




## Factors determining the fruit consumption level in a peri-urban area of Bangladesh

Sadia Sharmin Hoque<sup>1</sup>, Sadika Haque<sup>2</sup>, Arifa Jannat<sup>1</sup>, Md Salman <sup>2\*</sup>, Dewan Abdullah Al Rafi<sup>3</sup>, Md Kazi Faisal<sup>2</sup>, Abu Ahamed Sabbir<sup>2</sup>, Pooja Vortia<sup>4</sup>

<sup>1</sup>Institute of Agribusiness and Development Studies (IADS), Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

<sup>2</sup>Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

<sup>3</sup>Department of Agricultural and Resource Economics, The University of Arizona, USA

<sup>4</sup>Department of Agribusiness and Agricultural Economics, University of Manitoba, Canada

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Mahbub Hossain

[mahbub@bau.edu.bd](mailto:mahbub@bau.edu.bd)

#### \*Corresponding Author

Md Salman

[salman.20240112@bau.edu.bd](mailto:salman.20240112@bau.edu.bd)



### ABSTRACT

The study was designed to relate fruit consumption with income and determine the influencing factors of fruit consumption at Bangladesh Agricultural University (BAU) and the surrounding area. Data were collected through direct interviews with 155 respondents (90 fruit buyers and 65 non-buyers) who were selected through a random sampling technique. Descriptive statistics, Logit and Tobit models were applied to get meaningful results according to the stated objectives. The findings presented that, except banana, apple, grapes and orange had positive correlation with income and fruit consumption. Banana consumption has found negatively correlated with income. Regression results revealed that per head income, level of education and nutritional knowledge has a positive and significant influence which leads to the increase in fruit consumption of buyers. On the other hand, the higher price of fruits decreases the amount of fruit consumption and female buyers are more likely to buy fruits than male buyers. Therefore, policymakers should take adequate measures to keep the fruit price reasonable and to enhance increasing nutrition knowledge to increase fruit consumption for all people.

**Keywords:** Fruits, consumption level, correlation, peri-urban area



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## 1 Introduction

A Proper and adequate nutrition balanced diet with regular physical exercise is a good foundation for healthiness. Reduced immunity, increased susceptibility to disease, impaired physical and mental development, and decreased productivity result from an unbalanced and improper diet (WHO, 2013). The dietary patterns of populations around the world were primarily determined by the availability of food and food practices (Kearney, 2010). A balanced diet, adequate in all necessary nutrients, energy, protein, vitamins, and minerals, can satisfy both perceptible and hidden hunger. The typical rural diet in Bangladesh is not well balanced and nutritive (Islam, 2012). Cereals,

largely rice, are the main food in Bangladesh (Sarwar and Biswas, 2021). Many people of Bangladesh are suffering from malnutrition because of consuming an unbalanced diet (Fahim et al., 2021). The nutritional status of people can easily be improved by making available an adequate amount of fruits because they are rich in vitamins and minerals (Aman and Masood, 2020).

In 2016, the production of fruits in Bangladesh was 798012 metric tons, of which banana accounted for the highest proportion of 46%, followed by 19% of jackfruit, 11% of pineapple, and 8% of mango (BBS, 2017). The other fruit like papaya, melon, litchi, guava, lemon, etc. comprised only 16% of total pro-

duction (BBS, 2017). However, in the fruit shops of Bangladesh, both exotic and domestic fruits are available. Domestic fruits like banana, guava, papaya, jackfruit, pineapple, etc., also contain enough nutritional value to maintain a healthy diet (Ravi and Nazni, 2020). Therefore, fruit production and consumption in the country must be increased manifold to eliminate the deficiency in vitamins and minerals in the daily diet of Bangladesh. To increase fruit consumption, it is necessary to know the present fruit consumption patterns of different people under various income groups.

A large proportion of adults in Asia consume an inadequate amount (less than five servings a day) of fruits and vegetables, despite the abundant availability (Kanungsukkasem et al., 2009). Kapoor and Kumar (2015) attempted to understand selected behaviors of fruit and vegetable consumers of mid-sized cities of a developing economy, which are important for any retailer to appreciate. The study revealed that vegetables are consumed in greater quantity and purchased more frequently than fruits. Some previous studies also indicate that eating behaviors and food habits are determined by various individual, social, and environmental factors of the given context (Bandura, 1986; LaCaille et al., 2011; Deliens et al., 2014). Affordability and frequency of purchase of sugary drinks also can influence the daily intake of fruits and vegetables in resource-limited communities (Okop et al., 2019).

Various socio-demographic variables were found as the significant determinants of fruits and vegetable consumption in Nepal (Vaidya et al., 2014). The findings showed that fruit and vegetable intake in the community was low with 2.1% of the study population consuming the WHO-recommended five servings per day. According to Singh et al. (2019), almost 90% of adolescent girls consumed inadequate amounts of fruits and vegetables, arguing that socio-demographic and dietary factors should be considered while designing preventive strategies to increase fruit and vegetable consumption to the recommended levels. Kabir et al. (2018) investigated the factors that influence eating behavior and dietary intake among resident students in a public university in Bangladesh. The author found that individual factors (cooking skills, food taste, food taboos, and knowledge and perceptions), societal factors (influence of peers and social norms), factors related to university (campus culture and frequency of examination), and environmental factors (availability of cooking resources and facilities and food prices) emerged as the key aspects that determine students' eating behavior and dietary intake.

The recommended amounts of fruits are an important part of diets that reduce malnutrition for people of all ages, and purchasing behaviour is one of the determinants of increasing fruit consumption.

Bangladesh has received limited research attention on fruit and vegetable consumption, even though many studies have been conducted in developing countries. To better understand the purchasing and consumption behaviour to reduce malnutrition this study broadly aims to explore the determinants of fruit consumption in a peri-urban setting in Bangladesh. The two specific objectives are to measure the relationship between income level and fruit consumption pattern; and to identify the influencing factors of fruit consumption level.

## 2 Methodology

### 2.1 Study area and data collection

Fruit intake data were gathered from the six fruit shops of Kamal Ranjit (KR) market and Sesh Moor (another place nearby BAU) market from sample respondents in Bangladesh Agricultural University (BAU), Mymensingh. The authors collected data for 3 days (February 3rd, 13th and 23rd) after 9 days intervals using pre-designed interview schedules during the month of February, 2018 from 4 pm to 7.30 pm. About 65 non-buyers were selected randomly from various occupations, such as chef, electrician, canteen boy, gatekeeper, cleaner, auto driver, and rickshaw puller. Here the terminology non-buyers is used for people who did not buy fruit in February, 2018. When researchers collected the data, these low-income people could not memorize the time of their last consumption of fruits. For this reason, this is the non-buyers group.

In addition to field-level primary data, secondary data having relevance to this study were also collected and discussed for research from different handouts, reports, and published and unpublished documents of the Government of Bangladesh (GoB) and its different organizations and agencies such as Bangladesh Bureau of Statistics (BBS), the Bureau of Economic Research (BER), various journals, newspaper, notifications, World Health Organization (WHO) reports, etc. The data and information collected from surveys, interviews, discussions and communications were scrutinized, classified, edited and coded. Descriptive analyses and graphical representation were used to analyze data for presenting socioeconomic status of fruit buyers and non-buyers and for measuring income–fruit consumption relationship. The calculation was done by Microsoft Excel. To explore the factors influencing fruit consumption, the Logit and Tobit model were used. This function was chosen on the basis of the best fit and significant effects of using various factors affecting fruit consumption. The Logit and Tobit models were done in STATA-12.

## 2.2 Empirical models

The study utilized two regression models. The logic of using two models is to explore the fruits consumption from the two different points of view. Logit model is used to predict the consumption and Tobit model is to estimate linear relationships of the amount of fruits bought which is a censored dependent variables.

## 2.3 Logit estimation

The Logit regression model was used to determine the factors that have significant influence on the fruit consumption. This method was chosen because it is a standard method of analysis when the outcome variable is dichotomous and when the fruit consumption is measured as a dichotomous response variable having a value of 0 or 1, where 0 = Non-consumption of fruit 1 = consumption of fruit. The equation is as follows:

$$Y = \ln \left( \frac{p_i}{1 - p_i} \right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_7 X_7 + \varepsilon_i \quad (1)$$

where  $P_i$  is a probability of fruit consumption; Dependent variable (Binary):  $Y$ , where 1 indicates fruit consumption and 0 indicates non-consumption.  $X_1$  is the gender (1 for male, 0 for female);  $X_2$  is the age of the respondents (years);  $X_3$  is the education level of the respondent (number of years);  $X_4$  is the per capita income (Tk);  $X_5$  is the nutritional knowledge of the respondents (yes = 1, no = 0; which is measured by asking from what types of food should we consume every day. We have judged their knowledge based on the answer. We followed if they mentioned about fruits, vegetables and dietary diversity, then it was assigned value as 1, otherwise 0);  $X_6$  is the price of fruits (Tk/g);  $X_7$  is the marital status of the respondents;  $\beta_0$  is the intercept;  $\beta_1$  to  $\beta_7$  are the regression coefficients of the dependent variable; and  $\varepsilon_i$  is the disturbance term.

## 2.4 Censored regression or Tobit model

In a censored sample, some observations on the dependent variable corresponding to known values of the independent variables are not observable. Tobit model has been used to analyze the degree of contribution on fruit consumption of the individual consumers. Because in our sample some consumers were paying money to buy fruits and some never paid on fruit consumption. So, using Ordinary Least Square (OLS) Regression will give an inconsistent result (Gujarati, 2003). According to the Tobin (1958) approach,

when the model was first analyzed in the econometric literature. The model can be specified as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_{ik} + \varepsilon_{ij} \quad (2)$$

if the respondents consume any fruit  $y_i > 0$ ; if no, then = 0.

The dependent variable is the total value of fruit consumption (g), which has been calculated by the expected explanatory variables. where  $P_i$  is a probability of fruit consumption; Dependent variable (Binary):  $Y$ , where 1 indicates fruit consumption and 0 indicates non-consumption.  $X_1$  is the gender (1 for male, 0 for female);  $X_2$  is the age of the respondents (years);  $X_3$  is the education level of the respondent (number of years);  $X_4$  is the per capita income (Tk);  $X_5$  is the nutritional knowledge of the respondents (yes = 1, no = 0; which is measured by asking from what types of food should we consume every day. We have judged their knowledge based on the answer. We followed if they mentioned about fruits, vegetables and dietary diversity, then it was assigned value as 1, otherwise 0);  $X_6$  is the price of fruits (Tk/g);  $X_7$  is the marital status of the respondents;  $\beta_0$  is the intercept;  $\beta_1$  to  $\beta_7$  are the regression coefficients of the dependent variable; and  $\varepsilon_i$  is the disturbance term.

## 3 Results and Discussion

### 3.1 Socioeconomic status of fruit buyers and non-buyers

Bangladesh Agricultural University is situated in a peri urban area. In order to see the consumer behavior, 58% respondents were selected who buy fruits and rest 42% of the respondents who do not buy fruits. Socioeconomic status of buyers and non-buyers are presented in Table 1. The age of the respondents was classified into five groups i.e. 20 to 29 years, 30 to 39 years, 40 to 49 years, 50 to 59 years and 60 and above years. The majority (55.55%) of the respondents who buy fruits belonged to age group of 20 to 29. The highest (36.92%) frequency of age was 30 to 39 age groups for the respondents who did not buy fruits. Here, for both buyers and non-buyers' groups, male members (54.44% and 66.15%, respectively) are higher than females (45.56% and 33.85%, respectively). It was observed that 95.56% buyers completed their graduation degree where graduated non-buyers were only 1.54%. Additionally, a significant percentage of the non-buyers were illiterate (38.85%). That means highly educated people have more intention to consume fruits than others. Here, average family sizes were 4.26 for fruit buyers and 4.69 for non-buyers.

The distribution of monthly per-head income was classified into five groups i.e. less than Tk 5000, Tk

5000-10000, Tk 10000-15000, Tk 15000-20000 and more than Tk 20000. The income group of less than Tk 5000 was the largest among all the five groups and Tk 11000-15000 was the lowest group for buyers which accounted for 35.56% and 6.67%, respectively. However, almost all of the non-buyers belonged from the income group of Tk 5000-10000 and less than Tk 5000. Above all fruits only mango, banana and guava are produced in Bangladesh and other fruits are imported from abroad.

### 3.2 Income-fruit consumption relationship

In the BAU community, fruit buyers mostly buy bananas and apples. Here, some fruit buyers bought different varieties of fruits at the same time and most of the buyers bought one variety of fruit in large amounts. Here, income and consumption were calculated according to fruit bought by buyers (Table 2). Here, respondents who bought orange have found higher income than other varieties of fruit buyers. On the other hand, respondents who brought grapes found have higher average consumption. According to Engel's studies (1857), as the income of a family increases, the proportion of its income spent on necessities such as food falls and that spent on luxuries (consisting of industrial goods and services) increases. Fruit can be assumed as a luxury commodity. In Engel's law it can be seen that, if income increases, fruit consumption also increases and vice-versa. Correlation between income and fruit consumption was found to be 0.55. It means consumption is moderately associated with income and they move in the same direction.

Relationships between income and consumption of fruits (Apple, Banana, Grapes and Orange) are presented in Table 3. A simple correlation matrix has been calculated on the consumer income and weekly fruits consumption. In case of apple consumption, there is a moderate and positive correlation has found which is 0.663 indicating that, rising the income tends to rise the apple consumption as well. Grapes and orange have found the similar results like apple. A higher income would be resulted a higher level of consumption for both grapes (correlation = 0.554) and orange (correlation = 0.559). on the other hand, banana consumption has a negative and very weak correlation ( $-0.060$ ) with income. The result is justified as from the field survey it has evidenced that, banana is cheaper and available year-round. When income rises, people bought less of banana and take other exotic fruits. Consumer psychology is also a fact here. The thought, fruits with high price is better and more nutritious than cheap fruits like banana. Though the respondents who bought fruits did not buy the same variety of items all the time. Once after buying a fruit or a combination of different varieties, the consumers

do not buy again for some days, until stock finish at their households.

### 3.3 Determining factors

The result of Logit and Tobit regression has been presented in Table 4. Four out of seven variables (gender, age, education, per head income, nutritional knowledge, price and marital status) included in the both models were significant in explaining the variation in fruit consumption. These variables were gender, education, income, nutritional knowledge and price (Table 4).

#### 3.3.1 Gender ( $X_1$ )

The empirical result shows that the coefficient of gender for Logit model has negative value and it was 0.861, which was statistically significant at 5% level. It indicated that female buyers have higher probability of fruit consumption where male buyers consume less than female buyers, while the figure for Tobit model was 0.003 which was positive and statistically significant at 1% level that indicated that, female buyers purchase 0.003 gram more fruits than male. However, women in Nepal consumed more fruits and vegetables than men while a reverse trend had been observed earlier in all the Health and Demographic Surveillance System (HDSS) of Bangladesh, India, Vietnam and Thailand (Vaidya et al., 2014).

#### 3.3.2 Education level ( $X_3$ )

The parameter estimates from the Tobit model of education level carry a positive result which is 0.035 and statistically significant at 1% level. That means, fruits consumption rises by 0.035 grams if one year of additional schooling received by the respondents. This result evidently demonstrates that education emerges as an important factor in influencing the fruit consumption. According to Kanungsukkasem et al. (2009), education and behaviour change programs are needed to promote fruit and vegetable consumption.

#### 3.3.3 Per head income ( $X_4$ )

This result from both Logit and Tobit regression implies that per head income of the respondents was positive which was 2.863 and 0.221 respectively and significant at 1% level. This implies that the higher income of the respondents raise the probability by 1.863 times and raises fruits consumption by 0.221 grams. The result is in line with Muhammad et al. (2017) who found that fruits, unprocessed red meats, and fruit juices intake exhibited the largest positive responses to rising incomes globally.

**Table 1.** Socioeconomic status of fruit buyers and non-buyers

Variables	Categories	Fruit buyers	Non-buyers
Age (year)	20-29	50 (55.55)	15 (23.08)
	30-39	13 (14.44)	24 (36.92)
	40-49	17 (18.89)	12 (18.46)
	50-59	8 (8.89)	14 (21.53)
	60 and above	2 (2.22)	-
Gender	Male	49 (54.44)	43 (66.15)
	Female	41(45.56)	22 (33.85)
Education level	Illiterate	0	22 (33.85)
	Class 5-7	0	10 (15.38)
	Class 8-11	0	25 (38.46)
	HSC	4 (4.44)	5 (7.69)
	Degree		2(3.08)
Occupation	Graduate	86 (95.56)	1 (1.54)
	Student	47 (52.22%)	-
	Housewife	7 (7.78)	-
	Service holder	36 (40.00%)	-
Monthly income	Less than 5000	32 (35.56)	30(46.15)
	5000 - 10000	23(25.56)	35(53.85)
	11000 -15000	6 (6.67)	-
	16000-20000	12 (13.33)	-
	more than 20000	17 (18.89)	-

Source: Field survey, 2018; Figures within parentheses indicate the percentages of the total

**Table 2.** Average income level and average amount of fruits purchased

Fruits	No. of buyers	Average income (Tk)	Average consumption (g)
Apple	41	8011.46	1909
Banana	41	6361.79	980.91
Grapes	16	11573.96	2210.25
Orange	17	16416.67	2073.51

Source: Authors' estimation based on field survey, 2018

**Table 3.** Income-consumption relationship of fruits

	Income			
	Apple	Banana	Grapes	Orange
Consumption	0.663	-0.06	0.554	0.559

Source: Authors' estimation based on field survey, 2018

**Table 4.** Estimated value of Logit model

Variables	Result from Logit model			Result from Tobit model		
	Coefficient (SE)	z	P value	Coefficient (SE)	z	P-value
Intercept	3.414*** -0.902	3.785	0.001	2.254*** -0.993	2.269	0.001
Gender ( $X_1$ )	-0.861** -0.365	2.358	0.036	0.003*** -0.001	3	0.019
Age ( $X_2$ )	0.596 -0.751	0.794	0.534	0.339 -0.262	1.293	0.294
Year of schooling ( $X_3$ )	1.265 -0.874	1.447	0.343	0.035*** -0.016	2.187	0.002
Log of per head income ( $X_4$ )	2.863*** -0.932	3.072	0.007	0.221*** -0.09	2.456	0.008
Nutrition knowledge ( $X_5$ )	1.765*** -0.661	2.67	0.002	0.417* -0.092	4.533	0.063
Log of Price ( $X_6$ )	-3.475*** -0.869	3.998	0.009	-0.502** -0.214	2.346	0.038
Marital status ( $X_7$ )	0.352 -0.653	0.539	0.161	0.48 -0.301	1.595	0.33

Source: Authors' estimation based on field survey, 2018; Dependent variable: Fruit consumption, category = Yes or no and amount of fruit bought (g); \*\*\*, \*\*, \* indicates significant at 1%, 5% and 10% level, respectively; SE = standard error

### 3.3.4 Nutritional knowledge ( $X_5$ )

Opinion on the necessities of fruit intake and knowledge about balanced nutrition are mainly considered as indicators of nutritional knowledge. These coefficients of nutritional knowledge for both Logit (1.765) and Tobit (0.417) were positively significant at 1% and 10% level. This implies that higher nutritional knowledge of the respondents has the probability of increasing consumption of fruits by 0.765 times and they consume average 0.417 gram more fruits than who have lower level of knowledge. Wardle et al. (2000) also found that nutrition knowledge was significantly associated with 'healthy eating' (e.g., fruit and vegetable intakes) and knowledgeable individuals were 25 times more likely to consume adequate amounts of fruit and vegetables daily. Worsley et al. (1985) mentioned that nutrition interest is a key mediator of the link between personal values and dietary choices.

### 3.3.5 Price ( $X_6$ )

The empirical result of Logit model shows that the coefficient of price has negative value and it was 3.475, which was statistically significant at 1% level. Besides, the Tobit model also shows that the coefficient of price (0.502) was negatively significant at 5% level. It indicated that low price has a higher probability of fruit consumption by 2.475 times. Also, lower price resulted average 0.502 grams more consumption by the respondents. Bouis et al. (2011) found that a 50% increase in food prices results in a decrease in energy

intake of 5% to 15% and concluded that the increasing food prices will make fighting against micronutrient malnutrition in developing countries more difficult.

Here, from both Logit and Tobit regression models, we found that personal income and food prices are the key drivers of fruit consumption choices for different categories of consumers. Cox and Wohlgenant (1986) and Muhammad et al. (2011) found that the effects of these variables on dietary consumption may vary by food category, country, age, and sex, with important implications for policy interventions in different nations and population subgroups. Singh et al. (2019) found that the factors significantly associated with insufficient food variety consumption were education to under the 10th grade, household income in the first quartile, lack of awareness of the importance of FV consumption, the non-availability of FVs at the household level, the low level of dietary diversity, and under nutrition (body mass index, BMI <18.5). Vaidya et al. (2014) mentioned that though statistical models show that family income is a less important determinant compared to education, food insufficiency in the household and accessibility to fruit and vegetables are established pertinent factors that influence fruit and vegetable intake, particularly for the impoverished population.

## 4 Conclusion

Findings of the study and logical interpretation of their meanings in the light of other relevant facts conclude that gender, level of education, per head

income, nutritional knowledge and price had significant influence on fruit consumption. But gender, education level, per head income, and nutritional knowledge increase the fruit consumption of consumers. On the other hand, higher prices of fruits decrease the amount of fruit consumption. Also, the rising income tends to be higher fruits consumption as well. The study, therefore, suggests taking adequate measures by the policymakers to expand fruit consumption. In many cases, educated buyers are not also aware of the importance of fruit consumption, so we may need to find a way so that all buyers become aware of the nutritional value of fruits. In the fruit shops, most of the time, sellers sell exotic fruits and are not willing to sell indigenous fruits. On the other hand, most educated buyers would like to buy those fruits available at the well-organized formal shops and not the local fruits, which are even cheaper and contain more nutritional value.

## Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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