Demand for Diverse Diets: Evidence from Nigeria

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Abstract

Consumption of diverse diets is an important factor in promoting good health and nutrition. Most of the studies on food demand in developing countries focused largely on the quantity consumed of specific foods or food-groups with marginalized attention on dietary diversity. This study examines the extent of food consumption diversity and the factors influencing demand for diverse foods in Nigeria using micro-data on 18191 households. The transformed versions (logistic transformation) of Berry and Entropy measures of dietary diversity were used as regressands in the econometrics models employed for analysis. Low-income households and households whose heads are females or without formal education have lower than the norm in terms of diversity in food consumption. Income, food prices (captured by food price index), access to remittance, educational attainment up to secondary school, sex of household head and spatial factors are important determinants of demand for varied diets. Income improvement strategy, renewed emphasis on nutrition education especially in secondary schools, efforts to curtail food price inflation and sensitively-guided gender-based interventions are advocated, among others. Findings call for evaluation of the extent to which policy actions in agriculture and other relevant sectors weaken or advance diet diversity in order to devise holistic strategies for nutrition and health.

Key words: Food diversity, dietary quality, Berry and Entropy measures, food and nutrition interventions

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Introduction

Much of the empirical literature on food consumption behaviour among households in developing countries, especially in Africa have focused more on the quantity consumed of individual foods or food groups and their determinants. Diversity in food consumption and its causal factors is less studied. Paucity of empirical studies on what influences demand for food diversity among households could be partly responsible for why most African countries still domiciliate large number of malnourished population (Pinstrup-Andersen, 2009) despite the various policy actions to enhance food security and nutrition. In his view of the reasons for the limited success (slow progress) of programmes directed at addressing food insecurity and related concerns in many developing countries (Nigeria inclusive), Clover (2003) linked poor performance of interventions to faulty actions and incorrect analysis; which apparently, from demand side appraisal, include marginalization or complete overlook of other dimensions of food security (Pinstrup-Andersen, 2009; Barrett, 2010) such as food consumption diversity.

The diets of many households in Africa are predominantly plant-based, consisting largely of starchy staples (which contain low number of micro-nutrients that are often not easily absorbed) with little or no proteins of animal origin and few fresh fruits and vegetables (Arimond and Ruel, 2004)). Understanding diversity in food consumption is crucial in various areas. A varied diet is generally conceived by nutritionists as an essential component of high-quality diet; having high correlation with adequate of intake of protein and micro-nutrients as well as prevention of excessive intake of other nutrients such as fat and chronic diseases (Ruel, 2002; Johns and Sthapit, 2004). Inadequate intake of micro-nutrients is well pronounced in many developing countries leading, among others, to impaired cognitive development, blindness especially among children, heightened morbidity, and in severe cases, mortality. Poor immune functioning and high susceptibility to infectious diseases are also among the well known debilities associated with protein intake deficiency. Performance of interventions aimed at addressing some of these nutrition related health problems can be enhanced with better knowledge of the extent of diversity in food consumption and the factors responsible for the diversity. Given that consumption of diverse diets is related to nutritional quality and reduction of a plethora of health challenges, studies on demand for food variety would have far-reaching implications for the stock of human resources of a nation in terms of people's health Schultz (2001), labour productivity or wage earning capability and ability to contribute to the socioeconomic development of the nation. Following the macroeconomic view that consumption expands along consumers hierarchy of wants in the process of economic growth, Thiele and Weiss (2003) notes that consumption of more diverse products (food products inclusive) plays a crucial role in the process of long-run economic growth and development.

Information on food consumption diversity could guide food-processing industries on the variety of convenience foods to produce, as well as the marketing strategies to employ in order to meet consumers' needs (Thiele and Weiss, 2003) in different segments of the population. Besides, such knowledge could provide opportunities for farmers to increase earnings from agriculture. Some farmers who have predominantly engaged in the production of a particular crop may, in a bid to respond to consumers' needs for food varieties, diversify into production of other crops or livestock especially if such shifts in farm structure would stimulate higher farm profits. Improvement in farm earnings may also induce higher demand for non-agricultural goods and services in the rural areas. In response to the demands for these non-agricultural goods and services, some rural households may establish small businesses; thereby creating more employment opportunities and increased income for rural folks.

A number of empirical studies that examined the relationship between consumption of

diverse diets and some causal factors found, among others, income (although with very low impact), age, household composition, education, sex, and food prices and spatial factors (Moon et al., 2002; Moursi et al., 2008; Rashid et al., 2011; Taruvinga et al., 2013; Hirvonen and Hoddinott, 2014) as important predictors of dietary diversity. The main objective of the study is to examine the extent of diversity in household diets and its associated determinants in Nigeria. Specifically, the role of food prices (captured by general price index), income, access to remittance, household idiosyncratic characteristics and spatial/regional factors in influencing demand for diverse foods are examined. An understanding of the relationships between these variables/factors and diversity in food consumption could offer useful information on how policy levers can be controlled for better performance of food and nutrition related programmes.

Dietary diversity is broadly defined as "the number of different foods or food groups consumed over a reference period"(Ruel, 2002). Based on this definition, a number of studies have constructed a one-dimensional index to measure the degree of food consumption diversity by summing-up the number of individual/specific foods or food groups consumed by households/individuals in a given locality over a specified period. Although this approach is relatively simpler to compute and understand, it is nevertheless plagued with a number of limitations as it fails to account for the distribution of individual food items or food groups consumed. Since no weights are attached to food commodities, simple food or food-group counts leaves a vague idea of the health/nutritional contents of the food basket of the households as different food items contains different nutritional information. Among studies that followed the one-dimensional index, simple food or food group counts approach are (Ruel, 2002; Sanusi, 2010; Taruvinga et al., 2013; Hirvonen and Hoddinott, 2014). The second (two-dimensional index) approach measures dietary diversity by taking into cognizance both the number of different foods or food-groups consumed and their relative contributions (evenness of food consumption shares) in the total food spending-thus overcoming the limitation of the simple count approach. This approach was used by Thiele and Weiss (2003) who constructed both Berry and Entropy Measures based on individual foods and Lee and Brown (1989) and Das (2014) on food-group basis. Even though a number of findings suggest that food-groups could predict nutrient intake adequacy in the same way as, or better than individual foods (Hatløy et al., 1998; Ruel, 2002; Hoddinott and Yohannes, 2002; Torheim et al., 2004), the literature still appear inconclusive as to whether individual foods or food-groups should be used while assessing dietary diversity. The second objective is therefore to construct dietary diversity measures based on individual foods as well as on food-groups to see whether econometrics analysis would establish similar results. The Berry and Relative Entropy measures of food diversity are also computed respectively for individual foods and food-groups in order to ascertain the robustness of results since the two measures are sensitive to small changes in food consumption diversity at the upper and the bottom tails of the food expenditure distribution respectively[1]. The remainder of the paper is organized as follows. The next section describes the data for the study. Thereafter, the measures of dietary diversity and specification of econometrics models are presented. Results and discussion are presented in the following section while the conclusion and policy recommendations are covered in the last section.

[1]Changes in food consumption variety at the upper and the lower tails of the food expenditure distribution relates to the dominant foods (foods with larger expenditure shares) and minor foods (having lower expenditure shares) in the household's food baskets respectively. Berry index attaches higher weights to food items that are dominant while the Entropy Index ascribe larger weights to the minor foods.

Description of Data

The data used for is extracted from the Nigeria Living Standard Survey (NLSS) 2003/2004 data collected by the National Bureau of Statistics(NBS), Nigeria. The survey covered a total of 19158 households (from rural and urban sectors) across the 36 states of Nigeria sampled through a two-stage stratified sampling technique from September, 2003 to August 2004 using questionnaire as interview guide. However, a total number of 18191 households were used for analysis after data cleaning. Although data were collected on different areas of household livelihoods, data on expenditures on food commodities purchased in the markets, quantities of foods consumed out of what the household produced ("own-consumed foods"), the amount (price) each of the own-consumed food items could be sold for in the market (used as proxy for the market price of the food items), food price index (already computed by NBS), the sector (rural/urban) and geopolitical zones where household belongs, household demographic variables and non-food expenditure. In some cases where the proxy price of a food item was not recorded by household, the average of the proxy price estimated from the proxy price of that particular food item reported by households in the same sector was computed and applied as the market price for that food item. Food consumption (expenditure) data were collected from each household on a weekly basis over a period of six consecutive weeks during the survey period. Food records were collected on weekly basis to fend-off some of the challenges associated with memory recall. The six weeks period survey period form the dietary reference period used in this study. The values of own-consumed foods were computed and added to the corresponding expenditures on foods purchased to obtain the total spending on foods. Total expenditure on food was added to the non-food expenditure to obtain total expenditure used as proxy for household income. For the purpose of analysis, all food items were aggregated into thirteen food subgroups namely: cereals, beans and pulses, roots and tubers, seafood, meat, eggs; milk and dairy products, beverages, sweeteners, fruits, vegetables, fats and oils, and a miscellaneous category. Classification was aided by previous studies on food consumption and nutrition in the country (Oguntona and Akinyele, 1995; Maziya-Dixon et al., 2004; Obayelu et al., 2009). Information on individual food items that constitute the food-groups are indicated in table 1.

Broadly, the data on food intake/consumption and food purchases have been used in the literature while measuring food diversity. There are also no consensus as to the particular (established standard) reference period to use while studying dietary diversity. Some studies relied on the food intake/consumption records and used a reference period of one to three days (Hoddinott and Yohannes, 2002), seven days (Food and Agriculture Organization (FAO), 2011), 15 days (Drewnowski et al., 1997) and up to one month period for some food commodities (Hoddinott and Yohannes, 2002). Using food intake (consumption frequencies) data collected on daily, weekly, and monthly basis, Moon et al. (2002) also found that the length of time (reference period) for consumption is a crucial component in evaluating demand for varied diets. The concerns for food consumption infrequency is partly responsible for the difficulty in establishing a standard reference period. Among the studies that have used the records of data on food purchases include Lee and Brown (1989), Moon et al. (2002), Thiele and Weiss (2003), Rashid et al. (2011) and Das (2014) with survey period spanning between 1 and 2 weeks. These studies are also unshielded from the challenge of infrequency of purchase especially if the reference (survey) period is relatively shorter in comparison with the shelf lives of some food products. Households might report zero expenditures on foods (for example grains, vegetable oils and certain canned foods) during survey period because the purchase cycles of the food items fall outside the survey (reference) period. Even for food items that are

highly perishable such as fruits and vegetables, their shelf-lives might be up to two or three weeks (Sammi and Masu, 2009). Bearing in mind the issue of purchase infrequency, and the possibility of some food items such as grains (not to be purchased) within a month since their shelf lives could extend beyond a month, a six-week period is considered generally to be fair enough for households to accommodate consumption or spread expenditure over the range of food products or food-groups they would consume in the absence of economic, availability, health or other household idiosyncratic constraints.

Dietary Diversity Measures and Model Specification

As earlier mentioned, the Berry index and Relative Entropy measure are used in evaluating the degree of diversity in food consumption. The values of both Berry and relative Entropy index range between zero and unity. The higher the value of the index, the greater the degree of diversity in food consumption. If a household consumes a single food item or a classified food-group, the Berry diversity index is zero and comes close to unity if the household's total food spending is spread equally among a number of foods. Likewise, the Relative Entropy index yields a score of zero if household consumes a single food item and becomes higher with greater levels of food diversification.The Berry Index (BI_j) (Berry, 1971) for each household is specified as

$$BI_j = 1 - \sum_{i=1}^{N} w_{ij}^2 \tag{1}$$

where w_{ij} is the expenditure share of food commodity i consumed by household j. $w_{ij} = \frac{T_{ij}}{\sum_{i=1}^{n} T_{ij}}$ and T_{ij} is the amount on money (in Naira) spent on food commodity i by household j over the reference period. N is the total number of food items. For this study, N=133 if index is constructed from individual foods or 13 if constructed from food-groups. The Relative Entropy Index (REI_j)[2] for each household is also stated as

$$REI_j = \frac{-\sum_{i=1}^{N} w_{ij} ln\left(w_{ij}\right)}{ln\left(N\right)} \tag{2}$$

The Relative Entropy index derives from the Entropy Index $\left[-\sum_{i=1}^{N} w_{ij} ln\left(w_{ij}\right)\right]$ (Shannon, 1948). The Entropy Index has an undesirable feature in that it is undefined when there are zero food expenditures. For this limitation, the index cannot be estimated directly. Rather, it is computed by replacing the zero expenditures with discretionary (very small) expenditures. However, if zero expenditures are replaced with very small arbitrary values, the Entropy Index approaches its maximum value of ln(N)(Bellù and Liberati, 2006). The maximum value ln(N) is therefore used as the denominator in the Relative Entropy Index formulation (equation 2) to obtain an index whose value ranges between zero and 1. Given that the values of the dietary diversity measures fall within zero and unity, one may be doubtful of the normality assumption. In addition, one may be interested in an estimator that ensures the predicted values for the measures (Berry and Relative Entropy Index) are within the interval of zero and one. The study follows the conventional logistic (logit model) transformation (Greene, 1997, p. 227) of the Berry and Relative Entropy as used by Thiele and Weiss (2003). Consequently, the transformed measures (variable) become $TBI_j = ln\left(\frac{BI_j}{1-BI_j}\right)$ and $TREI_j = ln\left(\frac{REI_j}{1-REI_j}\right)$for

[2]"The ratio of the entropy of a source to the maximum value it could have while still restricted to the same symbols will be called its relative entropy" (Shannon, 1948).

Berry and Entropy measures respectively. Where TBI is the transformed Berry Index and $TREI$ is the transformed Relative Entropy Index. TBI and $TREI$ (for individual foods and on food-group basis) are used as response variables in the econometric models employed, and the statistical test (independent sample t-test[3]) of difference of means between the dietary diversity of some selected vulnerable households and other household groups conducted in this study. There exist very strong positive correlation between Berry Index and Relative Entropy measure for the 18191 households with coefficients of correlation being 0.951 and 0.91 for food diversity index based on food groups and individual foods respectively (Figure 2). Figure 2 also suggests existence of inter-household heterogeneity in food consumption diversity. Whether the between-household variations in the degree of food consumption variety can be explained by some key economic decision variables, household demographic characteristics and community/spatial factors are analyzed using the Ordinary Least Square Regression. The dietary/food diversity model is specified for the Transformed Berry Index as

$$TBI_j^V = \alpha + \beta_1 X_{1j} + \beta_2 X_{2j} + ... + \beta_k X_{kj} + \varepsilon_j \tag{3}$$

and for the transformed Relative Entropy Index as

$$TREI_j^V = \alpha + \beta_1 X_{1j} + \beta_2 X_{2j} + ... + \beta_k X_{kj} + \varepsilon_j \tag{4}$$

where α and β_1 to β_k are parameters to be estimated, X_1 to X_k are the explanatory variables while $\varepsilon_j$is the error term assumed to be normally distributed with zero mean and constant variance. ($V = 1, 2$). When $V = 1$, analysis relates to the individual foods and when $V = 2$, it relates to the case of food-groups. It follows therefore that four regression models were estimated in this study. Description of the variables used in the econometric models are presented in table 2.

Results and Discussion

The results of food consumption diversity among some selected vulnerable household groups are presented in table 3 while that of the t-test for comparing the mean dietary diversity index (scores) of the vulnerable households and counterpart household cohorts are presented in table 4. The results of the econometrics analysis of the determinants of demand for diverse diets are presented in table 5. Vulnerable groups such as the low-income households, households headed by females, and households whose heads are without formal education or those with large members have greater needs for more diverse foods as their dietary diversity values are lower than the mean dietary diversity scores for the entire sample households. The t-tests show that the dietary diversity (index) scores of the selected vulnerable households are significantly lower than that of counterpart household groups. Priority should be given to these household groups while devising food and nutrition interventions.

The regression results show that income exerts significant positive influence on diet diversity. The quadratic term of income is also statistically significant with a negative sign. This is suggestive of a non-linear Engel curve for the relationship between household income and food consumption variety. This implication is that although increases in income will stimulate demand for a varied foods, demand would rise at a declining rate as household income grows. Food price exerts negative influence on demand for diverse foods, suggesting that households

[3]Details of independent samples t-test of difference of means for equal or unequal sample sizes, and with equal or unequal variance are available in textbooks on statistics and will not be discussed further here.

would consume less diverse diets in the event of a general rise in food prices. Demand for varied foods or food-groups is likely to be higher among households in urban areas than in rural areas. The geopolitical zones where households belong (which reveals cultural differences among the people) has significant influence on consumption behaviour. Households in the South-East and South-South zones of the country would demand for more diverse diets than those in other zones. Female-headed households are much more likely to consume more varied diets than households headed by males. The could be indicative of role women could play in enhancing the quality of food consumed by the households if empowered and given more resources (income). Household composition is found to exert significant impact on demand for diverse diets. Presence of of school-age children or adolescents in the household would lead to lower demand for food variety. This has implications for the quality of diets consumed by members of these household groups particularly the school age children and the adolescents who are still actively growing and requiring more protein and micro-nutrients for body functioning. While primary school eduction appears to have a significant effect on the demand for food-group variety, it does not have influence on diversity in the consumption of individual foods. Secondary school educational level has significant positive influence, whereas education attainment above secondary schooling would not affect demand for dietary diversity significantly. Households whose heads are above forty-five years of age would exhibit less demand for diverse foods than other household cohorts. Those receiving remittance are likely to consume more divers food than non-recipient households. This lends support to the importance of remittance in stimulating food consumption diversity.

Conclusion and Recommendations

The study sought to examine the influence of some economic variables (income and price), household demographic characteristics and community/regional factors on consumption of varied foods in Nigeria using household survey data from the National Bureau of Statistics. The Berry and Entropy measures of food diversity were constructed and employed as the dependent variables in the econometric model used for analysis. The results of t-tests suggest that low-income households and households whose heads are females or without formal education are in greater need of diverse diets compared to the other household groups. Results of econometrics analysis of the regression model involving the Berry and Entropy measures of diversity (for individual foods and food-groups) consistently reveal food prices and income as economic factors influencing demand for diverse foods, exerting negative and positive influence respectively. While the specificity of being in a rural area could raise consumption of varied food-groups, it is unlikely to strongly stimulate diversity in individual food consumption. Access to remittance would raise consumption of diverse foods and the presence of school-age children and adolescents could result in lower demand for food variety. Educational attainment up to secondary school is crucial for inducing consumption of diverse foods. The sex of household head and spatial factors are also important determinants of demand for varied diets. Income improvement strategy, renewed emphasis on nutrition education especially in secondary schools, efforts to curtail food price inflation and sensitively-guided gender-based interventions are advocated, among others. Findings call for evaluation of the extent to which policy actions in agriculture and other relevant sectors weaken or advance diet diversity in order to devise holistic strategies for nutrition and health.

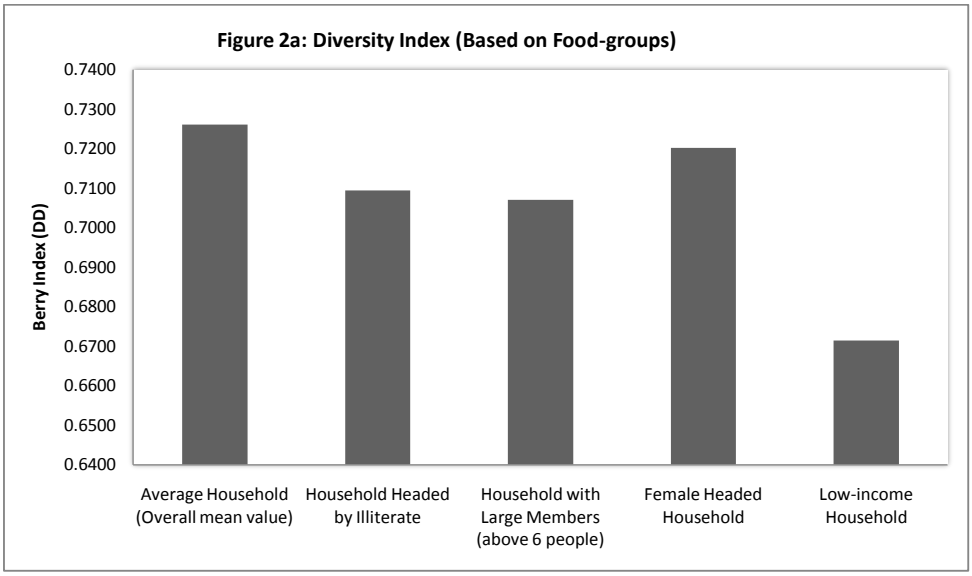
Table 1: Definition of Food Aggregates

Food-groups	Specific food items
Cereals	Guinea corn, Millet, Maize (white), Maize (yellow), Sorghum, Maize flour, Buns, Rice(local), Rice (agric), Rice (imported), Cooked rice/stew, Wheat flour, Biscuits, Bread, Corn flour, Millet flour, other grains, other (grain) flour.
Beans and Pulses	Beans (brown), Beans (white), Soya beans, Moinmoin, Kulikuli (groundnut cake), Akara (bean cake) Bambara beans, Cowpeas, Ground nut, Other pulses.
Roots and Tubers	Yam flour, Cassava flour, Plantain flour, Cassava, Cocoyam, Plantain, Tuwo/soup, Yam tuber, Other root/tubers; Other starchy products, Sweet potato, Fufu, Fufu/soup, Gari (yellow), Gari (white), Gari/soup, Cassava (akpu), , Amala/soup, Pounded yam/soup.
Meat	Chicken, Duck, Guinea fowl, Other poultry, Game bird, Beef fresh, Mutton, Pork, Bush meat, Goat meat, Snails, Other meat (skinned meat), Corn beef.
Seafood	Crabs/Lobster, Fresh fish, Smoke fish, Frozen fish, Dried fish, Fried fish.
Eggs	Egg (agric), Local eggs, Other eggs
Milk and Dairy Products	Fresh milk, Milk (powder) , Baby milk, Other milk products,Tin milk,
Beverages	Coffee, Chocolate drinks, Tea,Beer, Stout, Palm wine, Pitto, Apteshi/Spirit, Pineapple juice, Orange juice, Fruit juice, Maltina /Malt drink, Minerals, Gin, Other canned juice, Other wine(local/imported), Other alcoholic Beverages
Sweeteners	Jam, Honey, Confectionery (not frozen), Ice cream, Others (sweets)
Fruits	Avocado pear, Banana, Mango,Pineapple, Orange, Water melon, Pawpaw, Other canned vegetables, Other fruit (canned).
Vegetables	Cocoyam leaves, Garden eggs, Okra fresh, Okro dry, Onion/Sallot, Tomato, Pepper (green), Cabbage/lettuce, Tomato puree, Other vegetables (leafy vegetables),
Fat and Oils	Animal fat, Shear butter, Margarine, Coconut oil, Ground nut oil, Palm kernel oil, Palm oil,Vegetable oil
Miscellaneous category	Cashew nut, Other oil seeds and nuts, Other seeds/nuts, Dawadawa (locust beans) Coconut, Palm nut, Kolanut, Other restaurant meals, Other foods (not beverage)

Table 2: Definition and Descriptive Statistics of Variables Used for Analysis

Variables and there definitions)	Minimum	Maximum	Mean	Standard Deviation
Total Number of Individual Food-groups	2.00	13.00	8.58	2.41
Total Number of Individual Foods	2.00	64.00	18.55	8.04
Berry Index (Dietary Diversity Based on Food-groups)	0.01	0.90	0.73	0.14
Berry Index (Dietary Diversity Based on Individual Foods)	0.02	0.97	0.85	0.10
Transformed Berry Index (Dietary Diversity Based on Food-groups)	-4.49	2.21	1.05	0.68
Transformed Berry Index (Dietary Diversity Based on Individual Foods)	-4.14	3.37	1.85	0.67
Entropy Index Dietary (Diversity Based on Food-groups)	0.00	0.93	0.64	0.15
Entropy Index (Dietary Diversity Based on Individual Foods)	0.01	0.75	0.48	0.10
Transformed Entropy Index (Dietary Diversity Based on Food-groups)	-4.30	2.63	0.62	0.71
Transformed Entropy Index (Dietary Diversity Based on Individual Foods)	-4.65	1.10	-0.11	0.47
Sector, Dummy (1 if Urban, 2 if Rural)	1.00	2.00	1.78	0.42
Food Price Index	0.10	1.77	1.08	0.23
South South Zone, Dummy (1 if the household belongs to zone, zero otherwise)	0.00	1.00	0.16	0.36
South East Zone, Dummy (1 if the household belongs to zone, zero otherwise)	0.00	1.00	0.15	0.35
South West Zone, Dummy (1 if the household belongs to zone, zero otherwise)	0.00	1.00	0.16	0.36
North Central Zone, Dummy (1 if the household belongs to zone, zero otherwise)	0.00	1.00	0.16	0.36
North East Zone, Dummy (1 if the household belongs to zone, zero otherwise)	0.00	1.00	0.18	0.38
North West Zone, Dummy (1 if the household belongs to zone, zero otherwise)	0.00	1.00	0.21	0.41
Sex of Household Head, Dummy (1 if male, 2 if female)	1.00	2.00	1.14	0.34
Monthly Per Capita Income (Naira) (Proxied by Total Expenditure divided by the Household size)	200.00	160,350.40	1,199.33	2,689.77
Monthly Per Capita Income Squared	40000.00	25,712,251,315.00	8,672,843.73	252,216,951.71
Presence of School Age Children (Children less than 6 years), Dummy (1 if present, zero otherwise)	0.00	1.00	0.50	0.50
Presence of Adolescents (Children between 12 -18 years), Dummy (1 if present, zero otherwise)	0.00	1.00	0.45	0.50
Presence of Infant (Children less 6 years), Dummy (1 if present, zero otherwise)	0.00	1.00	0.44	0.50
Household head has only primary school education, Dummy (1 if has, zero otherwise)	0.00	1.00	0.29	0.45
Household head has only secondary school education, Dummy (1 if has, zero otherwise)	0.00	1.00	0.26	0.44
Household head has tertiary education, Dummy (1 if has, zero otherwise)	0.00	1.00	0.27	0.44
Age of Household head falls between 31 and 45 years, Dummy (1 if between, zero otherwise)	0.00	1.00	0.37	0.48
Age of Household head is between 46 and 60 years, Dummy (1 if between, zero otherwise)	0.00	1.00	0.32	0.47
Age of Household head is above 60v years, Dummy (1 if above, zero otherwise)	0.00	1.00	0.17	0.38
Household received remittance, Dummy (1 if received, zero otherwise)	0.00	1.00	0.06	0.23

Figure 1: Mean Dietary Diversity (Berry) Index (Scores) of Vulnerable Household Groups



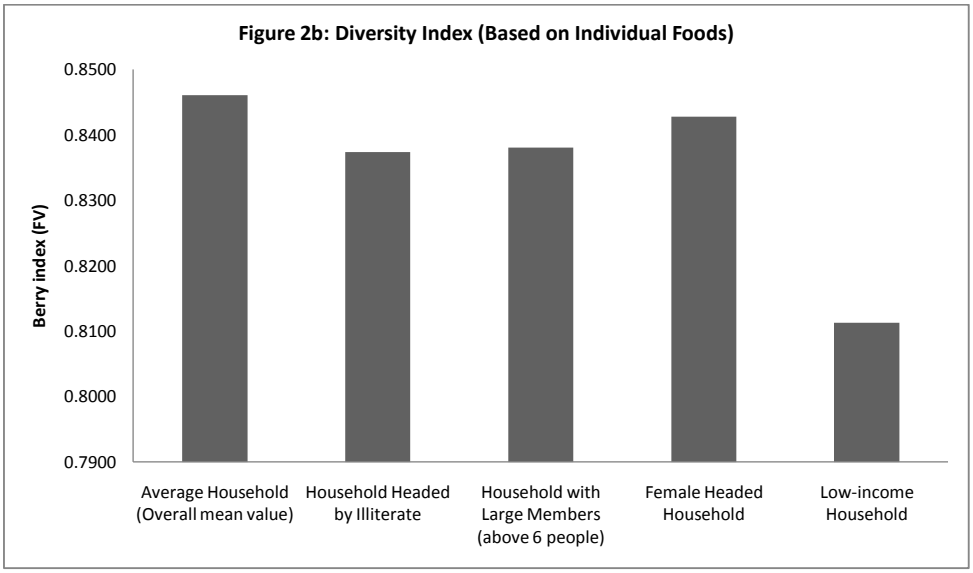


Table 3: Independent Samples Test of Comparison Between the Mean Dietary Diversity Index (Scores) of Vulnerable Household Groups and Counterpart Household Cohorts

Constructed Measures of DDI	Mean DDI (Scores) of VHG	Mean DDI (Scores) of CHG	t-value
	Household whose head had no formal education	Household whose head had a formal education	
Berry Index (BFG)	0.7094	0.7409	-15.619
Relative Entropy Index (BFG)	0.6172	0.6599	-19.200
Berry Index (BIF)	0.8374	0.8538	-10.764
Relative Entropy Index (BIF)	0.4597	0.4886	-18.889
	*Household with Large Members	Other households	
Berry Index (BFG)	0.7070	0.7320	-10.288
Relative Entropy Index (BFG)	0.6211	0.6457	-9.341
Berry Index (BIF)	0.8381	0.8486	-5.794
Relative Entropy Index (BIF)	0.4678	0.4773	-5.226
	Female Headed Household	Male Headed Household	
Berry Index (BFG)	0.7203	0.7629	-17.228
Relative Entropy Index (BFG)	0.6334	0.6807	-16.517
Berry Index (BIF)	0.8428	0.8669	-12.271
Relative Entropy Index (BIF)	0.4706	0.5031	-15.480
	Low Income Household	High Income Household	
Berry Index (BFG)	0.6714	0.7704	-42.388
Relative Entropy Index (BFG)	0.5733	0.6952	-48.326
Berry Index (BIF)	0.8113	0.8737	-34.744
Relative Entropy Index (BIF)	0.4306	0.5125	-46.967
	Aged (60 years and above)	Below 60 years	
Berry Index (BFG)	0.7361	0.7241	4.709
Relative Entropy Index (BFG)	0.6480	0.6382	3.364
Berry Index (BIF)	0.8506	0.8452	2.773
Relative Entropy Index (BIF)	0.4807	0.4739	3.296

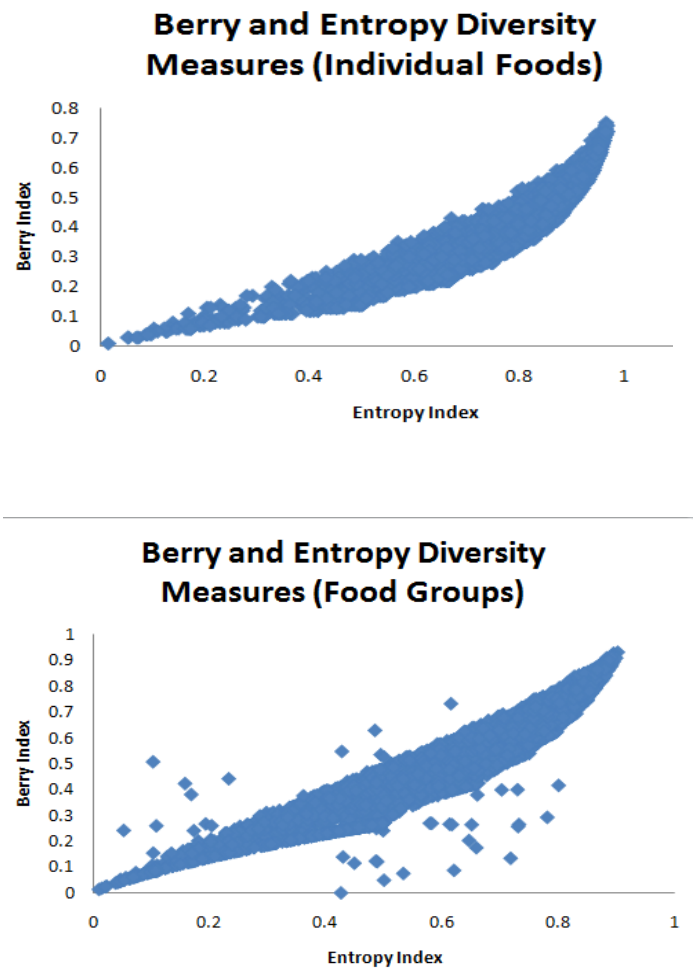
Note: VHG=Vulnerable Household Groups; CHG= Counterpart Household Groups; BFG=Based on Food-Groups; DDI=mean Dietary Diversity Index; BIF=Based on Individual Foods; *Household with more than 6 people

Table 4: Regression Results of Factors Influencing Diversity in Consumption of Individual Foods or Food-Groups

	TBI (Dietary Diversity for FG)			TREI (Dietary Diversity for FG)			TBI (Dietary Diversity for IF)			TREI (Dietary Diversity for IF)		
Variables	coeff.	t-value	p-value	coeff.	t-value	p-value	coeff.	t-value	p-value	coeff.	t-value	p-value
(Constant)	1.648	26.050	0.000	1.327	20.262	0.000	2.548	40.690	0.000	0.426	9.879	0.000
Sector (rural dummy)	-0.047	-3.728	0.000	-0.075	-5.679	0.000	-0.024	-1.928	0.054	-0.006	-0.692	0.489
Food Price Index	-0.351	-9.537	0.000	-0.369	-9.676	0.000	-0.459	-12.590	0.000	-0.365	-14.540	0.000
South East	0.010	0.510	0.610	0.053	2.674	0.007	0.067	3.567	0.000	0.062	4.760	0.000
South West	-0.140	-6.742	0.000	-0.258	-12.024	0.000	-0.212	-10.332	0.000	-0.218	-15.441	0.000
North Central	-0.436	-17.587	0.000	-0.554	-21.566	0.000	-0.552	-22.486	0.000	-0.454	-26.839	0.000
North East	-0.282	-10.624	0.000	-0.343	-12.509	0.000	-0.413	-15.750	0.000	-0.338	-18.717	0.000
North West	-0.505	-19.778	0.000	-0.575	-21.750	0.000	-0.441	-17.459	0.000	-0.378	-21.730	0.000
Sex (female dummy)	0.085	5.706	0.000	0.066	4.252	0.000	0.059	4.001	0.000	0.035	3.432	0.001
Per Capita Income	4.25e-5	15.380	0.000	5.25e-5	18.346	0.000	4.30e-5	15.710	0.000	3.35e-5	17.754	0.000
Per Capita Income Squared	-3.02e-10	-10.542	0.000	-3.67e-10	-12.373	0.000	-3.16e-10	-11.143	0.000	-2.46e-10	-12.581	0.000
School Age Children	-0.036	-3.427	0.001	-0.027	-2.496	0.013	-0.026	-2.534	0.011	-0.008	-1.159	0.247
Adolescent Children	-0.046	-4.599	0.000	-0.042	-4.020	0.000	-0.030	-3.054	0.002	-0.012	-1.761	0.078
Infant (below 6 years)	-0.001	-0.081	0.936	0.004	0.366	0.714	0.016	1.516	0.130	0.018	2.568	0.010
Primary School Education	0.058	1.824	0.068	0.058	1.767	0.077	0.026	0.828	0.407	0.019	0.874	0.382
Secondary School Education	0.071	5.592	0.000	0.074	5.611	0.000	0.072	5.685	0.000	0.052	5.946	0.000
Tertiary Education	0.033	0.987	0.324	0.052	1.498	0.134	0.040	1.196	0.232	0.027	1.195	0.232
Age of HH (31-45 years)	-0.040	-2.656	0.008	-0.018	-1.185	0.236	-0.008	-0.555	0.579	0.007	0.660	0.509
Age of HH (46-60 years)	-0.083	-5.266	0.000	-0.074	-4.539	0.000	-0.053	-3.383	0.001	-0.022	-2.049	0.040
Age of HH (above 60 years)	-0.059	-3.235	0.001	-0.064	-3.420	0.001	-0.052	-2.901	0.004	-0.027	-2.226	0.026
Receive Remittance	0.071	3.392	0.001	0.087	4.000	0.000	0.087	4.152	0.000	0.073	5.075	0.000
Model R-Square Value	0.106			0.133			0.102			0.133		
Model F-Value	107.654			139.35			103.41			139.22		

Note: IF=Individual foods; FG= Food-groups; coeff.=coefficient; HH=Household Head

Figure 2: Scatter plot of between Berry Index and Entropy Index (constructed for individual foods (FV) and for food-groups (DD) respectively) for the 18191 households



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