

**Fruit Consumption:  
Dietary Health and Policy Implications**

by

Luis Padilla<sup>1</sup>

Selected Paper Presented at AAEA Annual Meetings

Chicago, Illinois

August 5 - 8, 2001

---

<sup>1</sup> Author is research associate with the National Food and Agricultural Policy Project in the Morrison School of Agribusiness and Resource Management, Arizona State University, Mesa, AZ. 85212. Ph. 480-727-1520. FAX 480-727-1510. Email: [Luis.Padilla@asu.edu](mailto:Luis.Padilla@asu.edu). Copyright 2000 by Luis Padilla. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

## **Fruit Consumption: Dietary Health and Policy Implications**

### **Abstract**

Health benefits of a diet rich in fruit and vegetables has been emphasized in the U.S. However, consumption of fruits more than for vegetables has remained well below recommended amounts. Efforts to influence eating habits will be enhanced if socio-demographic factors and the nature of their interaction are better understood. This study uses logistic regression to determine the role of age, sex, race and place of residency to investigate this question. The analysis identifies that sex, social class and place of residence influence optimal fruit consumption. Particularly, this study finds that young adult males of modest means living in rural areas are less likely to incorporate the recommended amount of fruit in their diet.

**Keywords:** fruit consumption, nutrition, health promotion

## **Fruit Consumption: Dietary Health and Policy Implications**

### **Introduction**

Poor diet and lack of exercise is the second largest contributor to premature death in the U.S. (McGinnis and Foege, 1993). Poor diet in particular, has been identified as being a significant risk factor for cancer and cardiovascular disease. In the last decades, evidence has accumulated suggesting that by virtue of high vitamin and bioactive nutrient content, a fruit and vegetable rich diet has a role in protecting against degenerative diseases (Block, et al., 1992; Ness and Paules, 1997). Since that the precise mechanisms involved are not fully known, nutritionists recommend consuming fruits and vegetables rather than dietary supplements. It has also been noticed that in people with produce rich diets, fruits and vegetables may be acting as partial substitutes for fat and sugar thus, helping to reduce obesity.

Given the current epidemic of obesity, the incidence of cancer and the associated high human and economic cost, U.S. public health authorities have placed a greater emphasis on promoting the consumption of fruits and vegetables as a mean to achieve better overall health. Sharing a common cause, public-private partnerships such as the "Produce for Better Health Foundation" have been formed to raise consumer awareness of the health benefits of produce consumption. Such efforts have met with some success. U.S. per capita produce consumption has grown from 577 pounds in 1970 to 699.5 pounds in 1998. Yet, less than 40% of American adults and only 26% of children consume the recommended amount of fruit and vegetables per day.

This encouraging but insufficient growth has also not been equally distributed. While the

growth in vegetable consumption increasingly contributes to meeting dietary guidelines, there has been less movement in average fruit consumption (see figure 1). Per capita vegetable consumption has risen from 3.2 servings per person in 1980-85 to 3.8 while fruit consumption has only grown from 1.2 to 1.3 servings during the same period. More telling, the USDA's Healthy Eating Index (HEI) provides a yardstick of what these figures mean (Bowman et al., 1998; Variyam et al., 1998). The HEI tracks the consumption of 10 dietary components and measures how individual's actual diets compare with the Food Guide Pyramid recommendations. Each of the dietary component can range in value from 0 to 10. For example, a person meeting the consumption guidelines for fruit would have the maximum score of 10 on this category. Thus, the overall HEI may have the maximum value of 100 for an individual whose diet conforms completely with dietary recommendations.

According to this metric, this is a rare individual indeed. Between 1994-1996 the average overall HEI score for the American population was 63.6. Of particular concern is that while the vegetable category exhibits an average score of 6.2, the average fruit score equals 3.9 and is the lowest of the 10 components. Therefore, for adult Americans, this means that while the per capita servings of vegetables need only be increased by a moderate amount to meet food guide pyramid recommendations, fruit servings need to be more than doubled (Kantor, 1998 see figure 2).

Extremely low fruit consumption is an issue of particular concern to public health authorities and growers who want to increase fruit sales. Consequently, there is a need for agribusiness executives and public health promoters alike, to understand the socio-demographic factors related to fruit consumption.

## **Objective**

To this end, the objective of the analysis is to identify the most salient socio-demographic variables influencing fruit consumption, the relative importance of their influence and their interaction. Previous research has indicated that there are differences in fruit consumption patterns according to age, sex, social class and place of residence (Krebs, et al., 1995). In terms of age, USDA consumption tables indicate that as children enter adolescence, fruit consumption tends to decline. This may be due to the declining popularity of breakfast and increased frequency of eating away from home, as the children get older, and having more discretionary income (Lin, et al., 1996). Therefore, it is hypothesized that children and people over 55 are more likely to consume fruits than adolescents and middle-aged individuals. Eating patterns also indicate that while the movement of fruit consumption levels over time is very similar over their lifetime for males and females, females tend to consume higher amounts at each time point. A possible explanation is that, at a given age, females tend to have a higher level of awareness of dietary guidelines. Thus, it is expected the females are more likely to consume the recommended amount of fruit in comparison to males. Income also determines the ability to buy food.

Fruits are generally more expensive than vegetables and other common foods and it is expected that wealthier individuals will be more likely to incorporate enough fruit in their diet. Nevertheless, a different outcome would not be entirely surprising because wealthier individuals also tend to eat out more often. It is also widely acknowledged that culture plays a large role in the types of food consumed (Grivetti, 1991). Region of the country and city/rural place of residency are also widely considered to influence food consumption patterns. On the one hand, city dwellers may have greater exposure to fast food but supermarkets full of produce are also a short-distance away. On

the other, people living in the country may not have as many processed food choices, but supermarkets carrying fruit, particularly during the winter are farther away. Cultural and life-style factors for each region may also be involved.

### **Method of Analysis and Model Specification**

The influence of the socio-demographic factors on fruit consumption was evaluated using the USDA's 1996 Continuing Survey of Food Intakes by Individuals (USDA, 2000). This survey was designed to measure the eating and drinking patterns of Americans and contains a wealth of socio-demographic and nutritional intake information at the household and individual level. This survey includes around 5,500 individuals in 62 U.S. location and uses a scientifically selected sampling method that projects to the entire U.S. population. In this analysis, pyramid servings data was used to compare the characteristics of individuals meeting the daily fruit consumption guidelines to those of individuals not meeting the daily fruit consumption recommendations. A log-linear model was then fitted with fruit consumption as the predictor variable, categorized as an individual meeting or not meeting the recommended daily fruit intake.

### **Model specification**

Since the response variable is dichotomous, logistic regression would be an appropriate to model this binary response variable. This model is popular because the estimates range from zero to one and is easier to interpret (Agresti,1990; Kleinbaum,1994). Additionally, it has the attractive feature of an S-shaped description of the combined effect of the characteristics of consumers on the probability of consuming the recommended amount of fruit. The model is taken form the generalized linear model:

$$E(y_i|b) = p_i + e_i$$

For all observations ( $i = 1, \dots, T$ ) where  $E(y_i|\mathbf{b})$  is the expected value of the dependent variable,  $p_i$  is the probability of the outcome, and  $e_i$  is a residual or error term. The standard logistic regression transform yields:

$$\text{Logit } p_i = \mathbf{X}_i \mathbf{b}$$

Where  $\mathbf{X}_i$  is a matrix of independent variables including a constant and  $\mathbf{b}$  is a vector of coefficients, one vector for each column in  $\mathbf{X}$ . Model assumptions is that each unit is sampled independently from each other; that each  $e_i$  is uncorrelated with every other unit. For a binary response variable  $y$ , the linear logistic model has the form:

$$\text{Logit } (p_i) = \log(p_i/(1 - p_i)) = \alpha + \beta'x_i$$

Where:

$P_i = \text{Prob}(y_i = y_1 \mid x_i)$  is the response variable to be modeled, and  $y_1$  is the first ordered level of  $y$ .

$\alpha$  is the intercept parameter

$\beta$  is the vector of slope parameters.

$X_i$  is the vector of explanatory variables

(Allison, 1999). The specification for this model is written:

$$\begin{aligned} \text{Logit}(p) = & \beta_0 + \beta_1 \text{Gender} + \beta_2 \text{Age59} + \beta_3 \text{Age1014} + \beta_4 \text{Age1519} + \beta_5 \text{Age2024} + \\ & \beta_6 \text{Age2534} + \beta_7 \text{Age3544} + \beta_8 \text{Age4554} + \beta_9 \text{Age5564} + \beta_{10} \text{Age65} + \\ & \beta_{11} \text{Pov2} + \beta_{12} \text{Pov2} + \beta_{13} \text{Urban} + \beta_{14} \text{Mwest} + \beta_{15} \text{South} + \beta_{15} \text{West} + \\ & \beta_{16} \text{NHB} + \beta_{17} \text{NHA} + \beta_{18} \text{MXAM} + \beta_{19} \text{PR} + \beta_{20} \text{CB} + \beta_{21} \text{NHNA} + \\ & \beta_{22} \text{NHO} + \beta_{23} \text{Age1014} * \text{Gender} + \varepsilon \end{aligned}$$

where:

Gender = Sex of respondent

Age59 to Age65p = Age cohorts 5 to 9, 10 to 14, 15 to 19, 20 to 24, 25 to 34, 35 to 44, 45 to 54,  
55 to 64 and over 65 years old.

Pov1 = Having income from 0 to 131% over the poverty threshold

Pov2 = Having income from 131 - 350% over poverty threshold

Urban = Living in an urban area

Mwest = Living in the Mid-West region of the U.S.

South = Living the Southern region of the U.S.

West = Living the Western region of the U.S.

NHB = Non-Hispanic Black

NHA = Non-Hispanic Asian

MXAM = Mexican-American

PR = Puerto Rican

CB = Cuban

NHNA = Non-Hispanic Native American

NHO = Non-Hispanic Other

Age104\*Gender = Interaction between age cohort 10 - 14 and gender.

## **Results and Discussion**

Table 1. provides a summary of the estimation of the fruit consumption model. Model performance indicators show an A score statistic with a p-value of  $< 0.0001$ . Therefore, the null hypothesis that all the coefficients are equal to zero was rejected. The goodness of fit statistic of



Tau-a = 0.053 represents a good fit of the model. The model classified 73.2% of respondents correctly. It was found that gender, stage of life, socioeconomic status and where people live influence fruit consumption. The results for gender show that males are 2.78% less likely to eat the recommended servings of fruit than females. This difference may reflect women's tendency to be more health conscious both in terms of caring for their families and for themselves (Nayga, 2000). Surveys indicate that women as a group are most aware of the diet-cancer link. However, continuous vigilance is needed as dietary habits continue to evolve. While women are generally closer to meeting the guidelines, a recent California dietary survey found declining produce consumption among 35-50 year old women <sup>2</sup>. Lack of convenience was cited by many of these women as barrier to consumption. Consequently, how conditions associated with changes socioeconomic and lifestyle factors influence fruit consumption change as individuals age.

This analysis also finds that fruit consumption follows a U-shaped pattern in relation to age. The majority of children up to 4 years of age consume the recommended fruit servings but then, consumption starts to dramatically decline and reaches bottom amongst the 25-34 year old cohort. From this point, fruit consumption begins to climb again. Consequently, kids in the 5-9 year cohort are 17.98% are less likely to consume the recommended amount of fruit in comparison to the youngest group. Similarly the 10-14 year old cohort is 21.9%, the 20-24 cohort is 29.6%, the 25-34 cohort is 33.1%, the 35-44 cohort is 29.9% the 55-64 cohort is 18.9% and the 65+ cohort is 15.8 % less likely to eat within fruit consumption guidelines than 0-4 year old

---

<sup>2</sup> California Dietary Practices Survey: Focus on Fruits and Vegetables, Trends among Adults, 1989-1995, Topline Report. California Department of Health Services and Public Health Institute, Sacramento, CA 1997. [http://www.dhs.ca.gov/cpns/programs/women/wom\\_fact.htm](http://www.dhs.ca.gov/cpns/programs/women/wom_fact.htm)

children. Perhaps this is because young people are fed more fruit juices and bananas by their parents while very young and ideally, continue to be exposed to fruit in school lunch programs. Then consumption tends to decrease as teenagers develop their own personalities and are under greater external influence. Fruit consumption then reaches a bottom in the prime of life, maybe due to previously developed food habits and a busy lifestyle. Consumption increases once again after reaching middle age when worries about health or being on a restricted diet may exert a dramatic change in eating patterns.

The dramatic decline in fruit consumption and produce in general so early in life may have profound public health consequences. Already, the incidence of obesity in children and psychiatric eating disorders amongst teenagers is on the rise. Creating great uncertainty is that it is not known whether today's youngsters will increase consumption with age as seen in the past. Increasing consumption late in life is positive, but the cumulative effects of a poor diet over time may be substantial. Of greatest concern, however, is that no single age group, male or female is meeting the fruit consumption guidelines. Given age and gender, economics also plays a significant role.

As with any food, fruits compete not only for a share of the stomach, but also for a share of the budget. Taking into account family size, this analysis confirms that the overall probability of eating within the guidelines is highest amongst members of families in the upper income group. Individuals in the lower middle income group are 34% less likely to consume the recommended fruit servings than people in the upper income bracket while people in the low

income group are 51.93% less likely<sup>3</sup>. Thus, affordability for individuals and families is clearly an important issue. Consequently, given that food expenditure is limited and meeting caloric intake requirements is the prime physiological consideration, in the case of large, low income families, fruits may not be priority. Location also matters.

For instance, residents of the Northeast are the most likely to consume the recommended fruit servings followed by residents of the West, Midwest and the South. Compared to the Northeast, people living in the Midwest are 4.1 % less likely to consume the recommended amount and residents of the South are 8.17 % less likely. A significant difference was not found between the Northeast and the West coast. That regional differences exist is not surprising. Location is tied to cultural and lifestyle influences and is well known that traditional cuisines of parts of the Midwest and the South are arguably higher in protein and fat and low in fruit and vegetables. In fact, health statistical data have revealed a clustering of high rates for coronary heart disease in the states bordering the Ohio and Mississippi River Valleys<sup>4</sup>. Differences in fruit consumption also exist between urban and rural areas.

Somewhat surprisingly, people living in urban areas are 3.3 % more likely to be meeting the fruit consumption guidelines than rural residents. A possible explanation is that location may be related to availability. On the one hand, the expansion and sophistication of retail chains has

---

<sup>3</sup>For 1996, low income is defined as individuals earning 0-131% of the poverty threshold (up to \$13,405 for a family of two, \$16,396 for a family of three, \$21,007 for a family of four, and \$24,827 for a family of five). The lower middle income category is defined as individuals earning 131-350% of the poverty threshold (between \$13,406 and \$35,816 for a family of two, between \$16,397 and \$43,806 for a family of three, between \$21,008 and \$56,126 for a family of four, and between \$24,828 and 66,332 for a family of five). Upper income individuals are defined as individuals with incomes 350% above the poverty threshold (a family of two earns more than \$35,816, a family of three more than \$43,806, a family of four more than \$56,126 and a family of five more than \$66,332).

<sup>4</sup>Linda and Jack Gill Heart Institute at the University of Kentucky (GHI) at: <http://www.mc.uky.edu/ghi/>

provided urbanites with a steady, affordable supply of fruits. While, on the other, people living in the country may only have access to highly seasonal fruit supplies (i.e. fruit consumption is low and seasonally lower in winter) and have to drive long distances to reach a supermarket. Given the highly perishable nature of fruits, storing them in between trips is out of the question.

The combination of geographic and income factors together may shape fruit consumption. On the one hand, socially advantaged areas, with good food delivery infrastructure and higher proportion of educated, higher income residents, may exhibit higher fruit consumption. On the other, areas with poor food delivery infrastructure and a high proportion of low income residents may be living in an environment that discourages fruit consumption. These conditions then, may help to create a virtuous cycle where demand for fruit exists and is enhanced through availability and lower prices. Or conversely, a vicious cycle. Notwithstanding age, income and place of residency considerations, cultural and ethnic influences also matter.

This analysis also finds that there is no significant difference in the probability of meeting fruit consumption guidelines when comparing Non-Hispanic African Americans, Non-Hispanic Others, Mexican-American-Chicanos and Puerto Ricans to the Non-Hispanic White majority. However, Cubans are 23.8 % , Native Americans 17.3 % and Asians 6.6 % more likely than Non-Hispanic Whites to meet the fruit guidelines. Even though fruit consumption patterns between Non-Hispanic Whites and some minorities may not be different, this does not necessarily mean this is inconsequential. The fact remains that no single ethnic group meets the guidelines. For instance, a particularly pressing issue is that it is well known that the incidence of several diet related cancers (e.g. esophagus, pancreas, prostate) is higher amongst African Americans.

Constructing ethnicity and interpreting multiculturalism is difficult because there are no natural boundaries. Results for Native Americans were surprising given that many live in rural areas and need to improve their consumption of fruit (Basiotis et al., 1999). Perhaps this is due to a small sample of Native Americans and/or is reflective of the many individuals of diverse lifestyles and place of residency that identify themselves with the Native American heritage of distant ancestors. In the case of Cubans, high intake of plantains and geographical concentration in Florida may explain their high fruit consumption. Today's habits may not continue into the future and therefore, continuous monitoring of high fruit consuming ethnic groups is warranted to ensure that recent immigrants maintain fruit consumption as the tendency is to acculturate into a more mainstream diet (Aldrich and Variyam, 1999).

Finally, a particular interaction between age and gender was found to be influential. It was found that 10-14 year old males are 11.9 % less likely to meet fruit consumption guidelines than the rest of the population. This finding is detrimental because this is a crucial stage of physical and psychological development as well as of social transition. In this stage, individual food taste/preference start to diverge from family influence and lifetime patterns begin to emerge. This may be reflective of changing meal habits, particularly the growing incidence of snacking and higher reliance on fast foods. Compared to the messages from these food categories targeted at this age group, advertising for fruit is minuscule (Frazão et al., 1999).

### **Implications**

This analysis provides a variety of insights regarding fruit consumption. Southern adult males of modest economic means living in the country are the least likely to consume within the guidelines for fruit, while wealthy urban females living in the Northeast are most likely to meet

them. Access and availability are significant barriers and fruit consumption could be improved through alternative retailing formats, improved distribution and convenient fruit products. Affordability is also fundamental and should be taken into consideration when planning and implementing interventions and nutrition safety net programs. This research suggests, that while the entire population suffers from fruit undernourishment, particular attention should be paid to pre-teens and young adults, rural residents and low-income families. Specially, given that heads of households are low fruit consumers themselves, an integral family oriented approach for long-term dietary change needs to be formulated in order to stem the large consumption declines early in life. These efforts in turn, should be complemented with the broader community oriented measures. Given that eating patterns do not remain static, a continuous flow of information and dietary interventions may be needed to meet and sustain policy objectives. Clearly, educational efforts and dietary interventions must also take into account the lifestyle of the target group or individual.

## Reference List

Agresti, A.(1990) *Categorical Data Analysis*, John Wiley & Sons.

Aldrich, L., and Variyam, J.N. "Acculturation Erodes the Diet Quality U.S. Hispanics". *Food Review*, 23(1):51-55.

Allison, P. (1999) *Logistic Regression Using the SAS System : Theory and Application*. SAS Institute.

Block G, Patterson B, Subar A. "Fruit, vegetables, and cancer prevention: a review of the epidemiological evidence". *Nutr Cancer* 1992; 18: 1-29.

Basiotis, P.P., Lino, M., and Anand, R. "The Diet Quality of American Indians: Evidence From the Continuing Survey of Food Intakes by Individuals". *Family Economics and Nutrition Review*, 12(2)44-46. 1999.

Bowman, S.A., Lino, M. Gerrior, S.A., Basiotis, P.P. The Healthy Eating Index: 1994-96. *CNPP-5*. USDA, Center for Nutrition Policy and Promotion. July 1998.

Frazaõ E., ed. *America's Eating Habits: Changes and Consequences*. *Agriculture Information Bulletin No. 750 (AIB-750)*. USDA, Economic Research Service, Agriculture Information Bulletin No. 750 (AIB-750). May, 1999.

Grivetti, L.E. Cultural Nutrition: Anthropological and Geographical Themes. *Annual Review of Nutrition*, 1991 vol 1 pp. 47-68.

Kantor, L. A Dietary Assessment of the U.S. Food Supply: Comparing Per Capita Food Consumption with Food Guide Pyramid Serving Recommendations. *Report No. 772*. USDA, Economic Research Service, December 1998.

Kleinbaum, D.G. (1994). *Logistic Regression: A Self-Learning Text*, Springer-Verlag.

Krebs-Smith S.M., J. Heimendinger, B.H. Patterson, A.F. Subar, R. Kessler, and E. Pivonka. "Psychosocial Factors Associated with Fruit and Vegetable Consumption," *American Journal of Health Promotion*. Vol. 10, Nov-Dec 1995 pp. 98-104.

Lin, B.H., J. Guthrie, and J.R. Blaylock. The Diets of American Children: Influences of Dining Out, Household Characteristics, and Nutrition Knowledge, *AER-746*. USDA, Economic Research Service, Dec 1996.

McGinnis, J. Michael, and William H. Foege. "Actual Causes of Death in the United States," *Journal of the American Medical Association*, Nov 10, 1993.

Nayga, Jr., R.M. "Nutrition Knowledge, Gender, and Food Label Use". *Journal of Consumer Affairs*, 34(1)97-112. 2000.

Ness AR, Powles JW. Fruit and vegetables, and cardiovascular disease: a review. *Int J Epidemiol* 1997; 26: 1-13.

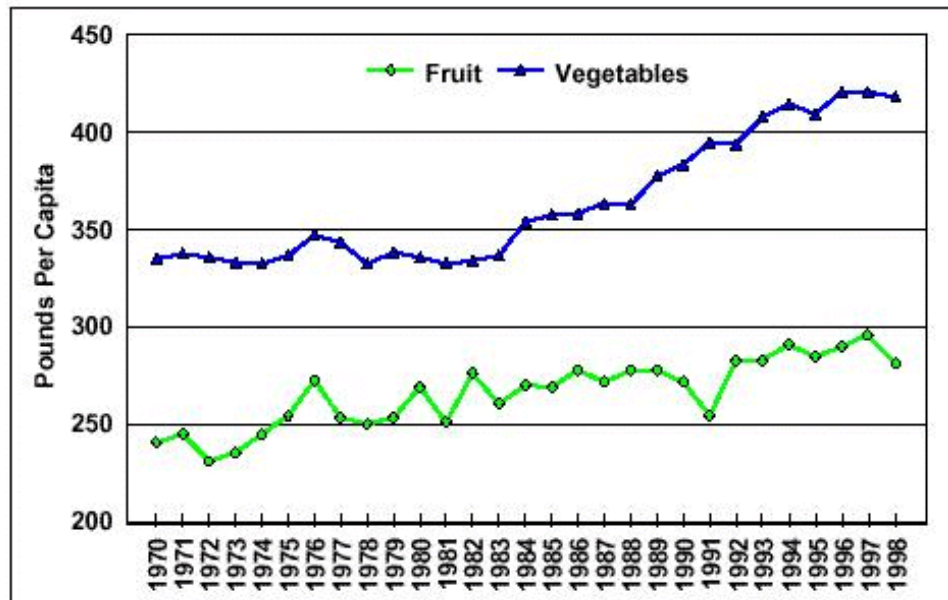
Scott, L. "Many Americans are not Meeting Food Guide Pyramid Dietary Recommendations". *Food Review*. USDA, Economic Research Service, Jan-April 1996 pp. 7-11

U.S. Department of Agriculture, Agricultural Research Service. 2000. Continuing Survey of Food Intakes by Individuals 1994-96, 1998. CD-ROM.

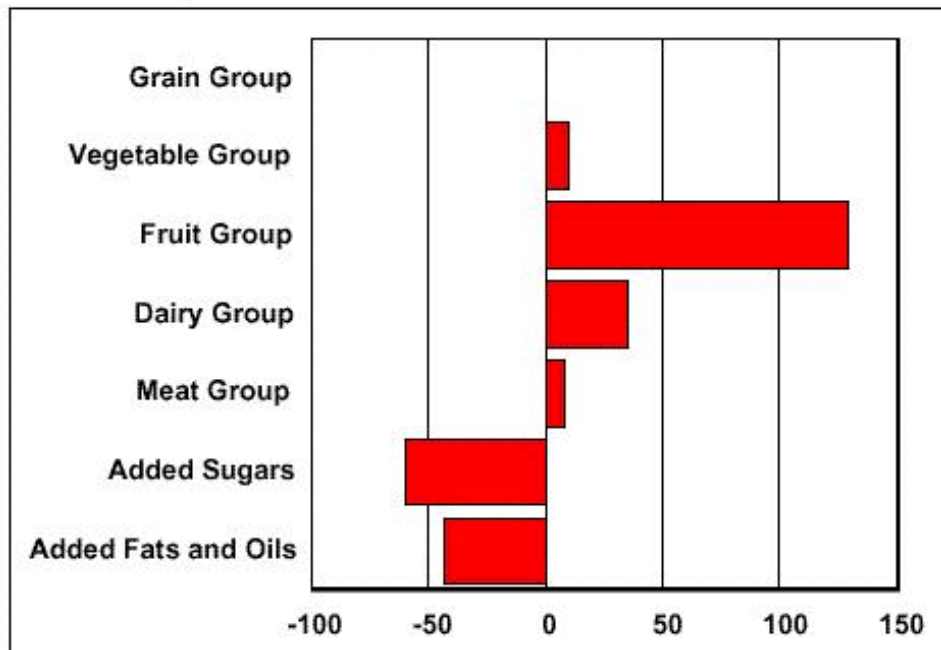
Variyam, J.N., Blaylock, J, Smallwood D., and Basiotis, P.P. USDA's Healthy Eating Index and Nutrition. *Technical Bulletin No. 1866*. USDA, Economic Research Service, Center for Nutrition Policy and Promotion. April, 1998.



**Figure 1. U.S. Fruit and Vegetable Per Capita Consumption - USDA**



**Figure 2. Percent Change in Supply Needed to Meet Food Guide Pyramid Recommendation (based on a 2,000 calorie diet) - USDA/ERS**



**Table 1. Estimated Marginal Effects of Consumer Characteristics on the Probability of Consuming the Recommended Servings of Fruit**

<b>Characteristics</b>	<b>Parameter</b>	<b>S.E.</b>	<b>P ( Z &gt;z)</b>	<b>Mean</b>
Male	-0.028	0.011	0.0124*	0.489
Age 5 - 9	-0.179	0.023	0.000*	0.074
Age 10 - 14	-0.219	0.031	0.000*	0.081
Age 15 - 19	-0.296	0.028	0.000*	0.066
Age 20 - 24	-0.296	0.028	0.000*	0.071
Age 25 - 34	-0.331	0.023	0.000*	0.147
Age 35 - 44	-0.299	0.021	0.000*	0.164
Age 45 - 54	-0.266	0.022	0.000*	0.125
Age 55 - 64	-0.189	0.023	0.000*	0.076
Age 65+	-0.158	0.020	0.000*	0.121
0 - 131% over poverty treshold	-0.519	0.017	0.000*	0.184
131 - 350% over poverty treshold	-0.342	0.012	0.000*	0.409
Urban resident	0.033	0.014	0.0188*	0.768
Mid-West	-0.041	0.016	0.0096*	0.234
South	-0.082	0.015	0.000*	0.349
West	-0.025	0.017	0.132	0.222
Non-hispanic Black	0.004	0.017	0.805	0.127
Non-hispanic Asian	0.066	0.031	0.0296*	0.027
Mexican-American	-0.005	0.026	0.853	0.061
Puerto Rican	0.059	0.056	0.293	0.008
Cuban	0.238	0.111	0.0317*	0.001
Non-hispanic Native American	0.173	0.066	0.0091*	0.005
Non-hispanic Other	0.002	0.058	0.973	0.007
Age 10 - 14 * Male	-0.119	0.045	0.0079*	0.044

Based on the asymptotic t-ratios, one asterisk denotes significance at the five percent level for a two-tailed test