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Relationship Between Individual Dietary Diversity Grade and Malnutrition among School Aged Children

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ABSTRACT

Background: Malnutrition is one of the major predisposing factors to infectious diseases globally especially among school aged children. Low grades of individual dietary diversity is a suspected risk factor for childhood malnutrition. **Objective**: To determine the relationship between individual dietary diversity grade and childhood malnutrition among 6-12-year old school pupils. **Materials and Methods**: This was a cross-sectional descriptive study that enrolled 203 primary school pupils. Socio-demographic data was collected using a pretested interviewer administered questionnaire. The number of food groups present in their immediate past 24-hour dietary recall was used to grade the dietary diversity of each study subject. Data was analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. The association between dietary diversity grades and occurrence of malnutrition was determined. Level of significance for tests of association was set at 5%. **Results**: The result showed that out of 203 subjects that were enrolled for data analysis, 105(51.7%) were males, and 117(57.6%) were 6-8 year old. Forty one (20.2%), 69(34.0%), 93(45.8%) were from upper, medium and low socio-economic class (SEC) classes respectively. Out of 203 subjects, 54(26.6%) had high Individual Dietary Diversity Grade IDDG (IDDS >5), 56(27.6%) had medium IDDG (IDDS 3-4) and 93(45.8%) had low IDDG (IDDS 1-3). Low SEC and lowest dietary diversity grade were significantly associated with occurrence of childhood malnutrition. (P< 0.05). **Conclusion**: Low IDDG and SEC were associated with malnutrition. Nutritional counseling on the need to increase dietary diversity grade of school children can help mitigate the impact of malnutrition.

Keywords: Individual dietary diversity grade, Malnutrition, School age children, Nnewi.

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INTRODUCTION

World Health Organization (WHO) defined childhood malnutrition as deficiencies, excesses, or imbalance in nutritional and or energy intake.[1] It addresses three broad groups of conditions thus: a) Under-nutrition, which includes wasting, stunting, underweight; b) overweight, obesity and diet related non communicable diseases like diabetes, stroke and cancers; and c) micronutrient-

related malnutrition, which includes micronutrient deficiencies and micronutrient excess.[1,2]

Childhood malnutrition was responsible for the death of up to half of siblings in a family.[3,4] United Nation Children's Fund (UNICEF) documented nearly four million African children death in 1985 following complications of childhood malnutrition.[5] Various levels and trends in burden of childhood malnutrition has been documented globally by UNICEF since 1990,[6,7] with higher burden noted in developing African countries, like Nigeria etc. There are many identified risk factors of childhood malnutrition like age,[8] sex,[9] low birth weight,[10] socio-economic class,[11] and dietary factors like low feeding frequency.[12] Despite interventional strategies instituted against these known risk factors of childhood malnutrition, it's surprising that the menace of preventable burden of childhood malnutrition is still ravaging the health and productivity of children, especially those from low and medium income countries like Nigeria, Cameroon etc.[13]

The food groups consumed by a child in a reference period of time say 24 hours is regarded as dietary diversity.[14] Dietary diversity score (DDS) is a scale to measure the number of food groups consumed by a person in a given reference time,(say 24hours) and this can be used to generate the individual dietary diversity grade (IDDG) depending on the IDDS.[15] The food groups include starchy staples, fruits and vegetables, organ meat, eggs, meat and fish, legumes/nuts/seeds, milk and milk products. Low IDDG is IDDS of ≤ 3 food groups, medium IDDG is IDDS of 4-5 food groups, while high IDDG is IDDS of ≥ 6 food groups consumed in a 24 hour period.[16] IDDG is a marker of the nutritional quality in a child's diet.[17] It can be used to assess the intake of both macro and micronutrients.[18] Carbohydrates, protein, fat, minerals,

vitamins and water are the main nutrients needed for optimum growth and development in children. These nutrients are obtained from different food groups like, grains, roots, tubers, millet, cereals, legumes, meat, egg, poultry, milk, nuts, organ meat, fish oil, oil seed, vegetables, fruits, mineral/salt, water, condiment and dietary fibers.[19] The number of these food groups consumed by a child in a reference period of time say 24hours is regarded as IDDS.[14]

Various researchers have shown that IDDG affects the nutritional status of children,[18] and is implicated in childhood malnutrition.[20] Both high and medium DDG are directly related to reducing malnutrition in children,[21] while low IDDG has been known to be a common risk factor to lack of protein, vitamins, minerals and is strongly implicated in childhood malnutrition.[21,22] Despite these known facts of the association of IDDG and childhood malnutrition, it has been noted that most parents are still too negligent of the number of food classes present in their wards' 24hours diet.[24] Most parents especially in developing countries often feed their children frequently with monotonous meals majorly carbohydrates (cereals).[23] This practice can easily be rectified by introduction of food classes like vegetables, fruits and nuts to their children's' routine meal through proper nutritional counseling and proper creation of awareness among the parents/care givers in our environment. Hence the need to motivate parents/caregivers on the need to consciously work towards increasing their wards IDDG as this can reverse the heavy burden of childhood malnutrition associated with low IDDG in our environment, since research has shown that proper nutritional counseling improved child's dietary diversity grade and feeding habit. [24]

The index study determined the association of IDDG and childhood malnutrition. The outcome of this study may help to halt the increasing burden of childhood malnutrition with its attendant complications in the sub-region. [14]

METHODOLOGY

This descriptive cross sectional study was conducted in Nnewi metropolis which is the second largest city in Anambra state Southeastern Nigeria.[25] The city spans over 2789km^2 in Anambra state.[25] The major occupation of the indigenes is trading and farming with few civil servants.[25] The city has a large market popularly known as Nkwo Nnewi that specializes in motorcycle and motor spare parts sales, however, it is also a market for other miscellaneous goods and

various classes of local food wares which are cheap and highly nutritious food sources.[25]

The study population comprised six- to twelve- year-old primary school children in Nnewi selected by multi-stage probability sampling technique, and are willing to participate. Children with chronic diseases that may impair communication or by their nature may contribute to malnutrition and children whose parents did not give consent or were not available during data collection were excluded from the study.

Sample size was calculated using the formulae for cross sectional observational study.[27] thus:

minimum sample size $n = z^2Pq/d^2$.[26,27]

Where: n= the desired sample size when population is greater than 10,000

Z=the standard normal deviate, usually set at 1.96

P= the proportion in the target population estimated to have a particular characteristic. The prevalence of Normal weight Primary School children in Anambra state is 85.2%, so the prevalence of malnutrition among these children is 14.8%.[28]

q=1.0-p; q=1.0-0.148; q =0.852

d=degree of accuracy desired, set at 0.05

Therefore $n= (1.96)^2 x\ 0.148x\ 0.852/ (0.05)^2$;n= 194

Minimum sample size = 194

Since some children selected for the study may not agree to participate, a response rate of 80% was allowed. The adjusted sample size (N_s) was = n/0.8.[27] ; N_s=194/0.8 ; N_s= 243

Attrition factor of 10% was accommodated, because some initial respondents could not get to the end of the research. Hence the corrected sample size (N_c) was= 243/0.9

N_c =270 was the corrected sample size.

So, two hundred and seventy, 6 to 12 year old primary school children in Nnewi that met the inclusion criteria were recruited for the study.

Sampling Technique and Recruitment of Participants

Participants were selected using stratified multistage sampling methods: Data obtained from Nnewi North Local Government secretariat on the list of schools in Nnewi showed that there were 302 primary schools in Nnewi; 30 were government owned schools (public school) while 272 were private schools. The proportion of public school to private school in Nnewi was 1: 9. And the total ratio was 10. So, ten primary schools were selected from 302 primary schools sampling frame in Nnewi metropolis in the proportion of 1:9 (public: private).So, in stage 1 of multi stage sampling, one public and nine private primary schools were selected from the 302 list of the primary schools in Nnewi sampling frame. The public schools were selected by simple random sampling. This was done by writing the names of the public primary schools separately on different pieces of paper which was folded and put in a sealed bag and shaken. Thereafter one school was chosen randomly from the bag. An individual who was not part of the study was engaged in that selection to avoid selection bias.

Also 9 (nine) private primary schools were selected from the sampling frame of the list of 272 private schools in Nnewi using systematic sampling technique of choosing one private school after every 30 private primary schools. So a total of 10 schools were used for the study, one public primary school and 9 private primary schools.[29] Different selection methods were used in selecting the public school and the private schools to allow variety in sampling process and also to ensure all the primary schools in Nnewi were given an equal and fair chance of being selected.

Ethical considerations

Ethical review was done and approval obtained from the ethics committee of Nnamdi Azikiwe University Teaching Hospital (NAUTH) Nnewi before commencement of the study. Also, approval for the study was gotten from ministry of Education in Anambra state (Anambra State Universal Basic Education Board- ASUBEB) before commencement of the study. Written informed consent was obtained from the School Parent Teacher Association and written informed assent was gotten from participants' ≥ 7-year-old before enrollment into the study. The parents/care givers of the participants were reassured that the study would cause no harm and there would be no additional discomfort to the child.

Confidentiality was maintained at all times throughout the study and afterwards. The participants' parents/caregivers were assured that any information gotten from them would remain confidential. Subjects did not incur extra cost by participating in this study and there was no financial inducement. Participants diagnosed to be malnourished were referred to Paediatrics nutrition/gastroenterologist clinic in Nnmdi Azikiwe University Teaching Hospital (NAUTH) Nnewi for appropriate management and follow–up according to the unit's protocol. The parents/caregiver of the identified malnourished children were engaged in proper nutritional counseling session on the need for immediate nutritional rehabilitation. They were also advised on the need to keep to hospital appointments and follow-up.

Data Collection

Three research assistants (Health workers) were involved in the data collection after training by the investigators prior to commencement of data collection. The detailed information about the study was given to the parents/caregivers before enrolment into the study. During the data collection, the parents/caregivers of the selected participants were met individually after school dismissal for data collection as they come to take their wards home. Pre-tested standardized semi-structured, interviewer administered questionnaire was used to collect relevant information. The following information was collected: child's age, sex, Social Economic Class(SEC) using Oyedeji's social classification method,[30,31] into upper SEC, medium SEC and low SEC. Measurements of height and weight of the selected pupils were taken and were used to establish each child's nutritional status using the WHO Z scoring system. [32,33,34] The nutritional status was computed using the WHO Growth reference charts for school age children and adolescents.[35]

Prior to the onset of the data collection, the principal investigator was trained by the Dieticians/Nutritionists of Nnamdi Azikiwe University Teaching Hospital, Nnewi on the techniques of accurate measurement/estimation of 24-hour dietary recall using house hold portion sizes of common food models, cups, spoons and food preparation methods/cooking methods. The detailed classes of food/ ingredients used in preparation of meals were obtained. This was used to estimate the IDDS of each subject from the 24hour dietary food recall records. Using the IDDS, the IDDG of each participant was established from the sixteen food class questionnaire.

Dietary Diversity Score

The IDDS was determined using the IDDS scoring system.[36] The participants were graded into lowest, medium and high dietary diversity grade depending on the number of food classes present in the individual's 24 hour dietary recall. The food classes include grains, roots, tubers, millet, cereals, legumes, meat, egg, poultry, milk, nuts, organ meat, fish oil, oil seed, vegetables, fruits, mineral/salt, water, condiment and dietary fibers.[19] Lowest IDDG if ≤ 3 food classes were identified, medium IDDG if 4 to 5 food classes were identified and high IDDG if ≥ 6 food classes were identified.[36] The association of IDDG with occurrence of childhood malnutrition was established.

Data Entry and Analysis

All completed questionnaire and proforma were given number codes before entry into the Statistical Package for Social Science (SPSS) software version 21.0 for windows for analysis. Frequencies and percentages were used to summarize categorical variables like sex, age groups, type of nutritional status, SEC and IDDG. The independent variable was the IDDG. The categorical variables like gender, parents SEC, age groups, nutritional status were tested for association to IDDG using Pearson's Chi-square (and Fisher's Exact test where appropriate) for bivariate analysis and P-value < 0.05 was considered as statistically significant.

RESULTS

A total of 270 primary school aged children (6-12years) where enrolled into the study, however 203 subjects had complete data and thus had their data analyzed. There were more males 105(51.7%) than females 98(48.3%). Children aged 6-8years were

117(57.6%), while those 9-12 years were 86(42.4%). Forty one children (20.2%) were from high SEC, while 69(34.0%) were from middle SEC, and 93(45.8%) were from low SEC. The age distribution of the participants had right (positive) skewness with the median age in the 6-8 year age group. Out of the 203 subjects that were analyzed, 54(26.6%) had high dietary diversity grade i.e. those with IDDS ≥ 6, while 56(27.6%) had medium dietary diversity grade, i.e. IDDS of 4-5 and 93(45.8%) had low dietary diversity grade, those with IDDS of ≤ 3. These are shown in Table1 below.

Association of individual dietary diversity grade with Age, Gender and SEC

Among children 6-8years, 62(66.7%) had lowest IDDG and 31(33.3%) had lowest IDDG among children 9-12years. The IDDG increased by 6.3 with increasing age and this was

Male children had higher IDDG than females though this finding was not statistically significant (P =0.41). Children from low SEC had the lowest IDDG 54(58.1%) than those from medium and high SEC. Children from high SEC were 17times more likely to have higher IDDG than children from low SEC and this was statistically significant with P = 0.002. These are shown in Table 2 below.

Table 1: Socio-Demographic Characteristics Of The Selected Subjects For The Study

Characteristics	Frequency n=203	Percent
Gender		
Male	105	51.7
Female	98	48.3
Age groups (years)		
6-8	117	57.6
9-12	86	42.4
Socio-economic class		
Upper	41	20.2
Middle	69	34.0
Low	93	45.8
IDDG		
High(IDDS ≥ 6)	54	26.6
Medium(IDDS 4-5)	56	27.6
Low(IDDS ≤ 3)	93	45.8

significant with P= 0.04. Hence age was significantly associated with IDDG.

Table 2: The Association Of Individual Dietary Diversity Grade with Age, Gender and SEC

Variables	Lowest Dietary Diversity n= 93(%)	Medium Dietary diversity n= 56(%)	High Dietary diversity n= 54(%)	X^2 (p-value)
Age (years)				**6.3(0.04)***
6-8	62(66.7)	30(53.6)	25(46.3)	
9-12	31(33.3)	26(46.4)	29(53.7)	
Gender				**4.0(0.41)**
Male	50(53.8)	24(42.9)	31(57.4)	
Female	43(46.3)	32(57.1)	23(42.6)	
SEC				**17(0.002)***
High SEC	10(10.8)	12(21.4)	19(35.2)	
Medium SEC	29(31.2)	21(37.5)	19(35.2	
Low SEC	54(58.1)	23(41.1)	16(29.6)	

*Statistically significant, X^2 = Chi square

Association of individual dietary diversity grade and Malnutrition

Highest IDDG were more among well-nourished than malnourished children. Well-nourished children were 8.5 times more likely to have higher IDDG than malnourished children and this was statistically significant with P= 0.014. See Tables III below.

Table 3: The Association of Individual Dietary diversity grades and Malnutrition

Variables			
Nutritional Status	**Normal nutrition N = 107(%)**	**Malnutrition N = 96(%)**	**X^2 (p-value)**
Grades of IDDG			**8.5(0.014)***
High(IDDS ≥ 6)	35(32.7)	19(19.8)	
Medium (IDDS 4-5)	21(19.6)	35(36.4)	
Low (IDDS ≤ 3)	51(47.7)	42(43.8)	

**Statistically significant, X^2 = Chi square*

DISCUSSION

This study was designed to determine the association of individual dietary diversity grade and malnutrition among 6-12 year old school children in Nnewi, Southeast Nigeria. From this study, the prevalence of high, medium and low IDDG were 26.6%, 27.6% and 45.8%, respectively. This prevalence is similar to the percentages gotten by Ukaegbu *et al* in Imo state, Nigeria, which is 1.3%, 25.2%, 73.5% for high, medium and low IDDG, respectively.[37] Furthermore, similar high prevalence of low IDDG were reported from studies done in other developing countries like Ghana by Frempong *et al*, [38] in Rwanda and Burundi by Custodio *et al*.[39] In contrast to these findings, lower prevalence of low IDDG was reported by Sealey-Potts *et al* in Florida, USA, which is a high income country, with low IDDG among school children at just 19%.[40] The higher prevalence of low IDDG found in this study, unlike in the high income country, may be because there are more low-SEC families in low and middle income countries(LMICs).

From this study, it was found that younger children had lower IDDG than their older counterparts. This is similar to the finding by Rakotonirainy *et al*[41] and Guirindola *et al*.[42] This may be because older children have more exposure to other sources of diet like fruits and vegetables outside their home routine meals. Furthermore, they have more tendency of belonging to

peer groups making it easy for them to out -source their meals and diet from their friends' families.

Males were 4 times more likely to have higher IDDG than females from this study, similar finding was reported by Nthya *et al* in India. [43] This could be because male children are more adventurous than their female counterparts. Males have more tendency of out- door activities in the bush, hence can indulge in eating wild edible fruits/ vegetables and wild meat

in addition to their routine family meals. Furthermore, the cultural practice of male preference and serving male children more balanced diets than their female counterparts in our community may be contributory to these findings.

From this study, children from high SEC were more likely to have higher IDDG than children from low SEC. Similar result was reported by Agrawal *et al* among Indian children,[44] Wolde *et al* among Ethiopian children[45] and by Singh *et al* in a review of IDD in school aged children from developing countries.[46]This is because of low purchasing power of low SEC family, hence they are more predisposed to household food insecurity, thus their children will tend to have low dietary diversity score. In contrast, another study found higher IDDG among low SEC family that are involved in diary/ poultry farmers.[47] This contrast can be explained by the fact that the low SEC families in the index study were mostly traders with little or no indulgence in farm work. Studies have shown that children whose parents indulge in farming and dairy farm have higher access to diverse food classes produced from the family farm, hence have higher IDDG with higher availability of nutrients to meet their daily nutrient requirement.[48] This lowers the tendency of being malnourished, irrespective of the fact that they're from low SEC families.

From this study, children with low IDDG were significantly more likely to be malnourished than children with higher IDDG. Similar results were reported by Olumakaiye *et al* in a study done in Southwest, Nigeria,[48] Khamis *et al* in a study done in Tanzania,[49]Sie *et al* in a study done in Burkinafaso,[50] and Frempong *et al* in a study done in Ghana.[38] This is because children with low IDDG tend to be exposed to lower nutrient content in their daily meals and hence will not attain their daily nutrient requirement, hence more tendency to be malnourished. In contrast to these findings, some Philippine studies by Viroria *et al*,[51] and Guirindola *et al*,[42] noted no association of dietary diversity score and malnutrition in their studies. This may be because the index study used 16 food class questionnaire method adapted from Food and Agricultural organization (FAO), which is more

elaborate in grading of individual dietary diversity of the immediate past 24 hour meals, while Viroria *et al* used 8 food groups based on FAO guideline while Guirindola *et al* used 7 food groups based on World Health organization (WHO) and United Nation Children's fund (UNICEF) in the grading of the IDDG. Again, both studies were conducted among younger children (6-23 months old) whose report of 24 hour meal intake is totally dependent on the recall of the care giver, unlike the index study that was done among older children (6-12 year old) that were able to participate in their dietary recall, also these children have more tendency of out sourcing their meal in their peers/friend's house.[42]

Most participants had low IDDG 45.8%. This is because the participants were mainly from low SEC with low purchasing power and mainly traders. The study population were noted to be eating monotonously especially carbohydrate diets like, cereals, roots and tubers (like yam, cassava); with minimal intake of other food classes like green leafy vegetables, legumes, nuts, fruits, eggs and organ meat. There is need to communicate the findings of this study to the parents/care giver through nutritional counseling by health workers and at school during Parent/Teachers Association (PTA) meetings. Also, pupils/students should be allowed to participate fully in the school farming programs, as this may help expose them to cheap food classes from the agricultural product and hence increase in their IDDG.

CONCLUSION

This study has shown that the prevalence of low IDDG is high among the participants and is associated with low SEC, younger participants and females. Alsolow individual dietary diversity grade was significantly associated with under-nutrition. There is need to help parents to be more proactive in improving their SEC. This possibly can be achieved through indulging in skill acquisition and getting a higher paying job to increase their purchasing power. Moreso, there is need to educate families to engage in farming to increase the availability of agricultural products like fruits, vegetables and different food classes to their children for consumption. Proper nutritional counseling can improve the dietary diversity grade and feeding habit among school aged children.

REFERENCES

1. Malnutrition fact sheet. WHO 2023[Internet](Cited 2023 March 5th). Available from: https://www.health.pa.gov>...
2. Malnutrition-Fact Sheets. WHO 2021 [Internet](Cited 2023 March 5th). Available from: http://www.health.ny.gov>diseases.
3. Kwashiokor in Africa. WHO 1952 [Internet](Cited 2023 April 20th) Available from: Https://apps.who.int/iris/handle/10665/40717.
4. Rijpma S. Malnutrition in the history of tropical Africa. Civilizations 1996;43:45–63.
5. Within human reach, A future for Africa's children.[Internet](Cited 2023 June 14th) Available from: Https://digitallibbrary.un.org>record.
6. Levels and trends in child Malnutrition, UNICEF, WHO, World bank Joint estimate. [Internet](Cited 2023June 20th) Available from: Https://www.who.int>nutgrowthdb.
7. Swaminathan S, Hemalatha PA. The burden of child and maternal malnutrition and trends in its indicators in the states of India: the global burden of disease study 1990-2017. Lancet, child Adolesc Heal. 2019;3:855–870.
8. Adenuga WU, Obembe TA, Odebunmi KO and Asuzu MC. Prevalence and Determinants of Stunting Among Primary School Children in Rural and Urban Communities in Obafemi Owode Local Government Area, South western, Nigeria. Ann Ibadan Postgrad Med 2017;15:7–15.
9. Kelishadi R. Childhood Overweight, Obesity and Metabolic Syndrome in Developing Countries. Epidemiol rev 2007;29:62–76.
10. Wong HJ, Moy FM and Nair S. Risk factors of malnutrition among preschool children in Terengganu , Malaysia : a case control study. BMC Public Health 2014;14:785-795.
11. Uthman OU. Decomposing soci-economic inequality in childhood malnutrition in Nigeria. Matern child Nutr 2009;5:358–367.

12. Abu HO, Oguejiofor EO, Gbarage MT and Idora SA. Feeding Practices and Determinants of the Nutritional Status of Pupils in a Public Primary School in Aladinma. Int J Clin Nutr 2016;4:12–18.
13. Dejenu G and Andualem A. Level of Knowledge and practice of mothers on minimum dietary diversity practices and associated factors for 6-23 month-old children in Adea Woreda, Oromia, Ethiopia. Biomed Res Int 2017;2017, arti:9 pages.
14. Arsenault JE, Yakes EA, Islam MM, Hossain MB and Ahmed HC. Very low adequacy of micronutrient intakes by young children and women in rural Bangladesh is primarily explained by low food intake and limited diversity. J Nutr 2013;143:197–203.
15. European Union Guidelines for measuring household and individual dietary diversity. 2013[Internet](CIted 2022 January 18th) Available from:
16. Guidelines for measuring household and individual dietary diversity.[Internet](Cited 2022 June 28th) Available from: https://humboldt-reloaded.uni-hohenheim.de>...
17. Guiding principles for feeding infant and young children during emergencies. Geneve WHO [Internet](Cited 2021 January 20th) Availible from: http://www.unhcr.org.45f6c8d62.
18. Arimond MT. Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys. J Nutr 2004;134:2579-2585.
19. Gopalan RB. Nutritive value of Indian food. Natl Inst Nutr Indian Counc Med Res hyderabad. 2006;27–31.
20. Chandrasekhar S, Aguayo VM and Krishna NR. Household food insecurity and children's dietary diversity and nutrition in India. Evidence from the comprehensive nutrition survey in Maharashtra. Matern Child Nutr 2017;13:12447.
21. Khamis AG, Mwanri AW and Ntwenya JE. The influence of dietary diversity on the nutritional status of children between 6 and 23 months of age in Tanzania. BMC Pediatr. 2019;Article Nu.
22. Li Y, Wedlick N, Lai J, He Y and Hux LA. Lack of dietary diversity and dyslipidaemia among stunted overweight children: the 2002 China National Nutrition and Health Survey. Public Heal Nutr2011;14:896–903.
23. Gewa CA, Murphy SP and Weiss RE. Determining minimum food intake amounts for diet diversity scores to maximize associations with nutrient adequacy: an analysis of school children's diets in rural Kenya. Public Heal Nutr 2014;
24. Moramarco S, Amerio G, Chafula ML, Bonvecchio D, Abramo E, Palombi L *et al.* Nutritional counselling improves dietary diversity and feeding habits of Zambian malnurished children addmitted in Rainbow nutritional programs. Biomed Prev issues 2017;1:93.
25. Description of Nnewi town, in Anambra Southeast, Nigeria [Internet](Cited 2020 February 12th). Available from: https://en.wikipedia.org/wiki/Nnewi
26. Singh S, Yadav ST, Mishra P, Mittal A, Kumar R and Singh J. An Epidemiological Study of Malnutrition Among Under Five Children of Rural and Urban Haryana. 2016;10–13.
27. Araoye MO. Research Methodology with statistics for Health and social sciences. Nathadex publications, saw-mill,Ilorin, 2nd Edition 2008:115-122.
28. Nwabueze AS, Ilika LA and Azuike EC. Assessment of Nutritional status among primary school pupils in rural and urban area of Anambra State. Eur J Prev Med. 2015;3:34.
29. Bardara ME, Livingstone BA and Alison EB. Biomarkers of Nutritional Exposure and Nutritional Status, Markers of the Validity of Reported Energy Intake. J Nutr Suppl. 2003;133:895s-920s.
30. Oyedeji GA. Socio-economic and cultural

background of hospitalized children in Ilesha. Niger J Paediatr 1985;12:111–117.
31. Oseni TA and Odewale AM. Socio-economic status of parents and the occuerence of pelvic inflammatory disease among undergraduates attending Irrua Specialist Teaching hospital, Irrua Edo state, Nigeria.Niger postgrad Med J 2017;24:114–120.
32. Growth Reference 5-19years: Height for age and BMI. WHO[Internet](Cited 2022 July 15th) Available from:https://www.who.int>…> indicators.
33. Definition of stunting, underweight and wasting. UNICEF[Internet](Cited 2022 July 13th) Available from: https://data.unicef.org>Nutrition
34. Tracking progress on child and maternal nutrition-a survival and development priority. UNICEF[Internet](Cited 2022 June 12th) Available from: http://www.unicef.org/publications/files/tracking-progress-on-child-and-maternal-nutrition-EN-110309.
35. De Onis M, Onyangwo AW, Borghie E and Siyam NS. Development of a WHO growth refernce for school aged children and adolescents. bull world Heal Organ 2007;85:660–667.
36. Gina K, Terri B and Marie CD. Nutrition and consumer protection Division Food and Agricultural Organization of the UN. Guidlines for Measuring Household and induvidual Dietary Diversity. 2013[Internet] (Cited 2022 April 15th) Available from: https://www.medscape.com>viewar.
37. Ukegbu PO. 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 2017;23:425–35.
38. Fremponga RB. Dietary diversity and child malnutrition in Ghana. Hellyon. 2017;3:e00298.
39. Custodio E, Herrador Z, Nkunzimana T, Weziak-Bialowolska D and Perez-Hoyos KF. Children's dietary diversity and related factors in Rwanda and Burundi: A multilevel analysis using 2010 Demographic and Health Surveys. PLoS One. 2019;14(10):e0223237.
40. Potts AC and Sealet-potts C. An assessment of dietary diversity and Nutritional Status of Preschool Children. Austin J Nutr Food Sci 2014;2:1040.
41. Rakotonirainy NH, Razafindratovo V, Remonja CR, Rasoloarijaona R, Piola P, Raharintsoa C et al. Dietary diversity of 6 to59 month-old children in rural areas of Moramanga and Morondava districs, Madagascar. PLoS One 2018;13(7):e0200235.
42. Guirindola MO. Association between dietary diversity score and Nutritional status of Filipino children 6-23 months. Philipp J sci 2016;145:57–69.
43. Nthya DJ. Dietary diversity and its relationship with nutritional status among adolescents and adults in rural India. J Biosoc Sci 2017;50:397–413.
44. Agrawal S, Kim R, Gausman J, Sharma S, Sankar R and Joe W. Socio-economic patterning of food consumption and dietary diversity among Indian children: evidence from NFHS-4. Eur J Clin Nutr 2019;73:1361–1372.
45. Wolde T and Belachew T. Predictors of thinness and improved dietary diversity among School aged children in Southern Ethiopia. Nutr Diet Supl 2019;11:S221739.
46. Singh BP. Dietary Diversity in School going Children: Review. Int J child Heal Nutr 2020;9:133–138.
47. Saakaa M and Osmana SM. Relationship between agricultural biodiversity and dietary diversity of children aged 6-36 months in rural areas of Northern Ghana. Food Nutr Res 2017;61:1391668.
48. Olumakaiye MF. Dietary diversity as a correlate of undernutrition among school age children in South western Nigeria. J child Nutr Manag 2013;37:9-22
49. Khamis AG and Mwami NE. The influence of dietary diversity on the nutritional status of

children between 6-23 months of age in Tanzania. BMC Pediatr 2019;19:518.
50. Sie A and Tapsoba CO. Dietary Diversity and nutritional status of children 2 to 5 years old situated in different ecological settings. EC Nutr 2018;13:443-449.
51. Viloria BS. Diet diversity and Nutritional status of children 2 to 5 years old situated in different ecological settings. EC Nutr 2018;13:443–449.