Urbanization and Food Security: Empirical Evidence from Households in Urban Southwest Nigeria

V. Okoruwa[1]; A. Ikudayisi[2]

1: University of Ibadan Nigeria, Agricultural economics, Nigeria, 2: University of Ibadan Nigeria, Agricultural Economics, Nigeria

Corresponding author email: vokoruwa@gmail.com

Abstract:

Abstract Rapid urban growth changes the composition as well as diversification of the food consumed among urban households. Achieving food security in the midst of rapid urbanization require understanding how urban and food consumption intertwined. Thus this paper uses combined measure of food security to determine urban household food security status as influenced by extent of urbanization in Nigeria. Results show that urban effect generated through urbanicity index using principal component analysis revealed that most households were in low urban category. On the average, most urban household had diverse diet. However, combining per capita expenditure and dietary diversity index as measure of household food security revealed different level of food security status. Multinomial logit regression results reveals that gender of household head, employment status, educational status, household income, occupational status and urbanicity index significantly determine the probability of urban household being food secured at different levels of food security status. Relevant policy interventions that aim at securing sustainable food security were identified. Keywords: Food security, Dietary diversity, Food expenditure, Urbanicity index, Urban Nigeria JEL classification code: D12, R22, C25, C38,

Acknowledegment:

JEL Codes: R22, C25

Urbanization and Food Security: Empirical Evidence from Households in Urban Southwest Nigeria

Abstract

Rapid urban growth changes the composition as well as diversification of the food consumed among urban households. Achieving food security in the midst of rapid urbanization require understanding how urban and food consumption intertwined. Thus this paper uses combined measure of food security to determine urban household food security status as influenced by extent of urbanization in Nigeria. Results show that urban effect generated through urbanicity index using principal component analysis revealed that most households were in low urban category. On the average, most urban household had diverse diet. However, combining per capita expenditure and dietary diversity index as measure of household food security revealed different level of food security status. Multinomial logit regression results reveals that gender of household head, employment status, educational status, household income, occupational status and urbanicity index significantly determine the probability of urban household being food secured at different levels of food security status. Relevant policy interventions that aim at securing sustainable food security were identified.

Keywords: Food security, Dietary diversity, Food expenditure, Urbanicity index, Urban Nigeria

JEL classification code: D12, R22, C25, C38,

1. Introduction

Globally, food systems are changing as a result of increasing urban growth. These changes within the food systems ranges through production, processing and packaging, distribution and consumption (Seto and Ramankutty, 2016). However, the resultant effect of these changes often brings about a gradual shift in food structure, dietary patterns and nutritional status that vary with the socio-economic strata. Cockx, *et al.*, (2017) identifies urbanization as one of the driving forces behind the nutrition transition which often sharpen dietary patterns. Consequently, the world is undergoing the largest wave of urban growth in history with the level of urbanization increasing in developing countries. In view of this, more than 50% of the world's population was said to live in the urban area in 2008 and it is estimated that by 2030, the number of urban dwellers will reach about 5 billion (UN, 2014). Nearly

90% of these projected urban population increase is concentrated in Africa and Asia, with China, India, and Nigeria alone is expected to add about 900 million urban residents by 2050 (Global Food Policy Report, (GFPR), 2017). The scale and pace of urbanization in Nigeria is also increasing, as she is presently Africa's most populous country with a population of about 185.9million in 2016, about 49.3% urban population and 4.82% annual rate of urbanization (UN, 2017). There is an increasing trend both in population growth and food production index, though agriculture contributes about 24.4% to Nigeria' s gross domestic product (GDP), with about 5.1% of export earnings (NBS, 2016). The rise in population and invariably food demand is still higher than food production since about 80% of small holder farmers produce this bulk of food (Mgbenka and Mbah, 2016).

Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active healthy life (FAO, 1996). This definition highlights the multidimensional nature of food security which includes availability, access, utilization, and stability. How urban areas expansion is managed in future years is critical for ensuring agricultural growth and global food security. With the continued growth in both population and consumption of Nigerians, there is the likelihood of worsening food insecurity condition among urban households. This could be seen in terms of food access and poor food utilization rather than food availability because most urban residents are net food buyers (Omonona and Agoi, 2007). Unequal economic access to available food supplies due to income inequality, and continual increase in food prices due to cost of transporting food products to urban areas also contributes to urban food insecurity (Babalola and Isitor, 2014). These factors could reduce the access and consumption of wider varieties of food that leads to poor food utilization.

Apart from urban food insecurity, the accelerated trend in shifts in diets has also increased the prevalence of several nutrition-related diseases. Awosan *et al.,* (2014) and Ekpenyong and Akpan (2013) observed that percentage of persons with noncommunicable diseases such as overweight, obesity, hypertension, cancer, diabetes mellitus is now prevalent in most urban cities in Nigeria. This is as a result of more sedentary lifestyles and the consumption of highly processed foods high in sugar, fats but nutritionally deficient in micronutrients (Liverpool, *et al.*, 2016). This situation necessitated the urgency to assess the effect of urbanization on food security as well as provide relevant policy interventions that aids in

securing sustainable food security and identify missing link or strengthen existing ones in food value chains.

Some of the most profound effects of urban areas on composition and types of foods consumed by urban population could help in the transformation of agricultural sector and reduce economic leakages through food importation which is rising at unsustainable rate in Nigeria (Adesina, 2012). In crafting improved policies and investments for the agrifood sector, it is therefore critical to have a better understanding of how demand and transforming diets would likely evolve within urban areas. This comparison helps to identify the shifting relative importance within urban areas in total food demand and such information will suggest possible areas where current food system development efforts could be modified to improve food security status.

Empirical studies (Omonona and Agoi, 2007; Arene and Anyaeji, 2010; Obayelu, 2010; Asogwu and Umeh, 2012; Ahmed and Naphtali 2014) have shown various food security indicators been used in classifying households into food secure or insecure. Some of these indicators ranges from self-report/assessment, cost of calorie, rasch method, two-third of per capita food expenditure to anthropometric measure among others. Meanwhile, some of these studies focused narrowly on one indicator which could underestimate the true state of food security as pointed out by Coates and Maxwell (2012). To better capture food security status, some studies combined different indicators. For example, Maxwell, *et al.,* (2013) used the coping strategy index and food consumption score which both captures quantity and quality aspect of food security to delineate food security level, while Smith and Subandoro, (2007) and Ogundari, (2017) used the two-third of per capita expenditure and dietary diversity score which respectively reprints food access and food utilization to categorize households into food security levels. Previous studies (Obayelu *et al*, 2009; Ashagidigbi *et al.,* 2012) have shown that food consumption pattern differ across rural and urban populations. However, these studies do not adequately distinguish food consumption pattern experienced at different stages of urbanization, a limitation that makes it difficult to take account of the multiple dimensions of urbanization. In the context of rapid changes in food system Cockx, *et al.*, (2017) was of the view that it was essential to disentangled urban effect in order to have a proper view of urbanization. To overcome these problems, a composite index is essential with different techniques. In view of this, Dahly and Adair, (2007), Jones-Smith and Popkin, (2010) constructed a validated urbanicity scale which comprised of diverse components

ranging from economic factors to urban infrastructure and healthcare. Meanwhile, studies like Van de Poel *et al.,* (2009); Liao *et al.*, (2013), Jie, *et al.*, (2010) Zhou and Awokuse, (2014) used Principal Component Analysis (PCA) in index approach to overcome the potential limitation of equal weighting associated with scale development.

Considering the multidimensional nature of food security and rising urban population, this paper estimated the effect of urbanization on household food security status in urban Nigeria. We also extend existing studies beyond the rural-urban dichotomy and explore the heterogeneity of our results by the extent of urbanization using the PCA. The rest of the paper is organized as follows: methodological review in section 2, while section 3 described the data and descriptive statistics. Results discussion and conclusion were documented in sections 4 and 5 respectively.

2. Methodology

2.1 Construction of Urbanicity Index

Urbanization according to Wen and Ren (2017) has various definition as well as method of measurement. Different forms of urbanization include population, land, economic, ecological, space extension, social behaviour, industrial structure, infrastructure and environment. The pathways linking urbanization and food consumption, however, are multifaceted. Urbanization often offers opportunities for improvements in food consumption through increased access to food, economic opportunities, occupational changes and improved basic infrastructure. How these factors jointly influence urban household consumption and subsequently food security is not well characterized. Due to the multifaceted nature of urbanization, this paper uses the aspect of urbanization that affect urban food system which include economy, infrastructures, education, health, social services. Following Jie *et al.,* 2010 and Liao *et al.,* 2013, we assessed the effect of urbanization on food security by constructing urbanicity index using the PCA. The PCA creates non-correlated linear combinations of the variables with maximal variance. The development of the index enables easy handling of several highly correlated urban characteristics variables and improves statistical efficiency. Using several single and disaggregated measures separately to reflect a single underlying concept such as urbanicity index introduces the risk of collinearity which PCA overcomes and improves statistical efficiency (Abdi and Williams, 2010). Filmer and Pritchett (2001), opined that PCA extracts from a set of variables those few orthogonal linear combinations of the variables that capture the common information most successfully. Intuitively the first

principal component of a set of variables is the linear index of all the variables that captures the largest amount of information that is common to all of the variables. The PCA is structured by a set of equation where the urban indicators are related to a set of latent factors expressed as:

$$a_{1x} = b_{11} \times A_{1x} + b_{12} \times A_{2x} + ... + b_{1N} \times A_{Nx} \qquad x = 1,...X$$
$$a_{Nx} = b_{N1} \times A_{1x} + v_{N2} \times A_{2x} + ... + b_{NN} \times A_{Nx} \qquad (1)$$

where, a_s are set of *N* variables, a^*_{1x} to a^*_{Nx}, represents the access to *N* urban indicators by each household *x*. These variables are normalized by its mean and standard deviation, where the A_s are the components and the b_s are the weights on each component for each variable. These selected variables are expressed as linear combinations of a set of underlying components for each household *x* with maximum variance. The final set of estimates is produced by scaling the *bns* so the sum of their squares sums to the total variance, with the scoring factor from the model recovered by inverting the system from equation (1), and this yield a set of estimates for each of the N principal components given by:

$$A_{1j} = b_{11}a_{1x} + b_{12}a_{2x} + ... + b_{1N}a_{Nx} \qquad x = 1,...X$$
$$A_{Nj} = b_{N1}a_{1x} + b_{N2}a_{2x} + ... + b_{NN}a_{Nx} \qquad (2)$$

The first principal component, expressed in terms of the original (unnormalized) variables, is therefore an index for each household based on the expression

$$A_{1j} = b_{11} \times (a^*_{1x} - a^*_1)/(s^*_1) + ... + b_{1N} \times (a^*_{Nx} - a^*_N)/ (s^*_N) \qquad (3)$$

The index so developed was used to disaggregate household urbanization level within urban settings which could help to show future food security hotspots, that is being location specific as opined by Cockx, *et al.,* 2017.

2.2 **Measures of Food Security and Dietary Diversity Indicators**

The essence of agricultural sector development is to synthesize its policies and programs to become "nutrition-sensitive" as suggested by USAID (2011). However, Herforth *et al.,* (2012) observed that though agricultural productivity increases, food production it often does not ensure of food security or improved nutrition. This is the case in Nigeria where most

policies are often geared towards food production rather than enhancing value addition. In recognition of this, food availability is not sufficient to achieve good nutrition and health. Given the multidimensional nature of food security, there is need for a variety of means of measurement that encompasses all aspect of food security as emphasised by Coates and Maxwell, (2012). However, Magrini and Vigani (2014) wondered if the multidimensional nature of food security as identified by the definition have been satisfied by a single measure of food security. Unfortunately, no single indicator can incorporate all the dimensions of food security as opined by Hoddinot (1999), because a combination of measures and indicators are needed to fully reflect the multifaceted nature of food security. Following Ogundari, (2017), this paper combines two indicators that represent food access and food utilization to generate urban household food security status. The study consequently used two-third of the mean monthly per capita food expenditure to construct the food security line among urban households (representing food access) and dietary diversity index derive from household expenditure from twelve (12) food groups (representing food utilization). The food groups include cereals, tubers and roots, vegetables, fruits, meat, eggs, fish and other seafood, legumes, milk and milk products, oils and fats, sweets and spices/beverages. This grouping was in line with the recommended FAO standard in calculating dietary diversity at household level (Swindale and Bilinsky, 2006; FAO, 2012) and also in line with the NBS's food composition tables (NBS, 2012). Household with per capita food expenditure (FEXP) greater (or less) than weighted two-third of mean of per capita expenditure was referred to as food secure (or food insecure).

Dietary Diversity Index

The dietary diversity as a measure of food utilization is the consumption of a wide variety of foods across nutritionally distinct food groups developed by the World Food Program (WFP) (Smith and Subandoro, 2007; Pangaribowo, *et al*., 2013). To determine the extent of diet diversity, Berry index was employed to construct dietary diversity index expressed as:

$$BI = 1 - \sum \omega(i)^2 \tag{4}$$

Where, w_i is the expenditure share of each food group i in the total food expenditure. The dietary diversity index (DDI) ranges between 0 and 1- (1/n), where n is the total number of food groups consumed. If the value assumes 0, it indicates only one food group was

consumed while 1- (1/n) means that food groups were consumed at equal share (Kumbarov and Zemke, 2014). The twelve (12) food groups earlier outlined was used in the construction of DDI with a reference period of seven days. This paper however extends the work of Ogundari, (2017) and used the mean of DDI as the threshold for classifying household into food secure (insecure) if the DDI is above (below) the mean.

2.3 **Empirical Model**

The determinants of household's food security status were estimated using a multinomial logit model (MNL). The MNL is used when there are more than two discrete possibilities for the dependent variable (Rose and Chariton, 2002) and uses the maximum likelihood estimation to evaluate the probability of categorical membership on a dependent variable based on multiple independent variables. Implicitly, the model can be expressed as:

$$(y) = \ln\left(\frac{p}{1-p}\right) = \alpha + \beta_1 x_1 + ... + \beta_k x_k \tag{5}$$

$$= \frac{\ell^{\alpha+\beta_1 x_1+...+\beta_1 x_2}}{1+\ell^{\alpha+\beta_1 x_1+...+\beta_1 x_2}} = \frac{1}{\ell^{-(\alpha+\beta_1 x_1+...+\beta_1 x_2)}} \tag{6}$$

MNL performs better in discrete choice models and computationally simplistic and since it does not assume normality, linearity, or homoscedasticity (Starkweather & Moske, 2011). Multinomial logistic regression provides an effective and reliable way to obtain the estimated probability of belonging to a specific population and a procedure by which estimates of the net effects of a set of explanatory variables on the dependent variable can be obtained. The MNL is preferred to the ordered models in this study because the food security categories were mutually exclusive and not ordered. Following Greene (2008), we assumed that the probability that the i'_{th} urban household falls in the k_{th} of four food security status is P_{ij}. This probability (P_{ij}) is represented by the identified thresholds discussed above, where households were grouped into four mutually exclusive food security levels. These include (i) completely food insecure status based on both DDI and FEXP; (ii) transitorily food insecure based on DDI but food secure based on FEXP; (iii) transitorily food secure based on DDI but food insecure based on FEXP and (iv) completely food secure state based on both DDI and FEXP.

The probability that household falls in the alternative *k* can be explained by a MNL model as:

$$P_{ij} = \frac{\exp(\beta_k X_i)}{1 + \sum_{k=1}^{4} \exp(\beta)} \qquad \text{for k=1,2,3,4} \qquad (7)$$

These four-food security categorisation, therefore represents the dependent variable (P_{ij}). Vector of socio-economic characteristics of the i_{th} household is denoted by x_i. The socioeconomic characteristics experimented with in this study include sex, age of household head, marital status, household size, educational status, engagement in employment activities, household income, membership of social group, occupational status and urbanicity index. The detailed description of household socioeconomic characteristics employed in the study are presented in Table 1. β_k represents parameter estimates associated with alternative *k*, and k=1,...,4 is the food security status categories. The first state of food security which represents completely food insecure households (based both on DDI and FEXP) served as the reference state. The probabilities of the urban household being in the other three categories (k = 2 or 3 or 4) can be estimated as:

$$P_i(k = n \mid X_i) = \frac{\exp(\beta_k X_i)}{1 + \sum_{k=1}^{4} \exp(\beta_k X_i)} \qquad \text{For n >1} \qquad (8)$$

By differentiating the equation (7) with respect to the explanatory variables, the marginal effects of the household characteristics on the probabilities can be estimated as:

$$\frac{\partial P_k}{\partial X_i} = P_k \left[\beta_k - \sum_{k=1}^{4} P_k \beta_k \right] = P_k \left[\beta_k - \overline{\beta} \right] \qquad (9)$$

These represents the probability of the household being in any of the four categories (Greene 2008). Since the parameter estimates were relative to the reference group, the estimated interpretation of the MNL would be that for a unit change in the predictor variable, the logit of outcome *n* relative to the reference group was expected to change by its respective parameter estimate given the variables in the model are held constant.

3. Data and Descriptive Statistics

The study was conducted in Southwest Nigeria which is one of the six geopolitical zones in the country. The zone is made of six states namely Ekiti, Lagos, Ogun, Ondo, Osun and Oyo

with a total population of 27,581,992 (National Population Commission, NPC, 2006). The area is noted for its quest for western education as most of its urban areas had larger educational facilities with higher literacy rate (NPC, 2006). In addition, major urban cities had growing manufacturing sectors, financial institutions, trading corporations, telecommunication sectors, government service centres. These factors characterise the extent of urbanization and rapid urban growth in the study area. The survey was carried out between the months of September and November 2016. Data were collected through a cross-sectional survey while employing a well-structured questionnaire administered to representative households. A multistage sampling procedure was used to select the respondents. Based on information obtained from NPC (2006), the six states were classified into high (Lagos, Oyo and Ogun States) and low (Ondo, Osun and Ekiti States) urban areas by population size. From this classification, one state was randomly chosen from each class to have a good representation; the selected states were Oyo and Ekiti States. One most urbanized city within each sampled state was purposively selected, namely Ibadan from Oyo state and Ado Ekiti from Ekiti state. Enumerated areas (EAs) were selected from the stratified urban residential zones (low, medium and high, density areas) within the selected urban cities while adapting Coker *et al*., (2008), EnyinnayaEluwa, *et al.,* (2012), Oriye, (2013) procedures. Finally, households were randomly selected from the identified EAs and questionnaires were administered. Data on the socio/demographic characteristics, food expenditures, dietary pattern etc, of a total of 482 sampled/interviewed respondents and urban indicators were collected and analysed.

The results of the PCA used to profile extent of urbanization among urban households shown in Figure 1 revealed that the first component of PCA explained a large proportion of the total variance (72%). In each case, this first component of the PCA was the average urbanicity index (0.46) derived from sum of square loadings. The urbanicity index was further broken down and used to classify the total sampled household into two categories namely, low and high urban areas. Household below the mean index were regarded as low urban household and the reverse for high urban household. The grouping show that a larger percentage (52.97%) of household fell in the low urban category while about 47.03% of the household were in high urban category. The reason could be that though the urban areas were more urbanised population wise, they were however not urbanised in terms of urban functions as most facilities have been over stretched by the growing urban population. This result is consistent with Jie *et al*., (2010) who reported urbanization index of 0.29 from infrastructural

based method and considered it lower than the reported population measure. This method implies that urbanization is multifaceted, as several factors determine how a place urbanises aside population. The result of robustness test for PCA as an index construction method revealed that Kaiser-Meyer-Olkin (KMO) value (0.8475) was significant at 1% and shows that the variables were adequate in explaining urbanicity index. The Factor Analysis Explained Variance (FAEV) value was 0.7084, which means that the selected indicators describe almost 71% of the urbanicity level in the study area, while the Cronbach alpha value was 0.8318 which shows the reliability of variables in index construction. This test of robustness was in line with that of Mehaina, *et al.,* (2016) who reported the use of this test for comprehensive urbanization level index. The test results showed that the PCA was reliable in developing the index and thus, the index of urbanicity developed was validated as this produced a better result as against scales and scores (Jone-Smith and Popkin, 2010; Van de poel *et al.,* 2010). It is of importance from the result that categorizing household within urban settings could help to show future food security hotspots and could be used to delineate food security issues as location specific.

The descriptive characteristics of the urban household presented in Table 2 reveal that majority of the household head (68.5%) were male, married (74.8%) with an average age of 47 years. It was observed that a larger percentage (33.0%) of urban household heads were still in their active and productive years which suggest that more food is needed for physical and mental activities. The average household size among respondents was about 5 persons with significant difference between the low and high urban areas where low urban areas had more persons per household than the high urban area. About 78.7% of household head had tertiary education, with high urban area having more house heads with tertiary education (80.6%) than the low urban area. Most household heads engaged in one income generating activities or the other as evident in large percentage (88.8%) of those engaged in employment activities. Further result shows that average monthly income among sampled urban household was ₦51, 123.03. There was evidence of income differentials across the two urban areas significant at 1%, as high urban area had more people with higher income (₦53,144.80) than low urban area. About 77.5% of household heads belong to a social organization or the other but high urban area had more house heads (82.0%) in social group than low urban area. The implications of these findings suggest that households in the different urban centres considered are likely to be affected by different socioeconomic characteristics which invariably would affect their food consumption pattern.

4 Empirical Results and Discussion

4.1 Household Food Security and Dietary Diversity Status

The results of dietary diversity among urban households are presented in Table 3. Results reveals that the average household dietary diversity index was 0.72, that is on the average about seven (7) food groups was consumed. When disaggregated across both areas, slight differences were observed between low (0.70) and high urban (0.73) areas being significant at 1% level. This suggest that improved distribution and marketing techniques in most urban centres offer household wider access to varieties of foods thereby stimulating diversity in food consumption which increase the nutritional status of the sampled respondents. This implies that urban household dietary diversity can be improved upon in the face of modernized food systems as this meets the nature of urban food demand. A multiplier effect could result in increase of farmers' income through integration of rural urban linkages by providing instant foods rich in nutrients to urban populace. This finding was supported by other studies (Akerele and Odeniyi, 2015; Codjoe *et al.,* 2017) that asserted that as a place urbanises diet are often diversified and hence consumption of nutritious foods. Further categorization of the household by the dietary diversity index into low, medium and high dietary diversity revealed that almost half (50.2%) of the urban household had moderate dietary diversity.

The classified food security status shown in Figure 2 indicated that about 50.1%, 25.6%, 10.6%, and 13.7% of the household were classified into completely food secure households by FEXP and DDI, transitorily food secure households based on FEXP only, transitorily food secure households based on DDI only, and completely food insecure households based on both FEXP and DDI measures respectively. This result shows the robustness of the combined measured as seen in different level of food security category. Consistent with the findings of Ogundari, (2017) who reported about 52%, 14%, 28%, and 6% of the respondents were considered to be completely food secure households, transitorily food secure households-based on DDS only, transitorily food secure households-based on EXP only, and completely food insecure households, respectively.

The result of factors that influences urban household food security status defined by per capita food expenditure (FEXP) and dietary diversity index (DDI), which represents food accessibility and food utilization, respectively are presented in Table 4. Sequel to categorization, the result of spearman correlation between the two indicators gave an

estimated coefficient of 0.1988, which was found to be significant at 1% level. It implies that the combined indicators were partially dependent measures of food security. This result however confirms the robustness of the two indicators (FEXP and DDI) in explaining various level of food security among urban household. Consistent with that of Ogundari, (2017) and Maxwell, *et al.,* (2013) that strong correlations exist among the two measures suggest mutual relationship useful for measurements of food security. This paper contributes to existing knowledge regarding urban food insecurity as evident in the disaggregation of the food security components across the two urban areas. Results show that level of urban food insecurity was higher among household in high urban areas (52.5%) relative to low urban area (47.5%). This could be as a result of incessant increase in food prices due to high transportation costs for most foods especially during fuel scarcity as suggested by Babalola and Isitor, (2014).

Table 4 further show the log likelihood (-451.23) and LR chi2 of 144.93 of the MNL model was significant at 1% and implies that the model is well fitted when compared to the null model without predictor. Though the coefficient explains the direction of the explanatory variable on the dependent variable, the marginal effect was reported because it shows the actual magnitude of the change in probabilities. Therefore, result presents the probability of being in any of the category relative to the reference group, that is, completely food insecure by FEXP and DDI for a unit increase in the value of explanatory variables.

From the result in Table 4, the probability of being food secure based on FEXP only, DDI only and completely food secured (FEXP & DDI) relative to completely food insecure increases significantly by 0.03, 0.05 and 0.02 respectively for male headed household. Also, there is more likelihood for household heads who engaged in employment activities to be food secured through DDI only by 0.20. This conform to the finding of Taruvinga, *et al*., (2013) that households with heads engaged in income earning activities which increases financial capacity are more likely to be food secured. Our estimation results also revealed that household head having formal education had the likelihood of being food secured by DDI only and by completely food secure by both measures (FEXP & DDI) relative to completely food insecure by 0.04 and 0.02 respectively. This suggests that being educated could help in assessing information about consumer dietary knowledge and its relevance to consumption of nutritious foods. Similarly, with increase in household size by 0.08, households are very less likely to be food secure based on both measures (FEXP & DDI) i.e completely food secure in

reference to completely food insecure households. This implies that larger household sizes are less likely to have access to food and diverse diet which reduces the nutritional status. This corroborates the findings of Akinboade *et al.,* (2016) and Ahmed and Napthali, (2014) who poised that larger households are less likely to be food secured relative to completely food insecure.

Likewise, a unit increase in household income level significantly increases the probability of being food secured based on DDI only and by completely food secured (FEXP & DDI) by 0.20 and 0.32 respectively. Other results show that household head belonging to a social group was found to be more food secured based on FEXP only and completely food secure (FEXP & DDI) by 0.42 and 0.43 respectively relative to reference group. However, household heads with formal jobs had more likelihood of being food secured based on FEXP only relative to reference group by 0.11. This support the notion that different occupational types peculiar to urban centres often influence and changes the urban food environment. This sedentary lifestyle results in greater access to choice of food and also financial capacity thus improving food security status as noted by Omonona and Agoi, (2007). Moreover, the extent to which a place urbanises significantly increases the probability of household being food secured in terms of FEXP and DDI by 0.21 and 0.07 respectively. To sum up, these findings suggests that effects of urban household socio-economic characteristics in determining food security at various level differ significantly and suggests that the combined food security indicator better capture different food security status in urban Nigeria.

5. Conclusion

The study examined the effect of urbanization on household food security. In the quest for measuring multidimensional nature of food security, the study combined two indicators of food security defined as food expenditure (FEXP) and dietary diversity (DDI) score to generate four food security levels which include; completely food secure households by FEXP and DDI, transitorily food secure households based on FEXP only, transitorily food secure households based on DDI only, and completely food insecure households based on both FEXP and DDI measures. Determinants of food security states were estimated using multinomial logit model while PCA was used to capture the extent of urbanization in the study area. The empirical findings show that food insecurity was more prevalent in high urban areas. The determinants of food security status reveal that urban household exhibit differently at the four identified food security levels. Our results also suggest that differences

exist within urban areas which influenced food security status as empirically evident by the urbanicity index. These results highlight the importance of place of residence in relation to issue of food security. In this regard, to achieve significant improvement in urban food security, there is need for improved synergy between nation's infrastructural and agricultural sector. This will help in the coordination of agricultural and development policies towards improving food and nutrition security in urban areas. Policy wise, there is need to strengthen rural and urban food linkages which could lead to improvement in food distribution and retailing. Such policies could facilitate household access to nutritious foods and enhance consumption of nutrition based foods thereby improving their food security and subsequently nutritional security in the country.

References

Abdi, H. and Williams, L. J., 2010. Principal Component Analysis. *Computational Statistics*, Vol 2, Issue 4, pp 433-459. DOI: 10.1002/wics.101.

Adesina, A., 2012. Investing in Nigeria's Agricultural Value Chains, Minister of Agriculture and Rural Development, Presented at the Bank of Industry's Nigerian Investment Forum, London, 2012.

Ahmed, F. F and Naphtali. J., 2014. Socioeconomic Characteristics and Food Diversity amongst High Income Households: A Case Study of Maiduguri Metropolis, Borno State, Nigeria. *American Journal of Social and Management Sciences*, Vol. 5(1) doi:10.5251/ajsms.2014.5.1.19.26.

Akerele, D. and Odeniyi, K.A., 2015. Demand for Diverse Diets: Evidence from Nigeria. Paper prepared for presentation at the 89th Annual Conference of the Agricultural Economics Society, University of Warwick, United Kingdom 13 - 15 April 2015.

Akinboade, O.A., Mokwena, P.M. and & Adeyefa S.A., 2016. Determinants of Food Insecurity among the Urban Poor in the City of Tshwane, South Africa. *Journal of Economics and Development Studies*, 4(2), 101-114 DOI: 10.15640/jeds. v4n2a9.

Arene, C. J and Anyaeji, R. C., 2010. Determinants of food security among households in Nzukka metropolis of Enugu state Nigeria. Pakistan Journal of Social Sciences, 3(1): 9-16.

Ashagidigbi W.M, Yusuf, S.A and Okoruwa, V. O., 2012. Determinants of Households' Food Demand in Nigeria. World Rural Observations 2012;4(4) http://www.sciencepub.net/rural.

Asogwu, B.C and Umeh, J.C., 2012. Food insecurity determinants among rural farming households in Nigeria. International Conference on Ecology, Agriculture and Chemical Engineering (ICEACS' 2012), December 18-19, Phuket Thailand.

Awosan, K. J., Ibrahim, M. T. O., Essien, E., Yusuf, A. A. and Okolo, A.C., 2014. Dietary pattern, lifestyle, nutrition status and prevalence of hypertension among traders in Sokoto Central market, Sokoto, Nigeria. *International Journal of Nutrition and Metabolism*. Vol. 6(1), pp. 9-17, January 2014 DOI: 10.5897/IJNAM2013.0158.

Babalola, D. A. and Isitor, S.U., 2014. Analysis of the Determinants of Food Expenditure Patterns among Urban Households in Nigeria: Evidence from Lagos State. *Journal of Agriculture and Veterinary Science*, 7(5);71-75.

Coates, J, and Maxwell. D., 2012. "Reaching for the Stars? Universal Measures of Household Food Security." UN FAO International Scientific Symposium on Food Security and Nutrition Measurement, Rome, February 2012.

Cockx, L, Colen, L. and De Weerdta, J., 2017. From Corn to Popcorn? Urbanization and Food Consumption in sub-Saharan Africa: Evidence from Rural-Urban Migrants in Tanzania.

Codjoe, S.N.A; Okutu, D. and Abu, M., 2016. Urban Household Characteristics and Dietary Diversity: An Analysis of Food Security in Accra, Ghana. *Food and Nutrition Bulletin 2016*, Vol. 37(2) 202-218. DOI: 10.1177/0379572116631882.

Coker, A., Awokola, O., Olomolaiye, P. and Booth, C., 2008. Challenges of urban housing quality and its associations with neighbourhood environments: Insights and experiences of Ibadan City, Nigeria. *Journal of Environmental Health Research*, 7 (1); 21-30.

Dahly, D. L. and L. S. Adair, 2007. Quantifying the urban environment: a scale measure of urbanicity outperforms the urban-rural dichotomy. *Soc Sci Med*. 64(7): 1407-19.

Ekpenyong C.E., and Akpan E.E. 2013. Urbanization Drift and Obesity Epidemic in Sub-Saharan Africa: A Review of the Situation in Nigeria. *European Journal of Sustainable Development* Vol (2) 4, 141-164 ISSN: 2239-5938.

EnyinnayaEluwa, S., Chin Siong, H., Abayomi, O. K., 2012. Urban Fabric and Trip Pattern of Ibadan Residents, Nigeria. *Journal of Environment and Earth Science*. Vol 2, No.3. ISSN 2224-3216.

Food and Agricultural Organization, 1996. Rome declaration on World Food Security., Worlds food submit. Food and Agricultural organization (FAO), Rome, Accessed Sept 2014

Food and Agriculture Organization of the United Nations, 2012. Making Agriculture Work for Nutrition: Synthesis of Guiding Principles. Rome, Italy.

Filmer, D. and Pritchett, L. H., 2001. Estimating Wealth Effects without Expenditure Data—or Tears: An Application to Educational Enrolments in States of India, Demography, 38(1), 115–132.

Greene, W. H., 2008. Econometric Analysis. 7th Edition Prentice-Hall, New Jersey.

Herforth A, Jones A, Pinstrup-Andersen P., 2012. Prioritizing Nutrition in Agriculture and Rural Development: Guiding Principles for Operational Investments. Health, Nutrition, and Population Family (HNP) Discussion Paper. World Bank. Washington, D.C.

Hoddinot J (1999) Choosing outcome indicators of household food security. Technical Guides #7. International Food Policy Research Institute (IFPRI), Washington D.C

International Food Policy Research Institute, 2017. *2017 Global Food Policy Report.* Washington, DC: International Food Policy Research Institute. https://doi.org.10.2499/9780896292529

Jie, S., Yingxuan, Z., Dan, H. & Huili, C., 2010. Statistical Methodologies Used to Calculate Urbanization Rates in China. Chinese Journal of Population Resources and Environment, Vol. 8(3), https://doi.org/10.1080/10042857.2010.10684996

Jones-Smith & Popkin, 2010. Understanding Community Context and Adult Health Changes in China; Development of and Urbanicity Scale. *Soc Sci Med*. Vol 71(8) Pp 1436-1446

Kumbarov N and Zemke, J., 2014. Water or Oil in the Fire? – Impact of Diversification on the Underpricing Phenomenon in IPOs & SEOs. Södertörns högskola | Institutionen för Samhällsvetenskaper. C-uppsats 15 hp | Företagsekonomi C | Vårterminen.

Liao, C., Tan, Y., Wu, C., Wang, S., Yu, C., Cao W., 2016. City Level of Income and Urbanization and Availability of Food Stores and Food Service Places in China. PLoS ONE 11(3): e0148745. doi:10.1371/journal.

Liverpool-Tasie, L.S.O., Adjognon, S.G., Reardon, T.A., 2016. Transformation of the food system in Nigeria and female participation in the Non-Farm Economy (NFE). Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2.

Magrini E and Vigani M., 2014. Technology adoption and multiple dimension of food security: the case of maize in Tanzania. LICOS Centre for Institutions and Economic Reforms. Discussion paper 352/2014.

Maxwell, D., Coates, J., and Vaitla, B., 2013. How Do Different Indicators of Household Food Security Compare? Empirical Evidence from Tigray. Feinstein International Center, Tufts University: Medford, USA.

Mehaina, M; El-Bastawissi, L. & Ayad, H., 2016. The comprehensive urbanization level index (CULI) as a new approach to reclassifying urban and rural settlements in Egypt. WIT Transactions on Ecology and The Environment, 204, WIT Press. doi:10.2495/SC160261.

Mgbenka, R.N., and E.N, Mbah, 2016. A Review of Smallholder Farming in Nigeria: Need for Transformation. *International Journal of Agricultural Extension and Rural Development Studies*, 3(2), 43-54.

National Bureau of Statistics, 2016. Quarter Four GDP Report http://www.nigerianstat.gov.ng/report/518.

National Bureau of Statistics, 2012. Consumption pattern in Nigeria 2009/2010. NBS Preliminary report March, 2012.

National Population Commission, 2006. Population and Housing Census of the Federal Republic of Nigeria (Volume I), Priority Tables, NPC.

Obayelu, A. E., Okoruwa, V. O. and Oni, O. A., 2009. Analysis of rural and urban households' food consumption differential in the North-Central, Nigeria: A micro-econometric approach. *Journal of Development and Agricultural Economics*, Vol. 1(2), pp. 018-026.

Obayelu, A. E., 2010. Classification of household into food security status in the central North central Nigeria: An application of Rasch measurement model. *Journal of Agricultural and Biological Science*, 5(3): 26-41.

Ogundari, K., 2017. Categorizing households into different food security states in Nigeria: the socioeconomic and demographic determinants. *Agricultural and Food Economics*, 5:8. DOI 10.1186/s40100-017-0076-y.

Omonona, B. T., and A. G. Agoi, 2007. An analysis of Food security situation among Nigerian urban households: Evidence from Lagos state, Nigeria. *Journal of central European Agriculture*, Vol. 8(3): 397-466.

Oriye, O., 2013. Urban expansion and urban land use in Ado Ekiti, Nigeria. *American Journal of Research Communication*, 1(2): 128-139. www.usa-journals.com, ISSN: 2325-4076.

Pangaribowo, E. H., Gerber, N and Torero, M., 2013. Food and Nutrition Security indicators: A review. Center for Development Research (ZEF), University of Bonn, Working paper No. 108, Bonn Germany.

Rose, D. and Chariton, K.E., 2002. Quantitative indicators from food expenditure survey can be used to target the food insecure in South Africa. *J Nutrition*, 132:3235–3242

Seto, K.C and Ramankutty, N. (2016). Hidden linkages between urbanization and food systems. *Science*, 352 (6288), 943-945. [doi: 10.1126/science. aaf7439]

Smith, L.C and Subandoro, A., 2007. Measuring Food Security using Household Expenditure Surveys. Food Security in practice Technical Guide series. Washington D.C, International Food Policy Research Institutes.

Starkweather, J. and Moske, A., 2011. Multinomial Logistic Regression, 2011.

Swindale, A and P. Bilinsky, 2005. Household Dietary Diversity Score (HDDS) for measurement of Household food access: Indicator Guide. Food and Nutrition Technical Assistance project, Academy for Educational Development, Washington DC.

Taruvinga, A., Muchenje, V. and Mushunje, A., 2013. Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts, South Africa. *International Journal of Development and Sustainability*, Vol. 2 No. 4, pp. 2233-2247.

United Nations, (UN) 2014. Department of Economic and Social Affairs, Population Division. World Urbanization Prospects: The 2014 Revision, (ST/ESA/SER.A/366).

United Nations, UN (2017). Department of Economic and Social Affairs, Population Division. World Urbanization Prospects: The 2017 Revision.

United States Agency for International Development (USAID) 2011. U.S. Investments in Global Nutrition. Feed the Future Fact Sheet. September 2011.

Van de Poel E, O'Donnell O, Van Doorslaer E., 2009. Urbanization and the spread of diseases of affluence in China. *Economics & Human Biology*. Vol 7, pp 200–216.

Wen, F. and Ren, L. 2017. The Measurement of Urbanization Level Based on Entity Space: A Case Study f JingJinJi Region, China. MATEC web of Conferences **100,** 055046 (2017). GCMM 2016, DOI: 10.1051/matecconf/201710005046.

Zhou,S. and Awokuse, T.O., 2014. Urbanization, Nutrition Transition, and Obesity: Evidence from China. Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2014 AAEA Annual Meeting, Minneapolis, MN, July 27-29, 2014.

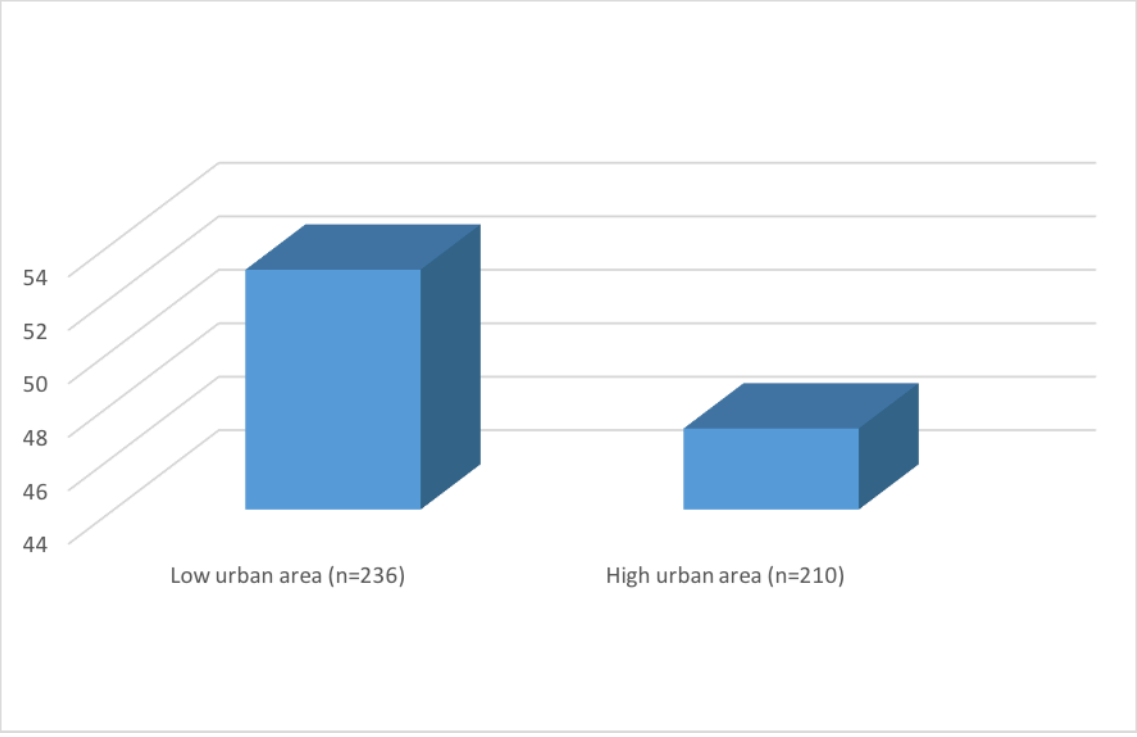

Figure 1: Percentage Distribution of Households by Urbanicity Index

Table 1: Description of Household Socioeconomic Characteristics Specified in the Model

Explanatory variables	Variable meaning	Type of measure	Expected sign
Sex	Household is male headed or otherwise (female headed)	Dummy (male=1, otherwise=0)	+/-
Age	Age of household head in years	Continuous , number of years	+/-
Marital status	Household head is married or otherwise (single, divorced and widowed)	Dummy (married=1, otherwise=0)	+/-
Household size	Number of persons in the household	Continuous , measured by number	-
Membership in social organization	Household head being in a social group (professional, cooperative societies, religious, non-governmental organization) or not	Dummy (member=1, otherwise=0)	+
Educational status	Household head level of education being formal(primary, secondary and tertiary) or otherwise(non-formal)	Dummy(formal=1, otherwise=0)	+
Engaged in employment activities	Engagement in one form of income generating activities or not	Dummy (engaged=1, otherwise=0)	+
Average monthly income	Income earned by household head on a monthly basis	Continuous, measured in Naira	+
Occupational status	Occupational type of household head is in formal sector(government worker, private organizations) or otherwise(traders, farmers, artisans)	Dummy (formal sector=1, otherwise=0)	+
Urbanicity index	Measure extent of urbanization	Continuous, an index	+

Table 2: Percentage Distribution of Urban Household Socioeconomic Characteristics by Urbanicity Group

Variables	Low urban areas	High urban areas	Test of difference	Total
Sex				
Male	67.28	69.26		68.54
Female	32.72	30.74		31.46
Age in years				
≤ 30	3.70	3.89		3.82
31 – 40	22.84	27.56		25.84
41 – 50	33.33	32.86		33.03
51 – 60	29.63	23.67		25.84
>60	10.49	12.01		11.46
Mean age	48 (10.69)	47 (10.81)	-0.77	47 (10.76)
Marital status				
Married	74.69	74.91		74.83
Single	14.81	15.19		15.06
Divorced	1.85	3.89		3.15
Widowed	8.64	6.01		6.97
Household size in number				
≤ 4	37.04	53.36		47.42
5 – 10	62.96	46.64		52.58
Mean household size	5 (1.60)	4 (1.53)	-3.55***	5 (1.57)
Educational status				
No formal	1.85	0.71		1.12
Primary education	2.47	1.06		1.57
Secondary education	20.37	17.67		18.65
Tertiary education	75.31	80.57		78.65
Engage in employment activities				
Yes	84.57	91.17		88.76
No	15.43	8.83		11.24
Average monthly income (₦)				
≤40,000	34.95	27.16		31.24
40001 – 60000	40.78	40.09		40.00
60001 – 80000	18.45	23.71		20.90
>80,000	5.83	9.05		7.87
Mean average monthly income	48,848.80 (16,794.13)	53,144.80 (18,465.58)	2.54***	51,123.03 (17,956.89)
Membership in social group				
Yes	69.75	81.98		77.53
No	30.25	18.02		22.47

*Figure in parenthesis are standard deviation. Statistical significance level for t test: ***1%, **5%*

Table 3: Mean and Percentage Distribution of Households by Category of Dietary Diversity Index and Urbanicity Group

Category	Low urban	High urban	Pooled
Low dietary diversity	18.52	5.30	10.11
Medium dietary diversity	49.38	50.88	50.34
High dietary diversity	32.10	43.82	39.55
Mean dietary diversity index	0.70 (0.08)	0.73 (0.05)	0.72 (0.06)

Figure in parentheses are standard deviation

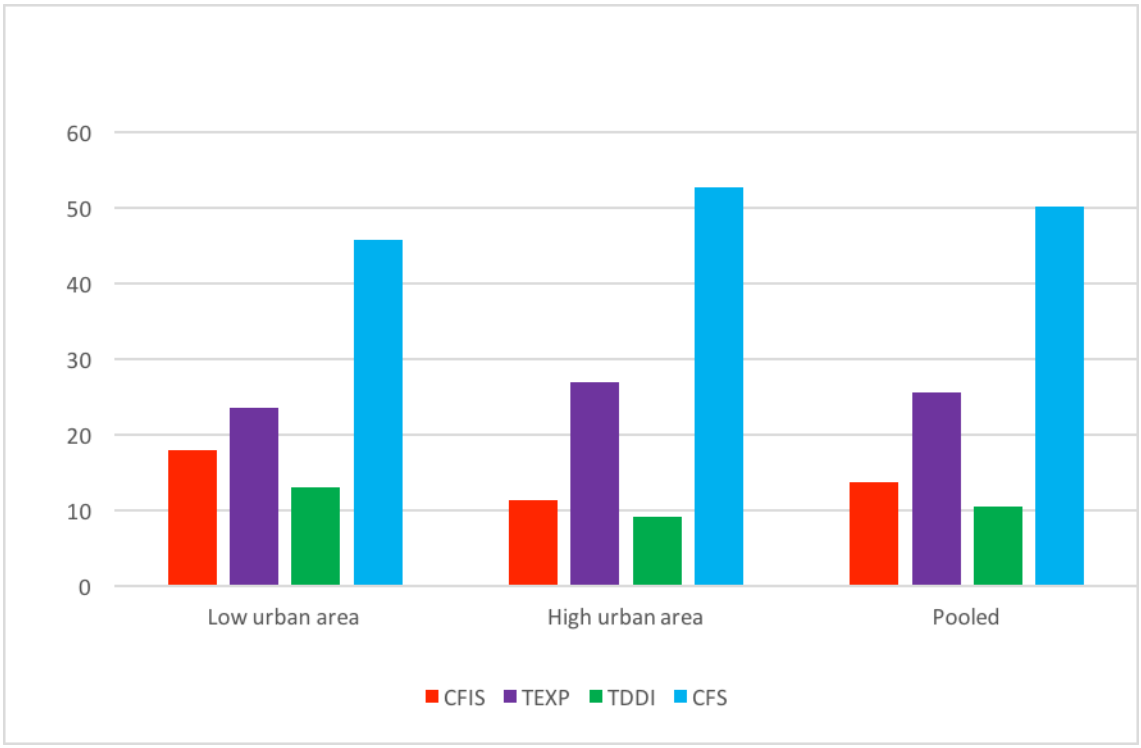

Figure 2: Percentage Distribution of Urban Household by Food Security Status

Note:

CFIS - Completely food insecure households by DDI and FEXP

FEXP- Transitorily food secure households-based on Per Capita Expenditure only

DDI- Transitorily food secure households-based on Dietary Diversity Index only

CFS- Completely food secure households by DDI and FEXP

Table 4: Parameter Estimates of the Determinants of Urban Household Food Security Status

	Food secured based on food access only			Food secured based on food utilization only			Completely food secure based on both food access and food utilization		
Variables	**Coefficient**	**Z statistics**	**Marginal Effect**	**Coefficient**	**Z statistic**	**Marginal Effect**	**Coefficient**	**Z statistics**	**Marginal Effect**
Sex (male=1)	0.8291**	2.16	0.0378	1.2830	2.59	0.0494	0.6976**	2.10	0.0164
Marital status (married=1)	0.0556	0.12	0.0133	-0.1643	-0.31	-0.0153	0.0035	0.01	0.0020
Age in years	0.2683	1.36	0.0170	0.0874	0.36	-0.0099	0.2350	1.33	0.0198
Age squared	-8.5494	-1.34	-0.6323	-1.8127	-0.23	0.3678	-6.9502	-1.22	-0.5437
Engaged in employment activities (engaged=1)	-0.3951	-0.56	-0.0113	1.6475**	2.18	0.2035	0.033	0.05	0.1737
Educational status (formal=1)	0.1146	0.24	0.074	0.8580**	2.22	0.0406	0.7110**	2.14	0.0148
Household size in number	-0.0490	-0.36	-0.0381	-0.0432	-0.27	-0.0146	-0.3589***	-2.97	-0.0810
Average monthly income in Naira	0.5980	1.03	0.0847	1.6904**	2.23	0.2077	1.5535***	2.94	0.3222
Membership of social group (member=1)	1.3929***	3.48	0.4176	0.4543	0.90	0.0286	1.0123**	2.43	0.4300
Occupation (formal sector=1)	0.8831**	2.03	0.1107	0.5562	0.99	0.0148	0.2546	0.70	0.0698
Urbanicity index	1.8766***	3.74	0.2115	1.7380***	2.86	0.0659	0.7356	1.65	0.1411
Log likelihood	-451.23								
LR chi2 (33)	144.93***								
Pseudo R^2	0.14								
Number of observation	445								

*Statistical significance: * p<0.10; ** p<0.05; *** p<0.01*