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Urban Differential Effects on Food Demand in Nigeria

by Adesola A. Ikudayisi and Victor O. Okoruwa

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Abstract

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Keywords - Elasticities, Food expenditure, Urban households, Urbanicity, Nigeria

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JEL classification- Q18, D12, C38

1. Introduction

As the world's population becomes increasingly urbanised, the proportion of persons living in urban areas is expected to rise to 67.2% by 2050 (UN, 2017). For instance, the urban population in Nigeria grew substantially from 43.5% in 2010 to 52.0% in 2020 at 4.25 per annum (UN, 2020). Urban growth, which is accompanied by several structural transformations, has resulted in the expansion of built environments and technological advancements, including communication services, educational facilities and health services (Gupta, 2013). Consequently, the current rate of expansion of urban areas has brought about changes in the food environment, as most foods are produced outside city boundaries (Seto and Ramakutty, 2016; Bren d'Amour, et al., 2020). In addition, occupational changes that result from the sectoral shift from predominantly agrarian activities to industrialised ones closely linked with the processes of urbanisation have increased women's participation in the modern workforce. This has created a growing demand for food with reduced cooking times and food away from home. This trend is significantly associated with changing urban dietary patterns (Tao and Xin, 2014). The pathways linking urbanization and food system, however, are multifaceted (AGRA, 2020). Overall, there is agreement that urbanization offers opportunities for improvements in urban food culture through increased income, access to economic opportunities, and improved basic infrastructure. Yet, there is no clear understanding why variation exists within and between urban food consumption pattern (Seto and Ramankutty, 2016; Cockx et al., 2018; Warr, 2020). Many studies, for example, presents food consumption pattern by only a comparison of urban diets to rural ones. However, a better understanding of how urbanization is influencing households' dietary pattern is not well characterized.

At present, the rate and growth of urbanisation differ considerably across regions owing to the varied definitions of urban (Farrell, 2018). As a result, urbanisation level varies within urban areas. To this effect, studies have shown that changes in urbanisation levels across regions are measurable (Champion and Hugo, 2004; Gupta, 2013). However, Van der Poel *et al.* (2009) and Allender *et al.* (2010) noted the importance of the disaggregation of urbanisation levels by their degree of urbanicity, which provides detailed information about the urban effect. Following Allender *et al.* (2010) and Zhou and Awokuse (2014), we hypothesised that food demand analysis in urban Nigeria, should be based on the categorisation of urbanicity levels. Empirical knowledge of this may be of policy relevance to food and national analysts owing to the challenges of attaining urban food security in Nigeria.

Previous empirical works on food demand in the extant literature focus on the rural versus urban dichotomy/classification (Bett *et al.*, 2012; Ashagidigbi *et al.*, 2012; Akerele, 2013; Mottaleb *et al.*, 2017). Hoang (2017) reported that the demand for rice with respect to prices and expenditure is relatively inelastic compared with that for other food, while demand for food tends to be less elastic at higher levels of income and for urban households in Vietnam. Guo (2016) discovered a changing consumption pattern associated with a reduction in the consumption of cereals grains and increased consumption of animal proteins and fruits owing to urbanisation and the structural shift of labour force in East Asia. Zheng *et al.* (2015) found a similar result for the consumption of food grains but an increased share of food with animal and high-value commodities, especially among urban residents in China. For India, Mittal (2010) found a decline in the intake of staples and sugar, while fruit, vegetable and oil consumption increases with urbanisation.

Adetunji and Rauf (2012) investigated the household demand for meat in southwest Nigeria. Their result showed that beef is mostly preferred and influenced by the income levels of household heads. However, the budget share of beef decreases with an increase in the price of chicken, and vice versa, but increases with its price. Ogbeide (2015) revealed that lean meat is the most preferred, followed by lean meat with moderate fat. Price, availability and socio-economic factors significantly determine consumer preference. A study by Udoh *et al.* (2013) showed that starchy and animal protein foods are necessary goods, while plant protein and fat food items are luxuries in urban cities in Nigeria. However, these studies did not account for urban differential effects on household food demand. Studies accounting for the differential in urban food demand are scarce. The few empirical works that centre on the differentiated levels of urbanisation are mostly health-related studies (Wu *et al.*, 2017; Li, 2017; Liao *et al.* 2016; Miao and Wu 2015; Zhou and Awokuse, 2014; Van der Poel *et al.*, 2009).

Our objective in this paper is to investigate the differences in the household food demand by level of urbanisation. Using cross-sectional data from 445 sampled households, we categorised the households into three groups by the constructed urbanicity index. Subsequently, using the quadratic almost ideal demand system (QUAIDS), we estimated expenditure and own-price elasticities as well as determinants of demand for the seven food groups. QUAIDS was chosen for its incorporation of quadratic form of expenditure as an additional regressor (Enriquez and Echevarria, 2015). This paper explores the heterogeneity in urbanisation using urbanicity-related variables in food demand analysis within urban centres in southwest Nigeria. Understanding the specific urban effects on food demand would help in identifying likely effective interventions for better food access by different segments of urban households. The remainder of the paper is structured as follows: section 2 outlines the methodology employed with the data and descriptive statistics. Section 3 presents the results and the discussion of results in section 4. Section 5 concludes the paper.

2 Methodology

2.1 Data

The data used in the study was a cross sectional urban household survey conducted from September to November 2017 in southwest, Nigeria. Southwest zone is noted for its rapid level of urbanization owing to high concentration of urban activities (Ikwuyatum, 2016). Two states were randomly selected from the southwest geopolitical zone. The most urbanized location within each of the sampled states was purposively selected on the basis of the administrative process and level of urbanisation. Households were randomly sampled from Enumeration Areas (EAs) mapped by National Population Commission which represented the primary sampling units used for 2006 population census in Nigeria. Following previous studies on food demand (Dybczak et al., 2014; Rizov *et al.* 2015; Korir *et al.* 2018), information was collected through structured questionnaires at the household level. The data provide information about household head's socioeconomic characteristics, records of the expenditure and quantity of foods purchased by the households. The socioeconomic factors of household head considered include the sex, age, education, income, occupation, household size and social group. Within our study, we distinguish the educational status of household head has (1) no formal education (2) primary/elementary education, (2) secondary education or (3) higher education. The no formal education refers to those without any form of school system while the primary level represents the completion of basic elementary years of education. The secondary school education refers to the completion of a high school and the tertiary level refers to completion of any higher institution of learning. Participation of household head in a social group refers to their involvement in social relationships which facilitate collective actions aimed at the improvement of society. The social groups include professional bodies, cooperative societies, religious groups and non-governmental organizations (NGO). We depict the occupational status of the household head in sub-groups:(1) government jobs (2) private sector (3) traders/artisans (4) the agricultural based, and (5) others (unemployed).

2.2 Construction of Urbanicity Index

The principal aim of this study was to analyse the effects of urbanisation on urban household food consumption behaviour. Although, population has been the basis for measurement of extent of urbanisation owing to its definition-the increasing share of population residing in urban areas (UN, 2017). In the case of Nigeria, a settlement is classified as urban if it exceeds a population threshold of 20,000 inhabitants (Ofem, 2012). However, most countries' population data are generated though census count which are often time-specific. In Nigeria, for example, a comprehensive census count was last conducted in 2006 by the National Population Commission (NPC, 2006). Beyond this year, there have been tremendous and continued growth in Nigeria 's economic opportunities, infrastructural investments and changing socioeconomic structures linked to rapid urbanization (Ikwuyatum, 2016; Farrell, 2018). As a result, it is expected that the changes in the level of urbanization may influence urban food consumption pattern. In this regard, there remains an unmet need for a more comprehensive measure aside population, useful in creating urban subgroups in Nigeria in the current wave of urbanisation. This study, however, differentiates itself in that it disaggregates urbanization by urban indicators and computes their individual contributions to the construction of the urbanicity index. The index was used as a proxy for the extent of urbanisation in the study area.

This paper closely follows studies that measure urbanization level from the perspective of the characteristics of urban environments referred to as urbanicity (Dahly & Adair, 2007). The term "urbanicity" shows the degree to which a community exhibits the characteristics of an urban environment (Vlahov and Galea, 2002). Based on this definition, we employed the urban functional characteristics measure identified by United Nations (2014), as a criterion through which urban areas can be grouped. This measure has been widely used in the literature (Van de Poel *et al.*, 2009; Jone-Smith *et al.*, 2014; Zhou and Awokuse, 2014), but scarcely in the food demand studies in Nigeria to the best of our knowledge. Following Van de Poel, (2009), we replicated and modified the urban functional variables in the areas of economy, communication, transportation, health, housing, education and land use to suit the Nigerian context. The data resource for the urban functional variables included household responses on their extent of access to community- and household- level urban facilities. The urbanization index, which is a key independent variable in this analysis, is a measure of urbanicity. This index is a multi-component scale to measure urban features on a continuum in southwest Nigeria.

The urbanicity index calculation used in this study followed the standard procedures outlined in literature on quantifying urbanization (Dahly & Adair, 2007; Van de Poel et al., 2009; Allender et al., 2010; Jones-Smith and Popkin, 2010, Zhou and Awokuse, 2014). This measure was used to generate the urbanicity index using Principal Component Analysis (PCA). Development of an index through PCA was necessary because the urban indicators are highly correlated, with possible risk of multicollinearity (Abdi and Williams, 2010). Notwithstanding, with regards to the use of urbanicity score which involves assigning and summing up the individual scores for each variable, we noted that subjectively assigning equal weight to the urban components may produce bias estimates. This is because the components of the urbanicity index are expected to have different influences on urbanisation (Allender, *et al*., 2010).

Principal component analysis

Principal component analysis (PCA) is a data reduction model that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables called principal components (Suryanarayana and Mistry, 2016). PCA merged the urban variables considered and determined their appropriate weights such that the components are optimally chosen to maximize the explained variance of the underlying latent urbanicity index. The model is expressed as

$$PC_1 = a_{11}X_1 + a_{12}X_2 + ... + a_{1p}X_p \quad (1)$$

where a_{11} represents the weight for the X_1 principal component with X_1, …, X_p representing the urban variables. However, the coefficient of the first principal component, a_{11}, a_{12}, a_{1p}, are chosen in such a way that the variance of PC_1 is maximized subject to the constraint that the sum of factor loadings must sum up to one as expressed in equation (2):

$$a_{11}^2 + a_{12}^2 + a_{1p}^2 = 1 \quad (2)$$

The first principal component generated from the extracted factor scores, therefore, represents the index. To ensure that the result of PCA constructed was valid and subsequently meet empirical expectations, we carried out some test of robustness which included the Kaiser-Meyer-Olkin (KMO), Bartlett test of sphericity and Cronbach alpha. This was necessary for sound relevant policy issues. The results obtained revealed that the KMO value of 0.8475 was significant at 1% which suggests that the urban variables adequately explain the urbanicity index. Bartlett's test of sphericity (17851.47) revealed that the correlation matrix was uncorrelated and significant at 1% level. The above test results indicated that valid PCA could be done successfully.

Using the Kaiser criterion (Field, 2005), the first three principal components (PCs) with eigenvalues greater than one explained about 71.8% of the variance in the data. The PCs was chosen because other components had eigenvalues that was less than one. This implies that the indicators describe almost 72% of the urbanicity level in the study area. However, the first PC_1, with the maximum variance of about 48% that offered some economic intuition about level of urbanisation in Nigeria was used to construct the urbanicity index. The mean urbanicity index derived from sum of square loadings of the first principal component (PC_1), was 0.46±0.16 (SD) with a range of 0.2174 and 0.8695. The Cronbach alpha value of 0.8318, which is higher than the acceptable value of 0.7 (Man *et al.*, 2008), indicates a high level of internal consistency for variables and also confirmed index reliability. To further explain the degree of urbanicity, the generated urbanicity index was classified into three categories namely: the low, middle and high urbanicity groups based on tercile distribution of the data. This categorization explains the magnitude of disparities within urban areas at various stages of urbanisation. From our result, the categorization of the respondents into their different thresholds of access to facilities was based on responses to factors that define urbanisation.

The results show that 34.4% of the households were in Low Urban Category (LUC). This group represented percentage of households with low level of access to urban functional facilities as measured by urbanicity index. Also, a larger percentage (41.6%) of households were in the Middle Urban Category (MUC); while only 24.0% of them were in High Urban Category (HUC). The categorisation implies that our hypothesized urbanization level varies within the urban area based on level of access to urban functional facilities. This ranking into urban categories builds on a previous study by Allender, et al. (2010).

Table 1 showed the summary statistics of household head's socioeconomic characteristics by the identified urban categories. The number of households with respect to each urban group are; LUC=153; MUC=185; HUC=107. A larger percentage of households had more male heads with almost three quarters of them in the HUC (74.7%). A greater proportion of household heads were in the age range 41−50 years whereas the least percentage was in the 30 and less category. The mean household size for the low and middle urban categories was 5 persons while the high urban category had 4 persons. A larger percentage (76-81%) of the household heads had tertiary education while only few of them had no formal education across categories. About three quarter of the household heads were members of a social group across the urban categories. Majority of household heads engaged in government jobs in LUC (46.6%) and MUC (34.4%) while more heads of household (36.9%) in HUC were in the private organizations. A greater percentage of household heads in MUC and HUC were within the income range of ₦40,000 − 60,000 (USD 111.11−166.67), while most household heads in LUC were within ₦40,000 and below.

2.3 Analytical Model

We modelled household demand behaviour on the traditional demand frameworks of Engel curves and elasticity estimation. A number of demand systems have been used for modelling the allocation of total expenditures among food commodities given a certain budget. These models which are Linear Expenditure system (LES), Rotterdam model, Indirect Translog System (ITS), Almost Ideal Demand System (AIDS) had some varying level of restrictiveness and flexibility (Okrent and Alston, 2011). Low Engel curve flexibility synonymous to these demand models might not readily provide the expected nonlinear relationship between expenditure and food budget shares especially at household level (Pangaribowo and Tsegai, 2011). We adopted the quadratic almost ideal demand system (QUAIDS) model that Banks *et al*. (1997) introduced. It extends the almost ideal demand system (AIDS) model by incorporating an additional quadratic term of the logarithm expenditure in the budget share equations. This evaluates the non-linearity effect in demand for disaggregated food commodities as expenditure changes. The model is expressed as

$$\ln V = \left\{ \left[\frac{\ln m - \ln a(p)}{b(p)} \right]^{-1} + \lambda(p) \right\}^{-1} \qquad (3)$$

where the term *V* denotes the indirect utility function, *m* represents the total food expenditure and *p* is the vector of prices. Assuming a(p), *b(p)* and λ*(p)* are flexible functions of the vector of prices, *p,* it is expected that *a(p)* is homogenous of degree one, while *b(p)* and λ*(p)* are homogenous of degree zero in prices.

The ln *a(p)* expressed in the translog form is given by:

$$\ln a(p) = \alpha_o + \sum_i \alpha_i \ln p_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j \tag{4}$$

b(p) is the simple Cobb-Douglas price aggregator defined as:

$$b(p) = \prod_{i=1}^{n} p_i^{\beta_i} \tag{5}$$

and $$\lambda(p) = \sum_{i=1}^{n} \lambda_i \ln p_i, \tag{6}$$

where $\sum_{i=1}^{n} \lambda_i = 0$

When Roy's identity or Shephard's Lemma is applied to the indirect utility function, it gives the QUAIDS model budget shares, w_i, expressed as:

$$w_i = \alpha_i + \sum_{i=1}^{n} \gamma_{ij} \ln p_i + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 \tag{7}$$

for i =1, 2, ..., n denotes the number of food groups used.

Further inclusion of socioeconomic and urbanisation variables into the demand model through the linear demographic translating method (Pollak and Wales, 1981) yields the equation:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_i + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)} \left\{ \ln\left[\frac{m}{a(p)}\right] \right\}^2 + \sum_{i=1}^{n} \delta_{is} Z_s + \varepsilon_i \qquad (8)$$

where w_i = the expenditure share allocated to each food group i,

p_i= the price of *ith* food group,

m = total food expenditure,

α_i = average value of budget share in the absence of price and income effects,

β_i = parameter that determines the expenditure elasticity,

γ_{ij} = effects of cross price elasticity,

λ_i = determine effects of quadratic term,

δ_{is} = vector of socioeconomic and urbanization variables,

Z_s= socioeconomic and urbanization variables,

ε_i = error term.

The theoretical restrictions of adding up, homogeneity and symmetry that utility maximization imposes on household demand functions are expressed as:

$$\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \beta_i = 0, \sum_{i=1}^{n} \gamma_{ij} = 0 \quad , \sum_{i=1}^{n} \lambda_i = 0 \text{ and } \gamma_{ij} = \gamma_{ji,} \qquad i \neq j \quad (9)$$

for all i, j=1, 2, …, n.

Furthermore, differentiating the budget share equation with respect to *ln m* and *ln* p_i, yields the expenditure and price elasticities, respectively. It is given as:

$$\mu_i = \frac{\partial w_i}{\partial \ln m} = \beta_i + \frac{2\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\} \tag{10}$$

$$\mu_{ij} \equiv \frac{\partial \omega}{\partial \ln p_j} = \gamma_{ij} - \mu_i\left(\alpha_j + \sum_k \gamma_{jk} \ln P_k\right) - \frac{\lambda_i \beta_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 \tag{11}$$

Household sensitivity to changes in price and income are measured by their elasticities. Expenditure elasticity is the percentage change in the quantity of food demanded with respect to changes in income. It is expressed as

$$\ell_i = 1 + \frac{\mu_i}{w_i} \tag{12}$$

The Marshallian (Uncompensated) price elasticity indicates changes in the quantity demanded as a result of changes in prices, is derived as

$$\ell_{ij}^u = \frac{\mu_{ij}}{w_i} - \delta_{ij} \tag{13}$$

where δ_{ij} is the Kronecker delta equaling one when $i=j$, and zero, if otherwise. It takes the value of one for own-price elasticity and zero for cross-price elasticity.

The compensated price elasticities computed using the Slutsky equation in elasticity form is given as

$$\ell_{ij}^c = \ell_{ij}^u + w_j \ell_i \tag{14}$$

We aggregated the food commodities into seven food groups based on their nutritional content following Obayelu *et al.* (2009) and Udoh *et al.* (2013): cereals, roots and tubers, legumes, meat and its by-products, fruits and vegetables, fats and oils and miscellaneous food products. The miscellaneous group comprises food commodities such as sweeteners, beverages, condiments, canned foods, confectionary foods. Also, the composition of the aggregated food items followed the food classification table developed by the National Bureau of Statistics (NBS, 2012). Following Torres, (2015), Rizov *et al.* (2015) and Korir *et al.* (2018), this paper adopted the weak separability approach for substitutability of food items from a consumer's viewpoint. This assumption of weakly separable preferences limits the number of goods included in the demand estimation and reduces the problem of zero consumption (Okrent and Alston, 2011).

3 Results

3.1 Determinants of household food demand

In the regression analysis, the explanatory variables - educational, occupational status of household head and participation in a social group- were treated has dichotomous variables. The pooled results of the QUAIDS analysis presented in Table 2 revealed that five variables influenced the demand of food groups studied at different significant levels. Factors that positively influenced the demand for cereals group were membership of a social group, occupational status and income of household head, while household size had a negative effect on their consumption. This suggests that all the positive variables will increase the budget share of cereals food group. The demand for roots and tubers decreased by the income of household head and urbanicity index but increases with the size of household at 1% significant level. For the legume group, their demand increased with income of household head at 1% level of significance. The urbanicity index positively influenced the demand for meats group at 5% level of significance. Membership of a social group by household heads had a negative effect on their demand for fat and oil group at 1% significant level. Participation in social groups might be a channel through which information on healthy food consumption practices are disseminated, particularly, reduction in the intake of fatty foods. The demand for fruits and vegetables was positively influenced by household size and urbanicity index at 1% and 5% levels of significance. Moreover, quantity demanded of miscellaneous food group increased by the income of household head, significant at 1% level.

3.2 Estimates of expenditure and price elasticities

Expenditure elasticity estimates for the three urban categories presented in Table 3 revealed that all the food groups are normal goods as shown by their respective positive values. However, some notable differences in magnitude were observed across the three urban categories. For cereals group, households in the MUC had the highest expenditure value (2.76), with the smallest value in the HUC (1.17). The large expenditure elasticity value for the cereals group suggests that households might increase their consumption of cereals if the household head income improves. Across the urban categories, the roots and tubers group were expenditure inelastic. As a necessity commodity, it implies that a 1% increase in household head income will lead to less than a 1% decrease in their demand. There was a rising trend in expenditure value of the meat group across all the categories. The luxury nature of the meat group indicates a greater demand as income of household head increases and suggests their relevance in urban household’s diet. Further, the miscellaneous group confirmed the flexibility characteristics of QUAIDS which permits changes in the nature of a good as expenditure varies. This was evident in their expenditure elasticity value which was a necessity at LUC (0.45) and a luxury goods at MUC (1.11) and HUC (1.18) categories.

The result of the own-price effects reported in Table 4 revealed that almost all the food groups had the expected negative signs, with the exception of the legume group in the LUC. This finding confirmed the inverse relationship between price and quantity demanded across food groups. However, the positive own-price value of the legume group did not fulfil the nonnegativity condition of demand. This suggests that households in LUC might increase their demand for legume with a change in price. The uncompensated and compensated own-price elasticity indicated that all the food groups were price inelastic, with the exception of the meat group in LUC and roots and tubers in MUC. The magnitude of own-price effect was highest for the meat group in uncompensated (-1.3447) and compensated matrix (-1.5532) of LUC and for the roots and tubers group in the uncompensated (-1.0507) and compensated (-1.2411) of MUC. This indicated that a unit increase in the price of the inelastic food groups will lead to less than one percent decrease in their demand, while that of elastic food groups (meat and roots and tubers) decreased by more than one percent. The observed sensitivity in meat and root/tuber demand pattern among households in LUC and MUC, respectively suggest a substitution effect as price increases. The findings revealed disparities in the effect of price shocks on the level of food group demanded.

4. Discussion

The constructed urbanicity index agrees with studies that maintained degree of urbanicity with the use of urban variables (Van de Poel *et al.*, 2008; Szabo, 2016; Sinyolo and Mudhara, 2017). Our result, therefore, suggests locational differences with respect to urban indicators used and confirmed heterogeneity within the urban areas of Nigeria. Categorisation of urbanicity index resulted in the creation of three urbanicity groups that consisted of about 40.6% of sampled households in MUC. This partitioning provided a basis for comparison of household food demand responses across different urbanicity levels. This gives a good understanding of urban food demand differentials and provide policy options for identifying future household food demand hotspots as the level of urbanization increases. These inter-urban variations suggest that the use of urban versus rural dichotomy in food consumption does not adequately capture the full spectrum of urban food demand complexities.

Analysis of the socioeconomic characteristics of the three urbanicity groups as presented in Table 1 revealed some interesting differences. Given the categorisation of households, over three quarters of household heads had tertiary education. This showed that household heads were literate and could process dietary information as Ogundari (2017) reported. Over three quarters of the household heads sampled belonged to different social groups. This indicated that the social groups serve as a channel through which information on food and nutrition issues are disseminated. The occupational structure of household heads revealed differences in urban job opportunities which might influence pattern of household food demand. Furthermore, result of analysis of variance (ANOVA) revealed significant differences in household size (F,11.99; $p<0.05$) and average monthly income of household heads (F,12.39; $p< 0.01$). We found that the percentage of persons in the household size within the range 5-7 was higher for LUC (53.6%) and MUC (51.1%) than those in HUC (39.3%). The decline in number of household size in HUC can be linked to enlightenment on family control which might help to meet household food demand needs. This means sensitization on birth control through family planning programmes tends to minimise the size of the family. Not surprisingly, household heads mean income are notably higher for the households in the HUC than those in the LUC. This suggests income disparities in urban areas as Zheng and Hennesberry (2010) similarly reported. These findings contribute to food demand studies as previous works maintained constant socioeconomic effects in most urban food analysis.

Furthermore, the study also confirmed the significant influence of some socioeconomic variables and urban effect on the level of demand of food groups considered. For example, household size increased the demand of roots and tubers group. This suggests that larger households tend to consume more of the food group as basic food commodities (gari, yam, plantain etc) in Nigeria. However, there was a decline in roots and tubers consumption with re spect to income of household head and urbanicity index. The reduction can be linked to changing dietary pattern towards foods rich in micronutrients. This suggests that as income of household head improves, priority is given to more nutrient dense foods probably rich in protein and micronutrients than the high intake of calorie dense foods. This finding is consistent with Zheng *et al.* (2015) as the demand for root and tubers in urban China decreased with the rise in household income and urbanisation. Bren d'Amour et al. (2020) identified differing socioeconomic and demographic factors, such as higher income, or smaller urban household size to urban food demand.

With respect to the urban effect on the demand of food groups, higher urbanicity associated with the increased demand for meat (0.0014) and fruits and vegetables (0.014) and decreased with the demand for roots and tubers (-0.0011). This finding was in accordance with previous works, as Adetunji and Rauf (2012) and Ogbeide (2015) reported increased consumption of meat and its product in urban areas of Nigeria. Also, Bren d'Amour et al. (2020) found differences not only between rural and urban areas but also between different urban areas as households in large metropolitan areas consume more than households in smaller nonmetropolitan urban areas. This affirmed that the effect of urbanisation can have differing impacts on the pattern of urban food consumption.

As food in urban areas is mostly purchased, income of the household head tends to influence the level of food consumption. This was shown by the significant increase in the demand for cereals, legume and miscellaneous food groups as their income changes. In general, the findings suggest changes in the demand patterns of urban consumers can be linked to household head's socioeconomic status, growing income and access to nutritional information. Moreover, these findings suggested a lower intake of staples and higher consumption of proteins which tends to fit the urban nutritional demand (Guo, 2016).

From the expenditure elasticity estimates across the urban categories (table 2), all the food groups were expenditure-elastic, with the exception of the roots and tubers group. This implies that an increase in income will generally lead to a higher consumption of these foods at varying magnitudes. For example, estimates for the meat group – a luxury commodity – implies that a 1% increase in household head income will lead to an increase of 1.2%, 1.4% and 2.4% in demand for LUC, MUC and HUC, respectively. The expenditure elasticities showed large differences across the urban groups, where households in LUC and MUC were more responsive to changes in income than those in HUC. This suggests that larger income growth for households in LUC and MUC relative to HUC will lead to a greater increase in food demand in urban Nigeria compared to a constant growth across levels. The large expenditure value of the cereals group in LUC and MUC suggests their increased consumption as expenditures change. This finding was not in accordance with those of Guo (2016), Rizov *et al.* (2015) and Zheng and Henneberry (2010). The rise in demand for cereals among urban households may be attributed to the processed form of these food groups (rice, wheat, semovita, bread, pastas, etc). Most importantly, is that of rice, a major staple that is widely consumed among urban households in Nigeria (Erhabor and Ojogho, 2011). Food items with a minimal cooking time tend to suit the urban lifestyle due to the shortened time necessary for their preparation, driven by women's increased participation in the modern workforce (Liverpool-Tasie *et al.*, 2016).

The elasticity estimates for roots and tubers across urban categories are less than one. HUC had the smallest value (0.31), suggesting that households might be approaching a saturation level in the quantity of the food group consumed owing to changes in dietary pattern. Moreover, these estimated elasticities are consistent with prior expectations. This is evident in the rising trend in the expenditure elasticities of animal-origin foods – meats, poultry, aquatic products and dairy products – across all urban categories, as similarly reported by Zheng and Henneberry (2010), Olorunfemi (2013), Rivoz *et al.* (2015), Guo (2016) and Zhu et al. (2021). These results suggest disparities in urban food expenditures across urban groups, as compared to aggregating urban food expenditure elasticities.

From the own-price estimates, a percentage increase in the prices of all the food groups considered will lead to less than a 1% decrease in their demand (price inelastic), with the exception of the meat and roots and tubers groups in LUC and MUC, respectively, whose quantity demand decreased by more than 1% (price elastic). A comparison of the own-price elasticities showed that the legumes group was the least price-sensitive among the food groups. Their estimated own-price elasticities were substantially small, although with different variations across the three urban categories. The positive own-price elasticities (uncompensated and compensated) for the legume group suggest that LUC households might be willing to buy more of the legume group as a cheap source of protein for urban households, as Olorunfemi (2013) observed. It could be that the legume group was quite affordable compared to other sources of protein that were more expensive. Households in LUC were price-sensitive to meat, which is in accordance with Adetunji and Rauf's (2012) findings. The price increase resulted in a decline in the quantity demanded as households switched to other less-expensive sources of protein. The cost of production of these animal-origin foods might push up their market prices, which is coupled with income inequalities in terms of food access among urban households. This price effect on protein intake might be responsible for the high macronutrient deficiencies and low dietary pattern among vulnerable urban households in Nigeria, as Iyangbe and Orewa (2009) similarly reported. However, this finding further revealed the effect of food price increases in attaining urban food security.

Conversely, households in MUC were price-sensitive to the roots and tubers group. The findings from MUC households revealed a pronounced shift from the monotonous consumption of dietary energy toward more diverse diets featuring other high-value food commodities. This was evident in the decline in quantity demanded for roots and tubers – a basic necessity commodity among urban households even at increased prices. This explains a transition to a varied diet and dietary quality (macro- and micronutrients), which can be attributed to growing access to nutritional information about diverse diets. These findings revealed the heterogeneous effects of price shocks on the level of food group demanded.

5. Conclusion

This paper provides empirical evidence that urban households have different food expenditure patterns in southwest Nigeria. It revealed that demand of food groups studied was not constant as shown by our hypothesised urbanicity categorization. Based on the findings, the constructed urbanicity index, a proxy for urbanisation was found to be a major significant factor that determined access to food groups considered. The heterogeneous expenditure elasticities across urban categories suggest a change in the consumer preferences as household head income changes. Households in the low, middle and high urban categories responded differently to price change with the meat and roots/tubers groups having the largest own-price effect in low and middle urban categories, respectively. The results suggest that a change in the level of urbanisation is expected to have a considerable effect on the demand for food groups. Therefore, food demand response based on aggregation of urban household food analysis may underestimate the effects of varying level of food demand.

The relevance of this paper can be found in its application to policy. This paper has maintained the need to go beyond a uniform understanding of the urban food demand to a more nuanced one, accounting for the differential effects in the stages of the urbanization. This view has important implications on the agro-food sector based on different household food demand responses. With improvements in the income distribution, demand for food with animal-origin (pork, beef, mutton, poultry, eggs, milk, and fish), vegetables, and fruits is expected to rise considerably in the future. In response to these differentials in expenditure patterns, there might be a shift in the agro-food structure towards more production of feed grains for livestock and improvement of the value addition segment for perishables (vegetables, fruits etc). The multiplier effects tend to increase employment opportunities and also reduces food importation. Also, the demand-driven responses from household expenditure pattern has to be accompanied by infrastructural development. This tends to address the rising food prices, seasonality and perishability nature of high-value products with a possible reduction in food wastage both at farm and table, while increasing access to food. Furthermore, findings from this paper creates the need to evaluate existing food policies against the backdrop of constant food demand pattern in most urban areas. This would help in location-specific strategies towards better access to nutritious foods with subsequent improvement in urban food security.

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Table 1: Socioeconomic Distribution of Household heads by Urban Categories

Variables	Low urban category N=153	Middle urban category N=185	High urban category N=107	Difference test
Sex				
Male	65.36	67.42	74.77	
Female	34.64	32.58	25.23	
Age in years				
≤ 30	1.96	3.93	6.54	
31 – 40	21.57	26.97	24.30	
41 – 50	37.25	29.78	38.32	
50 – 60	32.68	25.84	14.95	
>60	6.54	13.48	15.89	
Mean age	48	47	47	1.90
	(9.11)	(11.37)	(11.98)	
Household size in number				
≤4	42.48	46.07	57.94	
5 – 7	53.59	51.12	39.25	
>8	3.92	2.81	2.80	
Mean household size	5	5	4	11.99*
	(1.45)	(1.56)	(1.63)	
Educational status				
No formal	0.65	1.69	0.00	
Primary education	2.61	1.12	0.93	
Secondary education	20.92	16.29	20.56	
Tertiary education	75.82	80.90	78.50	
Occupational status				
Government jobs	46.55	34.35	32.24	
Private organization	20.69	30.35	36.92	
Trader/Artisan	20.69	18.63	15.42	
Agricultural-based	4.31	6.86	5.14	
Others	7.76	9.80	10.28	
Membership of social group				
Yes	77.12	74.72	82.24	
No	34.81	39.23	25.96	
Average monthly income in Naira				
<40,000	41.12	29.21	25.49	
40001 – 60,000	37.38	43.26	39.22	
60,001– 80,000	14.95	21.91	24.84	
>80,000	6.54	5.62	10.46	
Mean monthly income	47,711.31	50,076	54,730	12.39**
	(17,212.65)	(17,147.84)	(18,445.45)	

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

Table 2: Determinants of Urban Household Demand by Food Groups

Variables	Cereal	Roots and tubers	Legume	Meat	Fat and oil	Fruits/ vegetable	Miscellaneous foods
Sex (1=male)	-0.0001 (0.0005)	-0.0005 (0.0004)	-0.0002 (0.0002)	0.0008 (0.0005)	-0.0003 (0.0003)	0.0001 (0.0006)	0.0001 (0.0003)
Age (in years)	-0.0000 (0.0001)	-0.0001 (0.0002)	-0.0001 (0.0001)	0.0003 (0.0003)	0.0001 (0.0001)	-0.0000 (0.0002)	-0.0001 (0.0002)
Age squared(in years)	0.0041 (0.0045)	0.0063 (0.0056)	0.0019 (0.0036)	-0.0111 (0.0081)	-0.0021 (0.0036)	-0.0033 (0.0073)	0.0044 (0.0050)
Household size (numbers)	-0.0006** (0.0002)	0.0006** (0.0002)	-0.0001 (0.0001)	0.0002 (0.0002)	0.0001 (0.0001)	0.0008** (0.0002)	0.0002 (0.0002)
Membership of social group (1=yes)	0.0021** (0.0005)	-0.0004 (0.0005)	-0.0004 (0.0003)	-0.0003 (0.0006)	-0.0008** (0.000)	-0.0007 (0.0006)	-0.0002 (0.0004)
Education (1= formal)	0.0004 (0.0005)	0.0003 (0.0004)	-0.0003 (0.0002)	-0.0003 (0.0006)	-0.0001 (0.0002)	0.0005 (0.0006)	0.0005 (0.0003)
Occupation (1=formal)	0.0012** (0.0005)	0.0004 (0.0005)	-0.0002 (0.0003)	0.0010 (0.0006)	0.0004 (0.0003)	-0.0008 (0.006)	-0.0000 (0.0004)
Dependency ratio	-0.0012 (0.0010)	0.0011 (0.008)	0.0001 (0.0005)	0.0015 (0.0011)	-0.0003 (0.0005)	-0.0002 (0.0010)	-0.0011 (0.0007)
Household income (Naira)	0.0012** (0.0004)	-0.0012** (0.0005)	0.0013** (0.0003)	-0.0009 (0.0006)	-0.0003 (0.0003)	-0.0008 (0.0006)	0.0018** (0.0004)
Urbanicity index (number)	0.0002 (0.0005)	-0.0011* (0.0005)	0.0005 (0.0003)	0.0014* (0.0007)	-0.0003 (0.0003)	0.0014* (0.0006)	0.0007 (0.0004)

Source: Output from QUAIDS analysis.

Figure in parenthesis are standard error. Statistical significance: ** 1%, * 5%

Table 3: Estimates of Household Expenditure Elasticities by Urban Categories

Food groups	Low urban category	Middle urban category	High urban category
Cereal	2.64	2.76	1.17
Roots and tubers	0.45	0.66	0.31
Legume	1.69	1.95	1.93
Meat	1.16	1.41	2.42
Fat and oil	1.51	1.04	1.06
Fruit and vegetables	1.42	1.14	1.34
Miscellaneous foods	0.45	1.11	1.18

Source: Output from QUAIDS analysis.

Table 4: Own Price Elasticity Estimates of Food Groups by Urban Categories

Food groups	Low urban category		Middle urban category		High urban category	
	Uncompensated	Compensated	Uncompensated	Compensated	Uncompensated	Compensated
Cereal	-0.3627	-0.1573	-0.2610	-0.2873	-0.2800	-0.2709
Roots and tubers	-0.4448	-0.1139	-1.0507	-1.2411	-0.8348	-0.9730
Legume	0.1588	0.1897	-0.2153	-0.1439	-0.0814	-0.0442
Meat	-1.3447	-1.5532	-0.4974	-0.2819	-0.3221	-0.0975
Fat and oil	-0.3520	-0.3149	-0.3680	-0.3034	-0.6301	-0.5850
Fruits and vegetables	-0.3417	-0.1037	-0.4024	-0.1454	-0.4741	-0.2177
Miscellaneous foods	-0.3024	-0.2639	-0.3666	-0.3331	-0.2815	-0.2545

Source: Output from QUAIDS analysis