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Drivers of Regular Consumption of Fresh Fruits and Vegetables in Urban Households of the Republic of Uganda

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Abstract

Malnutrition poses health risks for the people in the Republic of Uganda. An increased consumption of fruits and vegetables which are rich in nutrients can substantially reduce these risks. To efficiently implement programs enhancing consumption of fruits and vegetables, knowledge about the consumption pattern across households is essential. This study examines factors that affect the regular consumption of eight selected fresh fruits and seven selected fresh vegetables across urban households in Uganda. The multivariate probit regression method applied to household survey data identifies relevant factors. Results show that education, age, gender, number of children, and location are important factors determining regular consumption. Knowledge of these factors provides guidance for policy makers in public and private institutions for targeting specific segments of the population in urban locations for effective implementation of programs promoting fruit and vegetable consumption.

Keywords: Republic of Uganda, regular consumption, multivariate probit, fresh fruits and vegetables, socioeconomic factors

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1. Background and Objective

The risks of disease and death due to malnutrition and non-communicable diseases (NCDs) are higher in households with low consumption of fruits and vegetables, given the WHO and FAO conclusions (Ihucha, 2011). Increased fruit and vegetable consumption can significantly reduce the incidence of malnutrition and NCDs (Lock et al., 2005). Vitamin deficiencies and related deaths are common in African countries, especially among children (Kikafunda et al., 1998; Bachou et al., 2006). Yet, many Africans consume less than one serving of fruit per day (Oniang'o et al., 2003). According to a World Bank report (2011), in the Republic of Uganda, 28% of preschool children and 23% of pregnant women are found to be deficient in vitamin A. Fruits and vegetables are rich in vitamins (including vitamin A) and minerals. Therefore, an increased consumption of fresh fruits and vegetables can alleviate the problem of widely prevalent malnutrition and nutritional deficiencies in Uganda.

Although Uganda produces a substantial volume of fruits and vegetables, the average daily fruit and vegetable consumption is only 50% (200g) of the daily intake of 400g recommended by the WHO (Ihucha, 2011). Therefore, an examination of how regularly Ugandan households consume fruits and vegetables and what factors determine this regular consumption is of particular interest to policy making and implementation. Such analyses of fruit and vegetable consumption are commonly prevented by the lack of micro-level data. This study of how fruit and vegetable consumption is distributed across households fills the knowledge gap. Policy decisions aimed at increasing fruit and vegetable consumption directly benefit from insights generated by the study and offer the opportunity to effectively lower the scale of an unbalanced diet and its detrimental, lasting consequences. Further, knowledge about the characteristics of households that regularly consume some of the commonly available fresh fruits and vegetables guides the formulation and implementation of programs aimed at increasing consumption to directly benefit household members and, through improved health, the society at large.

In Uganda, the benefits of fruit and vegetable consumption are particularly important because their nutrients can reduce the consequences of naturally occurring toxins. Kaaya and Warren (2005) report the presence of aflatoxins, toxic metabolites produced by certain species of fungi (Aspergillus), is very common in Uganda. Aflatoxins are toxic to humans and animals, affecting various organs, especially the liver. A study by Alpsoy et al. (2009) concludes that vitamins A,

C, and E inhibit the toxic effects of aflatoxin B_1 (AFB_1) in humans. Therefore, regular consumption of fruits and vegetables which are rich in these vitamins can provide protection from the consequences of aflatoxin B_1.

But the benefits of regular fruits and vegetable consumption are not limited to reducing aflatoxin effects. Increased fruit and vegetable consumption is recommended for weight management problems and overall health improvement. These benefits linked to fruit and vegetable consumption and have been well documented in studies of consumers in developed economies (Bazzano et al., 2002; Flood et al., 2002; Tohill 2005).

In Uganda, the simultaneous presence of malnutrition (Kikafunda et al.,1998) and weight management problems seem counterintuitive. Overweight and obesity among its population are on the rise and the obesity and overweight rates were 4.3% and 19.9%, respectively, in 2008 (WHO, 2011). Whereas rural populations may have access to fruits grown in their own fields or gardens and in the wild, urban residents are dependent on formal suppliers. The consumption of urban households is closely associated with the purchase of fruits and vegetables, and in an economy such as Uganda, the purchase refers to mostly unprocessed fruits and vegetables.

The current study examines factors that affect the regular consumption of some selected fresh fruits and vegetables in households located in five urban centers of Uganda. The selected fresh fruits are apple, watermelon, pineapple, orange, passionfruit, mango, sweet banana, and avocado. The selected fresh vegetables are cauliflower/broccoli, spinach/kale, pepper, carrot, potato, cabbage, and tomato. These fruits and vegetables are commonly available in Uganda, and are rich in vitamins and minerals essential for the human body. As Table 1 shows, the fresh fruits are fairly rich in vitamin A, vitamin C, calcium, iron, and dietary fiber. The percent daily value (%DV) of vitamin A per serving is the highest in passionfruit, followed by watermelon and mango. Orange, passionfruit, mango, pineapple, and watermelon are rich sources of vitamin C, with highest %DV in orange. Passionfruit is an exceptionally rich source of iron as the %DV suggests. The dietary fiber content is also highest in passionfruit, but other fruits are also rich in dietary fiber content.

Unfortunately, the proportion of households that report the regular consumption of the listed fruits is less than 50 %, except for avocado, banana, and mango (Table 1).

Among fresh vegetables, kale has the highest vitamin A content in terms of %DV value, followed by carrot and spinach (Table 2). Vitamin C is abundant in broccoli, pepper, kale, and cabbage. Dietary fiber content is also good in all these fresh vegetables. As in the case of fresh fruits, the proportion of households reporting regular consumption is less than 50 percent, except for potato, cabbage, and tomato. The proportions are much less for cauliflower/broccoli and spinach/kale which have the highest content of vitamin A and C. Being rich in essential vitamins and minerals, these fresh fruits and vegetables (along with other fresh fruits and vegetables) are essential in alleviating the problems of malnutrition, while offsetting the toxic effects of aflatoxins. Keatinge et al. (2010) report that vitamin A, iron, zinc, and iodine are the four major causes of micronutrient deficiencies in Africa. Therefore, regular consumption of fresh fruits and vegetables which are rich sources of two of these nutrients (vitamin A and iron) is important in improving the health conditions of people living in this continent.

This study identifies socioeconomic and demographic factors that influence the regular consumption of fruits and vegetables, providing insights about the groups vulnerable to deficiency of some key nutrients. The results of this study strengthen programs formulated to eradicate actual or potential vitamin and mineral deficiencies found in Uganda. More importantly, the study accounts for household location in the search for possible regional policy variations and effective focus of remedial efforts.

2. Data

The study applies data collected from urban households in Uganda in the first half of 2011. Once the survey instrument was drafted, the data collection was outsourced to a market company selected through the bidding procedure. The chosen market company had experience in implementing household surveys in Uganda for international organizations. Following the market company selection, the company and the researchers held a workshop to train enumerators. The workshop was immediately followed by a pilot study conducted in a selected Kampala neighborhood in October 2010. The debriefing of enumerators did not reveal problems in understanding questions by respondents or respondents having difficulty providing answers. To implement the survey in towns other than Kampala, additional enumerators fluent in local dialects or languages were recruited and trained. The data were collected in Gulu, Lira, Soroti/Serere, Mbale, and Kampala. A total of 1,638 respondents were interviewed. About one

half of them, (844) were located in Kampala, and 200, 201, 193, and 200 in Gulu, Lira, Soroti/Serere, and Mbale, respectively. Respondents provided insights about their food shopping habits and preferences for selected foods, consumption of selected foods, and socio-demographic characteristics of the household.

About 72 percent of respondents are females and nearly 70 percent are married (Table 3). The average monthly household income is $237 (calculated at the exchange rate in June 2011). About 37 percent are self-employed, while a little over 13 percent have permanent employment contracts. About 35 percent of respondents have higher secondary or above education. Almost 72 percent of respondents are females, and the average age is about 35 years. The average household consists of 2.3 adults and three children. Almost 55 percent of households have children age three or younger, 67 percent have children between four and 12 years of age, and 48 percent have children between 13 and 18. Almost 52 percent of households are located in Kampala, while the remaining households are distributed almost evenly among the other four cities.

For ease of understanding, the income has been converted into United States dollars ($) at the exchange rate reported in June 2011 (Bank of Uganda, 2011), the month when the data collection ended. One dollar equaled 2,583 Uganda shillings (UGS). The proportion of households that regularly consume the selected fresh fruits and vegetables is given in Tables 1 and 2. Regular consumption is interpreted as taking place during most days of the week. The cautious estimate implies a frequency of at least four times a week.

3. Empirical Specification

The multivariate probit regression is employed to accomplish the objective of finding the determinants of variation in regular consumption of selected fresh fruits and vegetables in urban households in Uganda. A probit or logit regression method is needed here, because the response variable in each of the seven equations (corresponding to seven fresh fruits and vegetables) is a binary variable taking a value of 1 if a household regularly consumes a particular fruit or vegetable, and a value of 0 if that household does not report a regular consumption of that item. In this study, a probit regression method is followed. The reason for a multivariate probit regression application is the fact that the regular consumption of one fresh fruit may not be

independent of regular consumption of other fresh fruits being considered. A similar behavioral assumption applies to fresh vegetable consumption. Therefore, a method that accounts for the correlation of errors across equations is considered in estimating equations of regular consumption of the selected fresh fruits and vegetables, or the multivariate probit regression.

3.1.Multivariate Probit Regression

The multivariate probit regression method has been applied to data analysis in diverse fields (for example, Gibbons and Wilcox-Gők, 1998; Cheng and Wen, 2011; Samal et al., 2011; Baskaran et al., 2013). Suppose there are M equations to be estimated, each with 'n' number of observations (which can be different for each of these equations), then each of the equations can be written as:

$$Y_{mi}* = \beta_m' X_m + \varepsilon_{mi},$$

where m = 1, 2, ..., M, and i = 1, 2, ..., n. Since $Y_{mi}*$ is a latent response variable, which cannot be observed, an observable binary response variable, Y_{mi} is created and takes the values:

$$Y_{mi} = 1 \text{ if } Ymi* > 0, \text{ or}$$

$$Y_{mi} = 0 \text{ otherwise.}$$

The error term of each of these M equations has standard normal distribution with mean zero and variance of one. However, because of the presence of correlation across error terms, the M error terms have a multivariate normal distribution with mean zero and a variance-covariance matrix, say V. The matrix V has a value of one on the leading diagonal (variance of error terms) and co-variances, $\rho_{jk} = \rho_{kj}$ on off diagonals, where $j \neq k$, with j, k = 1, 2, …, M.

4. Estimation Results

The following sub-sections discuss estimation results from the multivariate probit estimation of equations depicting regular consumption for eight fresh fruits and seven fresh vegetables. The total observations utilized for estimation is 1,541 out of a total of 1,638 surveyed households. Some observations are omitted due to incomplete or missing responses. The estimated coefficients are calculated and interpreted based on the sign of estimates. The sign of estimates indicate the direction of the effect of statistically significant coefficients of the

explanatory variables. If the sign is positive, the likelihood of regular consumption of that particular fresh fruit will be more with one unit increase in the case of a continuous explanatory variable, and with a change from zero to one in the case of a binary explanatory variable. The results are discussed below.

4.1. Regular Consumption of Selected Fresh Fruits

The results show that the model is globally significant based on the Wald Chi-square test, and the errors from individual equations are correlated based on a likelihood ratio test. The Wald Chi-square test value is 881.75 with a probability value (p>chi-square) of 0.0000, and the likelihood ratio test chi-square value is 2278.87 with a probability value of 0.0000. Therefore, the joint estimation of these eight equations is justified. The estimated coefficients and robust standard errors are given in Table 4. The results are discussed for each of the socioeconomic and demographic factors.

4.1.1. Household Income

The monthly household income significantly effects the regular consumption of watermelon, suggesting an increase in income is likely to increase the regular consumption of this fruit. Overall, the absence of significant effect is not surprising, since there are fruits (like apple) that are imported and tend to be expensive. Estimation results are supported by the report on the east African fruit and vegetable sector (USAID, 2013) that concludes that consumption of fresh fruits and vegetables does not significantly vary across various income groups in Uganda.

4.1.2. Employment

Households with respondents who are permanently employed are more likely to report regular consumption of apple or banana. A permanent source of income might create the perception of stability encouraging spending and consumption of expensive fruits like apple. Households with self-employed respondents, where income is less stable are less likely to have a regular consumption of nutrient-rich passionfruit. Generally, passionfruit is an expensive fruit.

4.1.3. Education

Higher level of education (at least upper-secondary level) of respondent in a household increases the likelihood of regular consumption of five out of the eight selected fresh fruits. They

are apple, watermelon, pineapple, passionfruit, and banana. All these fresh fruits are fairly rich in vitamins and minerals, as listed in Table 1. Therefore, this result provides an indication of how educating people about the benefits of regular consumption of fresh fruits can influence fresh fruit consumption.

4.1.4. Gender

In households with a male respondent, the regular consumption of five fresh fruits is likely to be absent. These fresh fruits are watermelon, orange, passionfruit, mango, and avocado. This is a matter of serious concern, since these fruits are rich sources of essential nutrients, particularly for growing children and pregnant women. The latter consumer groups need these nutrients in adequate volume for proper growth or child development.

4.1.5. Age and Marital Status

An increase in age of respondents increases the chances of regular consumption of watermelon and mango. This is a desirable effect, since older people in households can influence the food consumption pattern of children in such households. Both watermelon and mango are good sources of vitamin A, which prevents night blindness.

Being married has a positive effect on regular consumption only in the case of avocado, a fruit that is reported as regularly consumed by the majority of households. Avocado is rich in unsaturated fats that also positively affects human health.

4.1.6. Number of Adults

The likelihood of regular consumption of six of the fresh fruits increases as the number of adults in a household increases. Watermelon, orange, passionfruit, mango, banana, and avocado are the fruits that are consumed regularly more often in such households. Since adults influence the food consumption pattern of households, this result is also important from the perspective of increasing the fruit and vegetable consumption in urban areas of Uganda. Many adults are deficient in vital nutrients and the six fresh fruits can alleviate the shortage of key vitamins and minerals.

4.1.7. Number of Children and Presence of Children of Different Age Groups

A very alarming result is related to the number of children. An increase in their number decreases the likelihood of regular consumption of all fresh fruits, except orange. Malnutrition and vitamin deficiencies, like vitamin A deficiency (World Bank, 2011), are common among children in Uganda. This result shows the need for corrective measures to be adopted by concerned agencies to increase consumption of fresh fruits that provide nutrients needed for proper growth and development of children.

The result with presence of children of different age groups in a household shows a different pattern, as these factors are significant in the case of selected fruits. Households with children 3 years old or younger are likely to regularly consume watermelon, a fruit that is fairly rich in vitamin A. Households with children between 4 and 12 years of age report to regularly eat watermelon and banana, whereas the regular consumption of apple, passionfruit, and banana are more likely to be reported by households with children between 13 and 18 years of age. From increased vitamin A intake, the consumption of fruits like passionfruit would be more desireable in lower age categories.

4.1.8. Household Location

The four household locations, i.e., Gulu, Lira, Soroti, and Mbale, are compared with Kampala, the capital city of Uganda. Households from Gulu are less likely to report regular consumption of watermelon, pineapple, banana, and avocado than Kampala residents, while at the same time they regularly consume more oranges and mangos. Similarly, households from Lira tend to report regular consumption of apple, watermelon, pineapple, banana, and avocado, with a lesser likelihood in Kampala households, whereas orange, and mango are more likely to be consumed regularly at the latter town. Soroti-based households are more likely to regularly eat orange, passion fruit, and mango, but less likely to have a regular consumption of apple, banana, or avocado. The regular consumption of oranges in households in Soroti is not a surprise, since it is one of the major areas of orange production in Uganda (USAID, 2013). Finally, Mbale residents are less likely to report regular consumption of apple, watermelon, pineapple, banana, or avocado, than Kampala-based households.

4.2. Regular Consumption of Selected Fresh Vegetables

The model is globally significant based on the Wald Chi-square test, with a test value of 950.80, and a probability value (p>chi-square) of 0.0000. The likelihood ratio test value of 503.79 with a probability value of 0.0000 confirms that errors are correlated across equations and equations have to be analyzed together. The estimated coefficients and robust standard errors are given in Table 4. The results are discussed for each of the factors employed in analysis.

4.2.1. Household Income

A rise in household income increases the probability of regular consumption of cauliflower/broccoli. However, income has no significant effect on reported regular consumption of other fresh vegetables covered under this study. The USAID study suggests that there is no discernable income effect on vegetable consumption (USAID, 2013).

4.2.2. Type of Employment

Permanent employment positively influences the regular consumption of pepper and Irish potato according to the obtained results. It may be that consumption of Irish potatoes reflects a consumption pattern influenced by work environment, for example meals offered in workplace cafeterias. Being self-employed increases the chances of regular consumption of spinach/kale, carrot, cabbage, as well as pepper and Irish potato. The link between self-employed and regular vegetable consumption suggests longer dependence and perhaps easier access to fresh vegetables. Self-employment includes street vendors, hawkers, or traders at numerous open-air markets where vegetables are one of many items offered for sale.

4.2.3. Education

Respondents with at least an upper secondary level of education are likely to increase the regular consumption of carrot and Irish potato. Since carrot is rich in vitamin A content, it is highly desirable to have a regular consumption of that vegetable. The widespread prevalence of vitamin A deficiency in Uganda is more likely among less educated rural residents.

4.2.4. Gender

Male respondents report less regular consumption of spinach/kale, Irish potato, or cabbage, but are more likely to regularly consume peppers. This result resembles the pattern associated with fresh fruit estimation results, and again is a cause of concern, because, for example, spinach and kale are good sources of vitamins A and C.

4.2.5. Age and Marital Status

The effect of age significantly affects only the regular consumption of spinach/kale. Leafy vegetables are easy to prepare, relatively plentiful, and do not require mastication effort. As such the attributes of leafy greens encourage their consumption among older urban residents. Married respondents in households effect only the tomato equation and that effect is negative with regard to regular consumption.

4.2.6. Number of Adults in Household

The probabilities of regular consumption of spinach/kale, pepper, Irish potato, cabbage, and tomato increase with an increase in the number of adults in a household. The influence of adults in promoting such behavior in households is highly desirable from the standpoint of the health of household members.

4.2.7. Number of Children and Presence of Children of Different Age Groups

Similar to the estimation results of fresh fruit consumption, an increase in the number of children in a household reduces the likelihood of regular consumption of cauliflower/broccoli and Irish potato. Cauliflower and broccoli are excellent sources of vitamin C, and Irish potato also has a reasonable amount of vitamin C along with good amount of dietary fiber and iron. Consumption of both fresh vegetables has a prominent place in combating malnutrition among children. The presence in households of 3-year-old or younger children, leads to increased likelihood of regular consumption of spinach/kale, pepper, and cabbage. Households with children between 13 and 18 years of age increase the likelihood of regular consumption of cauliflower/broccoli, but relatively few households report eating these two vegetables.

4.2.8. Household Location

None of the four household locations (Gulu, Lira, Soroti, and Mbale) is likely to report regular consumption of any of the fresh vegetables under study compared to Kampala. Households from all non-capital locations are less likely to regularly eat cauliflower/broccoli, spinach/kale, carrot, Irish potato, or tomato. Additionally, households from Lira, Soroti, and Mbale are less likely to have regular consumption of pepper, while households from Mbale are less likely to report regular consumption of cabbage than residents of Kampala. Since this list of fresh vegetables includes those that are sources of vitamins and minerals, the eating frequency pattern of households in those cities warrants monitoring and possible action from agencies involved in promoting healthy diet.

5. Discussion

Estimation results have implications for formulating policy and the implementation of programs aimed at increasing fresh fruit and vegetable consumption in the Republic of Uganda. Salient findings from these analyses are summarized below.

Household income influences only regular consumption of watermelon among fresh fruits, and only cauliflower/broccoli among fresh vegetables considered in the current study. USAID (2013) examined the fresh fruit and vegetable sector in three East African countries and reports that frequency of fruit and vegetable consumption across households remains almost the same, regardless of income level. The insensitivity to income complicates the efforts to increase consumption of fresh fruits and vegetables because income support or price subsidy is unlikely to bring the desired effects.

Education plays an influential role in increasing consumption of fresh fruits and vegetables. Regular consumption of several of the fresh fruits and vegetables selected for this study is found to be positively affected by higher educational attainment level of a respondent, i.e., at least an upper secondary education. A USAID study (2013) suggests that lack of awareness about the benefits of fruits and vegetables is the major reason for low frequency of fruit and vegetable consumption in Uganda. The present study confirms this finding demonstrated in the positive effect of higher educational attainment level, presumably implying that the person may be more knowledgeable and aware of the valuable nutrient content of fresh

fruits and vegetables. Therefore, educational programs should be emphasized to increase the fresh fruit and vegetable consumption and sensitize consumers to important health implications of regularly eating fresh fruits and vegetables.

Respondent's gender has an interesting, and at the same time alarming result in terms of its influence on regular fruit and vegetable consumption. Male respondents tend to be less likely to regularly consume most of the fresh fruits and some of the fresh vegetables considered in the study. An increased likelihood in regular consumption is observed only for peppers among men. Smith et al. (2003) report that when women are in charge of household spending decisions, the expenditures on fruits and vegetables tend to be higher. Ruel et al. (2005) confirm such tendency in sub-Saharan African countries.

An increase in age of respondents increases the likelihood of regular consumption of watermelon, mango, and spinach/kale. This is highly desirable because of the high vitamin A, vitamin C, and iron content of these fruits and vegetables. Blisard et al. (2002) and Bittencourt et al. (2002) report a positive effect of age, as older people might become more aware of the health benefits from fresh fruit consumption. Therefore, older people can influence the consumption pattern of fruits and vegetables in their households, which will contribute to the success of programs and policies intended to increase fruit and vegetable consumption in the country. In a country like Uganda, the ability to bite and chew is also a factor and these three items do not pose a challenge.

Another source of concern is the result associated with the number of children in households. The increase in number of children decreases the likelihood of regular consumption of almost all fresh fruits, and two of the fresh vegetables considered in the current study. Because of the widespread malnutrition among children in Uganda, this result implies a limited role of fruits and vegetables as a source of vitamins, minerals, and antioxidants in the diet. Encouraging greater consumption of fruits and vegetables in households with children will remain a challenge in the near future.

With regard to locations, the results compare the effect between households located in four cities and households in Kampala. Even though Kampala is the capital city, households in that city do not regularly consume orange and mango, two fruits that are good sources of

vitamins, minerals, and dietary fiber (Table 1). Moreover, Kampala residents are also less likely to regularly consume passionfruit compared to households from Soroti. A serious concern is the regular consumption of selected fresh fruits and vegetables in other cities compared to Kampala. Non-capital households have less regular consumption of all fresh vegetables and five out of eight fresh fruits, i.e., orange, passionfruit, and mango. Therefore, location specific programs are essential to increase frequency of fresh fruit and vegetable consumption and, thereby, decrease the consequences of vitamin and mineral deficiency among urban populations.

Results provide unique insights and serve as a guidance for policy makers in public and private institutions targeting certain population segments. Accounting for location in the implementation of effective programs leads to an increase in fresh fruit and vegetable consumption. The final outcome is the increase in vitamin and mineral intake in Uganda.

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Table 1. Nutritive values of selected fresh fruits.

Fresh fruit	Percent daily values (%DV) based on 2,000 calorie diet per serving.					Serving size in ounces (oz) (1oz = 28.35g).	Proportion of households reporting regular consumption.
	Vit A	Vit C	Calcium	Iron	Dietary fiber		
Apple*	2	8	2	2	20	8.0	0.20
Watermelon*	30	25	2	4	4	10.0	0.33
Pineapple*	2	50	2	2	4	4.0	0.45
Orange*	2	130	6	0	12	5.5	0.46
Passionfruit**	60	118	3	21	98	8.3	0.47
Mango**	25	76	2	1	12	5.8	0.52
Banana*	2	15	0	2	12	4.5	0.60
Avocado*	0	4	0	2	4	1.1	0.63

*U.S. Food and Drug Administration (http://www.fda.gov/food/ingredientspackaginglabeling/labelingnutrition/ucm063367.htm).
** http://nutritiondata.self.com/facts/fruits-and-fruit-juices/1952/2
Note: Banana refers to banana type other than plantain.

Table 2. Nutritive values of selected fresh vegetables.

Fresh vegetable	Percent daily values (%DV) based on 2,000 calorie diet per serving.					Serving size in ounces (oz) (1oz = 28.35g).	Proportion of households reporting regular consumption.
	Vit A	Vit C	Calcium	Iron	Dietary fiber		
Cauliflower/broccoli*	0/6	100/220	2/6	2/6	8/12	3.5/5.3	0.10
Spinach/kale*	56/206	14/134	3/9	5/6	3/5	1.1/2.4	0.18
Pepper**	11	182	1	3	3	5.3	0.20
Carrot*	110	10	2	2	8	2.8	0.41
Irish potato*	0	45	2	6	8	5.3	0.56
Cabbage**	2	54	4	2	9	3.0	0.68
Tomato*	20	40	2	4	4	5.3	0.85

*U.S. Food and Drug Administration (http://www.fda.gov/food/ingredientspackaginglabeling/labelingnutrition/ucm063367.htm).
** http://nutritiondata.self.com/facts/fruits-and-fruit-juices/1952/2

Table 3. Sample descriptive statistics .

Variable	Mean	Std. Dev.	Min.	Max.	Description
totalincome	237.01	771.76	0.39	25938.83	Total monthly household income in $
permanent	0.1343	0.3410	0	1	1 = permanent job *
selfemploy	0.3718	0.4834	0	1	1 = self employed *
others	0.4915	0.5001	0	1	1 = other types of jobs *
education	0.3451	0.4755	0	1	1= upper secondary or higher
respgend	0.2784	0.4483	0	1	1= male; 0 = female
age	35.34	12.36	17	89	Age of the respondent in years
married	0.6923	0.4617	0	1	1= married
adults	2.29	1.41	0	15	Number of adults in the household
child	3.02	2.11	0	12	Number of children in the household
child3dum	0.5488	0.4978	0	1	1= if a household has children of 3 years old or younger
child12dum	0.6722	0.4696	0	1	1= if a household has children of age between 4 and 12 years old
child18dum	0.4822	0.4998	0	1	1= if a household has children of age between 13 and 18 years old
gulu	0.1215	0.3268	0	1	Residence in Gulu (=1)
lira	0.1221	0.3275	0	1	Residence in Lira (=1)
mbale	0.1215	0.3268	0	1	Residence in Mbale (=1)
soroti	0.1173	0.3218	0	1	Residence in Soroti (=1)
kampala	0.5153	0.4999	0	1	Residence in Kampala (=1)*

* Reference category

Note: $1 = 2,583 UGS, June, 2011.

Table 4. Estimation results for regular consumption of fresh fruits.

factor / fruit	Apple	Water melon	Pineapple	Orange	Passionfruit	Mango	Banana	Avocado
totalinc	1.87e-08	6.43e-08*	6.39e-08	-9.06e-10	1.04e-08	2.90e-08	1.06e-08	3.34e-08
	(1.93e-08)	(3.68e-08)	(4.17e-08)	(1.70e-08)	(1.76e-08)	(2.00e-08)	(1.18e-08)	(2.46e-08)
permanent	0.278**	0.164	0.114	0.0830	-0.0883	0.00206	0.335***	0.102
	(0.121)	(0.110)	(0.111)	(0.110)	(0.111)	(0.109)	(0.118)	(0.110)
selfemploy	0.0833	-0.0486	0.105	-0.106	-0.139*	-0.110	0.0395	0.0705
	(0.0831)	(0.0735)	(0.0720)	(0.0720)	(0.0713)	(0.0714)	(0.0740)	(0.0736)
education	0.290***	0.237***	0.267***	0.115	0.306***	0.109	0.228***	0.0742
	(0.0855)	(0.0757)	(0.0756)	(0.0748)	(0.0745)	(0.0740)	(0.0790)	(0.0766)
respgend	-0.00376	-0.196*	-0.0907	-0.217***	-0.336***	-0.205***	0.0657	-0.238***
	(0.0915)	(0.0817)	(0.0775)	(0.0783)	(0.0782)	(0.0790)	(0.0814)	(0.0790)
age	-0.00201	0.00793***	-0.000339	0.00241	-0.00196	0.00806***	-0.000301	-0.00338
	(0.00347)	(0.00296)	(0.00291)	(0.00298)	(0.00296)	(0.00303)	(0.00302)	(0.00295)
married	0.109	-0.0333	0.0565	-0.00750	0.00645	0.0406	0.0262	0.154**
	(0.0854)	(0.0772)	(0.0758)	(0.0749)	(0.0748)	(0.0754)	(0.0782)	(0.0761)
adults	0.0206	0.0475*	0.0335	0.0545**	0.0444*	0.0687***	0.0719***	0.0962***
	(0.0266)	(0.0265)	(0.0249)	(0.0242)	(0.0248)	(0.0259)	(0.0265)	(0.0256)
child	-0.0622**	-0.0932***	-0.0626**	-0.0233	-0.0553**	-0.0407*	-0.0671***	-0.0440**
	(0.0302)	(0.0264)	(0.0302)	(0.0249)	(0.0224)	(0.0221)	(0.0234)	(0.0222)
child3dum	0.0734	0.149*	0.0849	0.0812	0.00889	0.0874	0.121	0.0521
	(0.0875)	(0.0788)	(0.0779)	(0.0759)	(0.0746)	(0.0754)	(0.0792)	(0.0764)
child12dum	0.0355	0.153*	0.139	0.0160	0.0802	0.0102	0.170*	0.119
	(0.101)	(0.0895)	(0.0918)	(0.0874)	(0.0851)	(0.0844)	(0.0905)	(0.0865)
child18dum	0.177*	-0.00492	0.0325	-0.0420	0.140*	-0.0419	0.177**	0.102
	(0.0963)	(0.0862)	(0.0908)	(0.0844)	(0.0819)	(0.0822)	(0.0851)	(0.0838)
gulu	0.102	-0.441***	-0.196*	0.307***	0.0710	0.353***	-0.791***	-0.294***
	(0.118)	(0.118)	(0.113)	(0.112)	(0.113)	(0.114)	(0.115)	(0.113)
lira	-0.621***	-0.494***	-0.585***	0.417***	0.0721	0.420***	-1.313***	-0.792***
	(0.135)	(0.109)	(0.0985)	(0.0994)	(0.0995)	(0.103)	(0.105)	(0.104)
soroti	-0.667***	-0.0222	0.0419	0.832***	0.289**	0.761***	-0.881***	-0.375***
	(0.137)	(0.120)	(0.118)	(0.121)	(0.119)	(0.124)	(0.118)	(0.115)

mbale	-0.684***	-0.669***	-0.805***	-0.164	-0.130	-0.0316	-1.050***	-0.282***
	(0.134)	(0.110)	(0.114)	(0.108)	(0.104)	(0.104)	(0.106)	(0.106)
_cons	-0.882***	-0.606***	-0.191	-0.391***	-0.0941	-0.466***	0.375**	0.282**
	(0.160)	(0.142)	(0.142)	(0.143)	(0.141)	(0.142)	(0.148)	(0.141)

Note: Standard errors in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively.

Table 5. Estimation results for regular consumption of fresh vegetables.

factor / vegetable	Cauliflower/ Broccoli	Spinach/Kale	Pepper	Carrot	Irish potato	Cabbage	Tomato
totalinc	3.91e-08**	1.54e-08	1.07e-08	5.86e-09	5.58e-08	1.93e-08	2.61e-08
	(1.64e-08)	(1.44e-08)	(1.10e-08)	(1.37e-08)	(3.97e-08)	(1.91e-08)	(2.74e-08)
permanent	0.0745	0.162	0.244	0.0835	0.322***	-0.0539	0.0780
	(0.154)	(0.136)	(0.132)	(0.122)	(0.115)	(0.109)	(0.133)
selfemploy	-0.0527	0.149*	0.142*	0.173**	0.191**	0.139*	0.0515
	(0.101)	(0.0879)	(0.0844)	(0.0760)	(0.0739)	(0.0748)	(0.0895)
education	0.122	0.153	0.153	0.207**	0.296***	-0.0570	0.0626
	(0.108)	(0.0934)	(0.0878)	(0.0815)	(0.0800)	(0.0788)	(0.0940)
respgend	-0.0126	-0.252**	0.301***	-0.136	-0.172**	-0.147*	0.000384
	(0.123)	(0.106)	(0.0940)	(0.0864)	(0.0813)	(0.0808)	(0.0965)
age	-0.000240	0.00762**	0.00116	-0.00388	-0.00157	-0.000118	0.000804
	(0.00489)	(0.00361)	(0.00364)	(0.00319)	(0.00312)	(0.00300)	(0.00394)
married	0.150	0.113	0.0112	0.108	0.0545	-0.0341	-0.189**
	(0.110)	(0.0891)	(0.0862)	(0.0806)	(0.0776)	(0.0777)	(0.0959)
adults	0.0229	0.109***	0.0678**	0.0366	0.0436*	0.0446*	0.0540*
	(0.0495)	(0.0272)	(0.0277)	(0.0262)	(0.0260)	(0.0249)	(0.0295)
child	-0.102***	-0.0484	0.00310	-0.0266	-0.0633***	0.00994	-0.0267
	(0.0381)	(0.0306)	(0.0295)	(0.0244)	(0.0244)	(0.0242)	(0.0284)
child3dum	0.148	0.156*	0.161*	0.0608	0.103	0.151*	-0.0685
	(0.109)	(0.0903)	(0.0889)	(0.0824)	(0.0771)	(0.0777)	(0.0936)
child12dum	0.200	-0.0107	-0.00804	-0.0276	0.142	-0.0365	0.106
	(0.122)	(0.103)	(0.102)	(0.0899)	(0.0887)	(0.0885)	(0.104)
child18dum	0.233**	-0.0183	0.0169	0.0667	0.0252	0.0265	0.156
	(0.117)	(0.103)	(0.100)	(0.0890)	(0.0862)	(0.0857)	(0.104)
gulu	-1.198***	-1.434***	-0.0107	-0.826***	-0.625***	-0.0707	-0.725***
	(0.233)	(0.214)	(0.116)	(0.116)	(0.112)	(0.112)	(0.129)
lira	-1.117***	-1.594***	-0.606***	-1.699***	-0.982***	-0.0644	-0.483***
	(0.209)	(0.237)	(0.133)	(0.142)	(0.113)	(0.112)	(0.130)
soroti	-1.209***	-0.866***	-1.251***	-1.039***	-0.604***	-0.132	-0.912***

	(0.239)	(0.148)	(0.168)	(0.122)	(0.114)	(0.110)	(0.130)
mbale	-0.565***	-0.847***	-1.588***	-1.236***	-0.878***	-0.441***	-0.606***
	(0.156)	(0.148)	(0.241)	(0.120)	(0.108)	(0.106)	(0.130)
_cons	-1.224***	-1.148***	-1.144***	0.150	0.270	0.370*	1.322***
	(0.206)	(0.171)	(0.164)	(0.151)	(0.147)	(0.146)	(0.177)

Note: Standard errors in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively.