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## **Fruit and Vegetable Consumption of College Students: What is the Role of Food Culture?**

Christiane Schroeter<sup>Ⓐ</sup> and Lisa A. House<sup>ᵇ</sup>

<sup>ᵃ</sup>*Associate Professor, Agribusiness Department, California Polytechnic State University, San Luis Obispo, California, 93407 USA. Phone: 805-756-5045. Email: cschroet@calpoly.edu*

<sup>ᵇ</sup>*Professor, Food and Resource Economics Department, IFAS, PO Box 110240, University of Florida, Gainesville, Florida, 32611, USA. Email: lahouse@ufl.edu*

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### **Abstract**

Our primary objective is to assess the role of culture by linking college students' current consumption of fruits and vegetables with their produce consumption levels while with family. Using a Tobit model, we analyzed data from an online survey with college students. Family consumption of fruits was highly predictive of the individual's consumption of fruits. For each unit increase in the reported consumption of fruits (vegetables) with the family, the respondents' fruit (vegetable) consumption at school increased by 0.65 (0.30) units compared to the base consumption level of 1.95 (1.82) times of fruit intake per day.

**Keywords:** fruit and vegetable consumption, college students, food culture, health knowledge

<sup>Ⓐ</sup>Corresponding author

## Introduction

Food culture encompasses measurable factors that describe taste preferences, food choices and familiarity with foods (Schroeter, Anders, and Carlson 2013). Given that food culture is still a relative new construct, it is rarely considered in agribusiness literature. Often, the only proxy used for culture is ethnicity, which may be underrepresented in survey research. A recent study found that diet quality is strongly interrelated with food culture. Food culture includes factors over which the individual has complete control, such as type of activity performed while eating food or intake of vitamin supplements. Other elements of food culture over which the individual has no control include immigration or citizen status, heritage and ethnicity. The latter are indicators of the types of foods and/or traditional consumption patterns the individual has been exposed to over a long period of time (Schroeter, Anders, and Carlson 2013).

Eating habits formed during childhood have been shown to have a lasting impact on adult food habits (Becker 1992; Dietary Guidelines Advisory Committee 2010; Schroeter, Anders, and Carlson 2013). Previous research suggested that family customs such as meals influence the food culture of adolescents by establishing healthful habits (Gillman et al. 2000, Neumark-Sztainer et al. 2003, Rockett 2007). Thus, the impact of culture on food consumption should not be understated, given that it may provide the opportunity to prevent obesity in adolescents and young adults.

Physical activity, eating habits, socioeconomic status, and living environment define a person's lifestyle. More specifically, these characteristics can mold the eating habits and establish a certain food culture during adolescent years, which ultimately may lead to a strong or a poor diet in adulthood (Daniels 2006).<sup>1</sup>

Recently, increased policy attention has been placed on increasing efforts to change dietary habits. In particular, the World Health Organization, the U.S. Surgeon General, and the 2010 Dietary Guidelines for Americans (DGAs) associated the consumption of fruits and vegetables with the prevention of overweight, high blood pressure, heart disease, diabetes, and stroke (USDHHS-NCHS 2000; World Health Organization 2003; Centers for Disease Control and Prevention (CDC) 2007a). One of the national initiatives to increase the consumption of fruits and vegetables is the Half-Your-Plate Concept by the Fruits & Veggies- More Matters Initiative, which recommends that Americans make half their plate fruits and vegetables for meals and snacks (Fruits & Veggies More Matters 2014).

In 1995, the National College Health Risk Behavior Survey (NCHRBS) determined that 74% of U.S. college students ate less than five servings of fruits and vegetables daily and 22% consumed three or more high-fat foods per day (CDC 1997). About a decade later, Sparling (2007) found that produce consumption has further declined and 9 of 10 college students consumed fewer than five servings of fruits and vegetables per day. Recent data from the National College Health Assessment (NCHA) showed that 94.4% of its respondents consumed less than the recommended 5 or more servings of fruit and vegetables per day (American College Health

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<sup>1</sup> Whether an individual is overweight or obese is determined by the Body Mass Index (BMI), which is determined by the formula: weight (in kilograms)/height<sup>2</sup> (in meters). Among adults, overweight is classified by a BMI between 25.0 and 29.9, while a BMI greater than or equal to 30.0 defines obesity (CDC 2006).

Association (ACHA) 2013). These declining trends in produce consumption patterns are commonly attributed to a changing food culture, such as rising demand for convenience foods and declining food preparation skills (e.g. Mancino et al. 2009, Stewart and Blisard 2008).

In order to address the missing link between food culture, fruit and vegetable consumption, and young adult obesity, a deeper investigation is needed. Our primary objective is to assess the role of culture by linking college students' current consumption of fruits and vegetables with their produce consumption levels while with family. Providing a deeper understanding of the relationship between food culture and food consumption directly benefits policymakers and industry with information about the role that at-home consumption may play in forming young adult food choices.

## Background

Previous research (e.g. CDC 2007a) has given us insight into what variables are expected to be related to fruit and vegetable consumption. Demographics may impact the consumption of fruits and vegetables, such as age and gender. A study by the Centers for Disease Control and Prevention (CDC) determined that adults between 18 to 24 years ate the fewest vegetables, with almost 80% reporting they regularly do not consume any vegetables (CDC 2007a). In addition, research has shown differences in consumption of fruits and vegetables by gender, with consumption typically lower among men in comparison to women (CDC 2007a). Economic variables, such as individual income may influence the intake of fruits and vegetables, as high income could indicate a better access to nutrition information compared to lower income households (Drenowski 2003). In general, placing a higher value on labor market time leads to decrease in the time spent in the household, and thus, less time can be devoted to preparing meals. Working college students might buy more take-out foods or use ready-to-prepare entrees (Capps, Tedford, and Havlicek 1985, Chou, Grossman, and Saffer 2004).

In order to include variables that represent food culture, we researched the origins of this term in cultural anthropology, which is rooted in identifying cultural variations among humans. Douglas (1997) noted that food acts as a code, where the culture of food consumption is encoded in messages found in the patterns of social relationships. Behaviors such as work, sports, leisure, and celebration, are expressed through food consumption. However, while cultural anthropologists have been the pioneer in the definition and measurement of food culture, they have not used it to predict behavior, such as food consumption.

Counihan (1992) studied food rules among U.S. college students. He found that food culture focuses on the students' emotional associations. Though certain foods were related to specific meanings (i.e. turkey and Thanksgiving), the overall interest in food came from the students' relationship to it, rather than from the food's intrinsic qualities, such as the nutritional content of it. Eating was seen as a way to express power, with individuals feeling some sense of control from selecting their own diet. Many students were only vaguely aware about healthy eating and they had trouble being explicit about specific nutritional recommendations. They simply categorized fruits and vegetables as foods that were "good for you." Thus, there is a need to assess dietary and health knowledge when investigating students' fruit and vegetable intake.

Another variable that relates to food culture relates to the intake of vitamin supplements. Consumers have more favorable attitudes towards nutritional supplements as a perceived alternative healthy way to improve diet quality (Pole 2007). Many physicians advise the intake of multivitamin supplements because their patients might have difficulties consuming a balanced diet including a variety of fruits and vegetables (Wang 2011, Dooren 2011). Consumers may choose to take nutritional supplements to *complement* and improve their diet with specific micronutrients. As such, vitamins might serve as a disease-preventative input. The U.S. Council for Responsible Nutrition suggests that up to \$8.4 billion annually could be saved if people consumed at least 100 International Units (IU) of vitamin E on a regular long-term basis to reduce the risk of heart disease (Bendich et al. 1997, Dickinson 2002). Other consumers may choose to consume vitamin supplements to *substitute* for the lack of consuming vitamins from fruits and vegetables. However, there might be insufficient evidence that the same protective effect of fruit and vitamins could be derived from dietary supplements (USDA/USHHS 2010; Schroeter, Anders, and Carlson 2013).

## Model

We use a Tobit regression (Tobin 1958) to model food consumption because it is expected that not all students will report consuming fruits and vegetables. Censoring and truncation of the dependent variable (i.e. consumption of fruits or vegetables) is common in survey data and food consumption studies. For example, previous research on fruits and vegetable consumption found significant numbers of individuals with zero consumption (e.g. Crowley 2007, Newman 2013, Meng et al. 2014). The Tobit model accommodates dependent variables with only non-negative values (Woolridge 2006).

The Tobit model can be expressed by:

- (1)  $y_i^* = \beta' x_i + \epsilon_i$ ,  $\epsilon_i \sim N(0, \sigma^2)$
- (2)  $y_i = 0$  if  $y_i^* \leq 0$ ,
- (3)  $y_i = y_i^*$  if  $y_i^* > 0$

where  $y_i^*$  is the latent variable;  $y_i$  is the dependent variable;  $x_i$  is a vector of determinants;  $\beta$  is a vector of parameters to be estimated; and  $\epsilon$  is the error term followed using a normal distribution with zero mean and variance of  $\sigma^2$ . The model implies that  $y_i$  will only be positive given a value of  $y_i^*$  greater than zero.

In this study, two models are estimated. The first dependent variable is the frequency of consuming fruits and fruit juices per day. In the second model, the dependent variable is the frequency of consuming green salad, potatoes (not fried), carrots, and other vegetables per day. While controlling for demographics, and lifestyle characteristics, the relationship between fruit and vegetable consumption, food culture, and dietary and health knowledge, is considered.

## Data and Methods

Data for this study were collected at a large (>15,000 students) public university -California Polytechnic State University, San Luis Obispo (Cal Poly), via an online survey of undergraduate

and graduate students. Once granted Institutional Review Board (IRB) approval, the electronic survey was transmitted via e-mail to multiple academic departments at Cal Poly in order to gather a wide array of responses from students in various disciplines. E-mails were distributed using departmental aliases to collect a random, non-discriminated sample of Cal Poly students. The e-mail contained a link to the online survey, which was hosted at a non-University website to reduce bias from respondents. About 2,000 students received this email via class listservs given their enrollment in various classes in the College of Agriculture, Food, and Environmental Sciences (CAFES). A total of 223 students responded and completed the survey, for an overall response rate of approximately 11%.

In the survey, data were collected on five basic categories: 1) frequency of fruit and vegetable consumption; 2) demographics; 3) food culture; 4) dietary and health knowledge; and 5) lifestyle variables. Descriptive statistics of variables are shown in Table 1 (please see Appendix).

### *Frequency of Fruit and Vegetable Consumption*

Respondents were asked to indicate how frequently they consumed various fruits and vegetables within a time frame of their choosing (question shown in Figure 1). We calculated daily fruit and vegetable consumption by multiplying the student's reported consumption frequency by 365, 52, 12, or 1 for daily, weekly, monthly or less than monthly, respectively. As ChooseMyPlate.gov states, 1 cup of fruit or 100% fruit juice can be considered as 1 cup from the fruit group (USDA 2015); thus, we aggregated the fruit and fruit juice consumption into one variable. As respondents were asked to identify consumption of multiple types of fruits (fruit and fruit juice) and vegetables (green salad, potatoes (not fried), carrots, and other vegetables), we then summed the calculated daily consumption amounts for each food that belonged in the category. On average, respondents consumed fruits and 100% fruit juices 1.88 times per day and vegetables 2.03 times per day. The average frequency of fruit and vegetable consumption was 3.91 times per day, with 76.6% of the respondents consuming fruit and vegetables less than 5 times per day. These findings correspond to previous research. Schroeter, House, and Lorence (2007) found college students consumed fruit and fruit juice 1.64 times per day. Walker, Wolf, and Schroeter (2009) found California college students indicated an intake of 4.4 produce servings (both fruit and vegetable) per day. Finally, the analysis of the NCHRS data determined 74% of U.S. college students eat less than the recommended five servings of fruits and vegetables (CDC 1997).

### *Demographics*

Given the focus on college students, our sample contained a majority (58.9%) of respondents in the 18-21 year age range. Our sample was representative of the overall Cal Poly student body with respect to the age distribution, which is 20.2 years (Cal Poly News 2014). This represented a younger sample compared to Schroeter, House, and Lorence (2007), where 45.6% of the respondents were part of the 18-21 year age range and the ACHA (2013), which showed a mean age of 21.4 years. Our sample contained 44.8% male respondents.

The BMI of the individual respondent was calculated by asking respondents to identify their height and weight. On average, the respondents were slightly overweight, with an average BMI of 23.4. The average BMI for males (females) was 24.5 (22.6). In our sample, 35% (10%) of males (females) were overweight, while 6% (3%) of males (females) were obese. Our findings

are similar to another U.S. college-level health study (Lynn 2012), which took place at the University of Nebraska during about the same time period. In Lynn’s (2012) study, the average BMI for male college students (females) was 24.96 (23.1) and the total average BMI 23.1. About 35% (15%) of the males (females) were overweight, with 6% (5%) being obese. Thus, while the BMIs of male college students in California and the Midwest were identical, female Californian college students were on average of healthier weight, given the lower rates of overweight and obesity at Cal Poly compared to the University of Nebraska. The NCHA showed an average BMI of 24.33, with lower rates of overweight among male students (27.4%) and a higher percentage of overweight female students (18.7%) compared to our sample (ACHA 2013).

In the case of college students, income is difficult to judge as it could be the student or the parent (or some combination thereof) providing funds for food. To assess the impact, we collected data on two variables. The first was self-reported individual income (on a monthly basis). Over half (54.0%) indicated they have incomes of less than \$500 per month, while 19% indicated incomes of equal to or over \$1,000 per month. In addition to monthly income, respondents were asked if they work while attending school. In our study, about 56% of all respondents state they work while attending school.

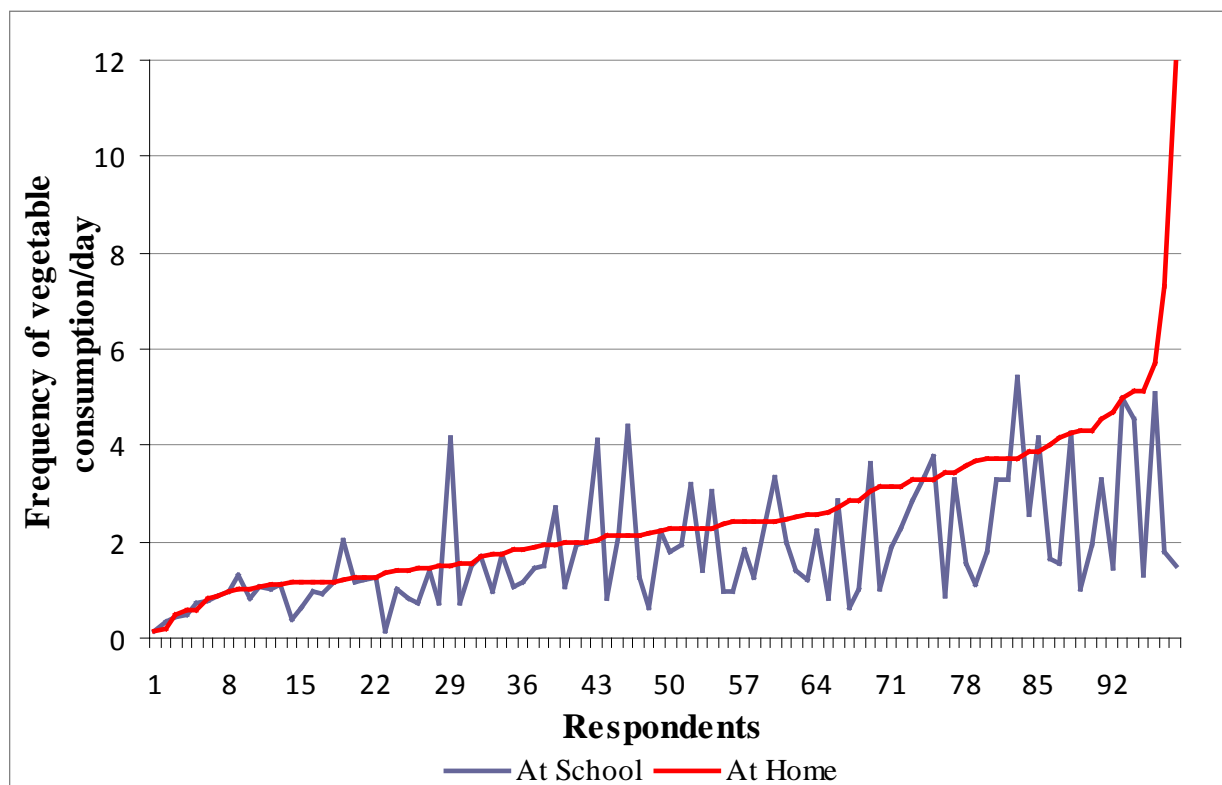
Please answer the following questions based on your behavior while you are <i>living at school</i> :					
Please indicate how frequently you regularly consume these products:	Daily	Weekly	Monthly	Less Frequent or Never	Based on the frequency you just answered, how many times per day, week, or month do you typically consume these products?
Fruit juices such as orange, grapefruit, or tomato					
Fruit (not counting juice)					
Green salad					
Potatoes (not including French fries, fried potatoes, or potato chips)					
Carrots					
Raw or cooked vegetables (not counting potatoes, carrots, green salad)					
French fries or potato chips					

**Figure 1.** Survey Question to Collect Frequency of Consumption Data

**Note.** \* A second question was asked with the same format, but substituting “living at home with your family” for “living at school”

### Food Culture

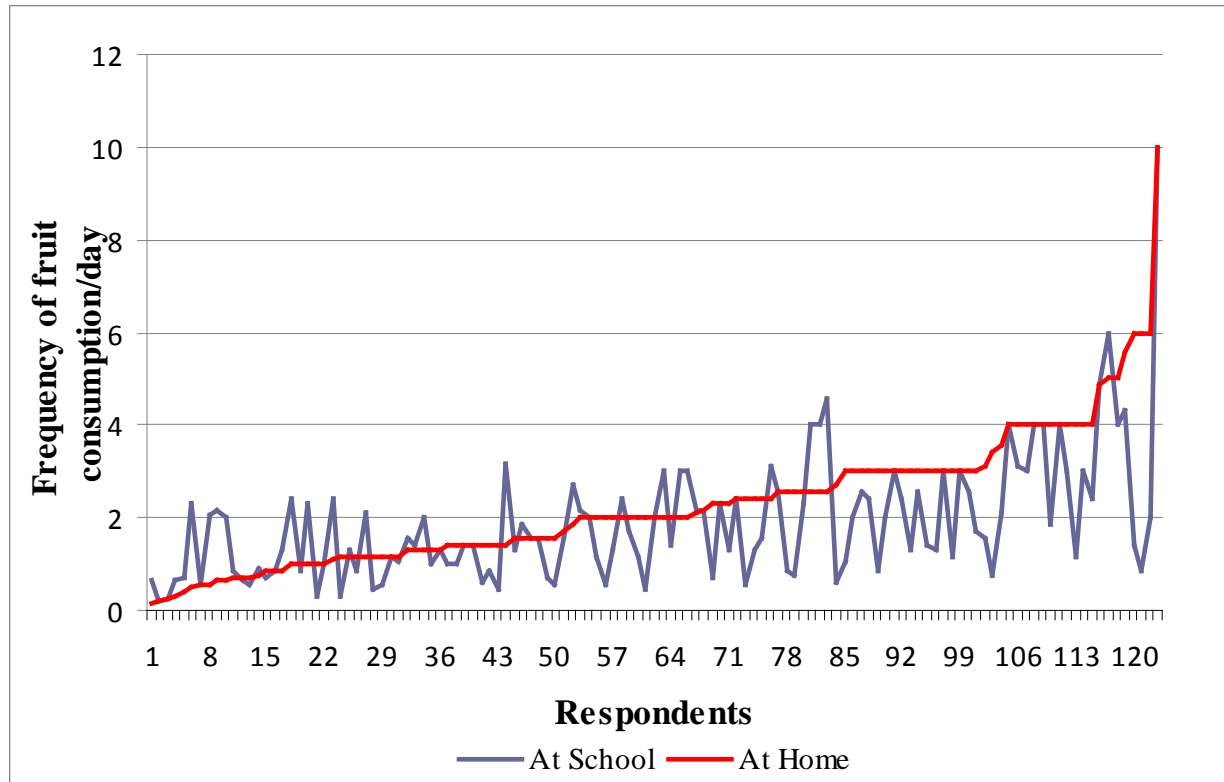
Food consumption has a strong cultural element, as it is not just influenced by food availability, but also by the traditions that extend across large numbers of people. Thus, we aimed at capturing taste preferences, food choices and familiarity with fruits and vegetables in our survey. Using a method similar to Gittelsohn et al. (2000), we measured food culture by having respondents identify an ideal set of goods, in this case, by identifying the expected behavior of food consumption in their family home. This represented their knowledge of the set of cultural foods typically eaten by their family. In this case, students were asked to identify the typical consumption of fruits and vegetables in the family home. It was expected that a higher frequency in the consumption of a certain food product with the family may lead to a higher frequency of the food product's consumption by the individual college student.



**Figure 2.** Individual Daily Frequency of Vegetable Consumption at School and with Family

**Note.** \* When the at-school line is above the at-home line, this implies the respondent indicated they ate more vegetables at school than at home.

A comparison of respondents' fruit and vegetable consumption at school and at home is shown in Figures 2 and 3. From observation of these graphs, it can be seen that some students reported consuming more fruits or vegetables at school than at home, while the majority of levels of reported consumption at school fell below the line of consumption at home, particularly for vegetables. Reported frequency consumption of fruits at home averaged 2.27 times per day (0.39 times per day more than at school) and vegetables at home averaged 2.46 times per day (0.43 times per day more than at school).



**Figure 3.** Individual Daily Frequency of Fruit Consumption at School and with Family

**Note.** \* When the at-school line is above the at-home line, this implies the respondent indicated they ate more fruits at school than at home.

In addition to including food culture as measured by the family's food consumption pattern, previous studies showed that ethnic origin determines food culture. In our study, the majority of respondents described themselves as non-Hispanic Caucasian (85.9%), followed by Hispanic or Latino (5.5%). In general, Cal Poly's College of Agriculture, Food, and Environmental Sciences has a smaller percentage of Hispanics compared to the average representation at rest of the University (14%) (CSU Mentor 2014). In order to assure the representativeness of our study, we compared our data to another large-scale data collection with a different sample at the same university and the averages for the ethnicity variables were comparable between the two studies (Schroeter and Wolf 2012). In our current sample, we found that Hispanics consumed fruits 2.29 times per day and vegetables 1.98 times per day at school. Non-Hispanic Caucasians reported consuming fruits 1.92 times per day and vegetables at a frequency of 2.07 per day. For family consumption, the results are different, with Hispanics reporting a consumption frequency of 1.99 per day of fruit and only 1.00 times per day of vegetables while non-Hispanic Caucasians report family consumption of 2.36 and 2.61 times per day for fruits and vegetables, respectively. If each intake would amount to about one serving size, this amount would come close to the recommended daily allowance of at least five servings per day.

Another measure of food culture is related to rituals (Barthes 1997). One way to measure rituals involved in food culture is to consider the locations of meal consumption or activity during consumption. The variables meal activity and home meal activity measure whether the meal is typically eaten while sitting at a table without the TV on (see Table 1) at college and in the



family home, respectively. At school, 22% of respondents indicated they eat meals sitting at a table without the television on, while 50% watch TV while eating. At home, 95% of the respondents typically ate at least one meal together as a family. Of all respondents, 69% indicated they ate more than one meal together. For those that ate meals together as a family at home, 76% indicated they eat the meal at a table without television, while 21% indicated they watched television during the meal.

Food culture also encompasses the intake of vitamin supplements. In our sample, 71% of respondents indicated they take vitamins at least sometimes, with 34% indicating they take them regularly. Vitamin-supplement takers (either regularly or irregularly), consumed vegetables 0.25 times less frequently per day than those who did not report being on vitamins. Though this result may at first seem counterintuitive, it may be the result of students either acting on the knowledge they are not consuming enough healthy foods and supplementing with vitamins; or, they may see vitamins as substitutes for eating fruits and vegetables. Thus, if supplements do replace a healthy diet in the student population, an additional intervention might be needed to encourage the intake of nutrients from food instead of supplements (Schroeter, Anders, and Carlson 2013).

### *Dietary and Health Knowledge*

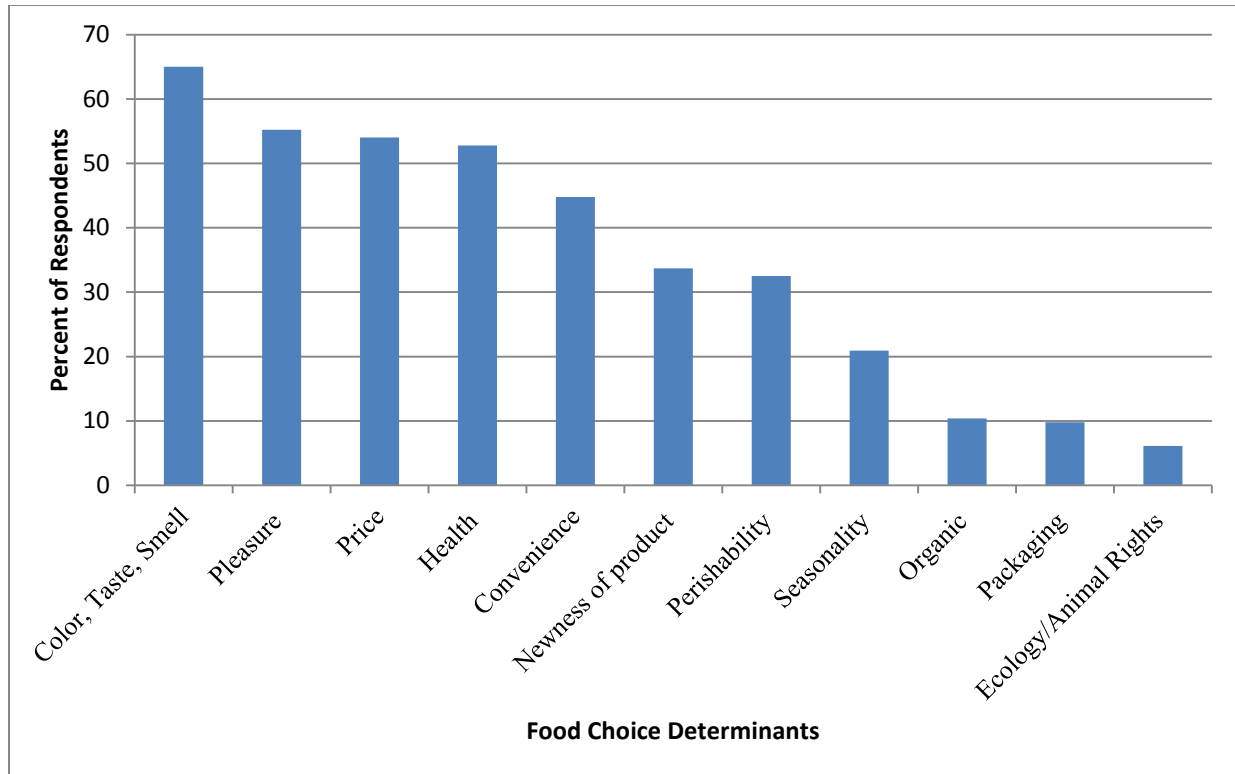
We assessed the student's dietary and health knowledge by asking the respondents to self-rate their knowledge about nutrition and health. The majority of respondents rate their own nutrition (health) knowledge as 'above average.'

### *Lifestyle Variables*

Several lifestyle variables such as physical activity, physical health, the amount of time spent watching TV, self-rating of the nutritional quality of their diet, and importance of various factors on food choice were included in the survey. Given that exercising goes along with a healthier lifestyle, respondents that engage in physical activity regularly may consume healthier food choices such as fruits and vegetables. To judge this relationship, students were asked to rate their level of physical activity. Nearly half (44.4%) of the respondents rated their physical activity level as high, with nearly one-quarter (22.7%) rating their activity level low. While rating the nutritional quality of their diet, nearly half of the students rated their diet quality as high (47.8%) while 15% rated it low. Related, respondents were asked to identify their current physical health. In this case, over half (57.7%) rated their health as high, while 11% rated their health low. Respondents reported watching an average of two hours of television per day.

Finally, empirical evidence from consumer marketing studies suggests that food purchases are mainly influenced by taste, cost, and convenience, with health assuming a subsidiary role (Drenowski and Levine 2003). In our study, respondents rated the importance of taste, price, convenience, health, ecology/animal rights, pleasure, packaging, newness, organic, seasonality, and perishability in their food choice. These results are shown in Figure 4.

Taste, pleasure, price and health were most frequently cited to be important. Convenience is another important decision factor for the food purchasing decision, which is consistent with previous research that showed that the individual cost of nutritional and leisure time choices have increased over the past two decades (e.g. Chou, Grossman, and Saffer 2004). Moreover, a loss of proper cooking skills increases the need to eat convenience food or food away from home (Hall 1992).



**Figure 4.** Ranking of Importance of Food Choice Determinants as Important

**Note.** \* Respondents rated attribute on a 5 point scale from not at all important to extremely important. Percent shown in graph answered attribute was a 3 (important), 4 (very important) or 5 (extremely important).

### Methods

Two Tobit regression models are estimated for this study (Equation 1). The dependent variables are fruits (the sum of fruit and fruit juice consumption) and vegetables (the sum of green salad, potato, carrot, and other vegetable consumption), as defined earlier.

$$(4) \text{ Frequency of fruit (vegetable) consumption} = f(\text{demographics, food culture, dietary and health knowledge, lifestyle})$$

where demographics include age, gender, BMI, whether the student has a job while in school, income, and whether they live in a city or rural area; food culture includes family fruit and vegetable consumption, race, ethnicity, whether television is watched while eating at school and home, if they take vitamins and if they are a vegetarian; dietary and health knowledge is represented by two self-rated variables; and lifestyle includes self-ratings of physical health, activity levels, and quality of the diet, time spent exercising, number of hours spent watching television, the importance of convenience, ecology/animal rights, price, color/taste/smell, and organic production in food choices.

## Results

Results from the analysis are presented in Table 2. Marginal effects are calculated and shown in Table 3.

**Table 2.** Results from the Regression Analysis of Fruit and Vegetable Consumption by College-Aged Students

	Fruits		Vegetables	
	Coefficient	p-value.	Coefficient	p-value
<i>Demographics</i>				
Age	-0.32	0.125	-0.42*	0.074
Male	0.15	0.448	-0.38*	0.071
BMI	0.01	0.601	0.01	0.668
Work	0.05	0.827	-0.46**	0.048
Low Income	0.53**	0.028	0.19	0.465
Medium Income	0.16	0.573	-0.17	0.565
City	0.15	0.486	0.02	0.932
<i>Food Culture</i>				
Family Fruit and Fruit Juice	0.65**	0.000	-0.11	0.151
Family Vegetables	-0.20**	0.003	0.30**	0.000
Caucasian	0.60	0.108	1.73**	0.000
Hispanic/Latino	0.78	0.126	1.14*	0.072
Meal Activity	-0.09	0.711	0.23	0.357
Home Meal Activity	-0.20	0.335	-0.14	0.539
Vegetarian	0.87*	0.061	1.54*	0.005
Vitamins	-0.03	0.803	-0.25*	0.058
<i>Dietary and Health Knowledge</i>				
High Nutrition Knowledge	0.25	0.319	0.54	0.124
High Health Knowledge	-0.08	0.351	-0.26	0.492
<i>Lifestyle</i>				
Low Overall Physical Health	-0.11	0.774	0.26	0.564
High Overall Physical Health	0.02	0.925	0.01	0.972
Low Level of Physical Activity	-0.53*	0.092	-0.33	0.317
High Level of Physical Activity	-0.05	0.852	0.40	0.180
Time Exercise	-0.23	0.453	-0.12	0.712
TV	-0.02	0.818	-0.17**	0.039
Importance of Convenience	-0.19	0.357	-0.37	0.118
Importance of Ecology/Animal Rights	0.25	0.561	-0.82	0.143
Importance of Health	0.35	0.117	0.73**	0.002
Importance of Price	-0.06	0.756	0.32	0.140
Importance of Color, Taste, Smell	0.28		0.49**	0.030
Importance of Organic	-0.67**	0.032	-0.47	0.269
Low Nutritional Quality	-0.18	0.553	-0.67**	0.048
High Nutritional Quality	0.00	0.818	-0.18	0.512
Log-Likelihood	-125.73		-109.81	

### *Demographics*

Demographics impacted the frequency of vegetable consumption more than fruit consumption. Respondents aged 21 and under were significantly likely to eat vegetables less frequently (-0.42 times per day), as were males (-0.38 times per day). Respondents who indicated they worked while attending school were significantly less likely to eat vegetables. This finding may relate to the time it takes to prepare vegetables; even though the importance of convenience of food was not significantly related to vegetable consumption. For fruits, those with reported lower incomes actually consumed a significantly higher frequency of fruits per day (+0.53 times per day).

### *Food Culture*

Family consumption of fruits was highly predictive of the individual's consumption of fruits. For each unit increase in the reported consumption of fruits with the family, the respondents' fruit consumption at school increased significantly (+0.65 units) compared to the base consumption level of 1.95 times of fruit intake per day (Table 3). The same is true for the vegetable model, with a significant increase in family vegetable consumption of one more time per day leading to an increase (+0.30 times per day) in consumption of vegetables at school compared to the base consumption level (1.82 times per day).

Race and ethnicity were significantly related to the frequency of vegetable consumption, but not to the fruit consumption frequency. Non-Hispanic Caucasians were likely to consume vegetables more frequently (+1.73 times per day) compared to non-Caucasians. Hispanic/Latino respondents were likely to consume vegetables more often (+1.14 times per day) than non-Hispanics.

Whether the television was on and the respondent sat at the table during dinner (both at school and at home) were not related to either fruit or vegetable consumption frequency. Though whether a person ate meals at a table with the television off was surprisingly not significant, we captured the expected effect through the variable "hours spent watching television." With each increase in hours spent watching TV, respondents would decrease the frequency of their vegetable consumption (-0.16 times per day) (Table 3).

Those who reported to be Vegetarian were significantly more likely to eat fruits and vegetables more often; with an increased fruit consumption (+0.87 times per day), and a higher vegetable intake (+1.54 times per day). We found that a student who reported to be Vegetarian would consume fruits and vegetables 6.15 times per day, which was a 53% increase compared to non-Vegetarians. Respondents who reported taking vitamin supplements were significantly would consume fewer vegetables (-0.25 times per day), but there was no relationship between supplement takers and fruit consumption.

### *Dietary and Health Knowledge*

Self-rated health and nutrition knowledge were not significantly related to fruit or vegetable consumption frequency. Table 2 shows that neither of the variables, high nutrition knowledge and high health knowledge, had any influence on fruit and vegetable intake.

### Lifestyle

As shown in Table 2, many lifestyle variables had a significant impact on fruit and vegetable consumption, but interestingly, none of the variables impacted the frequency of both fruit and vegetable consumption. Fruit consumption frequency was significantly lower for respondents who indicated a relatively low level of physical activity. This would be expected, as they may not be dedicated to a “healthy” lifestyle. Self-rated health and nutrition knowledge had no impact on respondent’s frequency of consuming fruits and vegetables (see Table 2). Respondents who self-reported to have a diet with low nutritional quality ate vegetables less frequently (-0.67 times per day), indicating the students are aware their behavior may have impacts.

Table 3 shows that respondents who indicated health and flavor were very important in their purchasing decision did consume vegetables more often, with health having a stronger impact (+0.72 times per day) compared to flavor (+ 0.49 times per day). Students who rated “organic” as being an important attribute in their purchasing decision, showed a lower frequency of fruit consumption.

**Table 3.** Marginal Effects for Significant Variables

	<b>Fruits</b>	<b>Vegetables</b>
	Marginal Effect	Marginal Effect
<i>Demographics</i>		
Age		-0.413
Male		-0.379
Work		-0.457
Low Income	0.527	
<i>Lifestyle</i>		
Low Level of Physical Activity	-0.527	
TV		-0.164
Importance of Health		0.723
Importance of Color, Taste, Smell		0.488
Importance of Organic	-0.660	
Low Nutritional Quality		-0.661
<i>Food Culture</i>		
Family Fruit and Fruit Juice	0.646	
Family Vegetables	-0.201	0.298
Caucasian		1.708
Hispanic/Latino		1.129
Vegetarian	0.861	1.521
Vitamins		-0.245

## Discussion and Conclusions

Our study assessed food culture by examining family food consumption and individual student behavior. In anthropology, a field where culture is the focus of the study, family behavior is likened to an ideal set of goods. Aggregating this ideal set across people allows patterns to emerge that would be considered culture, or similarities among different groups of people. Additionally, family behavior impacts food choice, as well as food consumption behavior. Thus, one key component of our survey measured the frequency of fruit and vegetable consumption at the family and individual college student level.

Our results suggest that family consumption of fruits is highly predictive of the individual college-student's consumption of fruits. For each unit increase in the reported consumption of fruits with the family, the respondents' fruit consumption at school increased. This finding is consistent with previous research, which determined that with a higher frequency of family dinners, the intake of fruits and vegetables increased among adolescents/young adults (Gillman et al. 2000, Neumark-Sztainer et al. 2003, Schroeter, House, and Lorence 2007). Gillman et al. (2000) found that children ate nearly one full additional serving of fruit and vegetables when they had daily dinners with their families.

An important result is to note the combined effect of family vegetable consumption. We found that family consumption of vegetables significantly decreased the consumption of fruits. Our findings suggest that if the family culture emphasizes the consumption of vegetables, such as salad, it might not stress fruit consumption jointly with it. We find that for each increase in the frequency of vegetable consumption per day with the family, the individual's consumption of fruits at school decreases. As such, a student at school consumes fruits and vegetables about four times per day at the base consumption level. The more vegetables students would consume in the family home, the higher would their individual vegetable consumption increase (+0.30 times), while fruit consumption would decrease (-0.20 times). Thus, the combined effect of fruit and vegetable consumption was only slightly above (+0.1 times per day) the base level.

Our demographic variables showed interesting findings. We found that college students with reported lower incomes consumed a higher frequency of fruits per day. This is not the expected relationship, as fruits are often perceived as more expensive. One possibility is that students reporting lower incomes are on meal plans, and have increased access to fruits through schools. A second possibility is related to the limitations of using an income variable for students, as they may not consider parental financial support that increases their spending money. With regard to lifestyle, college students who stated organic food was an important factor in their choice of fruits and vegetables also showed lower frequency of fruit consumption. This is somewhat unexpected as fruits and vegetables represent 39.7% of 2010's total organic food value and 11.8% of all U.S. produce sales (Organic Trade Association (OTA) 2011). The results suggest that given a preference for organic fruits/fruit juices, students might rather buy a smaller quantity at a higher price, which is likely associated with organic fruits. Thus, they might just purchase less, because they may prefer high-priced organics compared to conventional fruits, yet, they are constrained by a certain budget constraint. Our result could also be an indication that organic fruits are not easily accessible on college campuses and suggest further investigations into the food environment on campus.

Variables used to represent food culture included ethnicity, race, and activity during meals, and taking vitamins. With regard to ethnicity, we found that Hispanics consumed lower amounts of fruits and vegetables compared to Caucasians. A study by the CDC (2007a) indicates that Hispanics had the highest fruit and lowest vegetable intake, and Caucasians had the lowest (CDC 2007b). Other research determined that even though immigrants are in better health upon arrival to the U.S. compared to their U.S.-born counterparts, this health advantage erodes over time (Antecol and Bedard 2006), which is confirmed by our study.

Regarding the meal activity, our analysis determined that college students decreased the frequency of their vegetable consumption with each increase in hours spent watching TV, which is consistent with previous studies (Boynnton-Jarrett et al. 2003). It is alarming that television shows targeted at adolescents and young adults feature mostly commercials for high-calorie and high-sugar foods (Strauss and Knight 1999). There is need for more research that assesses the impact of TV-viewing on food choice behavior.

Given the lack of relationship between self-reported knowledge and fruit and vegetable consumption, our findings suggest that future research may need to consider assessing objective knowledge when measuring dietary and health knowledge. While our online data collection was associated with minimal cost, self-reported variables such as weight and diet habits are typically more reliable in intervention studies that collect this data directly. However, all typical food diary studies, such as the national representative Behavioral Risk Factor Surveillance System (BRFSS) collected by the CDC, rely on the 24-hour recall method – “what foods have you eaten in the last 24 hours” – because of the inability of people to accurately recall what they ate over a longer period of time (CDC-BRFSS 2005). Intervention studies that observe eating behaviors are more accurate, but also form a more costly method of data collection.

If attempting to influence fruit and vegetable consumption, we suggest that the emphasis should be placed on food culture and lifestyle. This suggestion is reinforced by the finding that self-rated nutrition and health knowledge were not related. Traditionally, nutrition policies have focused on consumer education. This approach may be a less effective intervention versus focusing on the importance of family traditions, which could have a greater impact than increasing information on the number of servings of fruits and vegetables people should consume. Understanding drivers of college students' food choices are important, not only to potentially improving students' health through increased fruit and vegetable consumption, but those increases in demand would be beneficial for agribusiness companies. To meet the DGA recommendations, Americans on a 2,000-calorie diet would need to significantly increase daily fruit and vegetable consumption (Buzby, Wells, and Vocke 2006). These increases would not only improve the nation's health, but also provide opportunities for U.S. fruit and vegetable growers. Previous studies have shown that if Americans changed their current fruit consumption patterns to meet the DGAs, U.S. production of fruit and vegetable production would need to rise. Substantial increases in U.S. fruit and vegetable production would also increase demand for farm labor, land, and transportation, which would increase labor and land costs. In some cases, the higher costs would likely be passed on to the consumer in form of higher fruit and vegetable prices. Furthermore, imports and exports would be affected; particularly the largest markets for U.S. vegetable exports, Mexico and Canada (Buzby, Wells, and Vocke 2006). Overall, firms along the supply chain in fruit and vegetable production would benefit from these increases in consumption (Jetter, Chalfant, and Sumner 2004).

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## Appendix

**Table 1.** Definitions, Means and Standard Deviations of Variables used in the Regression

Variable	Definition	Mean (Std. Dev.) or Percent
<i>Fruit and Vegetable Consumption</i>		
Fruits	Frequency of consuming fruits /100% fruit juices per day	1.88 (1.34)
Vegetables	Frequency of consuming green salad, potatoes (not fried), carrots, and other vegetables per day	2.03 (1.50)
<i>Demographics</i>		
Age	Percent of respondents between 18 and 21 yrs	58.9%
Male	Male percent of respondents	44.8%
Body Mass Index (BMI)	Weight (kg)/ (Height (m)) <sup>2</sup>	23.4 (3.43)
Work	Percent of respondents working while attending school	55.8%
Low Income	Percent of respondents with individual income of less than \$499 per month	54.0%
Medium Income	Percent of respondents with individual income of \$500-\$999 per month	25.2%
High income	Percent of respondents with individual income of ≥\$1,000 per month	19.0%
<i>Food Culture</i>		
Family Fruit and Fruit Juice	Frequency of fruit and fruit juice intake in family home per day	2.27 (1.44)
Family Vegetables	Frequency of consumption of green salad, potatoes (not fried), carrots, and other vegetables in family home per day	2.46 (1.54)
Caucasian, non-Hispanic	Percent of respondents who identify as Caucasian, non-Hispanic	85.9%
Hispanic/Latino	Percent of respondents who identify as Hispanic	5.5%
Other race/ethnicity	Percent of respondents who identify as Black, non-Hispanic, Asian or Pacific Islander, or other	8.6%
Meal Activity	Percent of respondents who typically consume meals while sitting at a table without TV while living at school	22.1%
Home Meal Activity	Percent of respondents who typically consume meals while sitting at a table without TV while living at home	72.4%
Vegetarian	Percent of respondents who are vegetarian	4.5%
Vitamins Daily	Percent of respondents who took vitamins daily	34.4%
Vitamins	Percent of respondents who took vitamins occasionally	36.8%
No Vitamins	Percent of respondents who did not take vitamins	28.8%
City	Percent of respondents who raised in an area with more than 50,000 people	44.8%

**Table 1- Continued**

<b>Variable</b>	<b>Definition</b>	<b>Mean (Std. Dev.) or Percent</b>
<i>Dietary and Health Knowledge</i>		
Low Nutrition Knowledge	Self - rating of nutrition knowledge is poor, fair, or average	42.3%
High Nutrition Knowledge	Self - rating of nutrition knowledge is above average or excellent	57.9%
Low Health Knowledge	Self - rating of health knowledge is poor, fair, or average	30.7%
High Health Knowledge	Self - rating of health knowledge is above average or excellent	69.3%
<i>Lifestyle</i>		
Low Overall Physical Health	Self-rating of overall physical health is poor or fair	11.0%
Medium Overall Physical Health	Self-rating of overall physical health is average	31.2%
High Overall Physical Health	Self-rating of overall physical health is above average or excellent	57.7%
Low Level of Physical Activity	Self-rating of physical activity is poor or fair	22.7%
Medium Level of Physical Activity	Self-rating of physical activity is average	33.1%
High Level of Physical Activity	Self-rating of physical activity is above average or excellent	44.2%
Exercise Lifestyle	Percent who indicate exercise is a part of their lifestyle	76.7%
TV	Number of hours the respondent watches TV per day	1.96 (1.76)
Importance of Convenience	Rated importance of convenience on food choice as important or higher	44.8%
Importance of Ecology/Animal Rights	Rated importance of ecology/ animal rights on food choice as important or higher	6.1%
Importance of Health	Rated importance of health on food choice as important or higher	52.8%
Importance of Price	Rated importance of price on food choice as important or higher	54.0%
Importance of Color, Taste, Smell	Rated importance of color/taste/smell on food choice as important or higher	65.0%
Importance of Pleasure	Rated importance of pleasure on food choice as important or higher	55.2%
Importance of Packaging	Rated importance of packaging on food choice as important or higher	9.8%
Importance of Newness of Product	Rated importance of newness on food choice as important or higher	33.7%
Importance of Organic	Rated importance of organic on food choice as important or higher	10.4%
Importance of Seasonality	Rated importance of seasonality on food choice as important or higher	20.9%
Importance of Perishability	Rated importance of perishability on food choice as important or higher	32.5%
Low Nutritional Quality	Self - rating of nutritional quality of diet is poor or fair	14.7%
Medium Nutritional Quality	Self - rating of nutritional quality of diet is average	37.4%
High Nutritional Quality	Self - rating of nutritional quality of diet is above average or excellent	47.8%