

ALIMENTAL FOOD CONSUMPTION AMONG URBAN HOUSEHOLDS: AN EMPIRICAL STUDY OF GHANA

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Abstract. In developing countries, problems such as malnutrition and food insecurity are shifting from rural to urban areas because of rapid urbanization. However, regional variations in alimental food consumption within urban settings have often been ignored. Using survey data, our study examines regional patterns of expenditure on fresh vegetables, fruits, and peanut products in urban households of Ghana. After accounting for socioeconomic and demographic factors, food expenditure on fresh vegetables and peanut products and income elasticity vary significantly across major cities. Food distributors may adjust their marketing strategies, while policy makers should pay attention to possible disparities in urban areas.

Keywords. Engle curve, modified Tobit, peanut, survey data, urban consumer

JEL Classification. Q13, Q19

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1. Introduction

The rapid urban population growth in many African countries (Fanzo, 2012) will double the size of cities over the next 15 to 20 years (Institute for Health Metrics and Evaluation [IHME] and Human Development Network, The World Bank, 2013). In Ghana, 58% of the population will reside in urban areas by 2030 (Farvacque-Vitkovic et al., 2008). The consumption gap between urban and rural areas has been studied (Fotso, 2007; Smith, Ruel, and Ndiaye, 2005; Van de Poel, O'Donnell, and Van Doorslaer, 2007), and regional variation in food consumption is consistently confirmed (Nayga, 1997; Ruel, Minot, and Smith, 2004; Wetherbee and Cortés, 2004). With the rapid expansion of cities, problems such as malnutrition and food insecurity are shifting from rural to urban areas (Maxwell et al., 2000), and the specific urban nature of the problem needs to be addressed (Buttersby, 2017). Widespread nutrient deficiencies still affect sub-Saharan Africa (Fanzo, 2012; World Health Organization [WHO]/Food and Agriculture Organization of the United Nations [FAO], 2005; IHME and Human Development Network, The World Bank, 2013; McLean et al., 2008) despite evidence of some progress (Kassebaum et al., 2014) and contribute to increasing chronic diseases, including hypertension (Cappuccio and Miller, 2016; Mensah, 2008; Yach et al., 2004). For example, hypertension affected 27.1% of Ghana's urban residents in 2008 and is expected to increase by 68% in Africa as a whole between 2008 and 2025 (Twagirumukiza et al., 2011). Diets low in fruit and vegetables are the most common dietary risk factor contributing to the burden of noncommunicable diseases (NCDs) (Kassebaum et al., 2014; Melaku et al., 2016). Peanut consumption studies examined and evaluated factors influencing consumer eating decisions in Ghana (Awuah et al., 2009; Florkowski and Kolavalli, 2016; Jolly et al., 2008; Meng et al., 2018), but not expenditure.

This study examines regional differences in household expenditure of alimental foods (i.e., fresh vegetables, fresh fruits, and peanut products) using primary survey data collected from urban households in Ghana. The current study addresses two major issues: (a) how the expenditure on fresh vegetables, fresh fruits, and peanut products varies across three regional capitals; and (b) the determinants of expenditure on these alimental food categories considering regional differences. Earlier studies regarding vegetable, fruit, and peanut product consumption in Ghana have focused on consumers at a single location (Glover-Amengor and Vowotor, 2013; Jolly et al., 2008; Kpodo, Mensah, and Dzah, 2015) or at a province level (Amo-Adjei and Kumi-Kyereme, 2015) and fail to capture the existence of regional differences in urban areas, which have implications for public health and marketing strategy. This study confirms the presence and magnitude of regional differences with regard to a common set of factors by applying rigor lacking in previous reports. Results suggest that after accounting for socioeconomic and demographic factors, urban

Table 1. Regional Food Production and Food Preferences in Accra, Takoradi, and Tamale

City	Food Production	Food Preferences
Accra	Cassava, pepper, tomatoes, carrots, lettuce, cabbage, maize	Rice, fried yam, banku, fufu, millet and maize porridge
Tamale	Tomatoes, okra, pepper, rice, cowpea, yam, maize	Tubaani (steamed cowpea pudding), rice balls, fried yam, Waakye
Takoradi	Cocoa, plantain, cocoyam, maize, pepper, tomatoes, garden egg, onion	Rice, fried yam, banku, fufu

Sources: Asante et al. (2015), Bellwood-Howard and Chimsi (2015), Djokoto, Afari-Sefa, and Addo-Quaye (2017), Gamor et al. (2015), and Ghana Statistical Service (2013).

household expenditures on fresh vegetables and peanut products still vary significantly across regions, and so do the corresponding income elasticities. However, such regional variation is not significant in the case of fresh fruit expenditures. Furthermore, this study also identifies key determinants that affect the consumption of alimantal foods, such as marital status, age and education of respondents, and household income and size.

An understanding of regional variations within a country and the urban-specific consumer profile in Ghana helps in responding to WHO's Global NCD Action Plan (2013) for country-specific prevention and control of NCDs. Kpodo, Mensah, and Dzah (2015) provide information for formulation of programs to increase fruit and vegetable consumption but ultimately make a general suggestion to develop social marketing strategies. The current study provides much broader insights, but the design and implementation of programs boosting fruit and vegetable consumption ultimately rest with the government. In addition, this study provides useful insights into the changing commercial food sector (Meng et al., 2014) in a country facing rapid urbanization and the resulting demand for alimantal foods popular in several West African countries (Affokpon et al., 2011). In Ghana, the vegetable and fruit consumption per capita was only 73.6 kg per year (Ruel, Minot, and Smith, 2004), well below the WHO's recommendation of 146 kg of fruits and vegetables annually. National per capita peanut consumption is about 0.61 kg per week (Awuah, 1999). Eighty percent of Ghanaians eat peanut products weekly or more often (Jolly et al., 2008) as peanuts are processed into a wide variety of food items (Meng et al., 2018; Tsigbey, Brandenburg, and Clottey, 2003). Urban food supply systems in Ghana also display regional variation (Table 1). Food production and consumption patterns vary across regions in Ghana because of different agroecological conditions and regional market structures (Cudjoe, Breisinger, and Diao, 2010). Typically, the Coastal Belt is warm and dry, the southwest is hot and humid, and the north is relatively hot and dry. Modern supermarkets have spread in Ghana during recent years, but traditional food retail outlets such as open-air markets and street hawking remain important (Meng et al., 2014). In Accra, more than

90% of all food consumed is purchased (Levin et al., 2000). In addition, food price levels vary significantly across regions. Urban households in the Western Region are facing much higher food prices than households located in most other regions. The consumer price index (CPI) for food and nonalcoholic beverages for the Northern Region and Greater Accra was 272.95 and 334.03, respectively, and for the Western Region it was 351.47 (using the year 2002 as the base).

The regional variation in expenditure patterns could be a consequence of several different factors (Lee, 1971). In spite of the rapid economic growth in Ghana, the regional divide has been significant. The north lags far behind the south in most development indicators (Grant and Nijman, 2004; Jatoe, Al-Hassan, and Adekunle, 2012). Differences are attributable to history, climate, agricultural production conditions, and postindependent political neglect (The Overseas Development Institute and the Center for Economic Policy, 2005). The regional disparity in economic development, food production, and the food supply system discussed previously contributes to different food consumption patterns and hence nutrition status in urban households. Therefore, the regional heterogeneous patterns, represented in this study by residents in three cities (approximately 10.4% of the country's population), are taken into consideration in exploring alimental food consumption. Knowledge of factors driving or hampering expenditure on any of the considered product categories is indispensable in formulating national or regional marketing strategies in countries where market intelligence is poor.

2. Conceptual Framework

The conceptual framework of this study is based on the consumer demand theory and the Engel curve. Within budget constraints, households decide optimal levels of their food and nonfood consumption to maximize their utility level (equation 1):

$$\text{Max } U = U(q_v, q_f, q_p, q), \quad \text{subject to } PQ = I, \quad (1)$$

where U is the household utility; q_v , q_f , q_p , and q are household consumption of fresh vegetables, fruits, peanut products, and other goods, respectively; P and Q are the corresponding price index and consumption vectors, respectively; and I , a scalar, denotes household income. After solving for the Lagrange, the optimal consumption q^* is determined by price index (P), household income (I), and household preferences (k) in equation (2):

$$q^* = q(P, I; k). \quad (2)$$

Given the stable price assumption (adjusted by regional CPI), the optimal expenditure (E^*), the product of price index and consumption, is found to be a function of household income (I) and household preferences (k) shown in

equation (3):

$$E^* = Pq^* = E(I; k|P). \quad (3)$$

The nonobserved household preferences (k) can be further shaped and captured by socioeconomic factors and demographic characteristics (Binkley, 2006; Ruel, Minot, and Smith, 2004; Ziol-Guest, DeLeire, and Kalil, 2006). In Ghana, fresh fruit consumption is associated with age, gender, and income (Wang et al., 2016). Jolly et al. (2008) report that peanut consumption is influenced by age and education.

Therefore, food expenditures are determined by household income, socioeconomic factors, and demographic factors including household location, which has been supported by a number of studies. The close relationship between consumption of specific goods and income has been well documented by the Engel curve (Wetzstein, 2005). Studies are remarkably consistent in supporting the theory that fresh vegetable, fresh fruit, and peanut product consumption are influenced by sociodemographic factors in developed economies (e.g., Binkley, 2006; Hall et al., 2009; Jolly et al., 2008; Ziol-Guest, DeLeire, and Kalil, 2006), in Africa (Ruel, Minot, and Smith, 2004), and in Ghana (Jolly et al., 2008). In addition, location factors may relate with other determinant variables, such as income, in affecting food expenditures as shown by Giles and Hampton (1987) in the case of significant income elasticity of demand variations between regions in New Zealand. In Ghana, location is associated with the consumption of selected fruits (Wang et al., 2016) and peanut products (Meng et al., 2018).

3. Data

The present study uses the survey data collected in three large cities in Ghana in 2011. Accra is the capital of Ghana, Takoradi is an important port and the fourth largest city, and Tamale is the capital city of the Northern Region. These three cities are among the top five largest cities in Ghana, which are home to half of the country's urban population (Farvacque-Vitkovic et al., 2008). In terms of ecological zone types and city location, Accra, Takoradi, and Tamale represent the south coastal area, the west forest area, and the north savannah area, respectively. This selection also captures differences in regional economic development and possible differences in household structure and behavior resulting from varying ethnicities in the local populations. Ethnic differences posed a challenge in data collection because they required training a different set of enumerators fluent in the local languages (besides English) in the northern and coastal areas. Households surveyed in this study were part of the sample surveyed by the GSS, and the enumerators had previously participated in data collection through personal interviews there.

After the preparation of the questionnaire, data collection in the three cities took place between February and June 2011. Pilot testing of the questionnaire

took place on the first day of data collection during the survey implementation in Tamale and did not reveal any potential problems in communicating issues or respondent difficulty in providing answers. During the following days, completed questionnaires were reviewed as they were gathered daily for potential response errors and data were entered concurrently into a spreadsheet. Similar procedures were applied to data collection in Takoradi and Accra.

Questions in the survey instrument were structured to ask respondents about their food shopping habits, food spending, and other information such as age, gender, occupation, household income, and household composition. Respondents were asked to report their weekly spending on fresh vegetables, fresh fruits, and peanut products. Peanut products include peanut paste, *dzowe* (ready-to-eat snack made of roasted, milled maize, roasted peanuts, sugar, and spices), *kuli-kuli* (snack made of fresh cake obtained after pressing peanuts for oil and fried in peanut oil; often rolled and shaped into rings in Ghana), and other common peanut-based products in Ghana.

After deleting incomplete records, 1,010 observations were analyzed in the study. [Table 2](#) shows the definition and units of variables included in the empirical analysis and selected descriptive statistics at the city level. Notice that food expenditure and income in our analysis were adjusted using the regional CPI calculated for May 2011 to tease out the different price levels across regions. In this sample, 60.6% of respondents are from Accra; 20.8%, from Takoradi; and the remaining 18.6%, from Tamale. On average, a Ghanaian household spends 13.3 cedis on fresh vegetables, 5.5 cedis on fresh fruits, and 3.5 cedis on peanut products per week, which accounts for 24.2%, 10.4%, and 7.6% of the household's weekly food expenditure, respectively (US\$1 = 1.49989 Ghanaian cedis on January 1, 2011; GSS, 2013). Among the respondents, 64.2% were reported as self-employed, 24.3% were government or civil employees, and 11.5% were students, retired, or unemployed.

Among the surveyed urban households, three out of four respondents were married. The married rate at the national population level was 58% in 2010, pooling urban and rural areas together (GSS, 2012a). The high percentage of married households in this study is lower than in some earlier reports (Quisumbing, Hallman, and Ruel, 2003). The average age of participants in our survey was 39.2 years old. There is no corresponding population statistic for age, but according to the GSS (2012b), a majority of the urban population in 2010 (61.3%) was within the range of 15–64 years old. In terms of education level, more than one-half of the respondents have an education higher than high school, which is consistent with the national education level (United Nations International Children's Emergency Fund, 2013). The mean household income in the month preceding the survey was 652.2 cedis, which is close to the population income statistic of 650.45 cedis (calculated based on the gross national income per capita [The World Bank, 2017] and four-person household).

Table 2. Descriptive Statistics of Variables Included in the Empirical Model

Variable Name	Variable Description/Units of Measurement	Sample Total	Accra	Takoradi	Tamale
Dependent variables					
Exp_Veg	Weekly household food expenditure on fresh vegetables/in Ghanaian cedis	13.268 (12.589)	14.385 (13.682)	10.540 (6.524)	11.911 (13.463)
Exp_Fruits	Weekly household food expenditure on fresh fruits/in Ghanaian cedis	5.535 (5.883)	5.686 (6.561)	4.923 (4.754)	5.150 (4.503)
Exp_Peanuts	Weekly household food expenditure on peanut products/in Ghanaian cedis	3.466 (3.785)	2.653 (2.789)	3.314 (2.700)	5.962 (5.864)
Independent variables					
Demographic factors					
Married	=1 if a respondent is married	0.753 (0.431)	0.725 (0.447)	0.819 (0.386)	0.771 (0.421)
Age	Actual age in years	39.222 (10.656)	39.802 (10.842)	39.076 (9.055)	37.494 (11.525)
Children	Number of household members between 4 and 12 years old	0.945 (1.067)	0.810 (0.993)	1.129 (0.972)	1.176 (1.311)
Adult	Number of household members between 19 and 60 years old	2.087 (1.751)	1.943 (1.508)	2.067 (1.784)	2.580 (2.289)
Elder	Number of household members 61 years or older	0.153 (0.505)	0.173 (0.521)	0.052 (0.263)	0.202 (0.630)
Socioeconomic factors					
Income	Household income in the month preceding the survey/in Ghanaian cedis	652.229 (783.50)	841.194 (936.143)	426.687 (296.634)	289.021 (209.721)
Employ_self	=1 if a respondent is self-employed	0.642 (0.480)	0.675 (0.469)	0.633 (0.483)	0.543 (0.500)
Employ_gov	=1 if a respondent is government/civil employee	0.243 (0.429)	0.214 (0.410)	0.295 (0.457)	0.277 (0.449)
Educ	=1 if a respondent has a formal education (including senior high/General Certificate of Education Ordinary and Advanced Levels, vocational school, technical school, teacher training, university, or postgraduate)	0.516 (0.500)	0.521 (0.500)	0.629 (0.484)	0.372 (0.485)
N		1,010	612	210	188

Table 3. Weekly Household Expenditure on Fresh Vegetables, Fresh Fruits, and Peanut Products in Three Cities in Ghana

Weekly Expenditure	Accra	Takoradi	Tamale	F-Statistic of ANOVA	P-Value
Fresh vegetables	14.385	10.540	11.911	9.55	0.0001
Fresh fruits	5.686	4.923	5.150	1.77	0.1702
Peanuts products	2.653	3.314	5.962	70.91	<0.0001

Note: ANOVA, analysis of variance.

The weekly household food expenditures on fresh vegetables, fresh fruits, and peanut products in the three cities are shown in Table 3. Weekly household expenditures on fresh vegetables are 14.4, 10.5, and 11.9 cedis in Accra, Takoradi, and Tamale, respectively; expenditures on fresh fruits are 5.7, 4.9, and 5.2 cedis, respectively; and expenditures on peanut products are 2.7, 3.3, and 6.0 cedis, respectively. Among the three cities, households in Accra have higher fresh vegetable expenditures, whereas households in Tamale reported higher food expenditures on peanut products.

4. Empirical Model

First, the analysis of variance (ANOVA) is employed to examine whether weekly household expenditure for each food category varies by location. In this study, ANOVA tests are conducted for three food categories (i.e., fresh vegetables, fresh fruits, and peanut products) separately across three big cities (i.e., Accra, Takoradi, and Tamale).

Second, the multivariate Tobit (MV-Tobit) model is used to examine the impact of regional differences on food expenditures after controlling for sociodemographic variables. A small number of zero food expenditures in three food categories suggest that the Tobit model is suitable (Greene, 2003).

For comparison, the equations are estimated using ordinary least squares, and the only difference is the statistically significant coefficient associated with expenditures on vegetables in Tamale; the same coefficient in the MV-Tobit results is marginally insignificant. However, the choice of the MV-Tobit is further supported by households' limited expenditure on the three foods. Also, household expenditures on the three food items may be related to each other because vegetables, fruits, and peanut products may be ingredients in the same dish or complementary dishes in the same week. The multivariate version of the Tobit model is applied to address the potential cross-equation correlations of food expenditure across different food items in our study to obtain more efficient results (Barslund, 2009) because the correlation parameters in the multivariate Tobit model allow capturing correlations of cross-equation errors if they exist. Equation (4) shows the empirical model. Latent variables of weekly household

expenditures (E^* 's) are the dependent variables, and explanatory variables (X) include sociodemographic characteristics, location, and interaction terms between location and income; B 's are the estimated coefficients; the subscripts v , f , and p indicate vegetables, fruits, and peanut products, respectively; and e 's are the stochastic error terms.

$$\begin{aligned} E_v^* &= XB_v + e_v \\ E_f^* &= XB_f + e_f \\ E_p^* &= XB_p + e_p \\ E &= \max(E^*, 0) \end{aligned} \quad (4)$$

The error term vector follows a multivariate normal distribution in [equation \(5\)](#):

$$\begin{aligned} e &= (e_v, e_f, e_p)' \sim N(0, V) \\ 0 &= \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \quad V = \begin{bmatrix} r_v^2 & r_{vf} & r_{vp} \\ r_{vf} & r_f^2 & r_{fp} \\ r_{vp} & r_{fp} & r_p^2 \end{bmatrix}, \end{aligned} \quad (5)$$

where V is the variance-covariance matrix of error terms, r_{ij} 's are the corresponding cross-equation correlations between equations i and j , and r_i 's are the standard deviations of error terms. For example, r_{vf} is the correlation coefficient between the error terms in the fresh vegetable expenditure equation and the fresh fruit expenditure equation. The model was estimated using the maximum simulated likelihood by STATA "mvtobit" program (Barslund, 2009).

Third, to check if the zero-excess issue exists in the data, the study compares the proportions of observed and predicted zero responses. Results indicate that probabilities of observed zero responses in fresh vegetable, fresh fruit, and peanut product expenditures are 1.21%, 7.53%, and 6.41%, respectively, which are much smaller than the predicted probability of zero expenditure by the MV-Tobit model (i.e., 14.8%, 19.8%, and 20.0%). Therefore, there is no need to consider a zero-inflated model in the current study.

5. Results

5.1. ANOVA on Alimentary Food Expenditure Mean across Regions

Results of ANOVA on food expenditure means regarding the alimental food categories across regions are displayed in [Table 3](#). The results indicate that the regional variation is statistically significant in the household expenditure on fresh vegetables and peanut products but not on fresh fruits. On average, Accra households spend more on fresh vegetables, followed by Tamale and Takoradi households. Such patterns are quite different in relation to peanut products, where Tamale households lead in expenditures followed by households in Takoradi and Accra. An earlier study indicated that the selected domestic fruit consumption frequency (i.e., pineapple and banana) by urban households

in Ghana is associated with location (Wang et al., 2016). The differences result from ability to grow specific fruit in a particular ecological zone, and the study did not provide price or expenditure information. The pineapple sector is well organized in Ghana and has been a traditional exporter.

To further examine location difference, control of the sociodemographic factors becomes necessary. Therefore, despite results from ANOVA supporting the existence of location differences in fresh vegetable and peanut product expenditures, whether such disparity originates from the location factor or from sociodemographic factors associated with location is still not clear. The following section compares the estimation results of determinants of household expenditure, including socioeconomic factors, demographic factors, location, and interaction terms between location and income.

5.2. Cross-Equation Correlations in MV-Tobit Model

Estimation results from the MV-Tobit model are in [Table 4](#), which displays estimated coefficients of demographic factors, socioeconomic factors, and location, as well as correlation parameters in the estimation equation system. As compared with the conventional Tobit model, the multivariate version of the Tobit model allows this study to examine potential correlations between each pair of food categories. This subsection focuses on the cross-equation correlations between three food categories, and the next two subsections separately discuss significant socioeconomic and demographic factors that affect alimentive food expenditure, as well as effects of household location.

First, the likelihood ratio (LR) test verifies the hypothesis that all three covariance parameters (i.e., R 's) are jointly equal to zero. If such a hypothesis holds, then the MV-Tobit model can be simplified to three single Tobit models. Results of the LR test suggest rejecting the null hypothesis in [Table 4](#) (Chi-square statistics = 510.512, $d = 3$). It indicates that the correlation parameters regarding the three equations do not jointly equal zero. In other words, the error terms in this specific equation system are correlated. Therefore, by considering the across-equation correlations, the MV-Tobit model provides more efficient results than three separate Tobit models.

Second, [Table 5](#) shows the estimation of correlation in the variance-covariance matrix of cross-equation error terms. The pair of vegetables and fruits has the largest correlation coefficient (0.59), followed by the pair of vegetables and peanuts (0.28), and fruits and peanuts (0.22). The large correlation between vegetables and fruits indicates that a household consuming more vegetables is also more likely to eat more fruits. Moreover, significantly positive correlations between peanuts and other food categories confirm the traditional diet in Ghana, where peanut products are often consumed as a complement to fresh vegetables and fruits. For example, a roasted banana and roasted peanuts can be combined for lunch, and peanut products and vegetables are often used as ingredients in the same dish like the well-liked peanut soup.

Table 4. Estimation Results of Food Expenditure on Fresh Vegetables, Fresh Fruits, and Peanut Products in Urban Households of Ghana, 2011

Variable Name/Coefficient (standard error)	Vegetables	Fruits	Peanuts
Intercept	2.3720 (2.1269)	-0.5827 (1.0327)	0.6793 (0.7664)
Demographic factors			
Married	2.2167** (0.8785)	0.8711** (0.4312)	0.0572 (0.2983)
Age	0.1300*** (0.0371)	0.0484*** (0.0181)	0.0128 (0.0130)
Children	0.3129 (0.3563)	0.0642 (0.1764)	0.1438 (0.1124)
Adult	0.2856 (0.2313)	0.3828*** (0.1144)	0.2348*** (0.0894)
Elder	-0.0088 (0.7415)	-0.5329 (0.3619)	-0.1315 (0.2387)
Socioeconomic factors			
Income	0.0040*** (0.0005)	0.0019*** (0.0003)	0.0004** (0.0002)
Employ_self	-0.0096 (1.2023)	0.0323 (0.5879)	0.1913 (0.4352)
Employ_gov	0.2810 (1.4090)	-0.1455 (0.6898)	-0.1769 (0.5206)
Educ	1.9320** (0.8665)	2.2880*** (0.4246)	0.6361** (0.2801)
Location			
Tamale	-2.8717 (1.7745)	0.3917 (0.8704)	2.3599*** (0.5226)
Takoradi	-2.6426* (1.5563)	-0.2660 (0.7587)	1.6190*** (0.4848)
Tamale×income	0.0110** (0.0047)	0.0019 (0.0024)	0.0048*** (0.0014)
Takoradi×income	-0.0002 (0.0028)	0.0004 (0.0013)	-0.0019** (0.0009)
Parameter			
Sigma of vegetable equation	11.8251*** (0.2785)		
Sigma of fruit equation	5.7016*** (0.1404)		
Sigma of peanut product equation	3.6202*** (0.0857)		
No. of observations	1,010		
Likelihood ratio test statistics (<i>P</i> -value)	510.512 (<0.0001)		

Notes: Asterisks (*, **, and ***) denote coefficients are significant at the 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses.

Table 5. Correlation Coefficients across Equations

	Vegetables	Fruits	Peanut Products
Vegetables	—	0.5890*** (0.0219)	0.2830*** (0.0314)
Fruits	0.5890*** (0.0219)	—	0.2294*** (0.0323)
Peanut products	0.2830*** (0.0314)	0.2294*** (0.0323)	—

Notes: Asterisks (***) denote significance at the 5% level.

Table 6. Marginal Effects of Significant Determinants of Food Expenditure on Fresh Vegetables, Fresh Fruits, and Peanut Products in Urban Households of Ghana, 2011

Variable Name/Marginal Effects	Vegetables	Fruits	Peanuts
Married	2.1899** (0.8679)	0.8055** (0.3987)	—
Age	0.1284*** (0.0367)	0.0448*** (0.0167)	—
Adults	—	0.3540*** (0.1058)	0.2197*** (0.0837)
Income	0.0040*** (0.0005)	0.0018*** (0.0003)	0.0004** (0.0002)
Educ	1.9086** (0.8560)	2.1157*** (0.3926)	0.5953** (0.2621)
Tamale	—	—	2.2086*** (0.4891)
Takoradi	-2.6106* (1.5375)	—	1.5152*** (0.4537)
Tamale×income	0.0109** (0.0046)	—	0.0045*** (0.0013)
Takoradi×income	—	—	-0.0018** (0.0008)

Notes: Asterisks (*, **, and ***) denote marginal effects are significant at the 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses.

5.3. Significant Socioeconomic and Demographic Factors

This section focuses on significant socioeconomic and demographic factors affecting alimentive food expenditure, and effects of household location will be discussed in the next section. Marginal effects of explanatory variables on the observed food expenditure are derived by multiplying the estimated coefficients by the probability of being in the noncensored part of the distribution (Brown, Harris, and Taylor, 2012) and are displayed in Table 6.

5.3.1. Fresh Vegetables

Results indicate that fresh vegetable expenditure is significantly affected by a number of sociodemographic factors including income, education, marital status,

and age. Household income has a positive effect on fresh vegetable expenditure, and the income elasticity is 0.20. Such a finding is quite consistent with previous studies (Hall et al., 2009; Ruel, Minot, and Smith, 2004). Increased income contributes to more nutritious food consumption (Hama and Chern, 1988), so well-off households tend to pursue a healthier diet and likely consume more vegetables. Well-educated respondents spend 1.90 cedis more on fresh vegetables every week than those with lower than high school education levels because, in general, higher educated people perceive nutrition as more important in food shopping (Nayga, 1997). Besides socioeconomic factors, the demographic characteristics such as marital status and age also have a statistically significant influence. Married households have higher spending on fresh vegetables than their counterparts, which is consistent with the finding by Ziol-Guest, DeLeire, and Kalil (2006) that married households allocate a greater share of their food budget on vegetables; a respondent from a married household spends 2.19 cedis more on fresh vegetable purchases. Moreover, because of increasing knowledge of the link between health maintenance and diet, age has a positive effect and leads to a fresh vegetable expenditure increase. Ten-year advancement in age brings about an increase of 1.3 cedis in weekly fresh vegetable spending. The finding confirms that fresh vegetable consumption varies by age (Lock et al., 2005). In Ghana, the effect may also be influenced by the Ministry of Health program focused on regenerative health and the key role of vegetable and fruit consumption to achieve its objectives (Amo-Adjei and Kumi-Kyereme, 2015).

As compared with an Accra household, those from Takoradi spend 2.61 cedis less on weekly fresh vegetable purchases. Amo-Adjei and Kumi-Kyereme (2015) suggested that the Coastal Zone may produce fewer vegetables implying that a change in distribution system could lead to a lower vegetable consumption there, but the analysis was at the province level using data for 2008. In case of Tamale, the interaction term suggests that an increase in income induces spending on fresh vegetables. It is plausible that the differences in the level of regional development contribute to the observed effect.

5.3.2. *Fresh Fruits*

Similar to the fresh vegetable expenditure discussed previously, high fresh fruit spending is also closely associated with changes in income and education. Consumers who have lower income or less education pay less attention to buying healthy food (Buzby et al., 2013). The results of this study indicate that weekly fresh fruit expenditure significantly increases with income. The income elasticity of fresh fruit expenditure is 0.21, which is slightly higher than the income elasticity of fresh vegetable expenditure. The finding is consistent with the results in the study by Ruel, Minot, and Smith (2004) that the estimated income elasticity for fruit expenditure is greater than the elasticity for vegetable expenditure in eight sub-Saharan countries including Ghana. Moreover, a high educational attainment of respondents leads to a 2.10 cedis premium in fresh fruit

expenditure per week (more than in the case of vegetables) as compared with that of households with less than high school education. Education has been linked to more frequent consumption of selected fruit in Ghana (Wang et al., 2016).

In terms of demographic factors, the effects of marital status, age, and household composition are found to be statistically significant. High fresh fruit expenditure is associated with the respondent's marital status, a finding consistent with results reported by Ziolo-Guest, DeLeire, and Kalil (2006). Specifically, the gap of weekly fresh fruit expenditure between married and nonmarried households is about 0.81 cedis (about 15%) but is considerably smaller than in the case of expenditure on fresh vegetables. Additionally, as age increases, food expenditure on fresh fruits grows. A 10-year increase in the respondent's age brings about an increase of 0.4 cedis in weekly fresh fruit spending, although the increase is less than the corresponding increase in vegetable expenditure. A noticeable difference between the set of factors influencing fruit and vegetable expenditure is associated with the number of adults in a household—that is, those with more adult members are found to spend more on fresh fruits, and the corresponding increase is 0.35 cedis per week per one additional adult member in a household. This finding is consistent with previous studies. For example, Ruel, Minot, and Smith (2004) found that adult share is positively associated with the budget allocated to fruits and vegetables in several sub-Saharan African countries.

5.3.3. *Peanut Products*

Income has a significant positive effect on peanut product expenditure, and the corresponding income elasticity is 0.07. Such a finding is consistent with the repeated reports of the importance of peanuts in Ghana's households (Jolly et al., 2008; Meng et al., 2018). Peanut product spending in urban households increases as income increases but at a much slower pace as compared with vegetable or fruit expenditure. Education also causes expenditure on peanut products to increase; households of well-educated consumers spend 0.59 cedis (17%) more on peanut products per week than those of less educated consumers. The finding confirms the positive role of education in peanut consumption (Moon et al., 1999). In addition, expenditure on peanut products is positively related to the number of adult household members, with a marginal effect of 0.22 cedis per week. It is likely that a larger number of adults leads to an increased purchase of peanut paste, a versatile peanut products used in various dishes and eaten on various occasions.

5.4. *Summary of Regional Variation Controlling for Sociodemographic Factors*

Based on the results of the MV-Tobit model, Figures 1–3 summarize the regional variation in household weekly fresh vegetable, fresh fruit, and peanut product expenditures. After controlling for sociodemographic factors, expenditures on

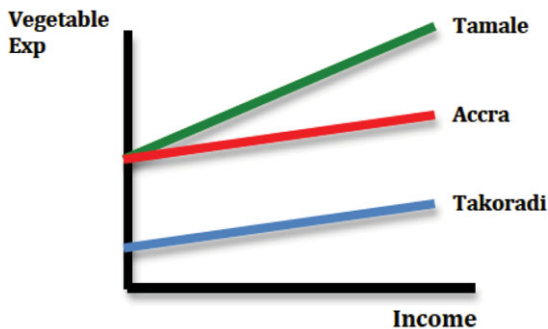


Figure 1. Regional Variation in Fresh Vegetable Expenditure

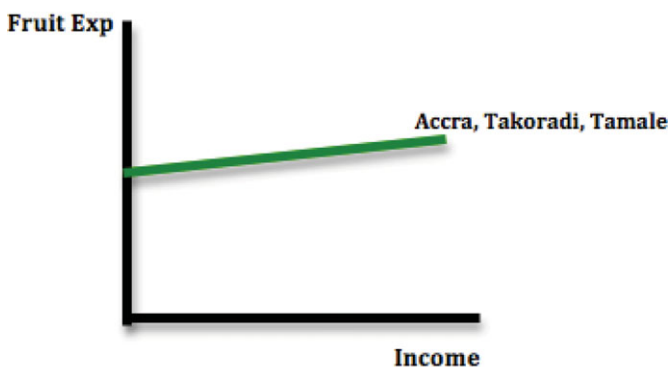


Figure 2. The Absence of Regional Variation in Fresh Fruit Expenditure

fresh vegetables and peanut products vary across regions, but the regional variation in fresh fruit expenditure is not confirmed. Regarding the latter, an earlier study of fruit consumption confirmed differences across ecological zones in Ghana (Amo-Adjei and Kumi-Kyereme, 2015).

Households in Accra and Tamale have significantly higher fresh vegetable expenditure than Takoradi-based households (Figure 1). The likely major factor hampering fresh vegetable consumption in Takoradi is the high food price in the Western Region of Ghana, which is 5% higher than in Greater Accra and 29% higher than in northern areas. Improvements in distribution system (Amo-Adjei and Kumi-Kyereme, 2015) and easing cross-regional shipments (road improvement) can increase fresh vegetable availability. In addition, the curve for Tamale households has a significantly steeper slope, suggesting that households are more sensitive to income growth than residents in the other two cities in terms of increasing their fresh vegetable expenditure. This finding suggests that increasing income is more efficient in northern Ghana than in southern and western Ghana if the enhanced fresh vegetable consumption is a goal. Given the

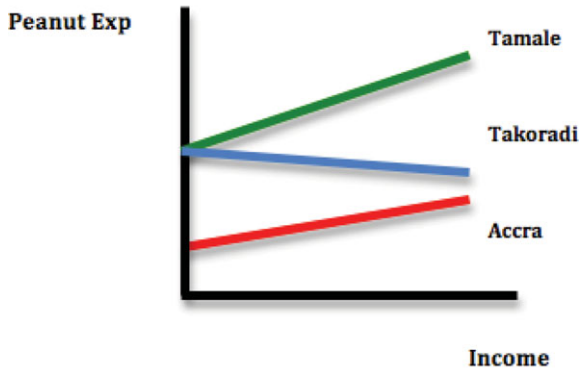


Figure 3. Regional Variation in Peanut Product Expenditure

relatively lower level of development in northern Ghana, a localized program that targets increasing vegetable consumption may make a real difference.

In the case of fresh fruits (Figure 2), after controlling for the selected sociodemographic factor effects, weekly household expenditure does not significantly vary across regions. This finding indicates that current household expenditure on fresh fruits can be fully explained by the sociodemographic characteristics associated with each household, for which regional variation is not significant. This result is different from the earlier reported differences in fruit consumption across ecological zones in Ghana based on 2008 national data (Amo-Adjei and Kumi-Kyereme, 2015). It also has to be noted that the availability of various fruits varies across the three cities in this study, and Kpodo, Mensah, and Dzah (2015) indicated that the choice of fruit was primarily influenced by availability. However, the absence of statistically significant differences in fruit expenditure suggests that distributors may have flexibility in choosing the fruit mix supplied to retail outlets in each city. However, from a public health standpoint, the fruit mix matters because of regional differences in nutrient deficits and their content in various types of fruit.

Regarding peanut product expenditure (Figure 3), households in regional capital cities (i.e., Tamale and Takoradi) have significantly higher expenditure than the Accra-based households. Tamale is located in the northern zone, generally considered to be a high production and consumption zone of peanut products, whereas Greater Accra is considered a low production and consumption zone (Awuah, Fialor, and Jolly, 2001). Moreover, income has a positive effect on peanut product expenditure in households in Tamale and Accra, but Tamale households' peanut product expenditure is more responsive to income growth. In contrast, as household income increases, the peanut spending decreases in Takoradi. Peanut and peanut-based products are an integral part of the diet in West African countries including Ghana, and results indicate that

regional capital cities such as Takoradi and Tamale adhere to the traditional diet more strongly than the capital city households, but Takoradi households, for reasons not discerned by this study, spend less on peanut products as income increases.

6. Discussion

This study identified specific characteristics of households associated with the change in expenditure on three alimental food groups. Factors resulting in an increase of expenditure on all three foods include income and education. The measured effect of income suggests that only a substantial income increase leads to higher expenditures, and the effect can be expected to be largest in the case of vegetables. This outcome is desirable as vegetables are low in calories and high in vitamins, minerals, and antioxidants (Smith and Eyzaguirre, 2007; Uusiku et al., 2010) and unlikely to contribute to the double burden of malnutrition and obesity observed in Africa (Schneider et al., 2009). Especially underutilized are African (indigenous) leafy vegetables, which are well adapted to local conditions, often characterized by a short growing season, and high in nutrients (Shiundu and Oniang'o, 2007). African leafy vegetables are often cooked with peanuts (Nguni and Mwila, 2007), and in Ghana, peanut soup is very popular. Exotic vegetables grown in Ghana tend to be more suited to the modern distribution system and sales at supermarkets as their postharvest handling is simpler, shelf-life is longer, and losses to retailers are smaller than those of indigenous leafy vegetables.

However, no single vegetable provides all nutrients necessary for good health (Uusiku et al., 2010). Encouraging leafy vegetable production in areas surrounding cities can be effective if distributors organize a supply system of rapidly moving the product to retail outlets, eliminating the barrier of accessibility. The expected increase in incomes in Ghana because of economic growth reduces the affordability barrier for many consumers who will seek variety (stimulated by gains in education) and creates opportunities for all types of vegetables. A similar effect of income and education has been established in the case of fruit expenditure in this study.

“Education and behavior-change programs” (Ruel, Minot, and Smith, 2004) promoting fresh vegetable and fruit consumption should focus on emphasizing the health benefits of high vegetable and fruit intake. The Republic of South Africa initiated a public health program aimed at increasing vegetable and fruit consumption (Faber, Laubscher, and Laurie, 2013). However, the program is educational in nature. An earlier study (Kpodo, Mensah, and Dzah, 2015) suggested the need for a program supporting the consumption of fruits and vegetables in Ghana. Results of the current study indicate that income is still the major constraint of alimentary food consumption. This information could be used to target certain population subgroups with specific public health interventions and food marketing campaigns (Hermann et al., 2008). A

nationwide program is unlikely because of a number of pressing issues including higher priority public health problems (e.g., rapidly growing hypertension among Ghanaians), but perhaps narrower, targeted programs could be initiated. The positive effect of location (Tamale) and income on vegetable expenditures (Table 5) suggests localized efforts could be beneficial. A public education program drawing attention to the benefits of fruit and vegetable consumption could make a difference.

Seasonality is a factor that can strongly influence vegetable and fruit supply and expenditure. However, there are vegetables and fruits that are suited to each season, and given Ghana's various ecological zones, domestic production opportunities exist year-round. Additionally, some root vegetables (e.g., yams, sweet potatoes) can be stored to extend the period of availability, but finding suitable storage may be the primary limiting factor. Emerging modern retail outlets such as supermarket chains are accompanied by a distribution system capable of the interregional shipment of fruits and vegetables. The investment in technical infrastructure that takes place in Ghana will facilitate transportation, enhancing accessibility outside the harvest season in a particular region.

Regional differences have also been confirmed in this study. Regional variations need to be taken into consideration when the public sector formulates health promotion programs. Households located in two regional capitals differ in the set of factors influencing expenditure. This result is consistent with the observed differences in vegetable and fruit consumption across ecological zones based on a 2008 national survey (Amo-Adjei and Kumi-Kyereme, 2015). Assistance programs, if possible, involving fresh vegetables need to focus on households in certain regions, and increasing household income seems an efficient way to promote fresh vegetable consumption, especially in areas with lagging development such as Tamale. Local development programs creating more job opportunities might be the key to increasing nutrient-dense food consumption in the long run. In the meantime, initiatives such as reducing postharvest loss and improving food storage (Ruel, Minot, and Smith, 2004) may increase food availability, decrease food price, and therefore, encourage healthy food consumption.

Although peanut product consumption has health-promoting effects, the public sector needs to be concerned about food safety issues such as aflatoxin contamination in these products (International Agency for Research on Cancer, 2015; Udomkun et al., 2017). Peanut products in African countries, including Ghana, have been reported to face a higher contamination risk. Results show that expenditure on peanut products is high and present in all areas, especially in the regional capital cities such as Tamale and Takoradi. Those households with relatively higher peanut product expenditures are, at the same time, potentially exposed to a higher risk of aflatoxin contamination. Therefore, the public sector needs to focus on monitoring peanut product production, storage, processing, and distribution to reduce contamination risk. Government food safety programs

may have to target the northern part of Ghana, where households eat more peanut-based products.

7. Conclusions

The fast pace of urbanization in Ghana supports examining issues affecting urban residents including the consumption of nutrient-dense foods (i.e., vegetables, fruits, and peanut products). However, there are no studies that examine the expenditure pattern of urban households on these specific food categories. In many sub-Saharan African countries, consumption of fresh fruits and vegetables is affected by the existence of ecological zones suiting varying plant production and distribution systems that suffer from underdeveloped technical infrastructure. Urbanization offers income opportunities unavailable in rural areas but also induces lifestyle change leading to rapid increases in NCDs. The burden of such diseases may be eased by increased consumption of vegetables, fruits, and peanut products. The current study fills the gap in the literature by quantifying the effects of sociodemographic, income, and location factors influencing expenditures on fresh fruits, fresh vegetables, and peanut products in three major cities in Ghana: Accra, Takoradi, and Tamale. This study complements and extends insights from earlier studies that either focused on consumption of fruits and vegetables in various ecological zones or at a single urban location.

Income plays an important and positive role in encouraging higher expenditures on all three food types considered in this study. The effect is largest in the case of expenditure on vegetables, a highly desirable outcome from a public health standpoint. This result is also important for the emerging presence of supermarkets in cities, suggesting increased marketing opportunities for this category in Ghana. If expansion of supermarket presence continues, it may be the food retail sector that modernizes the regional supply base, stimulating increased production by local farmers. Fruit consumption is also likely to increase in response to increasing household incomes. The effect on increasing peanut consumption is less, but still positive.

Household demographic characteristics that contribute to increased expenditure on fresh vegetables and fresh fruit include age and the number of adults in a household. An important factor consistently influencing such expenditure is the marital status of a consumer. Although married households have higher spending than households of nonmarried consumers, fruit and vegetable marketers may adjust their product mix to accommodate preferences of nonmarried individuals. Availability of fruits and vegetables and the time required for preparation may need to be considered.

This study identified differences in the effects of income and other factors on expenditure with regard to location. Consumers in Tamale and Takoradi display a different propensity to spend on vegetables and peanut products, but not on

fruits. The latter effect is interesting because it suggests that fresh fruit marketing practices do not differ across urban centers in Ghana. This tendency echoes the general increase in popularity of fruit worldwide, but this study did not consider the fruit mix purchased by consumers. Preferences for specific fruits still need to be considered because they have different postharvest requirements as well as different nutrient content.

This study is based on survey data collected at a specific time of year. The nature of cross-sectional data and the content of the questionnaire do not allow drawing conclusions with regard to availability of specific fruits or vegetables. Seasonality still strongly influences the production and supply of these two product groups in Ghana. Moreover, consumers may substitute one fruit or vegetable for another given availability and price without changing the total amount of spending. Future studies may investigate drivers of specific consumer choices. With steady economic growth, expanding road infrastructure, and changes in retailing, the pattern of expenditure on vegetables, fruits, and peanut products will require continuous research.

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