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Assessment of Dietary Diversity Score, Nutritional Status and Socio-demographic Characteristics of Under-5 Children in Some Rural Areas of Imo State, Nigeria

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ABSTRACT

Introduction: The study assessed dietary diversity score (DDS) of rural under-five children and the relationship with their nutritional status and socio-demographic characteristics of their mothers/caregivers. **Methods:** The study was a descriptive cross-sectional survey involving 226 mothers and their under-five children selected at random from rural communities in Imo state, Nigeria. A pre-tested questionnaire was used to obtain information on socio-demographics. Qualitative recall of the child's food consumption during the previous 24-h was used to calculate individual dietary diversity score (DDS= representing the number of food groups, based on a scale of 12 groups) and the scores were divided into terciles low= ≤4, medium=5 - 8, and high= 9 - 12). Weight-for-age (WAZ), height-for-age (HAZ) and weight-for-height (WHZ) Z-scores were used to determine nutritional status of the children. Descriptive statistics, Chi square and linear regression analyses were performed. **Results:** Average age of the children was 4.2±0.7years, with 51.8% being males, and 48.2% females. Stunting, wasting and underweight were 11.5%, 5.4% and 2.7%, respectively. Mean DDS for all food groups was 6.04±4.18. Cereals and vegetables had higher mean values (0.78±0.29 and 0.78±0.30, respectively), while eggs had the least value (0.15±0.25). The prevalence of low, medium and high DDS (in terciles) was 73.5%, 25.2% and 1.3%, respectively. DDS was significantly associated with HAZ ($\chi2$ =10.63;p=0.03), while total family income remained significantly and positively associated with dietary diversity score ($p<0.05$) in the linear regression model. **Conclusion:** Children with low DDS were more likely to be stunted. Therefore, efforts aimed at increasing diversity in meals, both at home and in schools, are likely to benefit children at nutritional risk.

Key words: Dietary diversity score, nutritional status, rural areas, socio-demographics, under-5 children

INTRODUCTION

Micro and macro nutrient deficiencies are public health concerns in most developing countries due to monotonous starchy and cereal-based diets, often with little or no animal products and few fruits and vegetables (Ruel, 2003). Consumption of inadequate quantities and poor quality of foods by households results in nutrient deficiencies (Mirmiran *et al.*,2004). A diverse diet is important in meeting the requirements for essential nutrients especially for those who are at risk of nutrient deficiencies, as this may lead to malnutrition. Malnutrition refers to an abnormal physiologic condition caused

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by inadequate or excessive consumption of macronutrients and/or micronutrient (FAO/IFAD/WFP, 2013). It can be under nutrition or over nutrition as well as micronutrient deficiency usually referred to as *hidden hunger* (FAO/IFAD/WFP, 2013). It is a major cause of morbidity and mortality in children under-5 years of age globally with approximately one-third of the nearly 8 million deaths attributed to it (WHO, 2013). Under-5 children are at risk of malnutrition because at this age, they need energy and nutrient dense foods to grow and develop both physically and mentally in order to live a healthy life (Martin-Prevel *et al.,* 2012).

Dietary diversity has been shown to correlate with nutrient intakes and various anthropometric measurements in children (Ruel, 2003). Anthropometric indices like weight-for-age, height-for-age and weight-for-height, especially of under-5 children are used to assess the nutritional status of children from birth to 59 months of age (FANTA, 2013).

Nigeria is a developing country undergoing rapid nutrition transition. This nutrition transition is underpinned by dietary changes in both rural and urban areas. This poses a threat to public health with a higher impact on the poor. Therefore, evaluating total diet quality is important. The use of dietary diversity has become increasingly popular as an indicator to assess diversity of diets, because they are valid, relatively simple to measure, and inexpensive to use in developing countries. Researchers have also indicated that dietary diversity is a useful indicator of nutrient adequacy among adults and children (Arimond & Ruel, 2004; Ruel, 2003).

Dietary diversity is defined as the sum of food groups consumed over a period of 24 hours (Hoddinott & Yohannes, 2002). It is usually calculated based on the number of different food groups consumed over a given period (Hoddinott & Yohannes, 2002). Currently, there are no established recommendations regarding the number of food groups considered in the dietary diversity score and how to deal with the amount of intake (Wirt & Collins, 2009). This study therefore determined the association of dietary diversity score with nutritional status and socio-demographic characteristics of mothers/caregivers of under-5 children in South-East Nigeria.

METHODS

Description of study area

This study was carried out in Ahiazu-Mbaise Local Government Area (LGA) of Imo state, Nigeria. The LGA has its headquarters in the town of Afor Oru. It has an area of 114k m^2 and a population of 170,902 (NPC, 2006). Ahiazu-Mbaise has two major clans (Ahiara and Ekwereazu) and 27 autonomous communities. Ahiara has 12 autonomous communities, while Ekwereazu has 15. Being a rural area, the people are mainly farmers and traders, with a minimal population of civil servants.

Study design

The study was a community based cross-sectional survey conducted on a sample of 226 under-5 children selected from rural communities in Ahiazu-Mbaise.

Preliminary visits

Formal written approval for the study was obtained from the Local Government Chairman. Community leaders and household heads were also informed about the study. Oral consent was obtained from mothers/caregivers of the under-5 children prior to enrollment in the study.

Sample size determination

Sample size was calculated using single proportion formula (FAO, 1990) assuming prevalence of low dietary diversity scores (DDS) among mothers and children (0-5years) is 16.5% (Sanusi, 2010), Z= 95% confidence level and d=desired precision.

$N = \underline{Z^2 \times P(100-p)/}\ d^2$

The final sample size was calculated by taking a 10% non-response rate to give 242.

Sampling technique

Simple random sampling was employed to select 6 villages from the 27 autonomous communities in Ahiazu-Mbaise. Preliminary surveys were then conducted in the selected communities to identify households with children between 2 to 5 years. Codes were given to such households and these served as a sampling frame. From the sampling frame, simple random sampling was used to select the households with under-5 children until the required sample size was obtained. In situations where more than one under-five child was present in a household, only the youngest child was included in the analysis. Age of each child was determined using their birth certificate and in the case where this was not available, the growth monitoring charts/clinic attendance card was used.

Data collection

Data for this study was collected between July and August 2015, which is the rainy season. Mothers/caregivers completed an interviewer administered structured, validated and pretested questionnaire on socio-demographic characteristics of mothers/caregivers and dietary habits of the children. This questionnaire was validated by lecturers in the Department of Human Nutrition and Dietetics, Michael Okpara University of Agriculture, Umudike. The instrument was pre-tested on 26 mothers from Aboh-Mbaise (another Local Government in the state). These groups of mothers were not used in the final data analysis. Oral consent was sought and obtained from mothers/caregivers before commencement of the study. Twenty four (24) hour recall was conducted with mothers/caregivers of each child by trained interviewers who visited the homes of each participant. Memory aids such as food models and pictures were used to assist the mothers/caregivers recall all foods eaten and beverages taken in the previous 24-h prior to the interview. Information from the 24-h recall was recorded into the 12 food groups in the dietary diversity questionnaire.

Dietary diversity score

Dietary diversity score was based on 24-h recall of mothers/caregivers of child's consumption of 12 food groups within the past 24-h using the FAO (2007) guidelines. Foods were categorised into 12 groups based on FAO recommendations as follows: (i) cereals, (ii) vegetables, (iii) fruits, (iv) meat, (v) egg, (vi) fish and other sea foods, (vii) legumes, nuts and seeds, (viii) milk and milk products, (ix) oil and fats, (x) sweets, (xi) spices, condiments and beverage, 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 one point. However, half point was awarded for food items less than two. In case where 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 this ranged from 0-12. Terciles of DDS were used to classify the children into low (≤4), medium (5-8) and high (9-12). These cut-offs were used due to lack of national and international guidelines on which to base cut-offs (FANTA, 2013). Mean scores were also calculated for each of the food groups.

Anthropometric measurements

Anthropometric measurements of height and weight for each child were determined using standard techniques. Heights of the children were measured by a stadiometer (a light portable wooden board with a graduated tape measure), while, a SECA floor electronic scale was used to record weight of the children (Gibson, 2005).

Nutritional status indicators

Anthropometric measurements were converted to sex specific Z-scores using WHO AnthroPlus Software. The three indicators assessed were weight-for-age, height-for-age and weight-for-height Z -scores for all the children. Children with weight-for-age, height-for-age and weight-for-height between -2SD to +2SD were classified as normal, those with greater than +2SD were regarded as overweight, tall and obese, while Z-scores between -3SD to -2SD were classified as underweight, stunted and wasted, respectively (FANTA, 2011).

Statistical analysis

Frequencies and cross tabulations were calculated in relation to relevant characteristics. Bivariate analyses were conducted to examine the associations between child DDS and various maternal socio-demographic factors. Socio-demographic factors that were significantly associated with child DDS were used in the linear regression analysis. Statistical Package for Social Sciences (SPSS) for windows version 21 was used to perform all statistical analysis. A *p*-value of less than 0.05 was accepted as statistically significant.

RESULTS

Child and parent socio-demographic characteristics

A total of 226 completely filled questionnaires were returned and used in this study. Educational level of mothers revealed that more than half (53.1%) reported having attained up to secondary level, while 44.2% were involved in trading. More than half (54.9%) had between 1-3 children and about one-third (35.4%) had total monthly family income of less than N18,000 (about USD50) (Table 1). There were about an equal percentage of girls (48.2 %) and boys (51.8%) in the study.

Table 2 shows the mean Z-scores for underweight, stunting and wasting. Underweight, stunting and wasting were 0.85±1.35, 0.24±1.47 and 1.03±1.5, respectively. Generally, 2.6%, 8% and 6.7% were underweight, stunted and wasted, respectively. When nutritional status indicators were separated based on sex, no significant difference ($p>0.05$) was observed between male and female under-5 children.

Dietary diversity score

The dietary diversity scores ranged from 1 to 10 over 12 possible range groups with a mean DDS of 6.04±4.18 food groups. The majority (73.5%) of the children fell within the low DDS group, while 25.2% and 1.3% were in the medium and high DDS groups, respectively. No association was found between gender and DDS score ($\chi2=1.78;p=0.939$) (data not shown in Tables). Dairy products, eggs, meat, legumes and fruits were the least consumed food groups by the children, while cereals, vegetables, fat and oils, roots and tubers, small fishes and beverages were commonly consumed (Table 3).

Relationship between DDS, anthropometric indices and socio-demographic variables

Bivariate analysis showed that birth order of a child ($X^2=22.47$; p=0.013), mother's educational level ($X^2=12.85$; p=0.045) and occupation ($X^2=24.30$; p=0.002), family income ($X^2=17.71$; p=0.007), number of children in the household (($X^2=16.29$; p=0.012) and family type ($X^2=6.21$; p=0.045) had an influence on DD scores. DDS was significantly associated with HAZ ($X^2=10.63$; p=0.03), but not with the other anthropometric indicators (data not shown in Tables). Multiple regression analysis using DDS as dependent variable,

Table 1. Socio-demographic characteristics of mothers/caregivers (n=226) and study children (n=226)

Variables	*n*	%
Educational level of mother		
No formal education	8	3.5
Primary	32	14.2
Secondary	120	53.1
Tertiary	66	29.2
Occupation of mother		
Trading	100	44.2
Civil service	47	20.8
Artisans	43	19.0
Farming	20	8.8
Others (housewife)	16	7.0
Household monthly income		
<₦18,000 (USD50)	80	35.4
₦18,001-23,000	55	24.3
₦23,001-29,000	15	6.6
>₦29,001 and above	76	33.6
Family type		
Monogamous	197	87.2
Polygamous	29	12.8
Educational level of father		
No formal education	12	5.3
Primary	25	11.1
Secondary	132	58.4
Tertiary	57	25.2
Occupation of father		
Trading	100	44.2
Artisans	61	27.0
civil service	44	19.5
Farming	17	7.5
Others	4	1.3
Characteristics of children		
Female	109	48.2
Male	117	51.8
Age of the child (years)		
2.0-2.9	41	18.1
3.0-3.9	56	24.8
4.0-5.0	129	57.1
Number of children in the household		
1-3	124	54.9
4-6	77	34.1
7-9	23	10.2
10 and above	2	0.9
Birth order		
1st	46	20.4
2nd	88	38.9
3rd	57	25.2
4th	23	10.2
5th	7	3.1
Above 5th	5	2.2

Table 2. Distribution of study children according to their nutritional status indicators

Nutritional status indicators	*Male*		*Female*		*Total*		*p-value*	
	n	*%*	*n*	*%*	*n*	*%*		
Weight-for-height							0.909	0.635[ns]
Wasted(-2 to -3SD)	9	8	6	5.2	15	6.7		
Normal(-2 to +2SD)	72	66.1	79	67.5	151	66.8		
Risk of overweight(>+2SD)	28	25.7	32	27.4	60	26.5		
Mean=1.03±1.5								
Total	109	100.0	117	100.0	226	100.0		
Weight-for-age							0.665	0.717[ns]
Underweight(-2to-3SD)	2	1.8	4	3.5	6	2.6		
Normal(-2 to +2SD)	89	81.7	92	78.6	181	80.1		
Above normal(>+SD)	18	16.5	21	17.9	39	17.3		
Mean= 0.85±1.35								
Total	109	100.0	117	100.0	226	100.0		
Height-for-age							2.088	0.352[ns]
Stunted(-2 to-3SD)	6	5.5	12	10.3	18	8		
Normal(-2 to +2SD)	95	87.2	99	84.6	194	85.8		
Very tall(>+2SD)	8	7.3	6	5.1	14	6.2		
Total	109	100.0	117	100.0	226	100.0		
Mean= 0.24±1.47								

Ns= not significant at $p<0.05$

Table 3. Mean dietary diversity of the different food groups

Food groups	*Mean(±)SD*
Cereals	0.78±0.29
Vegetables	0.78±0.30
Spices, condiments and beverages	0.76±0.40
Oils and fats	0.67±0.28
Fish, and other sea foods	0.61±0.28
Legumes, nuts and seeds	0.49±0.36
Tubers and roots	0.48±0.36
Fruits	0.45±0.36
Meat	0.35±0.34
Sweets	0.29±0.32
Milk and milk products	0.23±0.29
Eggs	0.15±0.25
Total	6.04±4.18

Table 4. Summary of regression statistics for the predictors of DDS

Variables	*Coefficient*	*Std. error*	*t-statistics*	*Probability*
Constant	1.299	.255	5.103	.000
Birth order	-.008	.035	-.223	.824
Number of children in household	-.018	.061	-.296	.768
Mother's education	.018	.066	.272	.786
Father's education	-.028	.064	-.443	.658
Mother's occupation	-.014	.033	-.435	.664
Family income	.088	.033	2.686	.008*
Family type	-.100	.123	-.814	.416
R squared		0.268		

*Significant at p <0 .05.

showed that family income appeared to be the most attributable determinant of all the socio-demographic variables (8.8%; $p<0.05$) (Table 4).

DISCUSSION

Malnutrition in terms of underweight (2.6%), stunting (8%) and wasting (4.5%) was prevalent among the under-five children. The Nigeria Demographic and Health Survey (NDHS) reported a prevalence of 29%, 37% and 18% for underweight, stunting and wasting, respectively among under-5 children in Nigeria (NPC & ICF, 2014). A lower prevalence of stunting (8%) was obtained in this study compared to 13.7%, 29% and 26.6% reported by the United Nations for the Caribbean region (Martinez & Fernandes, 2006), rural under-5 children in Ouagadougou, Burkina Faso (Chagomoka *et al.,* 2014) and Kenyan children (Nungo, Okoth & Mbugua, 2013), respectively. Stunting or chronic malnutrition is usually an indication of long term deprivation and remains a problem of greater magnitude than underweight or wasting. It more accurately reflects nutritional deficiencies and illness that occur during the most critical periods of growth and development in early life (UNICEF, 2009). The documented prevalence of underweight globally is reported to be 16% among under-5 children (UNICEF/WHO/World Bank, 2012); however, findings from this study indicated that underweight level was low in the study area (2.6%). The rate was much lower than that reported among under-5 children in rural Ouagadougou, Burkina Faso (15%) (Chagomoka *et al.,* 2014).

Individual dietary diversity reflects variability of typical foods consumed by individuals. For the classification of dietary diversity score, a different number of food groups and scoring systems had been used in different countries. The FAO/IFAD/WFP (2013) noted that there are no established cut-off points for low, medium or high DDS. However, there is a consensus that higher DDS is desirable and that a larger number of foods or food groups can help meet daily requirements for a variety of nutrients (Arimond & Ruel, 2002). This study therefore used terciles in ranking the DDS for the under-5 children. Agada & Igbokwe (2015) used 12 food groups and categorised participants in a similar way to this study. Children who fell in the low diversity group in this study were 73.5%, with only 1.3% having high dietary diversity. This indicates that in the previous 24 h, only about a quarter of the children (25.2%) met the minimum dietary diversity score (5 to 8 food groups) and would most likely meet with their adequate nutrient requirement for growth. The low DDS observed among the majority of the under-5 children in this study could be attributed to food insecurity. This is because a previous study (Ukegbu, 2015b) conducted in the same area showed that food insecurity was common in the area with 74.6% of rural households being food insecure. The prevalence of low DDS obtained in this study is similar to that reported among school aged children in Ethiopia (78.9%) (Herrador *et al*., 2015). The result was however slightly different for under-5 children in Ghana, as less than half (47.2%) met their required dietary diversity score (Bandoh & Kenu, 2017). A mean DDS of 6.04 was recorded for the under-5 children in this study, indicating that slightly above a quarter of the children in the study consumed at least 6 out of the 12 food groups studied. Results obtained from other developing countries showed a mean DDS of 4.91 for Filipino children aged 24-71 months using scores of 9 food groups and 4.6 for under-5s in Trinidad and Tobago using 6 food groups (Sealey-Potts & Potts, 2014).

The diet of children was mainly starchy staples consisting of maize, rice, roots and tubers eaten with green vegetable soups/ sauces. The high consumption of starchy staples stems from the fact that the local diet of inhabitants of the study area in the South-East geopolitical zone consists of starchy staples which are often used to prepare traditional dishes like *garri, foofoo* and rice, and are consumed along with soups or sauces of leafy vegetables. Moreover, the study area is a rural one and as such inhabitants engage more in subsistent farming and this could have increased availability of green vegetables in the area. The availability of these green leafy vegetables in the backyard gardens of households could play a critical role as a source of micronutrients, since they form an important part of the diet of people in the South-Eastern part of the country. Small fishes were consumed by the children as part of the staples. Often times, *crayfish* was added to the diet of the children as a source of protein, and this accounted for the high occurrence of fish in the diet. It should, however, be noted that the quantity of ground crayfish added is usually small and is used to enhance the flavour of the meals and may only contribute little to the protein intake of the children.

It was reported that the types of food consumed and the frequency of consumption determines the food security status of individuals (Kotler, 2000). Though, food security status was not assessed in this study, a previous study in the same area reported that during food insecurity, meat and fish were usually excluded from household diets (Ukegbu, 2015). The low occurrence of meat, egg and milk products in the diet of the under-5 children is not surprising, since it is basically a reflection of the diets of rural households in Nigeria which is usually monotonous and less diverse (Akerele *et al*., 2007). The low consumption of these food items by the children indicates that diets in the area constitute very little animal source proteins. The same study observed that when households cannot afford sufficient food, they adjust by either eating less preferred foods or reducing the quantity consumed and this may in turn lead to malnutrition with children suffering the consequences more than other groups in the household (Ukegbu, 2015b). Though, the nutrient intake was not calculated, the diets of these young children may be deficient in some micronutrients which are required for growth and development. Low intake of animal source foods (especially meat, poultry and dairy products) by these children could affect their growth and bioavailability of protein (amino acids). The possible explanation for low consumption of animal source foods (meat, poultry) could be due to economic reasons, which makes it difficult for mothers to purchase and feed their children these expensive food items in such rural setting. A study conducted in the Northern part of Nigeria similarly observed that in rural households, eggs, milk, meat, fruits, and vegetables were the least consumed food groups, while spices and condiments, oil and fat, roots/tubers, cereals and fish were the commonly consumed food groups (Agada & Igbokwe, 2015). Ekesa, Blomme & Garming (2011) also reported low intake of food items from the egg, meat and meat products and milk groups among preschool children in Burundi and the Democratic Republic of Congo.

The significant relationship between DDS and stunting in the children showed that stunted children were more likely to have low DDS. A study among children (6-59 months) in Bangladesh reported an association between dietary diversity and stunting, thus indicating that stunting was a predictor of low DDS (Rah *et al.,* 2010). On the contrary, other studies conducted in Africa: Bukania *et al.* (2014) in children aged 6-36 months in rural Kenya; Udipi & Hooshmand (2013) for rural children aged 6-59 months in rural Mali and Ekesa *et al.* (2011) in the Democratic Republic of Congo showed no association between both variables. On the other hand, a study conducted in rural China, showed that infants and child feeding index was associated with weight-for-length and weight-for-age *z*-scores, but not with HAZ (Zhang *et al.,*2009), due to the low prevalence of stunting (3.2%) in their study and samples consisting of only children aged 6-11 months.

In the multiple regression analysis, the socio-demographic variables shown explained only 26.8% variations for the dependent variable (DDS), out of which 8.8% was accounted for by family income. Hence, DDS in this study population may be influenced by other factors. The relationship between DDS and some socio-demographic related variables is consistent with other reports (Hatloy, Torheim & Oshaug, 2000; Hoddinott &Yohannes, 2002). The positive and significant association between family income with DDS indicates that families with a low income were significantly likely to eat a less varied diet. The result can further be explained by the fact that families with high income may have the economic ability to purchase different types of foods from different food groups. On the contrary, those with low income may only be able to purchase cheaper sources of available food stuffs and this can in turn limit diversification of diet among poor families. This may be the reason why starchy staples dominated diets of the children coupled with the fact that the average monthly family income was low (just about USD50 per month). This income range is lower than USD1 recommended per day for an individual (UNDP, 2002).

Strengths and limitations

A limitation of this study was the use of only one 24-h recall to assess dietary intake. The 24-h recall has, however, been shown to be useful at population level in monitoring the progress of interventions in various groups or target interventions (Gewa, Murphy & Neumann, 2007). Another limitation is that diets of the children were analysed qualitatively and not quantitatively. However, DDS has been validated as a useful tool to assess the likelihood of meeting micronutrient requirements.

CONCLUSION

The study showed that only a quarter of the under-5 children met the minimum dietary diversity. Cereals, vegetables, small fishes and beverages were the predominant food groups consumed over a 24-h period. Children with low DDS were more likely to be stunted. The low diversity of the children's diet shows a need to increase consumption of nutrient dense foods in order to improve nutritional status of the children. Family income significantly and positively predicted DDS of the children. Continuous nutrition education and agricultural extension services programs to promote consumption of micronutrient rich foods, dietary diversity and overall health should be encouraged in the communities.

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Conflict of interest

The authors declare that there is no conflict of interest.

REFERENCES.

Agada MO & Igbokwe EM (2015). Dietary diversity of rural households in North Central Nigeria. *Eur J Nutr Food Safety* 5(3): 150-155.

Akerele D, Sanusi RA, Fadare OA & Ashaolu OF (2017). Factors influencing nutritional adequacy among rural households in Nigeria: How does dietary diversity stand among influencers? *Ecol Fd Nutr* 56: (2)187-203.

Arimond M & Ruel MT (2002). Progress in developing an infant and child feeding index: an example using the Ethiopia Demographic and Health Survey 2000. *Food Cons Nutr Div Discussion Pap* 143: 2002.

Arimond M & Ruel MT (2004). Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. *J Nutr* 134: 2579–2585.

Bandoh DA & Kenu E (2017). Dietary diversity and nutritional adequacyof under-fives in a fishing community in the central region of Ghana. *BMC Nutr* 3(2): 1-6.

Bukania ZN, Mwangi M, Karanja RM, Mutisya R, Kombe Y, Kaduka LU & Johns T (2014). Food insecurity and not dietary diversity is a predictor of nutrition status in children within semiarid agro-ecological zones in Eastern Kenya. *J Nutr Metab* 14: 907153.

Chagomoka T, Drescher A, Glaser R, Marschner B, Schlesinger J & Nyandoro G (2016). Women's dietary diversity scores and childhood anthropometric measurements as indices of nutrition insecurity along the urban-rural continuum in Ouagadougou, Burkina Faso. *Food Nutr Res* 60:*29425 http://dx.doi.org/10.3402/fnr.v60.29425.*

Ekesa BN, Blomme G & Garming H (2011). Dietary diversity and nutritional status of preschool children from MUSA-dependent households in Gitega (Burundi) and Butembo (Democratic Republic of Congo). *Afr J Food Agri Nutr Dev (AJFAND*) 11: 4896-4911.

FANTA (2011). Anthropometry: Children under 5. Washington, DC: FANTA II Project. Food and Nutrition Technical Assistance.

FANTA (2013). Module 2. Nutrition Assessment and cCassification. Nutritional Assessment, Counseling and Support (NACS): A user's guide. Food and Nutrition Technical Assistance III project, Washington, DC.

FAO (1990). Conducting Small Scale Nutrition Surveys: A Field Manual. Nutrition in Africa, No 5. Rome. Policy and Nutrition Division.

FAO (2007). Guidelines for Measuring Household and Individual Dietary Diversity. FAO Nutrition and Consumer Protection Division, with Support from the EC/FAO Food Security Information for Action Programme and the Food and Nutrition Technical Assistance (FANTA) Project.

FAO/IFAD/WFP (2013). The State of Food Insecurity in the World 2013: The Multiple Dimensions of Food Security. Rome: Food and Agriculture Organization of the United Nations.

Gewa CA, Murphy SP & Neumann CG (2007). Out-of-home food intake is often omitted from mothers' recalls of school children's intake in rural Kenya. *J Nutr*137(9): 2154-9.

Gibson, RS (2005). Principles of Nutritional Assessment (2nded.) Oxford University Press, New York.

Hatloy A, Torheim LE & Oshaug A (2000). Food variety - a good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa. *Eur J Clin Nutr* 52: 891–898.

Herrador Z, Perez-Formigo J, Sordo L, Gadisa E, Moreno J, Benito A & Custodio E (2015).

Lowcdietary diversity and intake of animal source foods among school aged children incLiboKemkem and Fogera Districts, Ethiopia. *PLoS ONE* 10(7): e0133435. doi:10.1371/journal.pone.0133435.

Hoddinot J & Yohannes Y (2002). Dietary diversity as household food security indicator. *FoodcCons Nutr Div Discu Paper* No. 136. International Food Policy Research Institute (IFPRI).

Kotler, DP (2000). Body composition studies in HIV-infected individuals. *Annals of the New York Academy of Sciences* 904: 546–552.

Martinez R & Fernandez A (2006). Child malnutrition in Latin America and the Caribbean. Economic Commission for Latin America and the Caribbean (ECLAC), United Nations Children's Fund (UNICEF). *Challenges* 2: 1-12.

Martin-Prevel Y, Becquey E, Taosoba S, Castan F& Coulibaly D (2012). The 2008 food price crisis negatively affected household food security and dietary diversity in urban Burkina Faso. *J Nutr* 142: 1748-1755.

Mirmiran P, Azadbakht L, Esmaillzadeh A & Azizi F (2004). Dietary diversity score in adolescents - a good indicator of the nutritional adequacy of diets: Tehran lipid and glucose study. *Asia Pac J Clin Nutr* 13: 56-60.

National Population Commission (NPC) [Nigeria] and ICF International (2014). Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, Rockville, Maryland, USA.

NPC (2006). Population and Housing Census of the Federal Republic of Nigeria.

Nungo RA, Okoth MW & Mbugua SK (2013). Nutritional status of children under five years in cassava consuming communities in Nambale, Busia of Western Kenya. *Food Nutr Sci* 3: 796-801.

Rah JH, Akhter N, Semba RD, de Pee S, Bloem MW, Campbell AA, Moench-Pfanner R, Sun K, Badham J & Kraemer K (2010). Low dietary diversity is a predictor of child stunting in rural Bangladesh. *Eur J Clin Nutr* 64: 1393–1398.

Ruel MT (2003). Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. *Food Nutr Bull* 24: 231–232.

Sanusi RA (2010). An assessment of dietary diversity in six Nigerian States. *Afr J Biomed Res* 13: 161 -167.

Sealey-Potts C & Potts AC (2014). An assessment of dietary diversity and nutritional status of preschool children. *Afr J Nutr Food Sci* 2(7): 1040.

Udipi SA & Hooshmand S (2013). Dietary diversity and nutritional status of urban primary school children from Iran and India. *J Nutr Disorders* S12:001. doi:10.4172/2161-0509.S12-001.

Ukegbu PO (2015a). Breakfast eating habits and nutritional status of primary school children in Orumba South LGA of Anambra State, Nigeria. *Mal J Nutr* 21(3): 299-307.

Ukegbu PO (2015b). Food security status and coping strategies of rural households with of under five children in Mbaise LGA of Imo State. *Nig J Nutr Sci* 36(1): 95-104.

UNICEF (2009). Tracking Progress on Child and Maternal Nutrition. UNICEF, New York, USA.

UNICEF/WHO/The World Bank (2012). Joint Malnutrition Estimate UNICEF, New York; WHO, Geneva; The World Bank, Washington, DC.

United Nations Development Programme (UNDP) (2002). Kenyan Human Development Report: Addressing Social and Economic Disparities. Nairobi, Kenya, UNDP.

WHO (2013). Guideline: updates on the management of severe acute malnutrition in infants and children. Geneva.

Wirt A & Collins CE (2009). Diet quality–what is it and does it matter? *Public Hlth Nutr* 12: 2473-2492.

Zhang J, Shi L, Wang J & Wang Y (2009). An infant and child feeding index is associated with child nutritional status in rural China. *Early Hum Dev* 85: 247–252.