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FULL-LENGTH RESEARCH ARTICLE

Fruits and Vegetables Consumption Behaviour: A Case Study of Rural and Urban Households in the Techiman Municipality, Ghana

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Abstract The study examined the determinants of the consumption of fruits as well as the factors that influence the expenditure on fruits and vegetables among households in the Bono East Region of Ghana. Cragg's Double Hurdle model was used for the analysis of the determinants and consumption expenditure of fruits, whereas the two-stage least squares regression was used to analyse factors that influence the consumption of vegetables. From the study, gender, fruits health benefit awareness, education, household size, per capita household expenditure (poverty status) influenced the consumption of fruits positively. However, marital status, expenditure on cereals and non-food items negatively influenced the consumption of fruits. In terms of methodological approach, the results showed that the consumption of fruits is a two-stage decision process and not a one-stage decision. From the study, it is recommended that public health education on fruits consumption should be gendered as well as the targeting of school pupils along with other relevant identified segment is likely to have a positive impact. Future studies should consider the separability and selectivity tests for the determination of an appropriate methodological approach.

Keywords Fruits · Vegetables · Double Hurdle · Consumption · Techiman

Introduction

The Ghana Health Service health reports revealed the prevalence of lifestyle diseases (chronic non-communicable diseases) such as stroke, hypertension, type 2 diabetes, and other cardiovascular diseases (CVD) are on the increase, and they are among the top ten in-patient causes of death in Ghana [25, 26]. Besides, the reports further indicate that the prevalence of adult hypertension appears to be increasing, ranging from 19% in 2015 to 48% in 2016, while diabetes is about 9% as reported in 2016 and the Techiman Municipality which happens to be the study area is not an exception [25]. Complementary, the World Health Organisation (WHO) estimated, the probability of dying from CVD, cancer, diabetes, or chronic respiratory diseases of persons between ages 30 and 70 is 20% in Ghana [50]. One critical solution to mitigate these diseases is the consumption[1] of fruit and vegetable, which is a vital component of a healthy diet [37]. Regular consumption of fruit and vegetable prevents and reduces the risk of major chronic diseases such as cardiovascular diseases (CVD) and some cancers [16, 59]. FAO and WHO [21] revealed that a minimum of 400 g of fruits and vegetables intake per day equivalent to five servings prevents chronic diseases and alleviate several micronutrient deficiencies [21]. The Food and Agriculture Organisation (FAO) within its

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[1] In this study, the consumption of fruits and vegetables are used interchangeably with expenditure on fruits and vegetables. This is because expenditure on fruits and vegetables were used as a proxy variable to measure the consumption of fruits and vegetables respectively in a household.

framework of the Global Fruits and Vegetables for Health Initiative (PROFAV) promoted the awareness of fruits and vegetables consumption for improved health [22]. Likewise, in Ghana, the Regenerative Health Campaign was launched to increase the consumption of fresh fruits and vegetables and to avert the risk of non-communicable diseases [10, 47]. However, the average consumption of fruit and vegetable is relatively low [9, 23, 34, 38]. For example, in Africa, consumption ranges between 27 and 114 kg/capita/year [24]. Currently, an average Ghanaian consumes 1.5% portion of fruits and 2.3% portion of vegetables daily as against the WHO requirement of 4–6% per day [9, 21, 49, 59]. Fruit and vegetable consumption is as low as 36.6% and 38.0% for women and men, respectively [27, 34]. The situation is further heightened with the report that, the proportion of Ghanaians who do not consume any servings of fruits increases by at least 10% while the proportion that consumed five or more servings of fruits and vegetables decreases substantially [58]. As a result, the Food and Agriculture Organisation (FAO) validated that there is a dire decline in the consumption of fruits and vegetables in Ghana [9].

Consequently, to salvage the situation and assist in shaping policies and strategies to tame this growing threat to public health, some studies have examined socioeconomic determinants of the consumption of fruits and vegetables[2] in Ghana with acknowledged recommendations. For example, Kpodo et al. [41] and Mintah, et al. [48] studied the consumption of fruits and vegetables in schools in Ghana, whereas Glover-Amengor and Vowotor [30], Florkowski et al. [23] and Chagomoka et al. [18] concentrated on selected consumers within the Coastal and Northern regions. Moreover, Meng et al. [44, 45] focussed on Takoradi, Tamale and Accra cities of Ghana, whereas Amo-Adjei and Kumi-Kyereme [7] considered the effects of different ecological zones on the consumption of fruits and vegetables. Most recently, Amoateng et al. [6] studied the consumption of fruits and vegetables among the young people aged between 15 and 34 years.

It is evident that there remains very little research on the consumption of fruits and vegetables in the transitional zone of the country or the Brong Ahafo Region (currently Bono East, Bono and Ahafo Regions) [28]; specifically, the major city in the region, Techiman which is known for its trade in agricultural commodities especially fruits, vegetables, cereals and tube crops, and propose practical recommendations for the formulation of policies and programmes to improve and enhance the consumption of fruits and vegetables. Additionally, there is a scarcity of research on the factors that influence the consumption of fruits and vegetable in the Bono East Region and the identification of the knowledge gap as well as the documentation of the segment of the population for public health training on fruits and vegetable consumption in the study area. Besides the geographical difference of this study, this research also proposed the consumption of fruits as two-stage decision levels with the first discrete decision as the decision to consume fruits per week or not and the second as how much of the household budget is allocated to the consumption of the same. From the available literature, apart from Ogundari and Arifalo [51] who modelled the consumption of fruits as a two-stage decision in Nigeria, there is yet no study in the West of Africa and Ghana to be specific that has attempted to address the research objective by modelling it as two-stage. Therefore, this study also extends the frontiers of methodological approach in the fruits and vegetable consumption literature. Consequently, this study examined the determinants of the consumption of fruits as well as the factors that influence the expenditure on fruits and vegetables among households in the Bono East Region of Ghana.

[2] Fruits and vegetables in this study refer to fresh fruits and vegetables which are not industrially processed.

Consumer Behaviour and Consumer Decision-Making

Consumer behaviour and decision-making research has been of enormous interests to early economists such as Nicholas Bernoulli, John von Neumann and Oskar Morgenstern [53]. Their early studies advanced the topic from an economic view and focused exclusively on the act of purchase [43]. The most dominant model from this outlook is 'Utility Theory' which suggests that consumers make choices based on the expected outcomes of their decisions [35]. However, current studies have shown that consumer behaviour is affected by a broad range of factors as well as the activities of the consumer after purchase. These activities generally are limited to the publicity given to the product by the consumer. This can be good or bad grounded how the consumer views the product after usage. This is well enunciated in the contemporary definitions of consumer behaviour: Consumer behaviour conveys the concept of studying the procedures involved when individuals or groups select, purchase, use or dispose of products, services, ideas or experiences to satisfy needs and desires [12]. In other words, it is the behaviour that consumers display in searching for, purchasing, using, evaluating, and disposing of products and services that they expect will satisfy their needs [55].

Materials and Methods

Study Area

This study was carried out in the Techiman Municipality of the Bono East Region of Ghana. The Municipality is

known for its reputation as one of the major leading commercial zones in Ghana in addition to its illustrious trade history during the Trans-Saharan trade. It is known for its three-day wholesale market, especially for fruits and vegetables, root and tuber crops such as yams, cereals such as rice and maize [20, 46]. Techiman is considered as the net producer or source market where huge volumes of fruits, vegetables and cereals are exported to other markets in Ghana, while at the same time also acts as a net importer of the said commodities [1, 4]. The major fruits grown in the Techiman Municipality include orange, banana, pineapple, watermelon and mango. The major vegetables grown include cabbage, carrot, sweet pepper, onion, garden eggs, tomatoes, pepper and okra. Due to the presence of the market, fruits and vegetables are readily available and this could influence the consumption levels of households. This critical market attracts several market attendants who are mostly customers and traders (mostly upstream value chain actors) from various parts of the Bono East Region, within and outside Ghana [5]. Given these, we expect the factors that influence fruits and vegetable consumption in the study area to be different to other areas in Ghana. Figure 1 shows a map of the Techiman Municipality where the study was conducted.

Method of Data Collection

The sampling unit was the household defined for this study as a group of people who eat from the same "pot" and share common resources [15]. Data was collected on household characteristics, expenditure on fruits and vegetables and other staple foods and non-food items. Primary data was collected from household members in charge of food purchasing and preparation using a structured questionnaire. A multi-stage sampling procedure was adopted in this study. A combination of purposive and stratified sampling techniques was employed in the selection of respondent households. In the first stage, Techiman Municipality was purposively selected because of its largest food market in Ghana; hence fruits and vegetables are available all year round. The second stage involved dividing the area into two strata namely rural and urban areas with the help of officials from Techiman Municipal Assembly.[3] The urban and rural population in the Techiman Municipality are 95,323 (representing 64.5% of the population) and 62,049 (representing 35.5% of the population) respectively. Given the formula by Yamane [62] as for sample selection as $n = \frac{N}{1+N(e^2)}$, where $e = 0.1$ and N = the total number of the urban or rural population, the representative population will be 100 and 99 respectively. Also given a household can be made up of more than one person in the population. There is a likelihood that the total number of households will be less to the total population. However, to improve on the reliability of the results, we sampled 105 households from the rural population and 195 households from the urban population. In addition, the stratification was to aid the authors to get information from different income groups. Besides, research has shown that, residence in terms of urban and rural could influence consumption of fruits and vegetables [7, 32, 44, 63]. In the third stage, three (3) communities were selected from each stratum using the simple random sampling. In the fourth stage, thirty-five (35) households and sixty-five (65) households were selected from each selected rural and urban communities respectively via a simple random sampling procedure. A total of 300 households were selected for the study. Table 1 shows the communities sampled.

[3] The total population as well as the total rural and urban population of the Techiman Municipality was sourced from the Ghana statistical service. Kindly refer to http://www2.statsghana.gov.gh/docfiles/2010_District_Report/Brong%20Ahafo/TECHIMAN%20Municipal.pdf for more information on the same.

Method of Data Analysis

The demographic characteristics of respondents were analysed with the use of descriptive statistics and presented in frequencies and percentages. The econometric models used for the analysis were the Cragg's Double Hurdle model for fruit consumption while Two-Stage Least Square (2SLS) estimation of instrumental variable regression was used for vegetable consumption.

Empirical Models for the Determinants Influencing the Consumption of Fruits and Vegetables

Cragg's Double Hurdle and Heckman Selection Models

In this study, the authors hypothesised the consumption of fruits as two-stage decision levels with the first as, the decision to consume fruits per week or not and the second as how much of the household budget is allocated to the consumption of the same. Given this, the decision to purchase and allocate household budget to the consumption of fruits can be jointly determined or not [13, 14]. Assuming the two decisions are jointly determined, the Tobit model is preferred [3, 17]. However, if the two decisions are differently determined, it suggests a two-stage regression such as Cragg's Double Hurdle or Heckman Selection models should be considered [13, 14, 40] A decision on the use of a one-stage process or two-stage process, necessitated a separability test via the use of the likelihood ratio test statistic, λ which was estimated as

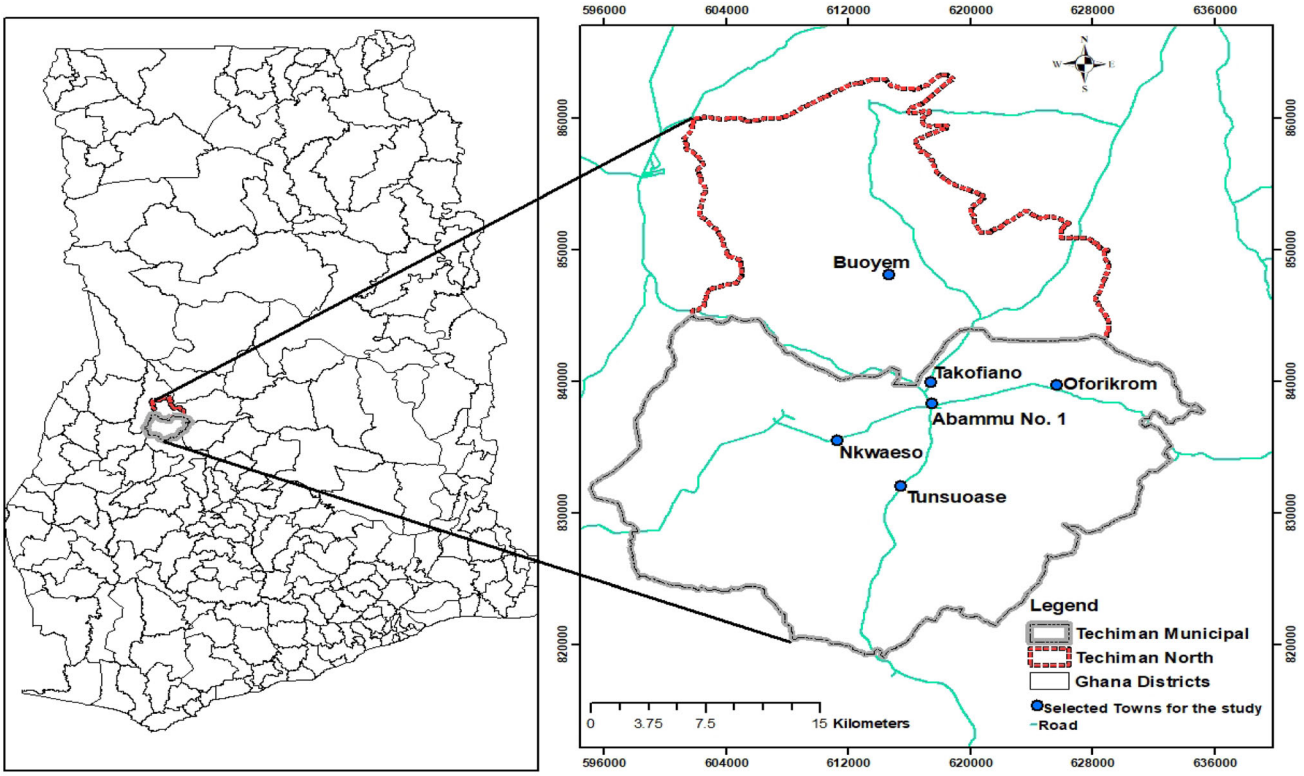

Fig. 1 Map showing Techiman Municipality of Ghana. *Source*: Authors' own construct

Table 1 Communities sampled *Source*: Authors' own (2019)

Location	Community	No. of households sampled
Urban	Abanmmu No. 1 and 2	65
	Tunsuoase/Hausa Line	65
	Pomaakrom/Takofiano	65
Rural	Buoyem	35
	Nkwaeso	35
	Oforikrom	35
Total		300

$$\lambda = -2(LL_{\text{Probit}} + LL_{\text{Truncated}} - LL_{\text{Tobit}}) \quad (1)$$

The two-stage process was selected because the estimated value of λ was greater than Chi square ($\chi_{0.1}$) critical value [13, 14]. The two-stage models were Cragg's double hurdle and Heckman selection model. Beyond this, a selectivity bias test was undertaken for a decision on the Cragg's Double Hurdle or Heckman Selection model. The decisions to consume fruits and the expenditure on fruits (intensity or extent of consumption) is a choice [19, 36]. In other words, the underlying factors that affect the extent of consumption of fruits may be observed such as age, education, gender etc. and unobserved factors such as level of motivation, among others which is very difficult to measure. Once there is a correlation between the unobserved factors and the actual expenditure on fruits, there is selectivity bias; hence Heckman Selection model should be considered over the Cragg's Double Hurdle model [24]. To statistically decide on the two models, the Inverse Mills ratio was used. From Table 4, the Inverse Mills ratio has a p value of 0.18 indicating a nonsignificance, therefore, the Cragg's Double hurdle model is preferred to Heckman selection model. In Cragg's Double Hurdle model, Probit and the truncated regression models were applied respectively [13, 14, 19]. In detail, the binary decision of purchasing fresh fruits was modelled using the Probit model. Thus, whether y is 0 positive or not:

$$\text{Prob}(y > 0) = \varnothing \alpha\prime\beta \quad (2)$$

whereby $\varnothing$ is the symbol of normal distribution.

After household decision to consume or spend on fruits, they then decide on how much to consume or purchase on fruits. In assessing the factors that influenced the actual expenditure on fruits per week, the truncated normal regression was used:

$$E\left(\dot{y}{:}y > 0\right) = \alpha\prime + \beta + \delta\lambda\left(\frac{\alpha'\beta}{z}\right) \quad (3)$$

The term $\frac{\alpha'\beta}{z}$ is an adjustment factor since respondents who do not consume fruits have been omitted in the truncated model.

Instrumental Variable Estimation and Two-Stage Least Squares Regression

Vegetable consumption was modelled based on the amount of money spent on fresh vegetables per week. Almost all the respondents spent part of the household budget on the consumption of vegetables. As a result, the Ordinary Least Square regression (OLS) was used for modelling the determinants of consumption; however, there was endogeneity problem with the model (refer to Table 8 at the appendix for more details). Consequently, the Two-Stage Least Squares (2SLS) regression was used as an alternative to avoid the violation of the classical Assumption III of the OLS estimation. The Assumption III states that the error term and each regressor variable must be uncorrelated with each other [57]. In the model, vegetable consumption expenditure was the dependent variable. The independent variables or the exogeneous variables were age, gender, expenditure on cereals, among others (refer to Table 5). Household per capita expenditure was endogenous variable in the model. An explanatory variable is deemed as endogenous when it correlates with the error term of the model. To correct for endogeneity, the instrument variables were used. Household size, education and religion were used as instruments for the endogenous variable identified. It is worth noting that, the instrumental variables are highly correlated with the endogenous variables but not with the error term [33, 57]. In the Techiman Municipality, Bannor and Oppong-Kyeremeh [15] revealed that the level of education positively influenced per capita expenditure hence could be a useful instrument. Similarly, per capita expenditure decreases is associated with increases in household size [42]. On religion, Islam et al. [39] reported that religion could have a positive influence on household per capita expenditure as such can also be a useful instrument for per capita household expenditure.

To use 2SLS regression, consider an unobserved ability in vegetable consumption for households as follows:

$$v = \beta_0 + \beta_1 X + u \tag{4}$$

where v is the weekly vegetable consumption expenditure and u is the estimated error term which contains a variable that correlates with x. For consistent estimators of β_0 and β_1 when x and u are correlated, x is denoted as endogenous variable; hence the model requires further information which is in the form of new variables known as instrument variables. Assume there is an observable variable p that satisfies these two assumptions:

1. P is uncorrelated with u, that is,

$$\mathrm{Cov}(p, u) = 0$$

2. P is correlated with x, that is,

$$\mathrm{Cov}(p, x) \neq 0$$

Then p is instrumental variable for x.

It is worth noting that, the fundamental procedure for the two-stage regression analysis is to estimate the reduced form Eq. 4 by OLS regression and obtain $\hat{v}$. Beyond, the estimates of $\hat{v}$ from the first stage is used for further estimation. These estimates are the two-stage least squares estimates [33].

Table 2 shows the description of variables used for the determinants of fruit and vegetable consumption analysis (refer to Table 7 at the appendix for more information of the budget share of fruits and vegetables consumption of the sampled households). From Table 2, household size, expenditure on staple foods, cereals and non-food items were hypothesised to have a negative influence on fruit consumption; however, a positive influence on vegetable consumption expenditure except non-food items. Conversely, religion, gender, ethnic group, residence, marital status, household expenditure awareness of health benefit of fruit and vegetable consumption which were modelled as dummy variables were expected to have a positive influence on fruit and vegetable consumption. Per capita household expenditure, income, which were modelled as continuous variables were expected to have a positive effect on the consumption of fruits and vegetables.

Results and Discussions

Table 3 describes the summary statistics of the variables used for this study. Out of a total of 300 respondents, 199 were fruit consumers, while 101 were non-fruit consumers. The average age of respondents was about 35 and 33 years for fruit consumers and non-fruit consumers, respectively. The mean age of fruits consumers and non-consumers were statistically different at 10% (< 0.10) indicating a possible influence of age on the consumption of the same.

Also, the means of fruit consumption relative to gender was 0.29 and 0.39 for consumers and non-consumers respectively. The means are statistically different at 10% (< 0.10) suggesting the influence of gender on fruits consumption. Again, the mean number of years of education of fruit consumers was 9.94, whereas non-consumers was 8.82. The results suggest that on average, both consumers and non-consumers, have a form of formal education of at least a Junior Secondary School (JSS) or Middle School (MSLC). The means are statistically different from zero at 5% (< 0.05). The average household size among fruit consuming household and non-fruit consuming household was 5.8 and 4 respectively.

Averagely, urban households had 56% and 82% for fruit consumers and non-fruit consumers, respectively (refer to

Table 2 Description of variables used for analysis. *Source*: Author's own (2019)

Variable	Description	Type	Measurement	Expected sign (fruits)	Expected sign (vegetables)
Dependent variables					
Fruits consumption	Decision to consume fruit	Dummy	1 = consumption of fruits, 0 = non-consumption		
Fruit consumption	Amount of money spent on fruits per week	Continuous	Ghana Cedis (GH¢)		
Vegetable consumption	Amount of money spent on vegetables per week	Continuous	Ghana Cedis (GH¢)		
Independent variables					
Age	Age of respondents in years	Continuous	Number	+	−
Gender	Sex of respondents	Dummy	1 = Female, 0 = Male	+	+
Religion	Religious affiliation of respondents	Dummy	1 = Christianity 0 = Otherwise	+	+
Marital status	Marital status of respondents	Dummy	1 = Married 0 = Otherwise	+	+
Ethnic group	Ethnic group of respondents	Dummy	1 = Akan 0 = Otherwise	+	+
Fruits Health benefits	Awareness of health benefits of fruits consumption	Dummy	1 = Yes 0 = Otherwise	+	
Vegetables health benefit	Awareness of health benefits of vegetable consumption	Dummy	1 = Yes 0 = Otherwise		+
Residence	Residence of respondents	Dummy	1 = Urban 0 = Rural	+	+
Education	Years of formal education of respondents	Continuous	Years	+	+
Household Size	Household size of respondent	Continuous	Number	−	+
Staples	Monthly expenditure on staple food	Continuous	Ghana Cedis (GH¢)	−	+
Cereals	Monthly expenditure on cereals	Continuous	Ghana Cedis (GH¢)	−	+
Non-food items	Monthly expenditure on non-food items	Continuous	Ghana Cedis (GH¢)	−	−
Income	Monthly income of household	Continuous	Ghana Cedis (GH¢)	+	+
Per Capita	Monthly per capita household expenditure on cereals	Continuous	Expenditure/household size	+	+

Table 6 in the appendix for more details). About 85.4% of fruit consumers were of the Christian religion, whereas 14.6% of the non-consumers were of different religions. In detail, about 82% of the respondents were Christians, whereas 18% were of other religions. The dominance of the Christianity religion among the respondents reflects the religious profile of Ghana. The means are statistically different at 5% (< 0.05). The results suggest that religion influences the consumption of fruits which agrees with Amo-Adjei and Kumi-Kyereme [7] and Amoateng et al. [6]. Whereas Amo-Adjei and Kumi-Kyereme [7] revealed that traditional religious believers are less likely to consume fruits and vegetables, Amoateng et al. [6] alternatively discovered that Christians are more likely to consume fruits and vegetables compared to other religions in Ghana. One plausible reason is that the communities where data collection was done has the high presence of the Seventh Day Adventist Christian group which actively promotes healthy living as a critical gospel message.

Consequently, it is not surprising that there is a relationship between religion and the consumption of fruits as well as most of the fruit consumers represented by 80% being aware of the health benefits of the consumption of the same. Expenditure on staple foods was averagely GH¢ 13.78 for consumers of fruits with GH¢ 14.10 for non-consumers of fruits.

On the contrary, expenditure on cereals was averagely the same (GH¢ 23) for both consumers and non-consumers of fruits. The household per capita expenditure revealed that non-fruit consumers have a little of over 2 Ghana cedis per household member more compared to fruit consumers. Surprising it may seem, the results give credence to Ghana Statistical Service et al. [28] report which revealed that consumption of fruits and vegetables were lower among wealthiest respondents with the differences more obvious among men than women.

From Table 4, the likelihood ratio tests indicate that the decision to consume fruits and the expenditure on fruits are

Table 3 Summary statistics of variables influencing fruit consumption. *Source*: Authors own computation based on field data (2019)

Variable	Fruit consumption			Non-fruit consumption			*T* value	Sig.
	N	Mean	SD	*N*	Mean	SD		
Age	199	34.81	11.28	101	32.70	8.95	1.63	0.10*
Gender	199	0.29	0.45	101	0.39	0.49	1.75	0.08*
Education level	199	9.94	3.98	101	8.82	4.65	2.18	0.03**
Religion	199	0.15	0.35	101	0.25	0.43	2.04	0.04*
Ethnic group	199	0.28	0.45	101	0.35	0.48	1.14	0.26
Household size	199	5.77	4.29	101	4.01	2.97	4.15	0.00***
Marital status	199	0.44	0.50	101	0.48	0.50	0.63	0.53
Residence	199	0.56	0.50	101	0.82	0.39	4.98	0.00***
Health benefit awareness	199	0.80	0.40	101	0.15	0.36	13.94	0.00***
Expenditure on staple foods[a]	199	13.78	10.02	101	14.10	10.10	0.22	0.82
Expenditure on cereals[b]	199	23.33	18.14	101	23.10	17.60	0.09	0.93
HH per capita expenditure	199	56.88	53.10	101	58.04	46.17	0.16	0.87

Staple food in this research refers to root and tuber crops such as yam, cassava, cocoyam well as Plantain (refer to Table 7 in appendix for more details)

Cereals refer to rice and maize

NB: Significance; 1% = ***, 5% = **, 10% = *

in two stages (Lambda () > $\chi_{0.1}$), hence, the use of the two-step model.

The Inverse Mills ratio from the Heckman model was used to determine which of the two-stage models was appropriate for this study. With *p* value as nonsignificant as shown in Table 4, it suggests no selection bias hence the selection of the Double Hurdle model for determining the factors influencing fruit consumption among households in the study area. The estimated determinants of the Cragg's Double Hurdle model and Heckman Selection models for discrete decision (decision to consume fruits or not) and continuous (expenditure) decisions of fruit consumption are shown in Table 4.

From Table 4, a household with a female as the head increased the probability of fruit consumption by approximately 65% compared to a male as a household head. Likewise, Naska et al. [49]; Amo-Adjei and Kumi-Kyereme [7] and Amoateng et al. [6] revealed that females are more likely to consume fruits compared to males across various ecological zones of Ghana. One plausible reason for this phenomenon could be because females are more concerned about the dietary needs of household members hence try to diversify meals for adequate nutrients. This result, however, contrasts with the findings by Greer et al. [31] who found no differences between consumption of fruits relative to gender. Unexpectedly, the probability of consuming fruits decreased by 12.5% among married household heads compared to non-married household heads. A possible reason for this empirical result is that married people have several responsibilities hence are compelled to fulfil the basic food needs of household members which is more of starchy roots and cereals that forms almost three quarters of the dietary energy and diversity of Ghanaian households [2].

In contrast, Meng et al. [44, 45] reported that expenditure on fresh fruits was higher among married households compared to others in Ghana. Moreover, an Akan ethnic group household was more likely to consume fruits by 15% compared to other ethnic groups. The result could be attributed to the fact that Akans are natives in the study area hence automatically own lands that accommodates several fruits which can be accessed easily for consumption compared to others who might own not own lands [15]. Another reason can be that, generally, Akans have no restrictions or taboos on the consumption of fruits. Expectedly, a respondent's health benefits awareness on the consumption of fruits increased the probability of fruit consumption in a household by 63% as well as expenditure on fruit by GH¢ 4.9. Kpodo et al. [41] and Wang et al. [61] identified similar results in Ghana. Likewise, the result is consistent with a systematic review by Shaikh et al. [56] and Ratcliffe et al. [52] who also found the relationship between knowledge and fruit intake as positive.

A household resident in an urban area decreased consumption of fruits by GH¢ 2.31 per week compared to a rural household. A conceivable reason could be the high price of fruits in the major cities compared to the rural areas albeit access to a variety of fruits by urban dwellers [44, 61]. Besides, in rural areas, the majority are farmers who grow one or different types of fruits or find fruits on

Table 4 Factors influencing fruits consumption *Source*: Authors own computation based on field data, 2019

Variables	Double hurdle estimates	
	Probit regression	Truncated regression
Age	− 0.001	0.002
	(0.003)	(0.054)
Gender	0.649**	− 1.036
	(0.045)	(1.109)
Religion	− 0.253	− 0.258
	(0.133)	(1.077)
Marital status	− 0.125*	− 0.189
	(0.060)	(0.971)
Ethnic group	0.153*	− 0.290
	(0.056)	(1.141)
Fruit health benefit	0.627***	4.917***
	(0.072)	(0.949)
Residence	− 0.052	− 2.314**
	(0.060)	(1.373)
Ln education	0.300***	6.069***
	(0.079)	(1.005)
Ln household size	1.179***	20.647***
	(0.340)	(6.233)
Ln staples	0.006	− 1.265**
	(0.034)	(0.637)
Ln cereals	− 0.208***	− 1.726*
	(0.059)	(1.026)
Ln food items	− 0.879***	− 12.705***
	(0.235)	(3.988)
Ln per capita	1.151***	19.746***
	(0.322)	(6.315)
Constant		
No. of observations	230	230
Wald χ^2 (13)	79.52	164.47
Prob > χ^2	0.0000	0.0000
Pseudo-R^2	0.6635	
Inverse Mills ratio p value from Heckman selection model	0.18	
Log pseudo-likelihood	− 47.55	− 839.09
Log pseudo-likelihood (Tobit)	− 658.83	
Lambda (λ)	455.65	
$\chi_{0.1}$	19.81	

NB: 1$ = GH¢ 5.0

their farms or place of residence. As a result, they spend little to nothing on fruit consumption; meanwhile, the same cannot be said for urban dwellers who mostly must purchase fruits. Consistent with a prior expectation, a 1% increase in the number of years of formal education of a respondent increased the consumption of fruits by 0.3% and the expenditure on fruit by 6.1%. Through formal education, one is made aware of the nutrient composition, types of diseases fruit consumption can eliminate and prevent as well as the health benefits of fruit consumption.

Consequently, the information, without doubt, increases the level of fruit consumption for a healthy living. Surprisingly, if the size of a household is increased by 1%, the probability of a respondent consuming and spending on fruits increased by 1.2% and 20.6% respectively. This finding contrast with the conclusions of Ruel et al. [54] who revealed a negative relationship between household size and fruit consumption. Additionally, one cedi increases in the price of cereals decreased the probability of the consumption and expenditure on fruits by 0.2% and 1.7% respectively. Likewise, a 1% increase in the price of non-food items decreased consumption of fruit by 0.9% as well as expenditure on fruit by 12.7%. Since the Ghanaian diet is largely starchy roots and tubers, cereals (maize, rice), a price increased means that, households would have to spend more on these foods to satisfy household requirements first before deciding to consume fruits as well as spending part of the meagre household budget on fruits which in such circumstances might be deemed as not an immediate priority. The positive marginal effect values of 1.151 and 19.746 reveal that for a per cent increase in the per capita household expenditure (proxy for poverty level of a household), the probability of consumption and the expenditure on consumption of fruits increased positively. The results agree with Florkowski et al. [23] who revealed that, expenditure on fruits is more reactive to household income status mainly because the consumption is viewed as less essential to household dietary requirements albeit household budget constraints.

Table 5 shows the factors influencing vegetable consumption via the use of the two-stage least squares estimation of instrument variable regression.

The p value for the whole analysis is significant signifying that the variables are ideal for this model. To test for endogeneity of per capita expenditure in the model, the Hausman test and the Durbin test for endogeneity were done. From Table 5, the Hausman test and the Durbin score statistics were significant at p value of < 0.001 hence per capita expenditure is deemed as endogenous variable. These results suggest that, OLS regression could not have been used as an alternative to instrumental variable regression. Further, from the report of the first stage statistics (refer to Tables 8 and 9 at the appendix for details), the F statistics or the minimum eigenvalue statistic was 52.42 and it was higher than any of the critical values under 5%, 10%, 20% and 30%. This suggests that our instruments are strong and not weak hence reject the null hypothesis of weak instruments. Moreover, the Test of

Table 5 Factors influencing vegetable consumption. *Source*: Authors own computation based on field data, 2019

Variables	2SLS regression	
	Coefficient	SE
Age	− 2.860**	1.341
Gender	− 132.778***	25.970
Ethnic group	18.582	26.728
Residence	137.323***	28.004
Income	− 0.028***	0.009
Cereals	2.587***	0.669
Staples	0.279	0.377
Per capita	− 2.565***	0.385
Constant	473.332***	62.122
Number of observations	300	
Wald χ^2 (8)	107.42	
Prob > χ^2	0.0000	
Endogenous variable	Per capita expenditure	
Test of homogeneity		
Ho: variables are exogenous	59.485(p = 0.0000)	
Durbin score χ^2	71.723 (p = 0.0000)	
Wu–Hausman F		
Test of over identifying restrictions		
Sargan (score) χ^2 (2)	0.6777 (p = 0.7126)	
Basmann χ^2 (2)	0.6543 (p = 0.7210)	

***Significant @1%, **Significant @5%. NB, 1$ = GH¢ 5.0

Overidentification results as shown in Table 5, revealed that, both Sargan score statistics and Basmann statistics were large and not less than p value of 10% hence we accept the null hypothesis that, our instrument set is valid, and the model used for this analysis is correctly fitted and specified. From the determinants of vegetable consumption in Table 5, even though, studies have reported that, increases in age correlate with the awareness of healthy nutrition mainly because of increases in doctors nutritional advice [28, 45, 60], the results, however, revealed that an increase in age, decreased the consumption of vegetables by GH¢ 2.86. The result is consistent with results by Hall et al. [34] who discovered that, there is low vegetable consumption among Ghanaians with increase in age. Atypically, a female-headed household spends about GH¢ 132.78 less on vegetables consumption compared to male-headed household. One credible reason could be that, the relationship between gender and expenditure on vegetable consumption might not be linear because vegetables serve as complements to all local meals in Ghana hence households spend more on the staples than the vegetables. The positive and significant coefficient value of 137.32 for residence implies that, averagely, a household resident in urban areas is likely to spend more on vegetables by GH¢ 137.32 compared to a rural household. The finding corroborates with earlier empirical study by Azagba and Sharaf [11] who revealed that vegetable consumption increases with urbanisation because urban areas have better access to high inventory of vegetables compared to rural areas. In contrast with our hypothesis, a one Ghana Cedis (GH¢ 1) increase in the income of a household decreases the expenditure on vegetable consumption by GH¢ 0.028 per week. The results, however, corroborate a study by Ghana Statistical Service et al. [28] which reported that, the daily consumption of vegetables was lower among the wealthiest in Ghana. The results, however, disagree with empirical evidences by Ogundari and Arifalo [51] in Nigeria, Terin et al. [60] in Turkey and Meng et al. [45] at Ghana. The possible explanation to this phenomenon is that, since vegetables are part of almost all served dishes in Ghana across various ethnic groups, the consumption is more stable and does not necessarily increase with increases in the income of a household. Similarly, using per capita expenditure as proxy for poverty, the results reveal that, consumption of vegetables, however, decreases with increase per capita household expenditure (decrease in poverty). The results disagree with Asfaw [8] but in agreement with Gido et al. [29] who revealed that vegetable consumption decreases with increase in income. Furthermore, for a one Ghana cedi expenditure increase on cereals (which is mainly rice and maize in the country), expenditure on vegetables increases by approximately 2.58% at probability level of 1% ($p > 0.001$). The attribution of the results is that, most of cereal meals in Ghana eaten by the major ethnic groups such as *banku*, *kenkey*, *tuo zaafi*., *akple*, etc., are served with vegetables hence the results [7, 23].

Conclusions and Recommendations

The study revealed that gender, fruits health benefit awareness, education, household size, per capita household expenditure (poverty status) influenced the consumption of fruits positively. However, marital status, expenditure on cereals and non-food items negatively influenced the consumption of fruits. Intensity of fruit consumption or expenditure on fruit consumption; however was influenced by fruits health benefit awareness, residence of household, household size, expenditure on cereals and non-food items as well as household per capita expenditure. Expenditure on vegetable consumption was however positively influenced by the residence of respondents and expenditure on cereals, whereas age, gender, income and per capita expenditure (poverty status) of a household negatively influenced the consumption of vegetables. In terms of methodological approach, the results showed that, the

consumption of fruits is a two-stage decision process where the factors that influence the decision to consume fruits and the expenditure on fruits consumption are not jointly determined as done in previous studies.

From the findings of the study, the following recommendations are made to improve fruits and vegetables consumption in the Techiman Municipality: Firstly, public health experts should intensify public education on the nutritional and health benefit associated with consumption of fruits and vegetables a day especially in urban areas. This can be started in primary and second cycle schools to inculcate the habit of fruits and vegetable consumption in children and the youth which can result in a multiple effect in the households. The Governments flagship programme on National School Feeding could incorporate fruits in the diets to serve as starter or desserts. Also, the mass media, mainly television and radio, should be used to intensify public education on the nutritional and health benefits of fruits and vegetables. Such public education could be gendered, and ethnic group targeted to have a positive impact. Besides, the Government of Ghana should continue to enact policies that will better the living standards of the citizens such that expenditure on non-food items as well as cereals do not increase randomly as this can have significant negative influence on consumption and expenditure on fruits consumption. In terms of methodological approach on the determinants of fruits consumption, the results could be misleading for researchers to assume that the factors that influence the consumption and expenditure on fruits are jointly determined without any separability and selectivity tests as done in previous studies. It is recommended that future studies should consider these tests for the determination of the appropriate methodological approach to be adopted. Furthermore, future research should focus on the consumption of both fresh and processed fruits and vegetable products in Ghana since this study looked at only fresh fruits and vegetables. Also, attempts should be made to capture away from home consumption in such a study to obtain a holistic picture of the fruit and vegetable consumption pattern in rural and urban areas.

Appendix

Tables 6, 7, 8 and 9.

Table 6 Household characteristics of respondents. *Source*: Authors' own computation based on field data (2019)

Variable	Fruit consumption		Non-fruit consumption		Total	
	Frequency (N = 199)	Percentage (%)	Frequency (N = 101)	Percentage (%)	Frequency (N = 300)	Percentage (%)
Gender						
Female	142.0	71.4	62.0	61.4	204.0	68.0
Male	57.0	28.6	39.0	38.6	96.0	32.0
Education level						
No formal education	12.0	6.0	10.0	9.9	22.0	7.3
Basic education	98.0	49.2	48.0	47.5	146.0	48.7
Secondary level	50.0	25.1	28.0	27.7	78.0	26.0
Tertiary level	39.0	19.7	15.0	14.9	54.0	18.0
Household size						
0–5	105.0	52.8	79.0	78.2	184.0	61.3
6–10	76.0	38.2	19.0	18.8	95.0	31.7
Above 10	18.0	9.0	3.0	3.0	21.0	7.0
Age (years)						
35 and below	125.0	62.5	70.0	69.3	195.0	65.0
Above 35	74.0	37.2	31.0	30.7	105.0	35.0
Location						
Urban	112.0	56.3	83.0	82.2	195.0	65.0
Rural	87.0	43.7	18.0	17.8	105.0	35.0
Marital status						
Married	112.0	56.3	53.0	52.5	165.0	55.0
Unmarried	87.0	43.7	48.0	47.5	135.0	45.0
Ethnic group						

Table 6

Akan	143.0	71.9	66.0	65.3	209.0	69.7
Other groups	56.0	28.1	35.0	34.7	91.0	30.3
Religion						
Christianity	170.0	85.4	76.0	75.2	246.0	82.0
Other religious groups	29.0	14.6	25.0	24.8	54.0	18.0
Occupation						
Farmer	72.0	36.2	13.0	12.9	85.0	28.3
Salary worker	61.0	30.7	30.0	29.7	91.0	30.3
Trader	49.0	24.6	35.0	34.7	84.0	28.0
Artisan	10.0	5.0	17.0	16.8	27.0	9.0
Student	7.0	3.5	6.0	5.9	13.0	4.3
Health benefit awareness						
Yes	160.0	80.4	15.0	14.9	125.0	41.7
No	39.0	19.6	86.0	85.1	175.0	58.3

Table 7 Mean weekly household food expenditure of household. *Source*: Authors' own based on field data (2019)

Expenditure items	Rural		Urban		Pooled sample	
	Amount (GH¢)	Budget share (%)	Amount (GH¢)	Budget share (%)	Amount (GH¢)	Budget share (%)
Fruits	14.52	7.96	15.86	7.24	15.2	7.57
Vegetables	10.86	5.95	13.51	6.17	12.19	6.07
Yam	19.35	10.61	23.23	10.60	21.29	10.60
Cassava	8.45	4.63	10.92	4.98	9.69	4.83
Plantain	10.98	6.02	14.18	6.47	12.58	6.26
Cocoyam	12.74	6.99	13.53	6.17	13.14	6.54
Rice	21.11	11.58	26.11	11.91	23.61	11.76
Maize	10.00	5.48	11.89	5.43	10.95	5.45
Meat	22.33	12.24	27.68	12.63	25.01	12.46
Fish	20.30	11.13	25.26	11.53	22.78	11.34
Egg	3.37	1.85	4.39	2.00	3.88	1.93
Non-alcoholic drinks	6.33	3.47	6.63	3.03	6.48	3.23
Sugar and sweeteners	2.28	1.25	3.72	1.70	3.00	1.49
Bread	7.87	4.32	8.34	3.81	8.11	4.04
Gari	1.73	0.95	2.10	0.96	1.92	0.96
Oil	10.15	5.57	11.79	5.38	10.97	5.46
Total	182.37	100.00	219.14	100	200.80	100.00

Table 8 First-stage regression summary statistics. *Source*: Authors' own based on field data (2019)

Variable	R^2	Adjusted R^2	Partial R^2	$F(3,289)$	Prob$\mid > F$
Per capita expenditure	0.4594	0.4407	0.3524	52.4236	0.0000
Minimum eigenvalue statistic		52.4236			

Table 9 Critical values of the first stage regression. Authors' own based on field data (2019)

2SLS relative bias	5%	10%	20%	30%
	13.91	9.08	6.46	5.39
Per capita expenditure	0.4594	0.4407	0.3524	52.4236
	10%	15%	20%	25%
2SLS size of nominal 5% Wald test	22.30	12.83	9.54	7.80
LIML size of nominal 5% Wald test	6.46	4.36	3.69	3.32
Critical values	No. of endogenous regressors: 1			
Ho: instruments are weak				

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