PJN
ISSN 1680-5194
ansinet.com/pjn

PAKISTAN JOURNAL OF NUTRITION

Science Alert
scialert.net

ANSInet
an open access publisher
http://ansinet.com

OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2020.61.67

Research Article
Dietary Diversity: Association with Academic Performance and Anthropometric Indices of Rural Nigerian School Children

[1]A.M. Okafor, [2]E.O. Odo and [1]E.O. Onodigbo

[1]Department of Nutrition and Dietetics, University of Nigeria, Nsukka, Nigeria
[2]Department of Obstetrics and Gynecology, University of Abuja Teaching Hospital, Abuja, Nigeria

Abstract

Background and Objective: A lack of dietary diversity is a qualitative reflection of inadequate nutrient(s) in the diet of individuals. This study was conducted to assess dietary diversity and its association with academic performance and anthropometric indices of primary school children (6-12 years) in Ukehe, a rural community in Nsukka, Nigeria. **Materials and Methods:** A multistage random sampling technique was used to select 522 respondents. Dietary diversity was assessed using the 2010 Food and Agriculture Organization guidelines for measuring individual dietary diversity. Academic records of the children were used to assess their academic performance. Anthropometric measurements of the respondents were obtained using standard procedures. Data were analyzed using the computer software package Statistical Product and Service Solution (SPSS). Significance was accepted at $p<0.05$. **Results:** Some (30.3%) of the respondents had low dietary diversity scores, whereas most (54.8%) had an average academic performance. Some (31.8%) of the respondents who were in the medium dietary diversity category also had an average academic performance. Stunting was present in 4.4% of the respondents, 5.0% were underweight and 3.4% were wasted. Dietary diversity was positively associated with academic performance and anthropometric indices. **Conclusion:** Medium dietary diversity and an average academic performance were recorded for most of the respondents. Low prevalence of stunting, wasting, underweight and overweight existed among the respondents.

Key words: Dietary diversity, anthropometric indices, malnutrition, schoolchildren, academic performance

Received: July 18, 2019 Accepted: November 26, 2019 Published: January 15, 2020

Citation: A.M. Okafor, E.O. Odo and E.O. Onodigbo, 2020. Dietary diversity: association with academic performance and anthropometric indices of rural Nigerian school children. Pak. J. Nutr., 19: 61-67.

Corresponding Author: A.M. Okafor, Department of Nutrition and Dietetics, University of Nigeria, Nsukka, Nigeria

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Dietary diversity is defined as the sum of the food groups consumed over a period of 24 h. It is widely recognized and accepted as a determinant of nutritional outcome[1]. It is therefore a key element of high-quality diets and the recommendation to consume a variety of foods appears in many nutritional guidelines[2]. Dietary diversity is essential to the consumption of adequate nutrients because there is no single food other than breast milk for the first six months of life that contains all of the nutrients required to maintain good health and nutritional status[2]. Consuming a wide variety of foods among and within food groups is a recommended strategy to help ensure an adequate intake of nutrients[3]. A diverse diet is important for meeting the requirements for essential nutrients, especially for those who are at risk of nutrient deficiencies[4].

Malnutrition refers to an abnormal physiological condition caused by inadequate or excessive consumption of macronutrients and micronutrients[5]. Malnutrition could be reduced by increasing the diversity of foods available for consumption[6] because non-diverse diets can have negative consequences on individuals' health, well-being and development, as this type of diet is unlikely to meet the micronutrient requirements[7]. A lack of dietary diversity is a particularly severe problem among economically disadvantaged populations in the developing world[8].

Ukehe is a rural community in Nsukka with school-aged children (SAC) who may be at risk of malnutrition as a result of the inadequate intake of diverse foods, intra-familial food distribution, culture, food insecurity and poverty, which is likely to result in poor intellectual development. The implication is that there will be decreased academic performance, growth retardation and an elevated prevalence of underweight. This is because insufficient daily consumption of different foods has been found to affect an individual's health and nutritional status, which may hinder a child's ability to learn[9]. Conducted in a rural area with marked economic deprivation, this study was designed to assess the associations of dietary diversity with academic performance and anthropometric indices in primary school children (6-12 years) in Ukehe, Nigeria.

MATERIALS AND METHODS

Study area and design: This study was carried out in Ukehe, a rural community in Igbo-Etiti local government area of Enugu State where the inhabitants are mainly farmers, traders and civil servants. Ukehe is located at 60'4 North and 42'7 East. A cross-sectional survey design was adopted for this study.

Study population and sample size determination: The study population for this research was composed of all (1044) primary school children aged 6-12 years old in Ukehe in the Igbo-Etiti local government area, Nsukka. Fifty percent (522) of the study population was used as the sample size for this study.

Sampling technique: A multistage sampling technique was used to select the respondents for this study.

- **Stage 1:** A list of all the primary schools in Ukehe was obtained from the Enugu State Universal Basic Education Board.
- **Stage 2:** The school registers in each school were used to identify school children who were within the age range of 6-12 years (n = 1044). This constituted the study population
- **Stage 3:** A proportionate sampling technique was used to determine fifty percent of the school children (6-12 years) in each school
- **Stage 4:** Random sampling by balloting without replacement was used to select the school children who participated in the study. Those who picked 'yes' were recruited for the study. This gave every school child an equal chance of being represented.

Data collection methods: Data were collected using the following methods:

Preliminary visit: The Igbo-Etiti Local Government Education Board was visited with an introductory letter from the Head Department of Home Science, Nutrition and Dietetics to obtain the population of government primary school children in Ukehe, Igbo-Etiti local government area, Nsukka. A preliminary visit was also made to obtain permission to carry out the study from the various school authorities

Ethics clearance and informed consent : An ethics clearance certificate with the reference number MH/MSD/REC18/013 was obtained from the Health Research Ethics Committee of the Ministry of Health, Enugu state. Consent from the respondents to be part of the study was obtained through their care-givers (parents and guardians). A meeting was held with the caregivers of the respondents to explain in detail what the study entailed. At the end of the meeting, consent forms were issued to the caregivers to sign indicating their

approval to enable their children participate in the study. Respondents whose caregivers gave consent were recruited for the study, whereas those who declined were replaced

Questionnaire: A structured and validated questionnaire was used to obtain information on the personal data of the respondents, socioeconomic status of the parents, dietary diversity, anthropometric measurements and academic performance of the children. The questionnaire was interviewer-administered to the children and their caregivers.

Anthropometric measurements: Anthropometric measurements of weight and height were obtained from the respondents.

Weight measurement: The weight of the subjects was measured using a Hanson bathroom scale (120 kg capacity). The scale was adjusted to zero before each measurement. The children were weighed with minimum clothing and without shoes. The reading was taken to the nearest 0.1 kg.

Height measurements: The height of the children was measured with a height meter calibrated in centimeters (cm). A good standing posture was maintained before measurement. The height of the child was measured without shoes on, with heels pulled together, head held erect and hands hanging at the sides in a natural manner. The measurement was taken to the nearest 0.1 cm.

Body mass index (BMI): The body mass index (BMI) was calculated from the weight and height measurements as follows:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

Using the WHO[10] reference standard, the respondent's date of birth was used to classify them into their respective height-for-age (HAZ), BMI for-age (BAZ) and weight-for-height (WHZ) z-scores. Children with HAZ, BAZ and WHZ scores ≤ -2.00 were considered to have moderate stunting, underweight and wasting, respectively, while those with scores ≤ -3.00 were severely stunted, underweight and wasted, respectively.

Dietary diversity: Dietary diversity was assessed based on 24 h recall of the children's consumption of 12 food groups within the past 24 h using the FAO[5] guideline. Foods were categorized into 12 groups based on the FAO recommendations as follows: (i) Cereals, (ii) Vegetables, (iii) Fruits, (iv) Meat, (v) Eggs, (vi) Fish and other seafood, (vii) Legumes, nuts and seeds, (viii) Milk and milk products, (ix) Oil and fats, (x) Sweets, (xi) Spices, condiments and beverages; and (xii) Tubers and roots. Commonly consumed foods in the area were incorporated into each food group. The response categories were "Yes" if at least two food items in a group were consumed and this was scored as one point. However, half of a point was awarded for fewer than two food items. In cases in which a food item was not consumed in a group, zero (0) point was given, representing "No". Dietary diversity was obtained by summing the number of food and food items consumed in each group separately. The total score was calculated and ranged from 0-12. The dietary diversity score was used to classify the children into low ($\leq$3), medium (4-5) and high >6 categories[5].

Academic performance assessment: The academic performance of the children was assessed by recording the grades scored in four subjects (English, Mathematics, Igbo and General Paper) offered during the first and second term examinations for the academic session 2017/2018. The average of the grades in the four subjects in each term was obtained. Then, the overall average score of the two terms was determined for each child as a measure of their academic performance. Academic performance was categorized as high ($\geq$75%), average (50-74%) and low (< 50%)[11].

Statistical analysis: Data collected were coded into the computer software and analyzed using SPSS (version 21.0). The results were presented as means, standard deviations, frequencies and percentages. Chi-square tests were used to analyze the relationships among variables. The associations between dependent and independent variables were established using multiple logistic regression. Significance was accepted at $p<0.05$.

RESULTS

Table 1 shows the mean dietary diversity score of the different food groups. Among the food groups, eggs (2.000 ± 0.000), milk and milk products (2.003 ± 0.179), sweets (1.943 ± 0.249), fruits (1.906 ± 0.541) and legumes, nuts and seeds (1.942 ± 0.791) were the least commonly consumed food groups by the respondents, as indicated by their high mean values, while cereals (1.467 ± 0.712), vegetables

(1.301±0.619), oil and fats (1.048±0.283), roots and tubers (1.393±0.645) and fish and seafood (1.412±0.685) were most commonly consumed categories by the respondents.

Table 2 presents the cross-tabulation of the dietary diversity score with the anthropometric indices and academic performance. Most of the respondents who were normal in terms of their height-for-age (94.1%), BMI-for-age (93.5%) and weight-for-height (96.6%) were in the medium category for the dietary diversity score. Only 1.1% of the stunted respondents were in the low category for the dietary diversity score. Some of the respondents with medium dietary diversity score had an average score on their academic performance (31.8%). There were positive associations between the dietary diversity score and height-for-age, BMI-for-age, weight-for-height and academic performance.

Table 3 presents the socioeconomic and anthropometric variables associated with the dietary diversity score. Children who had a high dietary diversity score were 1.244 times more likely to have good academic performance, 1.761 times more likely to have mothers who were moderate income earners, 0.950 times more likely to be 6-9 years old, 1.488 times more likely to have a normal weight-for-height, 0.806 times more likely to have a normal height-for-age and 1.464 times more likely to have a normal BMI-for-age.

DISCUSSION

Majority of the respondents fell within the medium dietary diversity group, which was contrary to the findings of Ukegbu and Ogu[4] who reported that the majority (73.5%) of the children in some rural areas of Imo State, Nigeria, were in the low level of dietary diversity. Mahbubur *et al.*[6] reported high level of dietary diversity in the majority (52%) of school-aged children in Bangladesh whereas Katungwe *et al.*[12] reported that 48.7% of rural school children in Ntchisi district

Table 1: Mean dietary diversity indifferent food groups

Food groups	Mean±SD
Milk and milk products	2.003±0.179
Egg	2.000±0.000
Sweets	1.943±0.249
Legumes, nuts and seeds	1.942±0.791
Fruits	1.906±0.541
Meat	1.770±0.526
Spices, condiments and beverages	1.558±0.586
Cereals	1.467±0.712
Fish and fish products	1.412±0.685
Tubers and roots	1.393±0.645
Vegetables	1.301±0.619
Oil and fat	1.048±0.283
Total	19.743±5.816

SD: Standard deviation

Table 2: Cross-tabulation of the dietary diversity score (DDS) with anthropometric indices and academic performance

	Dietary Diversity Score								
Anthropometric indices	High freq.	Percentage	Medium freq.	Percentage	Low freq.	Percentage	Total freq.	Percentage	p-value
Height-for-age									
Stunted (≤-2SD)	3	0.6	14	2.7	6	1.1	23	4.4	
Normal (-1 to +1SD)	69	13.2	276	52.9	146	28.0	491	94.1	
Tall (≥+2SD)	0	0.0	2	0.4	6	1.1	8	1.5	
Total	72	13.8	292	55.9	158	30.3	522	100.0	
$\chi^2 = 8.080$ df = 4									0.089
BMI-for-age									
Underweight (≤ -2SD)	0	0.0	17	3.3	9	1.7	26	5.0	
Normal (-1SD to <+1SD)	72	13.8	271	51.9	145	27.8	488	93.5	
Overweight (≥+2SD)	0	0.0	4	0.8	4	0.8	8	1.5	
Total	72	13.8	292	55.9	158	30.3	522	100.0	
$\chi^2 = 6.737$ df = 4									0.150
Weight-for- height									
Wasted (≤-2SD)	0	0.0	11	2.1	7	1.3	18	3.4	
Normal (-1SD to +1SD)	72	13.8	292	55.9	158	30.3	504	96.6	
Total	72	13.8	292	55.9	158	30.3	522	100.0	
$\chi^2 = 3.118$ df = 2									0.210
Academic performance									
High (≥75%,)	55	10.5	72	13.8	15	2.9	142	27.2	
Average (50-74%)	78	14.9	166	31.8	42	8.0	286	54.8	
Low (<50%)	25	4.8	54	10.3	15	2.9	94	18.0	
Total	158	30.3	292	55.9	72	13.8	522	100.0	
$\chi^2 = 7.146$ df = 4									0.128

High DDS: ≥6 food groups, Medium DDS: 4 and 5 food groups, Low DDS: ≤3 food groups, Freq.: Frequency

Table 3: Association of dietary diversity score (DDS) with socioeconomic and anthropometric variables

	Dietary diversity score (DDS)					
	Low≤3		High≥4			
Variables	F	Percentage	F	Percentage	AOR (95% CI)	p-value
Age						
6-9 years	87	29.8	205	70.2	0.950(0.653-1.384)	0.791
10-12 years	71	30.9	159	69.1		
Sex						
Female	68	26.7	187	73.3	0.715(0.491-1.042)	0.080
Male	90	18.7	177	66.3		
Academic performance						
Good (≥50%)	133	31.1	295	68.9	1.244(0.754-2.054)	0.392
Poor (<50%)	25	26.6	69	73.4		
Father's income						
Low income earners	148	30.3	340	69.7	1.045(0.487-2.240)	0.910
Moderate income earner	10	29.4	24	70.6		
Mother's income						
Low income earners	155	30.6	352	69.4	1.761(0.490-6.330)	0.380
Moderate income earner	3	20.0	12	80.0		
Weight-for-height						
Wasted	7	38.9	11	61.1	1.488(0.566-3.911)	0.418
Normal	151	30.0	353	70.0		
Height-for-age						
Stunted	6	26.1	17	73.9	0.806(0.312-2.083)	0.655
Normal	152	30.5	347	69.5		
BMI-for-age						
Underweight	13	38.2	21	61.8	1.464(0.714-.3.004)	0.296
Normal	145	39.7	343	70.3		

F: Frequency

of Malawi had minimum diversity. The minimum (≥4) requirement for dietary diversity, which was met by the majority, was higher than that reported in Northwest Ethiopia[13]. The medium level of dietary diversity score observed in the majority of the respondents could be responsible for the low prevalence of underweight, wasting and stunting among the school children.

Although most of the caregivers had low monthly incomes, their children had medium and high levels of dietary diversity score. The reason for this may be that in addition to engaging in business and civil service, some of the caregivers have inherited farmlands where they cultivate food crops that provide an additional source of food for the family. This finding is inconsistent with the report of Kumera *et al.*[13] who observed that those with low monthly income were less likely to have children with medium and high levels of dietary diversity.

It was observed that the majority of the respondents had an average academic performance, which was higher than the average academic performance (40%) reported in Sadder town, Karachi[14]. A child that is well fed or who has good nutrition will increase in weight, focus better and thereby perform better academically. Dietary diversity was positively associated with academic performance, showing that high dietary diversity translates to high academic performance.

Dietary diversity has been shown to correlate with nutrient intake and various anthropometric measurements in children[15]. There were positive associations between dietary diversity and anthropometric indices in the respondents, similar to the report of Wemakor and Laari[16] in Ghana and to the findings of Steyn *et al.*[17] in South Africa, who found significant correlations between the dietary diversity score and the height-for-age and weight-for-age Z-scores, indicating strong relationships between dietary diversity and indicators of child growth. Several studies have reported that low dietary diversity is associated with an increased likelihood of child stunting[18]and a double burden of malnutrition[19].

Stunting which measures the cumulative deficient growth associated with long-term factors including insufficient dietary intake, frequent infections, poor feeding practices over a sustained period and a low socioeconomic status of households[10] was not of public health significance (<10% prevalence) in Ukehe, Enugu state according to the WHO criteria[20]. The prevalences of stunting and underweight in this

study were lower than the findings of Ene-Obong and Ekweagwu[21] among school-aged children in Ebonyi state Nigeria, who reported stunting and underweight prevalences of 42.5 and 23.3%, respectively. Low weight-for-age (underweight) encompass chronic and/or acute malnutrition[20]. Nwamarah *et al.*[22] reported 19.5 and 8.5% prevalences of stunting and underweight among school-aged children in Okpuje, Nsukka L.G.A, Enugu state. These low prevalences could be a result of low dietary diversity that existed in few of the children, indicating that they had access to different types of food because Ukehe is a rural area with good agricultural practices and has varieties of nutritious foods and dishes. Steyn *et al.*[17]showed significant correlations between the dietary diversity score and the height-for-age and weight-for-age Z-scores contrary to the findings of this study.

The term wasting is widely used to describe a recent and severe process that has led to significant weight loss usually as a consequence of acute starvation and/or severe disease[20]. There was a low prevalence of wasting in this study compared to earlier report[21] on school children in Ebonyi state (6.1%) and among primary school children in the Obukpa rural community, Nsukka (6.3%)[23]. Akor *et al.*[24] reported a 2.4% prevalence in Jos, Plateau state, Nigeria among school-aged children.

Overweight had a low prevalence in the present study compared to those reported by Obianuju *et al.*[25] (8.5%) among school children in Enugu, Nigeria. This variation could be a result of the nutrition transition that exists more in urban than in rural areas where this study was performed. Overweight and obese children are likely to stay obese into adulthood and are more likely to develop non-communicable diseases like diabetes and cardiovascular diseases at a younger age[26]. Therefore, an increase in BMI should be prevented early in life. Seasonality (rainy season) and the area of study (rural area) could have contributed to the high consumption of vegetables (which were in season) by the majority of the respondents. The 24 h dietary diversity assessment revealed that cereals, vegetables, oil and fats, roots and tubers and fish were the foods most commonly consumed by the respondents. Similar results have been reported by Ukegbu and Ogu[4]who studied dietary diversity score among children in some rural areas of Imo State, Nigeria and reported that cereals (0.78±0.29), vegetables (0.78±0.30), oils and fats (0.67±0.28), fish and other seafood (90.61±0.28) and roots and tubers (0.48±0.36) were commonly consumed by the children. More consumption of roots and tubers, which constitute the major staple food in Ukehe, was consistent with the findings of Nwamarah *et al.*,[22,] who reported that cassava-based foods were mostly consumed by the respondents in the Okpuje community. This was probably because the majority of the parents engaged in farming and/or business or civil service. Farmers cultivate and have access to crops with which they feed their families. In addition, rural business owners have direct contact with the market where they access foods in season, which they know how to buy at a less expensive rate.

CONCLUSION

Among the primary school children (6-12 years), stunting, wasting and underweight existed. Underweight was the most prevalent. Most of the respondents were in the category of medium dietary diversity score. Children with normal anthropometric indices had high levels of dietary diversity. The dietary diversity score was positively associated with anthropometric indices and academic performance.

SIGNIFICANCE STATEMENT

Given the importance of the dietary diversity score in determining diet quality, this study shows that dietary diversity is associated with academic performance and anthropometric indices. This study helps researchers understand the diet quality of rural school children and how it affects their growth, development and intellectual capability. Thus, the results will highlight dietary diversity as an indicator of nutritional adequacy, which may be linked to high academic performance in rural areas.

REFERENCES

1. Arimond, M. and M.T. Ruel, 2004. Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. J. Nutr., 134: 2579-2585.
2. Kennedy, G.L., 2009. Evaluation of dietary diversity scores for assessment of micronutrient intake and food security in developing countries. Ph.D. Thesis, Wageningen University, Netherlands.
3. Willett, W., 1998. Nutritional Epidemiology. 2nd Edn., Oxford University Press, New York, USA.
4. Ogechi, U.P. and O.V. Chilezie, 2017. Assessment of dietary diversity score, nutritional status and socio-demographic characteristics of under-5 children in some rural areas of Imo State, Nigeria. Mal. J. Nutr., 23: 425-435.
5. FAO., 2010. Guidelines for measuring household and individual dietary diversity. Food and Agriculture Organization of the United Nations, Rome, Italy. http://www.fao.org/3/a-i1983e.pdf.

6. Rahman, M.M., J. Chakma, N. Sultana, I.J. Sima, F.S. Bari and M.A. Mannan, 2018. A study on nutritional status and dietary habit of school children associated with socio economic status in Dhaka North city corporation, Bangladesh. IOSR. J. Pharm. Biol. Sci., 13: 50-57.
7. Savy, M., Y. Martin-Pre´vel, P. Traissac, S. Eymard-Duvernay and F. Delpeuch, 2006. Dietary diversity scores and nutritional status of women change during the seasonal food shortage in rural Burkina Faso. J. Nutr., 136: 2625-2632.
8. Hooshmand, S. and S.A. Udipi, 2013. Dietary diversity and nutritional status of urban primary school children from Iran and India. J. Nutr. Disord. Ther., 10.4172/2161-0509.S12-001
9. Bansal, N., 2017. Relationship between nutritional status and academic performance in school children. Int. J. Applied Home Sci., 4: 736-740.
10. WHO., 2007. WHO reference 2007. Growth reference 5-19 Years. World Health Organization, Geneva, Switzerland. https://www.who.int/growthref/en/.
11. Nduagubam, O.C., T.A. Oguonu, N. Ojinnaka and R.C. Ibekwe, 2017. Academic performance of primary school children with Asthma. J. Exp. Res., 5: 72-79.
12. Katungwe, P., A. Mwangwela and N. Geresomo, 2015. Dietary adequacy of rural school children among Bambara groundnut growing farmers in Ntchisi district of Malawi. Afr. J. Food Agric. Nutr. Dev., 15: 9620-9634.
13. Kumera, G., E. Tsedal and M. Ayana, 2018. Dietary diversity and associated factors among children of Orthodox Christian mothers/caregivers during the fasting season in Dejen District, North West Ethiopia. Nutr. Metab., Vol. 15, No. 1. 10.1186/s12986-018-0248-0
14. Habibullah, S. and J. Ashraf, 2013. Factors affecting academic performance of primary school children. Pak. J. Med. Res., 52: 47-52.
15. Ruel, M.T., 2003. Operationalizing dietary diversity: A review of measurement issues and research priorities. J. Nutr., 133: 3911S-3926S.
16. Wemakor, A. and J. Laari, 2018. Association between household dietary diversity and nutritional status of children (6–36 months) in Wenchi Municipality, Brong Ahafo Region, Ghana. Nutrire, Vol. 43, No. 22.
17. Steyn, N.P., J.H. Nel, G. Nantel, G. Kennedy and D. Labadarios, 2006. Food variety and dietary diversity scores in children: Are they good indicators of dietary adequacy? Public Health Nutr., 9: 644-650.
18. Labadarios, D., Z.J.R. Mchiza, N.P. Steyn, G. Gericke, E.M.W. Maunder, Y.D. Davids and W.A. Parker, 2011. Food security in South Africa: A review of national surveys. Bull. WHO., 89: 891-899.
19. Bouzitou, G.D.N., B. Fayomi and H. Delisle, 2005. Child malnutrition and maternal overweight in same households in poor urban areas of Benin. Sante, 15: 263-270.
20. WHO., 1995. Physical status: The use and interpretation of anthropometry. Report of a WHO Expert Committee, Technical Report Series No. 854, World Health Organization, Geneva, Switzerland.
21. Ene-Obong, H.N. and E. Ekweagwu, 2012. Dietary habits and nutritional status of rural school age children in Ebonyi state, Nigeria. Niger. J. Nutr. Sci., 33: 23-30.
22. Nwamarah, J.U., O. Otitoju, G.T.O. Otitoju and C.U.D. Emewulu, 2015. Iodine and nutritional status of primary school children in a Nigerian community Okpuje, in Nsukka LGA, Enugu state, Nigeria. Der Pharmacia Lett., 7: 271-280.
23. Nwamarah, J.U. and E.C. Okeke, 2012. A pilot study of iodine and anthropometric status of primary school children in Obukpa, a rural Nigerian community. J. Public Health Epidemiol., 4: 246-252.
24. Akor, F., S. Okolo and A. Okolo, 2010. Nutritional status of newly enrolled primary school children in jos-plateau, Nigeria. Pak. J. Nutr., 9: 1166-1170.
25. Igbokwe, O., G. Adimorah, A. Ikefuna, N. Ibeziako, A. Ubesie, C. Ekeh and K. Iloh, 2017. Socio-demographic determinants of malnutrition among primary school aged children in Enugu, Nigeria. Pan Afr. Med. J., Vol. 28. 10.11604/pamj.2017.28.248.13171
26. WHO., 2019. Global strategy on diet, physical activity and health: Childhood overweight and obesity. World Health Organization, Geneva, Switzerland.