Determinants of Vegetable and Fruit Consumption in Colombia

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Abstract: This study aim to identify the determinants of consumption of vegetables and fruits in an application for Colombia. In order to do this, two types of specifications are used: in the first, a Tobit Model is used to estimate the determinants of household consumption expenditures. Then, a logistic regression model calculates the probability of consumption of this type of foods. The data used come from the national survey of income and expenditure of DANE in the period 2006-2007. The results show that the income, the socio-economics stratus and the size of the households as well as the type of employment and the sex of the individuals are fundamental factors in the consumption of vegetables and fruits. On the other hand, against what was expected education do not seem statistically consistent to these two specifications, the results show that this variable helps to increase spending but decreases the probability of consumption.

Key words: Consumption, vegetable and fruit, education, socio-economic characteristics, expenditure of DANE

INTRODUCTION

The increase in global obesity and its incidence in the probability of generating diseases related to heart, diabetes, cancer among others has aroused the interest of academics and experts on the effect of vegetable and fruit consumption in reducing these health problems. In general it is pointed out that the consumption of these foods significantly reduces the likelihood of suffering from these diseases (Schroder, 2010). A latent concern for developing countries is that the nutritional culture in consuming this type of food is very poor compared to those developed. For public policy, it is essential to know what determines the consumption of this type of healthy foods. This study analyzes whether some socio-economic characteristics can determine the increase in the expenditure and probability of vegetables and fruits consumption. One of the factors that is thought to significantly influence this behavior is schooling. An individual with a higher level of education is likely to make better choices for his or her well-being by being more informed he or she evaluates better the consequences on health of consuming certain items. The study aims to analyze this type of relationship with an application for Colombia through national survey of income and expenditure.

The document has two important contributions. In the first place, it tries to analyze this phenomenon for the Colombian case where this type of literature has been scarce. Second, an analysis is carried out under a framework that has been termed as "non-monetary effects of education" in an application for the consumption of vegetables and fruits.

Literature review: The literature on vegetable and fruit consumption is extensive. A part of it try to analyze the consequences that these habits of consumption have on the health of individuals. For example, some studies have assessed determinants of successful behavior change related to fruit and vegetable consumption (Chapman, 2010; Ransley *et al.*, 2010). In general, these authors have found that factors related to tastes, prices, beliefs, knowledge and education are key to changing habits in the consumption of fruits and vegetables.

One variable that is considered main in this analysis is education. From the point of view of consumer behavior, education can be a fundamental factor in consumption choices, since increases in the levels of this variable can improve resource management and interactions with market (by doing more efficient the purchases of goods and services and improving the individuals decision making) (for a discussion of this point see (Laverde, 2015). Education can affect relative prices by valuing certain products more than others, looking to maximize their well-being which eventually leads to an increase in the quantity and/or quality of consumption.

As an example, Roos *et al.* (2001) examine the association between household educational levels and

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consumption of raw vegetables among adolescents. Employed a multiple logistic regression analysis found a clear association between vegetable consumption and the educational levels among adolescents.

On the other hand, the empirical literature for developing countries is less extensive. In particular for a country such as Colombia studies are scarce, although the consumption of vegetable and fruit is low in relation to the recommended intakes (OMS, 2004; Havas *et al.*, 1994; Castaneda, 2014).

A particular case is given by Restrepo *et al.* (2014). It analyzes the consumption of vegetables for a population of university students through a multivariate analysis of variance. The findings indicate that vegetable consumption is low particularly among students from low socio-economic strata and public universities.

Acosta (2014) based on data from the National Demographic and Health Survey (ENDS) and the National Nutrition Situation Survey (ENSIN), analyzed whether socio-economic determinants are associated with high rates of obesity. The results show that high obesity rates are concentrated in male with lower socio-economic conditions, while in female, the lower income distribution is concentrated.

MATERIALS AND METHODS

The data used come from the National Survey of Income and Expenditure (ENIG) 2006-2007 of the National Administrative Department of Statistics (DANE). The ENIG is a national representation survey, covering 32 cities in the country. In addition to household expenditure variables, this survey allows the characterization of individuals through socio-economic and geographical location variables. At the same time, we want to analyze the incidence of education on the expenditure and probability of consuming vegetable and fruit (Mills *et al.*, 2016) in this way the analysis will be represented in Tobit and logistic models.

In general terms, we seek to find the relation in the consumption of vegetable and fruit (Y) and a matrix of socio-economic characteristics X, specified under the following linear regression (Eq. 1):

$$Y = X'\beta + e \qquad (1)$$

Where:

e = Represents unknown error terms

β = Parameters to be estimated

Given the censored survey data for vegetables and fruits, a Tobit Model was estimated as follow:

$$E(Y_i) = \Phi\left(\frac{\beta X_i}{\sigma}\right)\left[\beta X_i + \frac{\phi\left(\frac{\beta X_i}{\sigma}\right)}{\Phi\left(\frac{\beta X_i}{\sigma}\right)}\right] \qquad (2)$$

where, $\phi(.)$ and $\Phi(.)$ represent the normal probability density and cumulative distribution functions. Additionally, the present study aims to analyze the determinants of the consumption of vegetables and fruits through a logistic regression analysis described under the following regression (Eq. 3):

$$Pr(Y = 1 | x_2, \ldots, x_k) = E(Y_i | X = x) = \frac{e^{z_i}}{1 + e^{z_i}} \qquad (3)$$

where, $z_i = \beta_1 + \beta_2 x_2 + \ldots + \beta_k x_k$. The dependent variable is dichotomous which takes the value of 1 if the individuals declare to have consumed vegetable or fruit in a period less than a month, 0 otherwise. The vector X contains the following dependent variables:

- Age: completed years of the individual
- Household size: number of individuals per household
- Sex: Dichotomous variables that take the value of 1 if it is male and 0 if it is female
- Years of schooling: number of years of study
- Educational level: primary, lower secondary, upper secondary and tertiary
- Type of employment: dichotomous variable that takes the value of 1 if it is a domestic employee, unpaid family worker, worker without remuneration of companies or businesses of other households and laborer or pawn, 0 otherwise
- Average income of households: income belonging to the main job (these variables should include other types of income such as interest income, pensions, etc. However, since there is a high correlation between these measures in this study is used as a proxy for income. On the other hand, individual's income presents several problems that need to be corrected including missing data and underreporting. In this research we opt for a correction through imputations with multiple regression models)
- Geographical area: city of housing
- Strata: classification made by the DANE according to the socio-economic conditions of the households (this ranges from 1-7 with 1 being the lowest condition)

RESULTS AND DISCUSSION

The results for the two models are presented in Table 1 and 2. In the first, the impact of socio-economic

Table 1: Estimates for the Tobit Model

Variables	Coefficient	SE	t-vaues	p-values
Intercept	-56.810	-1.392	-40.82	0.000
Education	1.099	0.045	24.41	0.000
Education^2	-0.020	0.001	-26.36	0.000
Age	0.048	0.002	30.11	0.000
Age^2	-0.001	0.000	-43.80	0.000
Edu x age	0.001	0.000	17.15	0.000
Ln(Incomes)	6.634	0.202	32.82	0.000
Incomes^2	-0.226	0.007	-30.43	0.000
Edu x income	-0.090	0.003	-26.35	0.000
Edu2 x incom^2	0.000	0.000	31.02	0.000
Sex	0.205	0.014	14.85	0.000
Edu x sex	0.018	0.001	17.44	0.000
Incom x sex	-0.000	0.000	-34.85	0.000
Strata	0.287	0.006	50.49	0.000
Strata^2	-0.030	0.001	-40.22	0.000
Size	1.281	0.005	272.03	0.000
Size^2	-0.066	0.000	-181.21	0.000
Employment	-0.047	0.016	-2.98	0.003

Goodness of fit test: F-test = 5685.94; p>F; 0.000

Table 2: Estimates for the logistic regression model

Variables	Coefficient	SE	t-vaues	p-values
Intercept	-10.133	0.427	-23.72	0.000
Education	-0.391	0.016	-24.90	0.000
Education^2	0.006	0.000	23.75	0.000
Age	-0.002	0.001	-2.82	0.005
Age^2	-0.000	0.000	-18.92	0.000
Edu x age	0.001	0.000	59.96	0.000
Ln(incomes)	1.370	0.061	22.56	0.000
Incomes^2	-0.058	0.002	-26.41	0.000
Edu x income	0.025	0.001	20.62	0.000
Edu^2 x incom^2	-0.000	0.000	-19.57	0.000
Sex	0.011	0.005	2.35	0.019
Edu x sex	0.003	0.000	9.90	0.000
Incom x sex	-0.000	0.000	-9.18	0.000
Strata	0.087	0.002	46.75	0.000
Strata^2	-0.011	0.000	-44.64	0.000
Size	0.471	0.002	301.77	0.000
Size^2	-0.021	0.000	-172.81	0.000
Employment	-0.043	0.006	-7.41	0.000

Own calculations based on ENIG of DANE. Although, the full results are not shown the analysis is performed for 23 cities. Results are estimated for ages≥25; Goodness of fit test; Wald χ^2 = 241942.80; p>χ^2 0.000

variables (i.e., education, income, age, type of employment, socio-economic strata, sex, household size and geographic location) on household expenditure of vegetables and fruits is analyzed. Subsequently, it is estimated a model of the probability of consumption on this type of articles.

Household expenditure: As expected, the education and income turn out to be highly significant for the purchase in this type of items (Table 1). The educational variable and household income show the expected signs (positive) and are highly significant as well as their quadratic forms. The interactions of these two variables show that the effects on income are different for levels of education (negative sign), i.e. that although rises on education and income increase consumption of vegetable and fruit, the marginal effects of education on income are negative.

The socio-economic conditions (strata) favor positively the increase of the expenses of vegetables and fruits. This variable shows a positive sign and is highly significant. However, by exploring the incidence of household size it is shown with the opposite sign to the expected. One explanation for this is that for households with lower incomes and larger household size the impact of relative prices is higher. In this way, relatively expensive foods for instance meats should be replaced by cheaper goods such as vegetable and fruit (in Colombia, foods such as fruits and vegetables are relatively cheap given the climatic and geographical conditions that the country has).

On the other hand, the age affects significantly the consumption of this type of goods being significant and with the expected signs, both its variable in levels and its quadratic form. The marginal effects of age show mixed results. With regard to education, the marginal effects of age favor consumption as individuals increase in age, while they decrease in relation to income. On the other hand, being a male favors both the consumption of these foods as well as their marginal effects on education (Edu x sex) while being a female favors consumption as income increases (Ingre x sex).

Finally, when analyzing by type of employment the results show that the most precarious employees (laborers, domestic employees, etc.) reduce the consumption of vegetables and fruits.

Probability of consumption: Table 2 shows the probability of consumption of vegetables and fruits according to socio-economic characteristics of households. The results reveal that education reduces the probability of consumption (comparing the results with the previous model, it follows that this variable does not remain robust). In the light of these results, education does not behave consistently, since increases in education are unlikely to increase consumption but decrease their probability. The opposite happens with the income of the households in the face of an increase of these the consumption of vegetables and fruits also increases, showing the importance that this variable has for consumption of this type of products.

Regarding gender condition being a male increases the probability of consumption, showing a high consistency in both models. In this new model this variable is shown to be highly significant. The marginal effects of this variable show that being a man increases the probability of consumption as education increases, the opposite happens in relation to income.

On the other hand, the socio-economic strata and the size of the households corroborate the results found

previously, both are highly significant and in the case of the size of the households with a strong impact on the probability. As for the type of employment the results are consistent with the previous model, an improvement in the type of employment increases the probability of consuming this type of foods.

CONCLUSION

Although the importance of vegetable and fruits intake has been empirically proven to diminish the likelihood of chronic disease and the reduction of body weight, consumption of this type of food is well below recommended standards, particularly in developing countries. In this way, this study tries to elucidate the factors that affect the expenditure and the probability of consuming this type of foods in an application for Colombia.

The results show that the main determinants are the income, the characteristics of the households (such as size, socio-economic strata, etc.) the type of employment and the sex. These variables are shown with the expected sign, with a high impact and highly significant both in the expenditure and in the probability models. These factors are linked to the budgetary constraints of households which affect the relative valuations of the goods that they choose. In light of the results, households with higher incomes and better economic conditions have a greater chance of rearranging their consumption towards products that improve their health in this case toward vegetables and fruits.

A fundamental objective of this study was to examine the impact of education on the consumption of this type of goods. In principle it would be believed that a person with a higher level of education would tend to increase the consumption of vegetables and fruits. This hypothesis is verified in this study, the estimated coefficients are shown to be highly significant and with a strong impact. However, the sign expected to explain the probability of consumption is negative and highly significant. It is difficult to explain how education can increase consumption but negatively affect the probability of consumption. This leaves the door open for further exploration of this question in future investigations for the Colombian case, since at the international level the results have shown a positive relationship in these two variables.

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