Assessment of Dietary Intake of School Age Children (7-12 years) in Selected Urban and Rural Schools in Ogun State, Nigeria

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Abstract

This study was to assess the dietary intake of the school age children (7-12 years) in selected urban and rural schools in Ogun state, Nigeria. Specifically, it determined socio-economic characteristics of school children's parents in rural and urban local government areas (LGAs) in Ogun state, nutrient intakes of rural and urban school age children (7-12 years) in selected urban and rural schools, and relationship between socio-demographic status of the parents and the nutrient intake of the school age children. This study adopted survey research design. Two LGAs (urban and rural) were randomly selected in each of the three senatorial districts. Population was made up primary school children aged 7-12 years in the area of the study. Questionnaire was used for data collection. Data were analyzed using frequency counts, means, standard deviations, and correlations. Results show that 36.5 percent of the respondents' families earned less than two hundred thousand Naira annually. Also, 43.0 percent and 62.0 percent of the mothers had secondary and tertiary education, respectively. Dietary intake showed that energy intake was above 60 percent of required dietary allowance (RDA) for both sexes, while protein and fat intake for females in urban LGAs was above 80 percent of RDA. Some micronutrients were below 50 percent RDA (Vit A- 42.5% RDA, calcium – 45 percent RDA and iron – 48.9 percent RDA). The correlation shows a significant relationship between micronutrients and economic status because mothers' education was related to vitamin A (p= 0.321) and vitamin B2 (p= 0.211) intake income was significantly related to irintake (p= 0.134). It was concluded that a significant relationship between socio-economic and dietary status. This means that poor economic status will eventually affect dietary intake, which in turn may result in poor nutritional status.

Keywords: Intake, Assessment, Children, Nutrition, Dietary, Income, Socio-economic, Status.

Introduction

Adequate nutrition is essential for growth, development, and health of children (Diethelm et al, 2014). Children's survival, protection, and development are the prerequisites for the future development of any society that will be great (Ranjita et al., 2022). Adequate nutrition is an integral part of healthy growth and development during childhood and to prevent diseases later in life (CDC, 2021). The school age is

believed to be the active growing phase of childhood and a dynamic period of growth when children undergo physical, mental, emotional, and social changes. During this age, children in their wisdom establish habits of their choice in eating, selecting hobbies, participating in sports, and performing exercise that stick with them for their entire lives. The availability of good-quality food, the affordability of families, the choice of children, etc. are the critical factors contributing to undernourishment and malnutrition (Ranjita et al., 2022).

Proper nutrition during childhood is a vital component for healthy growth and development and to prevent the risk of diseases later in life (Centre for Disease Control, 2021). School-aged children are particularly prone to inadequate dietary behaviors that affect their nutritional status and increase their risk of excessive weight gain and associated co-morbidities (Nasreddine et al., 2022). Meanwhile, micronutrient deficiencies could have serious adverse effects on children's physical growth (Lassi*et al.*, 2017); psychosocial development (Galler et al., 2017); academic performance (Galler et al., 2017; Das et al., 2018); as well as their economic productivity (Galler et al., 2017; McGovern et al., 2017) during adulthood. Poor nutrition is also of particular concern for girls, as their risk of malnutrition during childhood can span a life cycle and across generations, contributing to the 'intergenerational effects of malnutrition' (Das et al., 2018; Galler et al., 2014). Thus, for girls, adequate nutrition is imperative at all stages of their growth and development to ensure their health and that of their future offspring (Nasreddine et al., 2022).

Good nutrition is an essential component of a healthy life that determines health, physical growth, and mental growth. Assessment of food quality and quantity through dietary surveys is therefore essential for schoolchildren (Ranjita et al., 2022). Children need more nutrients than adults in relation to their body weight (Stang et al., 2005), requiring, therefore, a diet providing a higher nutrient density.

The regular monitoring of nutrition and dietary behavior is, therefore, relevant for children. Children are more vulnerable to malnutrition at that stage of life, so there is a need for a group of interested parties to follow up on whether their meals meet the recommended guidelines or not. Improving the nutritional intake of children is therefore a goal for global public health (UNICEF, 2019). Therefore, regular monitoring of nutrition and dietary behavior for these age groups is very necessary (Barbosa *et al.*, 2017) to help address the problems of malnutrition that may arise as a result of inadequate intake of the necessary diets at the right time and amount. Children who do not have access to proper nutrition are much more likely to suffer from psychological disorders, such as anxiety or learning disabilities. These children are also significantly more likely to require mental health counseling. Poor nutrition negatively impacts a child's ability to develop properly and adapt normally to certain situations. The age groups considered in this study (7–12 years old) are potentially vulnerable and susceptible to growth and general developmental challenges. Often, the adverse effects of poor nutrition at this age are not reversible (Mesfin*et al.*, 2015). The outcome of this study will provide the necessary data for

the planning and implementation of positive strategies for the resolution of nutrition and health problems among schoolchildren, particularly those in rural areas, where most Nigerians live (Maziya-Dixon *et al.*, 2004).

Objectives of the Study
The general objective was to assess the dietary intake of the school age children (7-12years) in selected urban and rural schools in Ogun State, Nigeria
Specifically, the study determined:
1. socio-economic characteristics of school children's parents in rural and urban local governments area (LGA) in Ogun State
2. nutrient intakes of rural and urban school age children (7-12years) in selected urban and rural schools.
3. relationship between socio-demographic status of the parents and the nutrient intake of the school age children.

Methodology
Design of the Study: This study adopted survey research design.
Area of the Study: The area of the study was Ogun state is in southwestern Nigeria. It is made up of three senatorial districts. There are 20 local government areas (LGAs) in the state. There are primary schools in the urban and rural areas of the state.
Population for the Study: The total number of primary schools was reported to be 6,336 in Ogun state (Sasu, 2022). The study population consisted of all the school children (7-12 years old) in both urban and rural local government areas of Ogun State.
Sample for the Study: The sample size was 1200 children. To obtain this sample, six LGAs were purposively selected to include three rural and three urban

LGAs. From each of the six LGAs, 200 children were also purposively selected to exclude children who were on any medication or had any infection that could affect the data collected.
Data Collection Instrument: Questionnaire was used to collect data. The questionnaire was used to collect information on the respondents (family) bio-data and socio-economic characteristics. Then, twenty-four (24) hour dietary recall was used to obtain food intake data from the children and their caregivers/parents according to methods of Onimawo et al (2007).
Data Collection Method: During the 24-hour dietary intake interviews, various food models, local kitchen utensils, such as plates, cups, spoons, and slices commonly used in Nigeria were used to quantify foods consumed. The children with the help of the caregivers were asked to recall all the foods the patients consumed in the last 24hours and the consumption was quantified using food models. The food models were later used to determine the equivalent weights of various food portions in grams and later converted to nutrient equivalents which is used to determination the nutrient consumption of the subjects.
Data Analysis Techniques: The frequency and percentages were used for data analysis. Mean energy and nutrients intake of the children, percentage recommended dietary allowance (RDA) met, were determined. Significance was set for all analyses at $P < 0.05$.

Results

Table 1: Socio-demographic Characteristics of the Children

Characteristics	Urban F (%)	Rural F (%)
Age (Yrs)		
7-8	160 (28.0)	125 (22.3)
9-10	196 (34.3)	139 (24.8)
11-12	215 (37.7)	297 (52.9)
Total	571 (50.4)	561 (49.6)
Average Annual Income of Family		
<100, 000	20(3.5)	82 (14.6)
100,000-199,000	134(23.5)	205 (36.5)
200,000-299,000	103(18.0)	193 (34.4)
300,000-399,000	209(36.6)	40 (7.1)
400,000-499,000	73(12.8)	31 (5.5)
500,000 above	32(5.6)	10 (1.8)
Total	571(50.4)	561 (49.6)
Educational Level of the Mothers		
No formal	18(3.2)	47(8.4)
Primary	32(5.6)	125(22.3)
Secondary	167(29.2)	241(43.0)
Tertiary	354(62.0)	148(26.4)
Total	**571 (50.4)**	**561 (49.6)**

Table 1 shows the socio-demographic characteristics of the children and family sampled. The age of the children ranged between 7-8years, 9-10years and 11-12years. Majority of the children were within the ages of 11-12years, with urban and rural variations. The average annual income of the family ranges from less than a ₦100,000.00 - ₦500,000.00 and above with 3.5 percent and 14.6 percent earned less than ₦100,000.00, 23.5 percent and 36.5 percent less than ₦200,000.00 5.5 percent earned less than ₦500,000.00, 5.6 percent Considering the educational level of the mothers, 3.2 percent and 8.4 percent had no education in both urban and rural LGAs respectively. There are variations based on urban and rural locations.

Energy and Nutrients Intake of the children

Table 2: Energy and Nutrients Intake of the children in Urban LGAs

Age group	Nutrient	Male Mean Intake	%RDA MET	Female Mean Intake	RDA MET	p-value
7-9Yrs	Energy(kcal)	1088.9±546.4	60.5	1105.1±483.6	69.1	0.321
	Protein(g)	20.08±14.3	74.4	23.1±18.5	85.6	0.032*
	Fat(g)	27.4±14.7	97.9	30.7±10.3	118.1⧣	0.365
	Cal(mg)	853.2±505.1	81.3	903.2±611.3	86.0	0.816
	Iron(μg)	7.2±5.3	80.0	7.1±2.7	78.9	0.261
	Vit A(mg)	378.7±102.2	75.7	356.6±101.3	71.3	0.318
	VitB2 (mg)	0.7±0.5	87.5	0.6±0.4	75.0	0.104
	VitB6(mg)	0.6±0.4	75.0	0.4±0.3	50.0	0.512
10-12Yrs	Energy(kcal)	1440.8±703.3	62.6	1008.6±306.8	63.0	0.072
	Protein(g)	27.3±14.3	80.3	29.8±13.7	87.6	0.812
	Fat(g)	26.2±13.7	93.6	37.6±18.1	144.6⧣	0.231
	Cal(mg)	756.6±451.5	58.2	792.9±332.6	61.0	0.025*
	Iron(μg)	6.5±4.1	81.3	6.2±3.7	77.5	0.125
	Vit A(mg)	342.9±187.3	57.2	456.4±299.1	76.1	0.012*
	VitB2 (mg)	0.8±0.6	88.9	0.7±0.6	77.8	0.253
	VitB6(mg)	0.8±0.5	80.0	0.7±0.4	70.0	0.113

[a]‡ Inadequate intake   [b]⧣ Excessive intakeRDA- recommended dietary allowance
* Significant at p<0.05   RDA MET- percentage of RDA achieved

Table 2 shows the energy and nutrients intake of the respondents in Urban LGAs. Different age groups are considered based on the recommended dietary allowance (RDA). For age group 7-9years, the mean value of energy consumption for males is 1088.9±546.4Kcal and the percentage RDA met is 60.5% while that of female counterpart is 1105.1±483.6 and 69.1% of them met the requirement for energy. The mean protein intake for male is 20.08±14.3Kcal and that of female is 23.1±18.5Kcal and the percentage of those that met the requirement for protein is 74.4% males and 85.6% females. Except for fat intake of the female, other nutrients are below the RDA. As for calcium, the average intake for males is 853.2±505.1mg and 903.2±611.3mg for females while the percentage RDA met considering the average values are 81.3% for males and 86.0% for females. Another is iron with mean values of 7.2±5.3µg and 7.1±2.7µg and percentage RDA met were 80.0% and 78.9% for males and females respectively. The result for the vitamins shows that 75.7%, 87.5% and 75.0% males and 71.3%, 75.0% and 50.0% females met the RDA for vitamin A, B2 and B6 respectively.

For age group 10-12years, the mean value for energy for males is 1440.8±703.3Kcal while that of female counterpart is 1008.6±306.8$Kcal$, when comparing the value with standard RDA for that age group; it shows that 62.6% male and 63.0% females met the requirement for energy.

The average protein intake for male is 27.3±14.3g and that of female is 29.8±13.7g and the percentage of those that met the requirement for protein is 80.3% males and 87.6% females. As for calcium, the average intake for males is 756.6±451.5g and 792.9±332.6g for females while the percentage RDA met considering the average values are 58.2% for males and 61.0% for females. Also, iron is with mean values of 6.5±4.1µg and 6.2±3.7µg and percentage RDA met as 81.3% and 77.5% for males and females respectively. The result for the vitamins shows that 57.2%, 88.9% and 80.0% males and 76.1%, 77.8% and 70.0% females met the RDA for vitamin A, B2 and B6 respectively in urban LGAs. The result showed a significant difference in the consumption of protein (p=0.032), calcium (p=0.025) and vitamin A (p=0.012) among male and female in urban LGAs.

Table 3: Energy and Nutrients Intake of the children in Rural LGAs

Age group	Nutrient	Male Mean intake	%RDA MET	Female Mean intake	RDA MET	p-value
7-9Yrs	Energy(kcal)	1852.9±638.4	102.9ꝕ	1614.1±527.4	100.9ꝕ	0.543
	Protein(g)	15.1±12.3	50.6	18.2±14.3	67.4	0.021*
	Fat(g)	25.4±12.4	90.7	24.7±8.6	95.0	0.238
	Cal(mg)	449.2±405.1	42.8ꝕ	472.2±409.3	45.0ꝕ	0.802
	Iron(µg)	5.3±3.7	58.9	4.4±2.7	48.9ꝕ	0.025*
	Vit A(mg)	141.3±97.0	28.3ꝕ	212.6±72.2	42.5ꝕ	0.031*
	VitB2 (mg)	0.6±0.4	75.0	0.5±0.3	62.5	0.166
	VitB6(mg)	0.4±0.5	50.0	0.6±0.3	75.0	0.072
10-12Yrs	Energy(kcal)	2561.6±905.4	111.4ꝕ	1750.6±511.8	109.4ꝕ	0.163
	Protein(g)	21.7±14.3	50.7	22.8±13.7	51.9	0.413
	continue	*in the next*	*page*			

Fat(g)	26.2±13.7	93.6	23.8±15.1	91.5	0.212
Cal(mg)	568.6±251.5	43.8‡	610.9±310.6	47.0‡	0.125
Iron(µg)	4.7±3.1	58.8	3.7±2.4	41.3‡	0.024*
Vit A(mg)	119.9±87.3	20.0‡	242.4±99.1	57.1	0.032*
VitB2 (mg)	0.7±0.6	77.8	0.6±0.5	66.7	0.373
VitB6(mg)	0.7±0.5	70.0	0.4±0.3	40.0	0.443

*[a]‡ Inadequate intake   [b]‖ Excessive intake   RDA- recommended dietary allowance   * significant at p<0.05   RDA MET- percentage of RDA achieved*

Table 3 shows the energy and nutrients intake of the respondents in rural LGAs. Different age groups are considered based on the recommended dietary allowance (RDA). For age group 7-9years, the mean value of energy consumption for males is 1088.9±546.4Kcal and the percentage RDA met is 60.5% while that of female counterpart is 1105.1±483.6 and 69.1% of them met the requirement for energy. The average protein intake for male is 15.1±12.3 and that of female is 18.2±14.3 and the percentage of those that met the requirement for protein is 50.6% males and 67.4% females. As for calcium, the average intake for males is 449.2±405.1 and 472.2±409.3 for females while the percentage RDA met considering the average values are 42.8% for males and 45.0% for females. Another is iron with mean values of 5.3±3.7 and 4.4±2.7 and percentage RDA met as 58.9% and 48.9% for males and females respectively. The result for the vitamins shows that 28.3%, 75.0% and 50.0% males and 42.5%, 62.5% and 75.0% females met the RDA for vitamin A, B2 and B6 respectively.

For age group 10-12years, the mean value for energy for males is 2561.6±905.4Kcal while that of female counterpart is 1750.6±511.8, when comparing the value with standard RDA for that age group; it shows that 111.4% male and 109.4% females meet the requirement for energy.

The average protein intake for male is 21.7±14.3 and that of female is 22.8±13.7 and the percentage of those that met the requirement for protein is 50.7% males and 51.9% females. As for calcium, the average intake for males is 568.6±251.5 and 610.9±310.6 for females while the percentage RDA met considering the average values are 43.8% for males and 47.0% for females. Also, iron is with mean values of 4.7±3.1 and 3.7±2.4 and percentage RDA met as 58.8% and 41.3% for males and females respectively. The result for the vitamins shows that 20.0%, 77.8% and 70.0% males and 57.1%, 66.7% and 40.0% females met the RDA for vitamin A, B2 and B6 respectively. There is a significant difference in protein (p=0.021), iron (p=0.025), vit A (p=0.031) consumption among the male and female respondents in rural LGAs. It also showed that consumption of calcium, iron and vitamin A is inadequate while their energy level is beyond the requirement.

Correlations between Dietary Indices and Socio-Economic Status

Table 4: Pearson's Correlations between Dietary Intake and Socio-economic Status

Variable	ENERG (Kcal)	PROT (g)	FAT (g)	CAL. (mg)	IRON (ug)	VIT A (mg)	VIT B2 (mg)	VIT B6 (mg)
Mothers Edu.	0.142*	0.120	0.096	0.064	0.060	0.128	0.211*	0.093
Family Income	0.241	0.140*	0.030	0.090	0.134*	0.068	0.061	0.142*
Childs Age	0.123*	0.106	0.062	-0.103*	-0.145*	0.228*	0.012	0.231
Mothers Age	0.055	0.089	0.011	0.158**	0.096	0.115	0.129*	0.033
HH Size	-0.429*	0.033	0.134*	-0.207*	-0.104*	0.001	-0.003	0.055

*HH- Household   **Correlation coefficient is significant at the 0.01 level (2- tailed)*
Correlation is significant at the 0.05 level (2- tailed).

Table 4 shows the correlations between dietary indices and socio-economic status. Mothers education shows a positive correlation to Vitamin B2 (r= 0.211, p= 0.05), energy (r= 0.142, p= 0.05). Also, Family income shows a positive correlation to protein (r= 0.140, p= 0.05), iron (r= 0.134, p= 0.05) and Vitamin B6(r= 0.142, p= 0.05).

Mothers age positively correlated to calcium (r= 0.158, p= 0.01) and vitamin B2(r= 0.129, p= 0.05). The result also shows that household size negatively related to energy (r= - 0.429, p= 0.01), calcium (r= -0.207, p= 0.05) and iron (r= - 0.104, p= 0.05).

Discussion

Adequate nutrition is very necessary during childhood because it is a serious factor for growth and development. Children who have poor diets whether because of a lack of food or because of patterns of eating that lead to inadequate intake of nutrients are prone to significant short-term and long-term health impacts and diseases. Children afflicted by sustained poor nutrition are at greater risk for obesity, mental and emotional health problems, and even a failure to thrive academically.

The data from Global Nutrition Reports indicates that malnutrition affects one in three people, and one in 20 children complain of hunger while poor diet is attributed to one in every five deaths in the world (Hawkes, 2021).

However, the outcome of this study shows that the level of protein intake was within the RDA range for both urban and rural children which is contrary to the report of Sultana et al (2017) with low protein consumption, though the percentage was higher in urban LGAs when compared with the rural LGAs. As the result shows the rural subjects at the borderline because they met only 59.6% of the RDA for protein, Onimawo *et al*. (2007) recorded low protein intake for both groups (urban and rural). The level noticed in rural Nigeria may be a result of prevailing economic trends in Nigeria, which made it difficult for the low-income population to afford foods of animal origin because of their expense. This has often resulted in a serious imbalance of nutrient intake, as evidenced by the prevalence of malnutrition among rural children (Roots *et al.*, 1987).

The energy consumption of rural children was higher than that of urban children. Culturally, a large portion of Nigerian staple foods comprises carbohydrates. From the findings, about nine out of ten respondents reported they fed at least three times daily. A food intake assessment through a 24-hour recall showed that about the same ninety percent of them consumed more

carbohydrates with little in the way of micronutrient-based foods. This result is consistent with those of several studies: there is a very low consumption of micronutrient-rich foods such as vegetables, fruits, and milk by a large number of children (Kelishadi*et al.,* 2014; Garcia-Continente*et al.,* 2015). The food consumption pattern showed that rice was the major staple food consumed by the children in urban areas, while garri and lafun were consumed in rural areas. Others include yam, beans, and pap. The dietary assessment showed that in both groups, carbohydrates contributed a larger percentage of the total energy intake. This is not surprising because roots, tubers, and legumes are the most abundant and cheap staple foods available in Nigeria (Lemchi*et al.,* 2012). Azis et al (2014) also reported the highest carbohydrate consumption amongst children from Balochistan which is in-line with this study.

It may be surprising that, despite the availability of green leafy vegetables and fruit in rural areas, some of the children are not getting enough calcium. Calcium intakes were very low among school-age children in the rural LGAs, which may be as a result of low intakes of food groups with calcium-rich food sources (green leafy vegetables), cooking methods, and low consumption of dairy products as buttressed by the study of Khan et al (2022) that reported micronutrient deficiencies in their study. This finding also corroborates Henry and Chapman's (2014) report of low calcium intakes in African populations of 300–400 mg/day, which is well below the recommended daily intakes. Children with enough calcium start their adult lives with the strongest bones possible.

The nutrient intake result showed that the children in urban LGAs, irrespective of their age groups, are fairly adequate (above the RDAs) in all the nutrients in the study except for iron, calcium, and vitamin A. In contrast, the intakes of the majority of the children in rural LGAs were below the RDA for their age. This is consistent with the findings of the survey by Onimawo *et al.* (2007) that recorded low levels of iron, vitamin A, and calcium in children. Iron deficiencies are common in children and especially risky because children's bodies are still growing and developing. Vitamin A, *which is* a fat-soluble *vitamin* that is also a powerful antioxidant, plays a critical role in maintaining healthy vision and neurological function. It showed from the result that vitamin A consumption was low among rural children despite their access to various fruits and vegetables. The deficiency may be largely due to ignorance on the part of the parents because part of the information gathered from the rural areas is that fruits are only consumed in the absence of other foods like rice, beans, etc., and the method of cooking some of the vegetables is another factor.

The result of this study shows that most of the families of the urban children were better educated and earned a higher monthly income than those of the rural children, and thus may be more informed and able to provide more adequate nutrition for their children and attain a higher nutritional status. The finding in this study is consistent with the survey by Oninla, Owa, Onayade and Taiwo (2007) in their comparative study of the nutritional status of urban and rural children in Nigeria. The low level of education of mothers of rural children, coupled with low income levels, often translates to reduced access

to food and an adequate diet in particular, and thus inadequate food intake and resultant under nutrition.

Conclusion

This study shows that the dietary status of the children is not that healthy because of the micro nutrient deficiency found out most especially in the rural areas. Most of the meals are not nutritious for appropriate growth of the children at that critical stage of their development. The income of many of the families involved in this study reflected a little that may not give the family the adequate diet that can secure a healthy living, especially in the rural settlements. In general, the results of the nutrient intakes of both male and female school children in this study were low in some nutrients (calcium, vitamin A, and iron) compared to the RDA. More of these inadequate intakes occurr in rural areas. The outcome of the study revealed a significant relationship between socioeconomic status and dietary intake among the children that participated in the study. There is therefore need for educational and public health interventions to enhance healthier diet and also prevent micronutrient deficiencies in the children.

Recommendations

Based on the findings of the study, the following recommendations were made;

1. There is need for government intervention in improving the nutritional status of the children.
2. The media should play a significant role in raising awareness about nutritional status and adequate food consumption among the masses.
3. Mothers and relevant caregivers should be provided with nutrition education so that they can obtain necessary knowledge on the basic needs and nutrient requirements of children for optimal growth and development, as well as the sources of these nutrients.

References

Aziz, S. Hosain, K. (2014). Carbohydrate (CHO), Protein and fat intake of healthy Pakistani school children in a 24-hour period. J Pak Med Assoc. 64:1255–9

Barbosa, C.L. Brettschneider, A.K. Haftenberger, M. (2017). Comprehensive assessment of food and nutrient intake of children and adolescents in Germany: EskiMo II-the eating study as a KiGGs module. BMC Nutr. 3:75. DOI;10.1186/ s40795-017-0196-5. PMID: 32153853.

Centre for Disease and Control. (2021). Childhood Nutrition Facts: [Available from: https://www.cdc. gov/healthy schools/ nutrition/facts.htm.

Das, J.K. Lassi, Z.S. Hoodbhoy, Z. Salam, R.A. (2018). Nutrition for the next generation: older children and adolescents. Ann NutrMetab.72(3):56–64.

Diethelm, K. Huybrechts, I. Moreno, L. De Henauw, S. Manios, Y. Beghin, L. Gonzalez-Gross, M. Le Donne, C. Cuenca-Garcia, M. Castillo, M. J. (2014). Nutrient intake of European adolescents: results of the HELENA (healthy lifestyle in Europe by nutrition in adolescence) study. Public Health Nutr. 17:486–97.

Galler, J. Rabinowitz, D.G. (2014). The intergenerational effects of early adversity. ProgMolBiolTransl Sci. 128:177–98.

Galler, J.R. Koethe, J.R. Yolken, R.H. (2017). Neurodevelopment: the impact of nutrition and inflammation during adolescence in low-resource settings. Pediatrics;139 (Supplement 1):S72–84.

Garcia-Continente, X. Allué, N. Pérez-Giménez, A. Ariza, C. Sánchez-Martínez, F. López, M. Nebot, M. (2015). Eating habits, sedentary behaviors and overweight and obesity among adolescents in Barcelona (Spain). Anales

de Pediatría (English Edition). 303. 10.1016/j.anpede.2015.05.017.

Hawkes C. (2021). Global Nutrition Report 2018. Shining a Light to Spur Action on Nutrition. 28–51 p. Available online at: https://globalnutritionreport.org/50bff8#section-2-1.

Henry, C.J.K. Chapman, C. (2014). The nutrition handbook for food processor. Woodhead Publishing Limited, Abington Cambridge. ISBN 1855734648.

Kelishadi, R. Azizi-Soleiman, F. (2014). Controlling childhood obesity: A systematic review on strategies and challenges. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, 19(10), 993.

Khan, D.S.A. Das, J.K. Zareen, S. Lassi, Z.S. Salman, A. Raashid, M. Dero, A.A. Khanzada, A. Bhutta, Z.A. (2022). Nutritional Status and Dietary Intake of School-Age Children and A Early Adolescents: Systematic Review in a Developing Country and Lessons for the Global Perspective. Front. Nutr. 8:739447.

Lassi, Z. Moin, A. Bhutta, Z. (2017). Nutrition in Middle Childhood and Adolescence. Disease Control Priorities: Child and Adolescent Health and Development; 8, 1896.

Lemchi, S.N. Nwambekwe, E., Okeke, E.N. Onyemaobi, G.A. &Ekomaru, C.I. (2012). Assessment of Nutritional Status of Primary School Children in Owerri Urban, Imo State, Nigeria. Journal of Home Economics Research, 16, 21-31.

Martins, V.J. Toledo Florencio, T.M. Grillo, L.P. Do Carmo, P. Franco, M. Martins, P.A. Clemente, A.P.G. (2011). Long-lasting effects of undernutrition. International journal of environmental research and public health; 8(6):1817–46.

Maziya-Dixon, B. Akinyele, I. O. Oguntona, E. B. Nokoe, S. Sanusi, R. A. Harris, E. (2004). Nigerian Food Consumption and Nutrition Survey 2001–2003, Summary. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

McGovern, M.E. Krishna, A. Aguayo, V.M. Subramanian, S. (2017). A review of the evidence linking child stunting to economic outcomes. Int J Epidemiol. 46 (4):1171–91.

Mesfin, F. Worku, A. Berhane, Y. (2015). Prevalence and associated factors of stunting among primary school children in Eastern Ethiopia. Nutrition and Dietary Supplements. 7. 61. 10.2147/NDS.S80803.

Nasreddine, L. Hwalla, N. Al Zahraa, Chokor, F. Naja, F. O'Neill, L. Jomaa, L. (2022). Food and nutrient intake of school-aged children in Lebanon and their adherence to dietary guidelines and recommendations. BMC Public Health; 22, 922. https://doi.org/10.1186/s12889-022-13186w

Nnebue, C. &Ilika, A. Uwakwe, K. Duru, C. Onah, S. & Abu, H. Oguejiofor, O. Gbarage, M. Idoro, S. Onah, H. Abu, E. Oguejiofor, M. Gbarage, S. (2016). Feeding Practices and Determinants of the Nutritional Status of Pupils in a Public Primary School in AladinmaOwerri, Nigeria. International Journal of Clinical Nutrition; 4. 12-18. 10.12691/ijcn-4-1-3.

Onimawo, I.A. Ukaegbu, P.O. Abaoja, N.J. (2007). Assessment of nutritional status of pre-school children in urban and rural areas in Umuahia, Abia State. Nigerian Journal of Nutritional Sciences, 28(2) 30-37.

Oninla, S.O. Owa, J.A. Onayade, A. A. Taiwo, O. (2007). Comparative study of Nutritional Status of Urban and Rural Nigerian School Children. Journal of Tropical Pediatrics. 53(1): 39-43.

Ranjita, M. Diptimayee, J. Snehalata, N. Sumitra C. Amarendra, M. (2022). Assessment of dietary practices among school going children (7-12 years) of selected private and govt. schools. The Pharma Innovation Journal; SP-11(2): 340-344.

Rivera, J.A. Hotz, C. Gonzalez-Cossio, T. Neufeld, L. Garcia-Guerra, A. (2003). The effect of micronutrient deficiencies on child growth: a review of results from

community-based supplementation trials. J Nutr. 133(11):4010S-S4020.

Roberts, A. Susan, A.A, Paul, T.J. Whitehead, R.G. (1981). Seasonal changes in activity, birth weight and lactational performance in rural Ghambian women, Transaction of the royal society of tropical medicine and hygiene. 76(5):668-678.

Roots, W.R. Oyekan, P.O. Dashiell, K.E. (1987). West and central Africa: Nigeria sets an example for expansion of soybeans for the Tropics, Singh, S.R, Rachie K.O and Daniel K.E (Eds.). John Willey and sons, London. pp 7-12.

Sasu, D.D (2022). Number of elementary schools in Nigeria 2019. www.statista.com

Stang, J. Story, M. (2005). Guidelines for adolescent nutrition services. Minneapolis, MN: Center for Leadership, Education and Training in Maternal and Child Nutrition, Division of Epidemiology and Community Health, School of Public Health, University of Minnesota.

Sultana, F. Abdullah, Z. Farrukh, Z. (2017). Magnitude of obesity and its contributory factors in school going children of affluent families of Rawalpindi and Islamabad, Pakistan. J Rehman Med Inst. 3:25–8.

UNICEF. (2019). The state of the world's children. Children, Food and Nutrition: growing well in a changing world. 2-12.