained using 10% of the total sample, which were used in determining the casual urinary iodine excretion

$[10 \times 330] / 100 = 33$

The 33 were marked up to 66 in case of any drop out.

Sampling procedure

A multistage sampling procedure was used in the study. The names of all the primary schools in Obukpa Community were collected from the Local Government Area Education Authority. Three schools were randomly selected from the list of schools in the community. The sampling frame comprised all school children from elementary 1 to 5. The source of sample frame was obtained from the school register. This was done by stratified systematic random sampling and simple random sampling. The three schools constituted the three strata. The total sample size was 330 children.

Data collection

Two research assistants from the community were trained on collection of urine and taking of anthropometric measurements. General anthropometric measurements were made on all the units in the sample size to determine their nutritional status.

Anthropometric measurements included height and weight. The heights of the children were taken using a portable height gauge calibrated in centimeters (cm). The children were measured without shoes on a flat floor. A good standing posture was maintained before measurement. The heels were pulled together touching the base of the wall. The head was erect and hands hung at their sides in natural manner. The child's line of sight was level with the ground for accuracy. The measurements were taken to the nearest 0.1 cm. after the head piece was placed on the head of each subject; the reading was taken to the nearest 0.1cm.

Weight

The weights of the children were taken using a Salter beam balance scale this was calibrated in kilograms and pounds. The scale was adjusted to zero before each measurement. The children were weighed with minimum clothing. The reading was taken to the nearest 0.1 kg. Ages of the children were derived from the school registers the school records of pupils' age were derived from birth certificates on admission.

Anthropometric status was derived by computing weight-for-age, height-for-age and weight-for-height using the z-score classification system. The anthropometric value was compared with World Health Organization (WHO, 2006) reference standard.

Urinary Iodine collection

Casual urine samples were collected from the subjects, in sterilized clean containers marked, numbered and distributed to the children on the day of collection. The samples were transported in an ice pack to the laboratory and were analyzed immediately, with the help of a biochemist, using “method H”, as recommended by IDD Newsletter 1999. Urinary Iodine levels were determined using small samples of urine (250 to 500 µl) digested with ammonium persulfate at 90 to 110°F, adding arsenious acid and uric ammonium sulphate. The decrease in yellow colour over a fixed time period was measured by a spectrophotometer and plotted against a curve constructed from standards with known amounts of Iodine, ran in the same assay. Replicates of 3 samples were analyzed to check the accuracy and reproducibility of the method

Data analysis

The data were coded and keyed into the computer, then analyzed using the Statistical Package for the Social Sciences (SPSS) version 12 computer software. Descriptive statistics such as frequencies, percentages, mean, standard deviation as well as correlation coefficient (r) were used to appraise the validity and reliability of the dependent variables such as weight-for-age, height- for-age, weight-for-height, and causal urinary iodine levels. Analysis of variance (ANOVA) was used to compare means such as weight- for-age, height-for-age, weight-for-height, and causal urinary iodine levels. The Student t-test was used to compare the males and females' urinary Iodine mean levels.

RESULTS

Figure 1 shows the prevalence of (13.0%) underweight of the surveyed respondents, using weight-for-age, while 25.0% were stunted using height-for-age and 5.3% were wasted using weight-for-height.

Figures 2 and 3 compared the mean weight-for-age and height-for-age of the males and females with their NCHS/WHO reference 50th percentile. Figure 2 shows that the entire age-groups of the males fell below their NCHS/WHO reference 50th percentile. There were fluctuations in the weight as the ages increased but from 10 years on, there was a steady increase. Figure 2 shows that the females in the age-groups also fell below their NCHS/WHO reference 50th percentile, but had a steady appreciation in weight as the ages increased. All the males in the age-groups in Figure 3 had their heights be- low their NCHS/WHO reference 50th percentile. Like the males, the heights of the female age-groups fell below their NCHS/WHO references except age-groups 6 to 7 years, 11 months.

Anthropometric status classification according to sex in Table 1 showed that more females (3.0%) than males (2.3%) were wasted, while more males (13.7%) than females (11.3%) were stunted and more males (6.7%) than females (6.3%) were underweight.

Table 2 displaying anthropometric status classification according to age-group, revealed that more of age-group (6 to 9 years, 11 months) (3.3%) than age-group (10 to 13 years, 11 months) (2.0%) were wasted. Weight-for-age showed that more (9.3%) of (10 to 13 years, 11 months) were underweight than 3.7% of age-group 6 to 9 years, 11 months. Height-for-age revealed that more 15.4% of 10 to 13 years, 11 months were stunted than 9.8% of 6 to 9 years, 11 months.

Iodine status of the children in the studied communities

Figure 4 revealed that majority (58.33%) of the children had <20 µg/L Iodine in urine which denotes severe Iodine deficiency. About 13.89% had 50 to 99 µg/L (mild Iodine deficiency), and 11.11% had >300 µg/L (possible excess). On the other hand, 8.33, 5.56 and 2.78% had 100 to 199 µg/L (optimal), 20 to 49 µg/L (moderate Iodine deficiency) and 200 to 299 µg/L (more than adequate), respectively. Table 2 shows that more boys (33.33%) than girls had <20 µg/L (severe Iodine deficiency level) and more girls (13.89%) than boy (0%) had 50 to 99 µg/L (mild Iodine deficiency). More girls (5.56%) than boys (2.78%) had 100 to 199 µg/L (optimal) Iodine in urine. However, only girls (2.78%) had 200 to 299 µg/L (more than adequate) and more boys (8.33%) than girls (2.78%) had >300 µg/L (possible excess) Iodine.

Table 3 shows that the correlation coefficient (r) between urinary Iodine level of the pupils and the under- weight and stunted had positive values (r = 0.240) and (r = 0.314), respectively and the wasted had negative value (r = -0.179). The relationship was stronger among stunted children and urinary Iodine level (r = 0.314). However, it was generally weak with other nutritional parameters. Stunted children had the highest urinary Iodine correlation coefficient (r = 0.314) level. This relationship could be regarded as below average within the degree range of 0 to 1. Table 3 also shows a correlation coefficient (r = 0.351) between underweight and stunting as being sig- nificant (P < 0.05). There was a negative relationship (r = -0.398) between wasted and stunted children and it was significant (P < 0.05).

ANOVA test in Table 4 shows that Owerre-Obukpa CPS had the maximum (94.0 µg / L ± 7134) mean urinary Iodine level followed by Ajuona CPS (63.0 µg / L ± 70.05) and Amarua/Amagu (55.0 µg / L ± 48.28) and there was no significant (P > 0.05) differences. The student t-test comparing urinary Iodine level of the males and females, shows that the females had the highest (80.0 ± 63.12) urinary Iodine level than the males (54.0 ± 58.40) and there was no significant (P > 0.05) difference

DISCUSSION

The 25.0% stunting, 13.0% underweight and 6.3% wasting observed in this survey agreed with those of Granthan-McGregor et al. (1989) who observed that glo- bally stunting is much more prevalent. The FGN/UNICEF (1994) study observed more stunting (36 to 52%) and underweight (27 to 45%) than wasting (5 to 12%). On the other hand, the magnitude of stunting and wasting observed in the present study was lower than that of Nnanyelugo et al. (1990). They observed 50.0% stunting

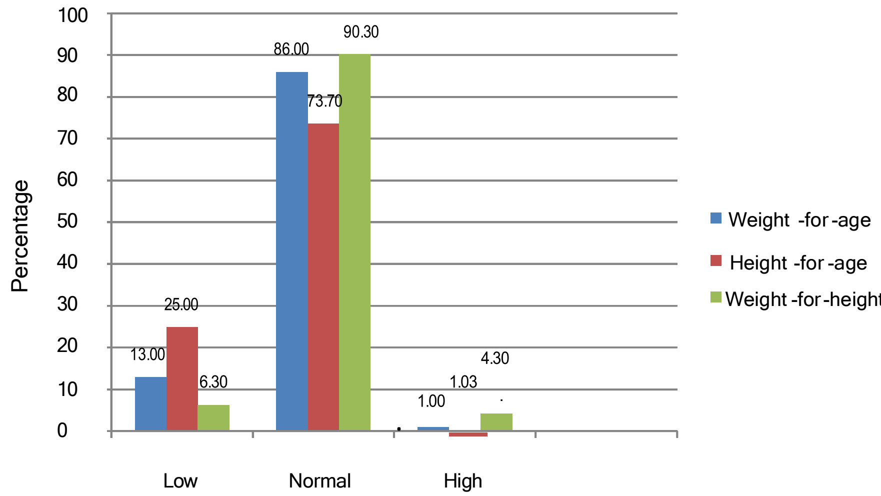

Figure 1. Prevalence of underweight, stunting and wasting of school children in Obukpa community.

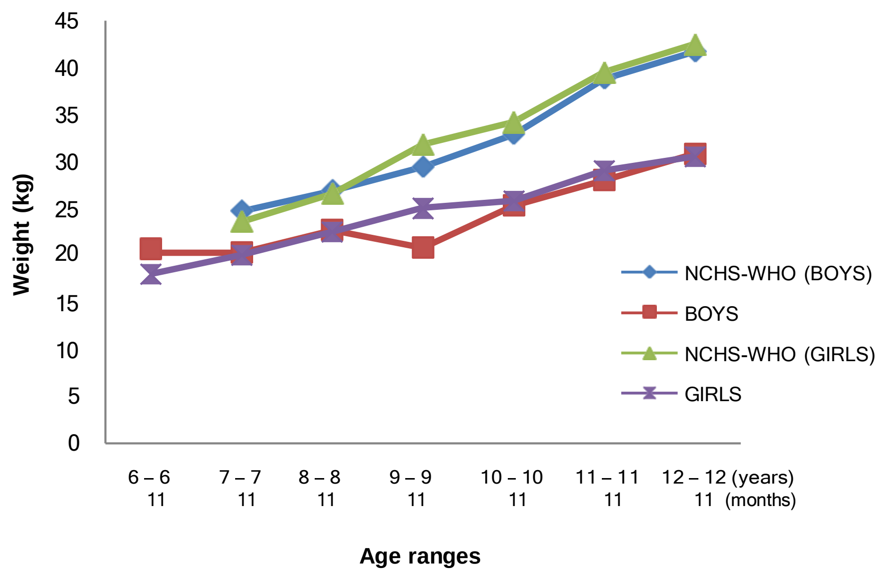

Figure 2. Comparing mean weight-for-age of males, females with NCH/WHO reference group.

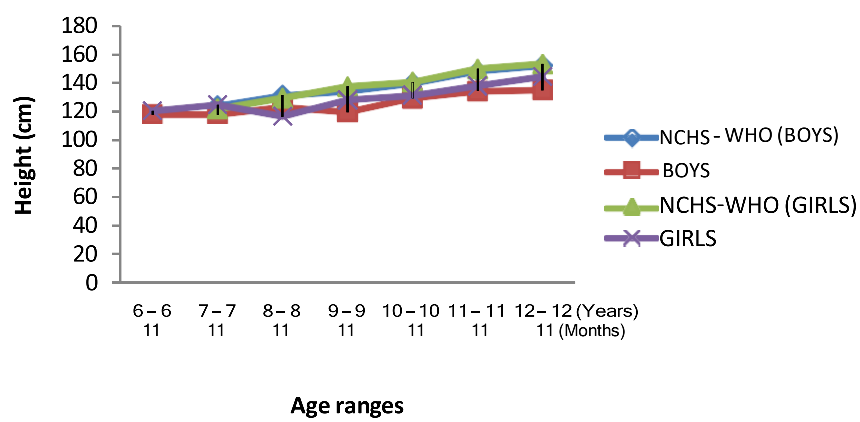

Figure 3. Comparing mean height-for-age of males and females with NCH/WHO reference group.

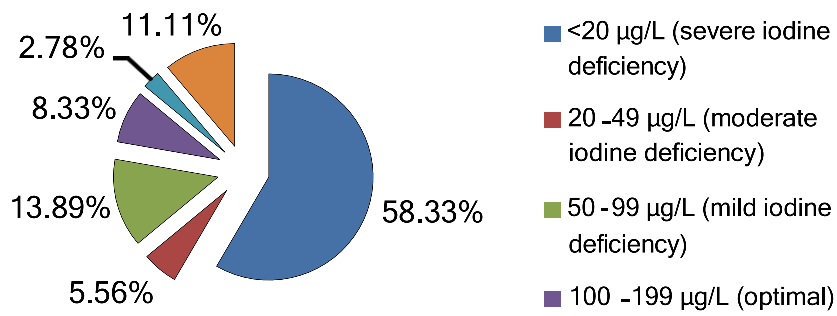

Figure 4. Iodine status of the school children.

Table 1. Distribution of underweight, stunting and wasting among males and females in Obukpa community.

Variable	N (%)	
	Boys	Girls
Weight-for-age		
<-2SD	20 (6.7)	19 (6.3)
-2 to +2SD	131 (43.7)	127 (42.3)
>+2SD	3 (1.0)	-(-)
Total	154 (51.3)	146 (48.7)
Height-for-age		
< -2SD	41 (13.7)	34 (11.3)
-2 to +2SD	111 (37.0)	110 (36.7)
>+2SD	2 (0.7)	2 (0.7)
Total	154 (51.3)	146 (48.7)
Weight-for-height		
<-2SD	7 (2.3)	9 (3.0)
-2 to +2SD	139 (46.3)	132 (44.0)
>+2SD	8 (2.7)	5 (1.7)
Total	154 (51.3)	146 (48.7)

< -2SD, Low; -2 to +SD, normal; >+2SD, above normal; W/A, weight-for-age; H/A, height-for-age; W/H, weight-for-height. Z-score of < -2.0SD from NCHS-WHO (1976) median value was used as cut-off. Low weight-for-age, underweight; low height-for-age, stunting; low weight-for-height, wasting.

Table 2. Iodine status of the children according to sex.

Iodine level in urine (µg/L)	Status	Boys		Girls		Total	
		N	%	N	%	N	%
<20	Severe Iodine deficiency	12	33.33	9	25	21	58.33
20 - 49	Moderate Iodine deficiency	1	2.78	1	2.78	2	5.56
50 – 99	Mild Iodine deficiency	-	-	5	13.89	5	13.89
100 - 199	More than adequate	1	2.78	2	5.56	3	8.34
200 - 299	Optimal	-	-	1	2.78	1	2.78
>300	Possible excess	3	8.33	1	2.78	4	11.11
Total		17	47.22	19	52.79	36	100.0

Table 3. Correlation coefficient (r) values expressing the relationship between the iodine level in the urine and malnutrition status. N= 33.

Variable	Underweight	Stunted	Wasted	Iodine level in urine
Underweight	1	.351 (*)	-.110	0.240
Stunted	0.351	1	-0.398 (*)	-0.314
Wasted	-0.10	-0.398 (*)	1	-0.179
Iodine level in urine	0.240	0.314	-0.179	1

*Correlation is significant at 0.05 level (tailed).

Table 4. Mean (±SD) urinary iodine level as influenced by schools and sex of respondents.

School	Minimum	Maximum	Mean	Standard deviation
Ajuona CPS	14.9	163.40	63.0	±70.05
Amagu/ Amarua CPS	14.9	133.70	55.0	±48.28
Owerre-Obukpa CPS	14.9	208.0	94.0	±71.34
$LSD_{(0.05)}$			NS	
Sex				
Male	14.90	163.40	54.0	±58.40
Female	14.90	208.00	80.0	±63.12
$LSD_{(0.05)}$			NS	

and 70.0% wasting. Onofiok (1998) reported 43.0% underweight, 33.0% stunting and 18.6% wasting. The explanation for the differences might be that the previous studies were conducted in the rural farmland communities who depended heavily on cassava con- sumption. Obukpa is a semi-urban who consumed a lot of mixed cereals, legumes and vegetable dishes. These foods are rich in nutrients and essential amino acids which are more energy dense than cassava. The community is very close to the University of Nigeria Teaching Hospital, coupled with, possible improved maternal literacy. However, Olivieri et al. (2007) reported that if substantially more than 5% of an identified child population has height-for-age that is less than the 50th percentile on the reference curve, then the population is said to have a higher-than-expected prevalence of stunting, and malnutrition is generally the first cause considered.

Much is still being desired for children of developing countries to catch-up with their WHO reference age- group. The 58.33% severe Iodine deficiency (<20 µg/L), 5.56% moderate Iodine deficiency (20 to 49 µg/L) and 13.89% mild Iodine deficiency (50 to 99 µg/L) were observed in this survey. Kennedy et al. (2003) also noted that the true prevalence of Iodine deficiency is even more widespread than the number of those affected with goiter which seems to indicate, however, that there were no glo- bal estimates for prevalence of low urinary Iodine, which is the best sub-clinical indicator. The study agreed with Kennedy et al. (2003) that sub-clinical iodine deficiency was detected by measuring urinary Iodine which was an indication of low Iodine intake and/or utilization. The low urinary Iodine level reported in this study may be an indi- cation of poor utilization of Iodine consumed. Goitrogens are able to disrupt normal thyroid function by inhibiting the body's ability to use Iodine, block the process by which Iodine becomes the thyroid hormones thyroxine (T4) and triiodothyronine (T3), inhibit the actual secretion of thyroid hormone, and disrupt the peripheral conversion of T4 to T3 (thyroid.about.com). Akunyili (2007) rightly reported that Nigeria currently ranks high on global and regional report cards. In 2005, the goitre rate was 6.2%, down from 20% in 1993. Median urinary Iodine excretion rate has consistently been over 130 µg/dl since 1999. Improvements in urinary Iodine excretion and goitre rates have been substantive. In addition, the 10 point criteria for USI certification have consistently been met, which paved way for Nigeria's certification as the first country in Africa to achieve USI compliance in 2005 by the Network for Sustained Elimination of Iodine Deficiency. There is need therefore to look into the states foods that are consumed and their preparations

Low urinary Iodine level of the stunted children was observed in this study. Stunting may be the effect of low Iodine utilization, although there may be other predispo- sing factors, such as infections and poor nutrition that could give rise to stunting. Sofra et al. (1998) defined Iodine as an essential mineral required by the body that directly affects thyroid gland secretions, which themselves to a great extent controls heart actions, nerve response to stimuli and rate of body growth and metabolism. Therefore, estimates for prevalence of low urinary Iodine, is the best sub-clinical indicator.

The non-significant (P > 0.05) differences observed in the urinary Iodine level between the community primary schools and sexes may be attributed to the small sub-samples size, which was a result of non-funding of the study.

CONCLUSION AND RECOMMENDATIONS

The study indicated a higher prevalence of stunting than underweight. The existence of stunting, underweight and wasting in the school children in the semi-rural community may have serious implications in the general wellbeing of the children and their achievement and attainment later as adults. There was evidence of the intake/utilization of inadequate Iodine as evidenced in the urinary Iodine output. Important findings of this study are information on the relationship between growth and Iodine deficiency and significant information on the nutritional status of Obukpa rural school children which can be extrapolated to other rural communities in Iodine endemic areas for the purpose of intervention programmes, such as eradication of micronutrient deficiency.

The study revealed that more attention should be given to school children in developing countries like Nigeria. A large sample size should be studied in this community; also, urgent intervention programmes are recommended.

REFERENCES

ACC/SCN (2000). . Explaining Trends in Child Underweight in the Developing World. Fourth Report on the World Nutrition Situation. Geneva: ACC/SCN in collaboration with IFPRI.

Akunyili DN (2007). Achieving and sustaining universal salt iodization (USI): Doing it well through regulation and enforcement. Lessons learned from USI in Nigeria. In: Kaia Engesveen (ed.), SCN News-Universal Salt iodization (USI). Lavenham Press, UK. 35:43. www.unsystem.org/scn/Publications/SCNNews/scnnews35.pdf

Clements J (2006). One in four children in developing countries underweight. The Independent, UK. http://www.independent.co.uk/news

FGN/UNICEF (1994). The nutritional status of women and children in Nigeria. UNICEF, Lagos.

Granthan-McGregor S, Gardner JMM, Walker S, Powell C (1989). The relationship between under nutrition, activity levels and development in young children. In: Schurch B, Scrimshaw NS (eds.) Activity energy expenditure and energy requirements of infants and children. Proceedings of an IDECG Workshop, Waterville Valley, NH, October 1991. Lausanne, Switzerland: IDECG. pp 63-80.

Kennedy G, Nantel G, Shetty P (2003). The scourge of 'Hidden hunger': global dimensions of micronutrient deficiencies. In: Food, Nutrition and Agriculture. Rome, FAO. pp. 8-14.

Maziya-Dixon B, Akinyele IO, Oguntona EB, Nokoe S, Sanusi RA, Harris E (2004). Nigeria food consumption and nutrition survey summary 2001-2003. In: International Institution of Tropical Agriculture (IITA). IITA, Ibadan, Nigeria. pp. 39-42.

National Centre for Health Statistics (NCHS)/WHO (1976). Growth curves for children (birth -18years). U.S. Department of Health Education and Welfare. Public Health Services.

Nnanyelugo DO, Ngwu EK, Asinobi CO, Ezumah HC, Nweke FI, Nwagbara CA, Chiobi CG (1990). Nutritional status of cassava farm households in Ohosu area, Bendel State, Nigeria. Tech. Rep. Nutr. Stud. 1:1.

Olivieri F, Semproli S, Pettener D, Toselli S (2007). Growth and malnutrition of rural Zimbabwean children (6-17 years of age). Am. J. Phys. Anthrop. 136(2):214-222.

Onofiok NO (1998). Growth, iron status and parasitic infection of primary school children in a rural Nigeria community. Ph.D Thesis. Dept. of Home Science, Nutrition and Dietetics, Univ. Nigeria Nsukka.

Sofra JE, Yannias CS, Goulka JE (eds) (1998). Encyclopedia Britannica. (USA) Hypothyroidism, 6: 205: 3b.

van de Poel E, Hosseinpoor AR, Speybroeck N, van Ourti T, Vega J (2008). Socioeconomic inequality in malnutrition in developing countries. Bull. WHO 86(4):241-320.

WHO (2006). Child growth standards. Geneva: World Health Organization.thyroid.about.com

www.herkimershideaway.org/writings/sizesam.htm - Cached - Similar. Sample size needed for specified margin of error. Accessed March, 2012.

www.lookchem.com>Chemical Encylopedia>Health and Chemical. The Physiogical Effects of iodine-Chempedia-LookChem. Accessed September, 2012.