Eating Healthy

An Investigation into the Health Conscious Eating Habits of Teens

May, 2010

TABLE OF CONTENTS

I. Research Question

Which demographic group at a boarding high school maintains the healthiest dietary habits?

This study seeks to identify dietary health consciousness of students at a single, large boarding high school. The importance of maintaining healthier diets among American youth, coupled with recent government efforts to improve American health consciousness in schools, inspired the selection of this study's topic. Concerning the White House *Let's Move* initiative, First Lady Michelle Obama remarked, "One of our goals was to focus on the importance of educating our kids about healthy eating".[i] The investigators seek to identify demographic variables that relate to the degree of dietary health-consciousness.

Demographic variables considered by the investigation include age, ethnicity, gender, residence, and political preference. Dietary heath consciousness was gauged by the frequency with which students seek whole grains, non-fried foods, fruits, and vegetables, as well as the type of milk consumed.

The high school students considered in this survey attend the 9^{th}, 10^{th}, 11^{th}, 12^{th}, and post-graduate grades offered at the private boarding school. Based on a school census, these students range from ages thirteen to twenty - a minor portion of which do not board.

II. Defining Healthy and Health Conscious

In our study, we examined the association between the previously different demographic variables and healthy eating. We decided to ask several questions in our survey that we believe represent the healthy eating habits of individuals. Healthy Eating Research, a national program funded by the Robert Wood Johnson Foundation , defines healthy eating as "Eating the recommended types and amounts of foods and beverages, nutrients and calories recommended in the Dietary Guidelines for Americans, while limiting low-nutrient, high-fat and high-sugar foods and beverages."[ii] In addition, HelpGuide.org recommends that young people obtain their necessary daily calories from lean protein, low-fat dairy, whole grains, fruits and vegetables. In our study we chose to examine these specific aspects of students' diets including diary, grain, fruit and salad, as well as the choice to avoid fried foods.[iii] We chose these groups of food because we believe they provide a balanced and accurate representation of how "healthy" students are eating. The health consciousness we discuss throughout the study is measured using student's conscious choice to choose the healthier food options when offered, which we observed through

our carefully picked survey questions. This health consciousness also implies maintaining the healthiest dietary preferences and habits.

III. Research Design

Sampling

We collected the names of all students attending a single private boarding school during school year 2009-2010.

We selected one hundred and twenty five students with a simple random sample. The simple random sample was collected by compiling one hundred and twenty five integers with a random number generator. The integers compiled were matched to the placement of the students, listed in alphabetical order, on the master list.

The random number generator produced two integers of the same value. The corresponding student was included in the sample once.

Two students selected by the random integers could not be included in the sample: one selected student was taking part in a year-long academic program outside the United States; one student on the master list had been permanently suspended at the time the survey was conducted. These two students were not included in the sample because they are exposed to different food options and living conditions than other students at the boarding school.

The sample size of n=125 is greater than one-tenth of the surveyed population, which is a total of n=1107. The ideal sample size should have been less than or equal to n=110. However, given the high likelihood of non-response of student surveys on campus, the large sample size was large in order to ensure adequate response. The survey was designed to only include the first 110 responses. The survey remained open for 87 hours, during which time 100 to 98 people responded to the survey.

Survey

What is your gender?

- ○ Male
- ○ Female

What is your age as of May 17, 2010?

- ○ 13
- ○ 14
- ○ 15
- ○ 16
- ○ 17
- ○ 18
- ○ 19
- ○ 20

What is your ethnicity?

- ○ White/European
- ○ African/Black
- ○ Latino
- ○ Asian
- ○ Native American
- ○ Arab
- ○ Multi-ethnic

How would you best describe the location of your primary residence?

- ○ Urban
- ○ Suburban
- ○ Rural

What best describes your political beliefs?

- ○ Liberal
- ○ Conservative
- ○ Libertarian
- ○ Moderate
- ○ Undecided

Do you consciously avoid fried food?

- ○ Yes
- ○ No

What type of milk do you drink?

- ○ Whole
- ○ Low Fat
- ○ Skim
- ○ Soy, Almond, Coconut etc.
- ○ No Milk

How often do you eat salad?

- ○ More than once a day
- ○ Once a day
- ○ Three to six times a week
- ○ Once or twice a week
- ○ Less than once a month

How often do you eat fruit?

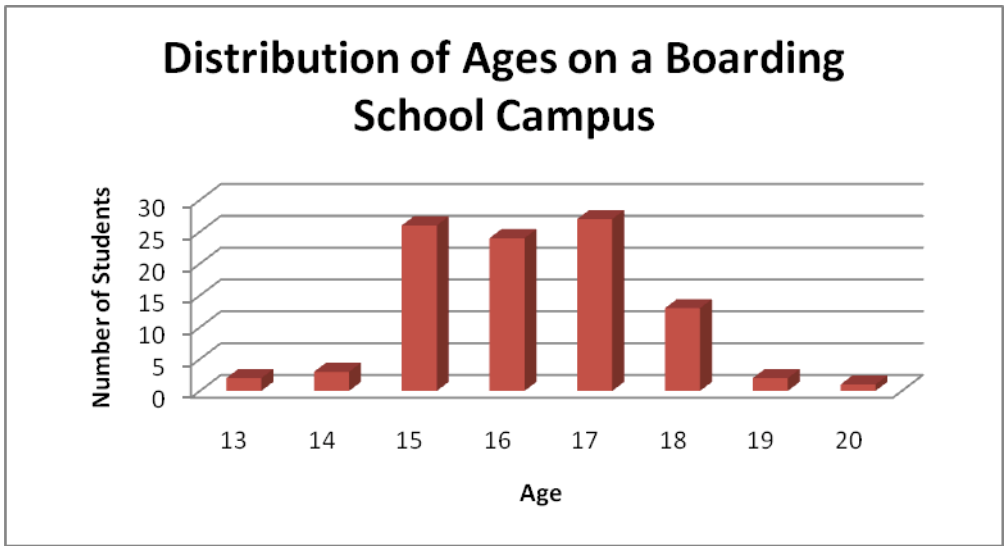
- ○ More than once a day
- ○ Once a day
- ○ Three to six times a week
- ○ Once or twice a week
- ○ Less than once a month

Do you seek out whole grain foods (pasta, bread, rice and pizza)?

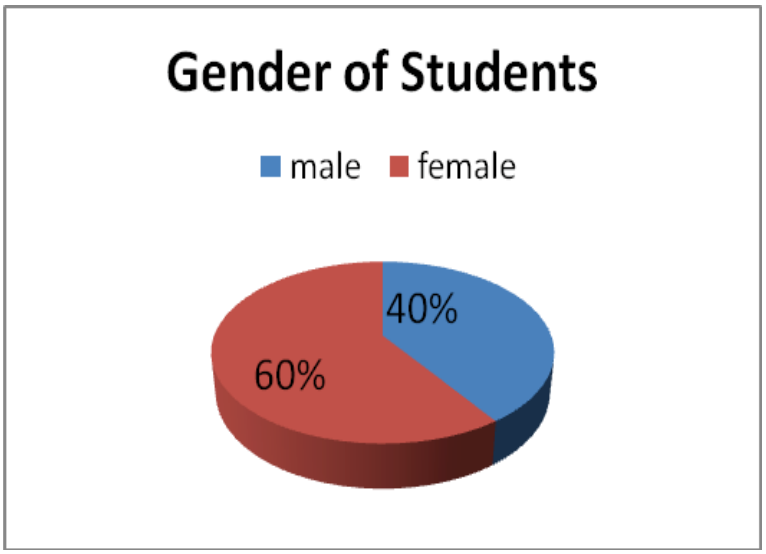
- ○ Always
- ○ Sometimes
- ○ Never

IV. Data and Results

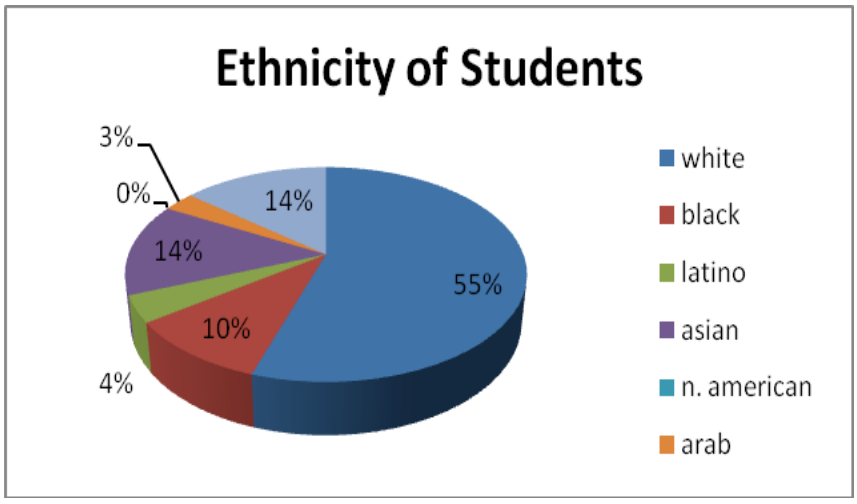
Because we decided to look at five different student demographics and five different aspects to healthy eating, we organized our data in ways to see their distributions and compare the results of our survey by each variable.



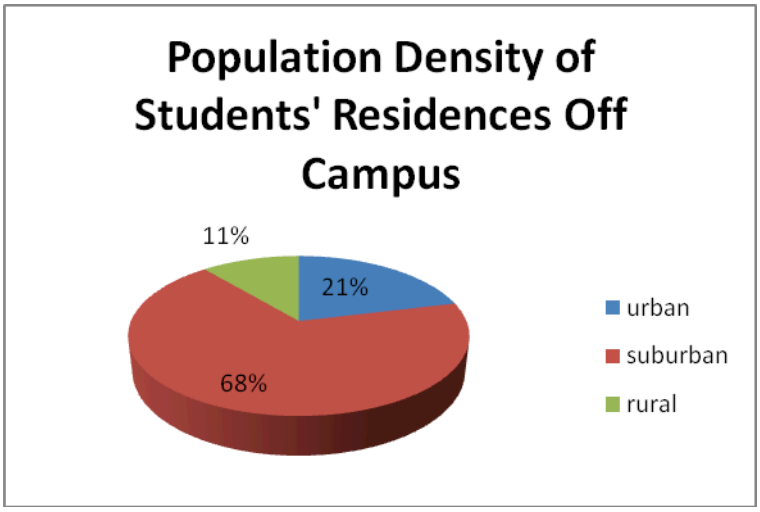
The ages in students on this campus appears to be somewhat normally distributed with a mean and median around 16.



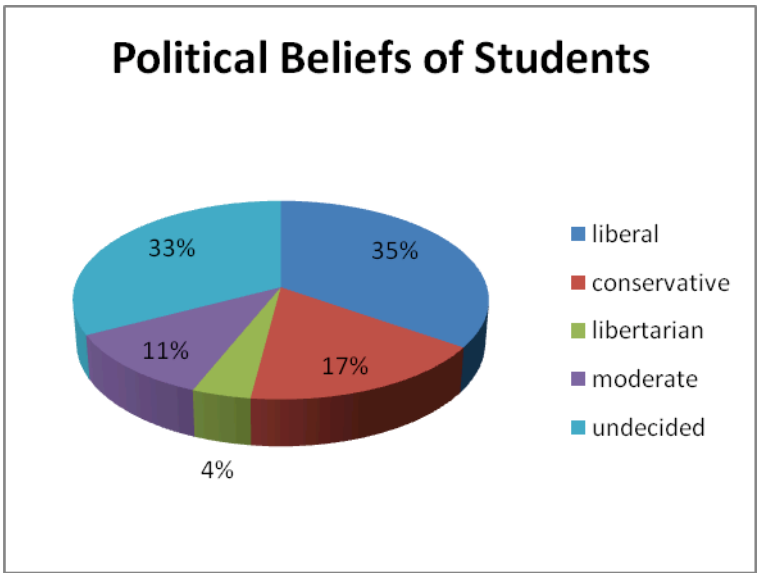
More females responded to the survey than males. An even distribution was expected given the population proportion is around 0.5.



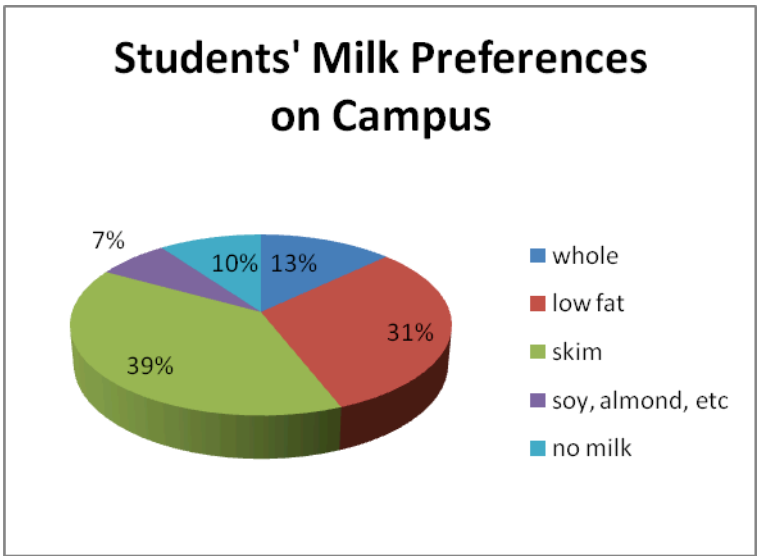
The ethnicities of sampled studentse reflects a diverse population. The categories with low proportions resulted in low observed counts.



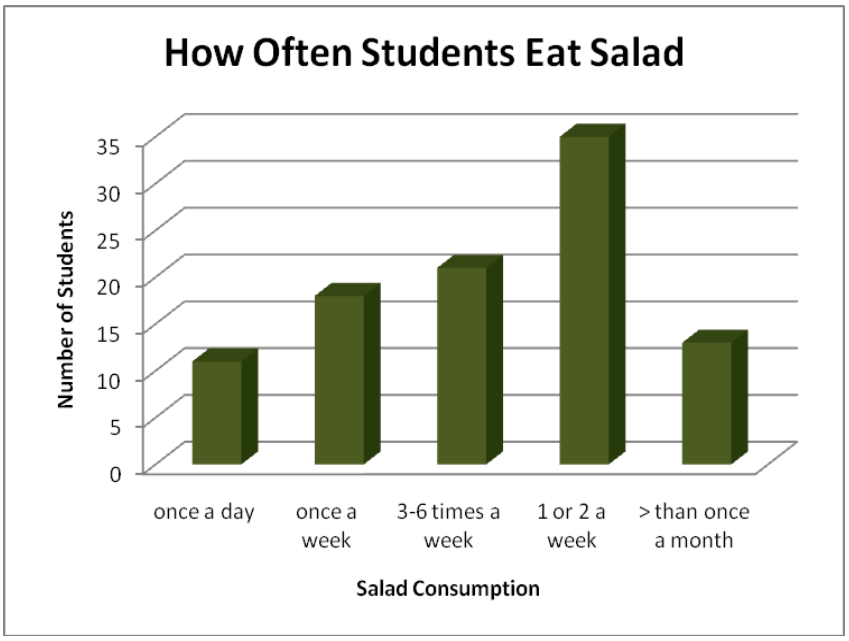
Most of the students identify their primary as being suburban.



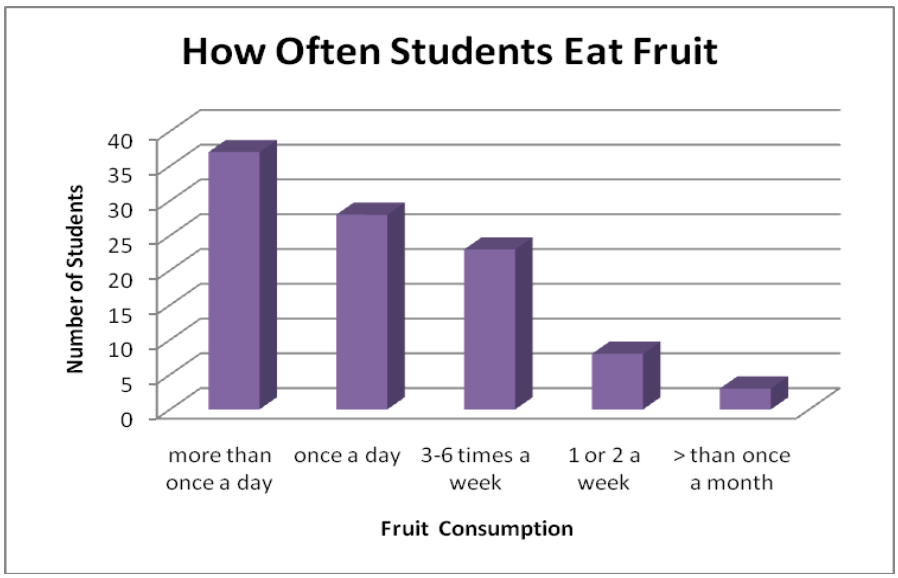
Students' political beliefs were highly diverse. The low proportions resulted in low counts.



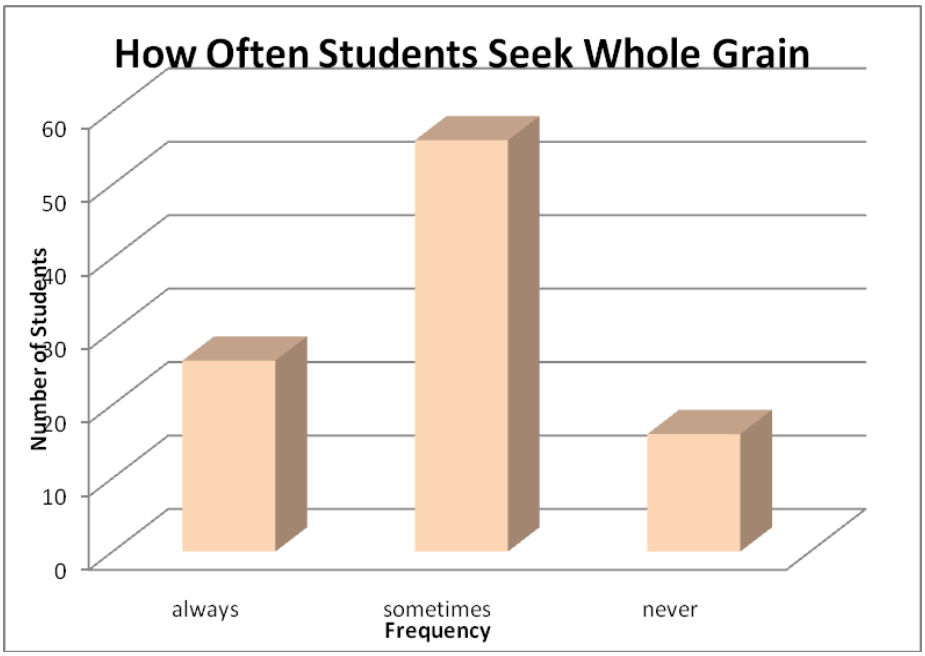
Most students sampled prefer skim milk and low fat milk, while 10% do not drink milk.



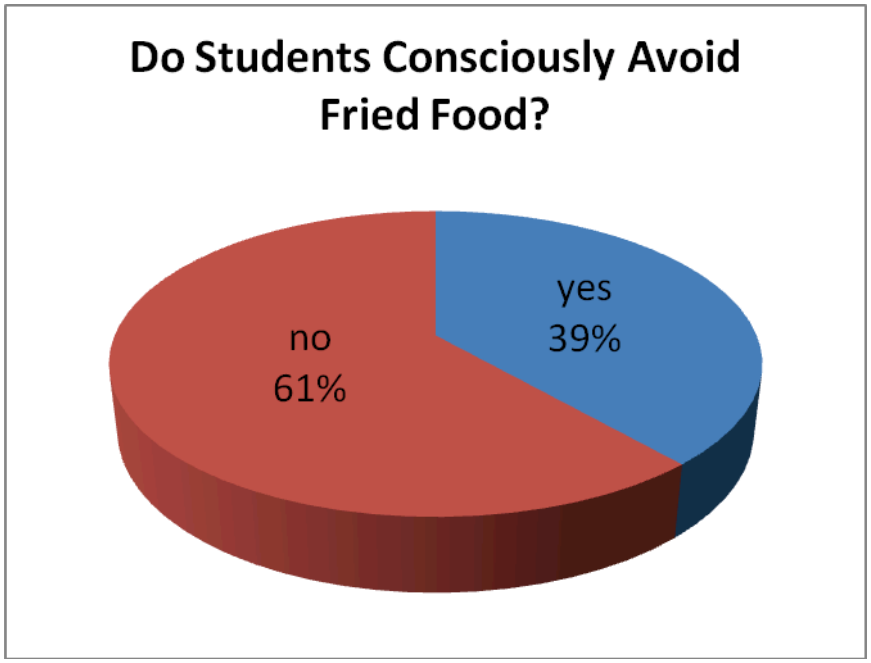
The distribution of salads is not normally distributed, but rather skewed left. Salads were consumed mostly 1-2 times a week, which might be due to other ways students get their vegetable intake.



The distribution of fruit consumption was not normally distributed and rather skewed right. Students seem less likely to consume fruit in other foods and therefore are more aware of the number of fruit servings they consume.



It was not necessary to break down this question into as many frequencies as we did for fruit and salad, and most people chose the more moderate frequency.



Like most teens, this campus had more students who did not consciously avoid fried food, but the number who did was found to be higher than expected.

Table 1. Probability Values for Chi-Squared Tests of Association

	Gender	Age	Ethnicity	Residence	Political View
Fried Food	0.00082	0.756	0.648	0.503	0.573
Milk	0.00078	0.052	0.462	0.011	0.170
Fruit	0.047	0.000	0.000	0.260	0.428
Salad	0.010	0.212	0.704	0.666	0.389
Whole Grain	0.024	0.114	0.922	0.382	0.654

Table 1 displays the probability values of cross-tabulation and chi-squared tests of association for each demographic variable versus a dietary variable. All inference tests were performed and analyzed at the $\alpha = .05$ level. The age vs. fruit test and ethnicity vs. fruit test show very low p-values, but this is to due to the number of low expected counts and several observed counts of 0. As the table shows, the strongest p-values appeared when gender was tested against each dietary valuable, suggesting an association between gender and health consciousness. These tests for gender are performed within the next several pages, verifying our original thoughts. We are aware that the larger number of females responding to the survey could influence our results, but we believed that the observed numbers still showed a striking difference in the health consciousness of females and males. It was found that not many of the other demographic variables showed much association with the dietary variables and therefore the decision to eat healthier, or health consciousness. We performed a chi-squared test of association with residence and the decision to avoid fried food to provide and example of the many tests that were performed to ultimately reveal no association. The highlighted boxes are the tests that were performed and written up on the next several pages.

V. Analysis

Tests of Association

I. Gender and Fried Food

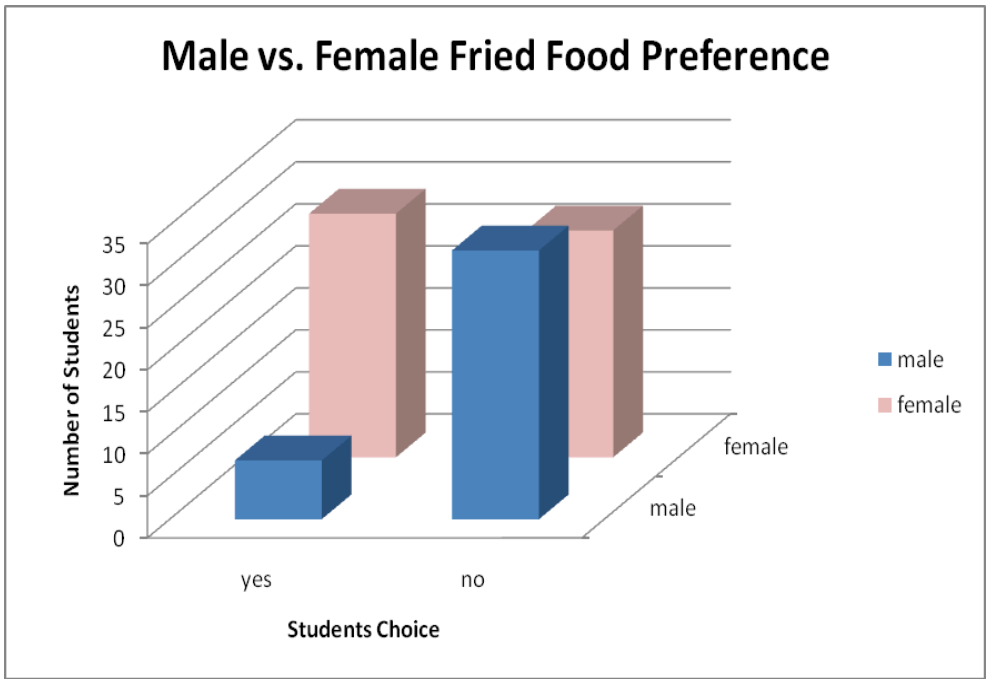


Table 2. Results: Gender and Avoidance of Fried Food

	Male	**Female**	**Total**
Yes	7	29	36
No	32	27	59
Total	39	56	95

Chi-Squared Test of Association
Population: Students at a certain private boarding high school
Parameter: Distribution of proportion of females and males who avoid fried-food
Procedure: Chi-Squared test of association

Conditions:

- 80% of expected counts are greater than or equal to 5 ✓
- None of the expected counts are less than 1 ✓
- Results are obtained from a simple random sample ✓

- Variables are independent ✓

Expected Counts:

$$\frac{Row\ Total * Column\ Total}{Table\ Total}$$

Example: $\frac{36*39}{95} = 14.8$

Table 3. Gender and Fried Food Expected Counts

	Male	**Female**	**Total**
Yes	14.8	21.2	36
No	24.2	34.8	59
Total	39	56	95

Hypotheses:
Null Hypothesis H_o: There is no association between gender and avoidance of fried food

Alternative Hypothesis H_a: There is an association between gender and avoidance of fried food

Test-Statistic

$$X^2 = \sum \frac{(Observed - Expected)^2}{Expected}$$

Degrees of Freedom = (rows – 1)(columns – 1) = (2 – 1)(2 – 1) = 1

Example:

$$X^2 = \frac{(7 - 14.8)^2}{14.8} = 4.1 + \dots$$

$X^2 = 11.2$

Pr $(\mathcal{X}_{df=1}{}^2 > 11.2) = 0.00082$

Conclusion:

Since the p-value of 0.00082 is below the α = .05 level, the results are statistically significant and we reject the null hypothesis. We conclude that there is an association between gender and non-fried food preference. This implies that females are more likely to avoid fried food than males. The largest contributor to the chi-squared statistic is the proportion of males who responded "yes" to avoiding fried food. The observed count for this proportion is 7, which

is significantly lower than the other observed counts. These results support our conclusion and demonstrate that males are less likely to avoid fried food. Using our definition of healthy, we can conclude that in this case females are more likely to be dietary health conscious than males.

II. Gender and Whole Grains

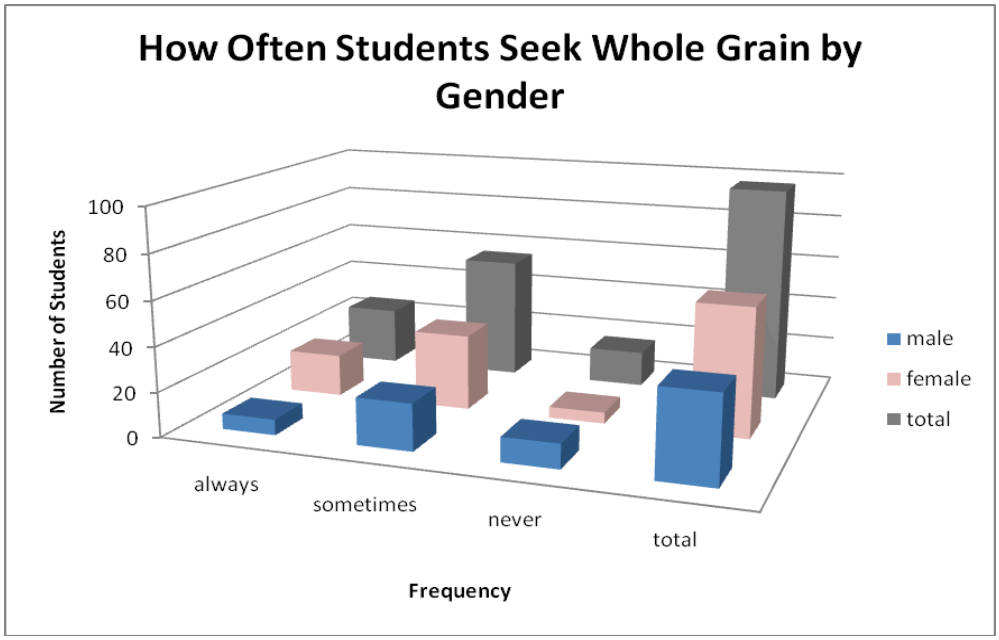


Table 4. Results: Gender and Frequency of Whole Grains

	Male	Female	Total
Always	7	19	26
Sometimes	21	34	55
Never	11	5	16
Total	39	58	97

Chi-Squared Test of Association
Population: Students at a certain private boarding high school
Parameter: Distribution of proportion of females and males and how often they seek whole grain options
Procedure: Chi-Squared test of association

Conditions:

- 80% of expected counts are greater than or equal to 5 ✓
- None of the expected counts are less than 1 ✓
- Results are obtained from a simple random sample ✓
- Variables are independent ✓

Expected Counts:

$$\frac{Row\ Total * Column\ Total}{Table\ Total}$$

Example: $\frac{26*39}{97} = 10.5$

Table 5. Gender and Frequency of Whole Grains Expected Counts

	Male	Female	Total
Always	10.5	15.5	26
Sometimes	22.1	32.9	55
Never	6.4	9.6	16
Total	39	58	97

Hypotheses:

Null Hypothesis H_o: There is no association between gender and how often students seek whole grains

Alternative Hypothesis H_a: There is an association between gender and how often students seek whole grains

Test-Statistic

$$X^2 = \sum \frac{(Observed - Expected)^2}{Expected}$$

Degrees of Freedom = (rows – 1)(columns – 1) = (3 – 1)(2 – 1) = 2

Example:

$$X^2 = \frac{(7 - 10.5)^2}{10.5} = 1.2$$

$X^2 = 7.42$

Pr $(\mathcal{X}_{df=2}{}^2 > 7.42) = 0.024$

Conclusion:

Since the p-value of 0.024 is below the $\alpha = .05$ level, the results are statistically significant and we reject the null hypothesis. We conclude that there is an association between

gender and how often students seek out whole grains. Our results demonstrate that females seek out whole grains more often than males.

III. Gender and Milk Preferences

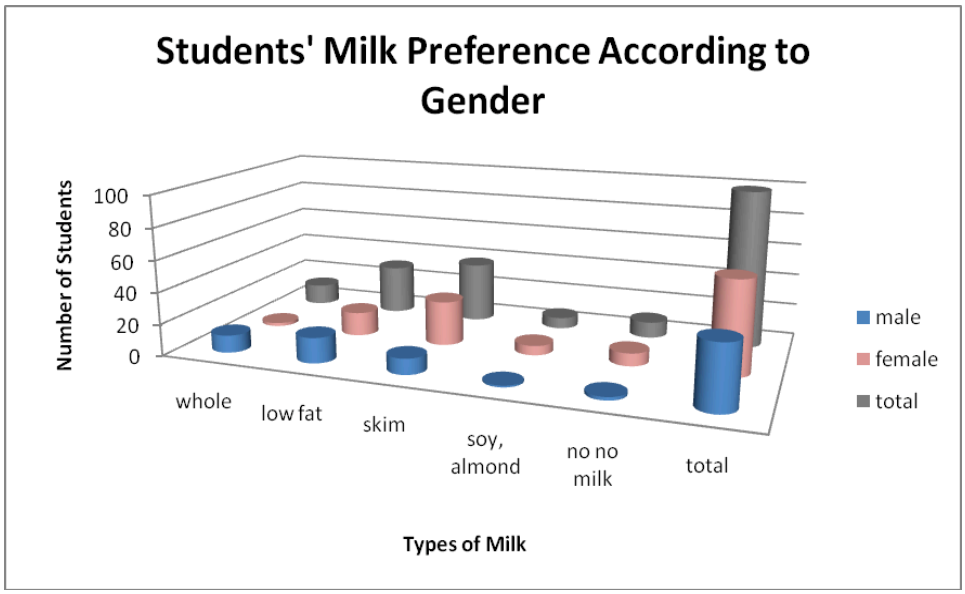


Table 6. Results: Gender and Milk Preference

	Male	**Female**	**Total**
Whole	11	2	13
Low fat	16	15	31
Skim	10	28	38
Soy, Almond, Coconut etc.	1	6	7
No Milk	2	8	10
Total	40	59	99

Chi-Squared Test of Association
Population: Students at a certain private boarding high school
Parameter: Distribution of proportion of females and males and their milk preferences
Procedure: Chi-Squared test of association

Conditions:

- 80% of expected counts are greater than or equal to 5 ✓
- None of the expected counts are less than 1 ✓
- Results are obtained from a simple random sample ✓
- Variables are independent ✓

Hypotheses:
Null Hypothesis H_o: There is no association between gender and milk preference
Alternative Hypothesis H_a: There is an association between gender and milk preference

Test-Statistic
$X^2 = 19.015$
Degrees of Freedom = 4
$\Pr\left(\mathcal{X}_{df=4}{}^2 > 19.015\right) = 0.00078$

Conclusion:

Since the p-value of 0.00078 is below the $\alpha = .05$ level, the results are statistically significant and we reject the null hypothesis. We conclude that there is an association between gender and milk preference. Our results suggest that females are more likely to drink skim milk or soy, almond and coconut milk, while males are more likely to drink whole milk. The largest contributors to the chi-squared statistic appear to be the proportion of females who drink whole milk (2) and the females who drink skim milk (28). The observed count of females who drink whole milk (2) appears to be very low in comparison to the other counts, while the observed count of females who drink whole milk appears very high. These results suggested that there was an association between gender and milk preference, and our low p-value confirms this association that females are more likely to drink skim milk and less likely to drink whole. We hypothesized that females believe skim milk is healthier, than say whole (which they may believe is fattening). Our results confirm this and we are able to conclude, according to our definition of healthy, that when choosing milk females tend to be more health conscious than males.

IV. Gender and Salad

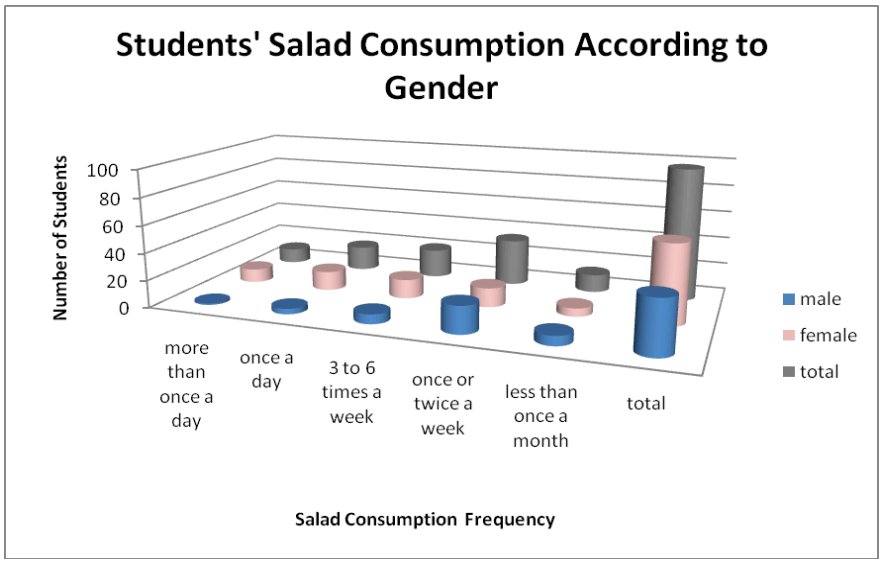


Table 7. Results: Gender and Frequency of Salad

	Male	**Female**	**Total**
More then once a day	1	10	11
Once a day	4	14	18
3-6 times a week	7	14	21
Once or twice a week	20	14	34
Less than once a month	7	6	13
Total	39	58	97

Chi-Squared Test of Association
Population: Students at a certain private boarding high school
Parameter: Distribution of proportion of females and males and how often they eat salad
Procedure: Chi-Squared test of association

Conditions:

- 80% of expected counts are greater than or equal to 5 ✓
- None of the expected counts are less than 1 ✓
- Results are obtained from a simple random sample ✓
- Variables are independent ✓

Hypotheses:

Null Hypothesis H_o: There is no association between gender and frequency of salad eating

Alternative Hypothesis H_a: There is an association between gender and frequency of salad eating

Test-Statistic

Degrees of Freedom = 4
$X^2 = 13.172$
$\Pr(\chi_{df=4}^2 > 13.172) = 0.010$

Conclusion:

Since the p-value of 0.010 is below the $\alpha = .05$ level, the results are statistically significant and we reject the null hypothesis. We conclude that there is an association between gender and how often one eats salad. Our results suggest that females tend to eat salads more often than males.

V. Residence and Fried Food

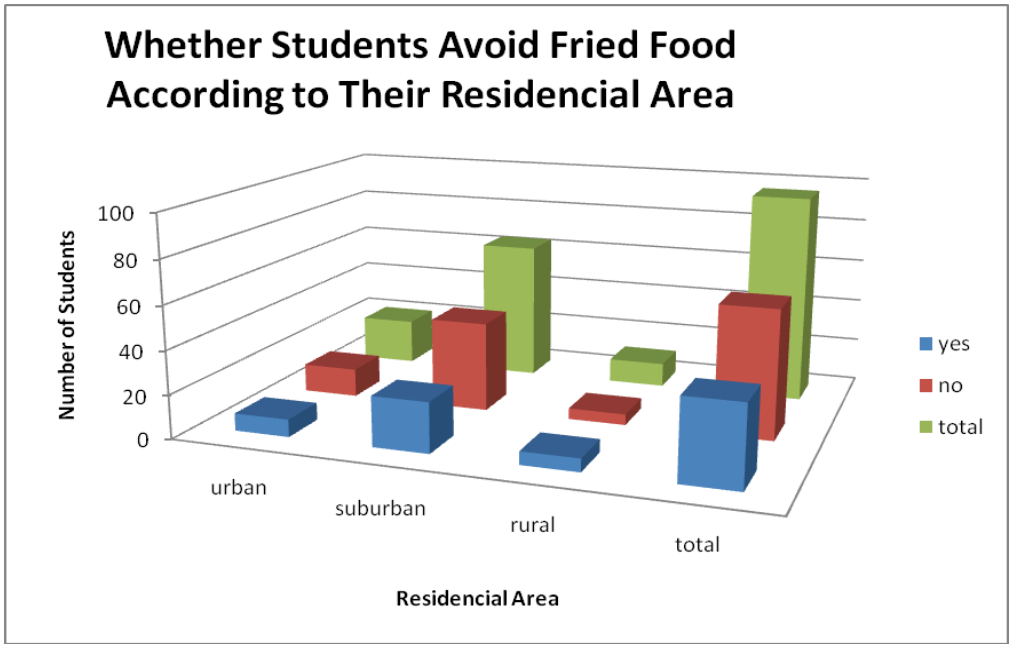


Table 7. Results: Residence and Avoidance of Fried Food

	Urban	Suburban	Rural	Total
Yes	8	23	6	37
No	13	41	5	59
Total	21	64	11	96

Chi-Squared Test of Association

Population: Students at a certain private boarding high school

Parameter: Distribution of proportion of students' residence settings and their tendency to avoid fried food

Procedure: Chi-Squared test of association

Conditions:

- 80% of expected counts are greater than or equal to 5 ✓
- None of the expected counts are less than 1 ✓
- Results are obtained from a simple random sample ✓
- Variables are independent ✓

Hypotheses:

Null Hypothesis H_o: There is no association between residence setting and avoidance of fried food

Alternative Hypothesis H_a: There is an association between residence setting and avoidance of fried food

Test-Statistic
Degrees of Freedom = 2
$X^2 = 1.374$
$\Pr(\mathcal{X}_{df=4}{}^2 > 1.3.74) = 0.503$

Conclusion:

Since the p-value of 0.503 is just above the $\alpha = .05$ level, the results are not statistically significant and we fail to reject the null hypothesis. We conclude that there is no association between the setting of one's primary residence and their tendency to consciously avoid fried food.

VI. Conclusions

Our results and the conclusions from our many chi-squared tests indicate that there is an association between gender and health consciousness. Our study asked about a number of different demographic variables to investigate which specific variable had the biggest influence on healthy eating. A series of chi-squared tests of association it was clear that gender happened to be the most influential demographic variable. When compared with the dietary variables, the gender variable had the strongest associations. Our p-values for the gender tests were relatively low, partially due to the increased response of females. Examining the other demographic variables and their associations with eating healthy, we obtained mostly high p-values or those that were insignificant at the $\alpha = .05$ level. Several of the variables, such as age and ethnicity, did not meet conditions when compared with salad and fruit consumption, but we were still able to obtain relatively low p-values for these tests.

In conclusion, we found that females were more likely to avoid fried food, choose whole grains, drink healthier milk options (low-fat and skim), and consume salad and fruit more frequently than males. In response to our question, it appears that females are the demographic group that maintains healthier dietary habits in comparison to other demographic groups at boarding school.

VII. Research Reflection

Strength, Weaknesses, and Bias

The investigation reduced many potential sources of bias. Firstly, all of the survey food options are provided on the respondents' school campus. Second, campus dining is both free and open to

all students. Third, all students eat at least one meal in the school dining hall, while most eat three meals in the dining hall. The accessibility of these options to students means that the student's socioeconomic environment and convenience does not influence the formation and implementation of the eating options included on the survey, eliminating potential lurking variables.

Non-response bias is the largest bias in survey studies; however, this bias was limited in the undertaking of this study. Of our one hundred and twenty five samples, one hundred responded thoroughly, giving the survey an 80% response rate. The rate is relatively high for most surveys conducted on campuses - therefore non-response bias is unlikely to be a major problem that will affect the counts of the variables collected.

Non-response bias was reduced by the easy, free, daily access students have to computers and internet which can access, complete and submit the survey anonymously.

Non-response bias was also eliminated by ensuring that students were given four full days to access and submit the survey.

Non-response bias may affect the results in different ways. Firstly, many fewer responders considered themselves to be male compared to female, despite the sample proportion of males to be 0.448 (56/125). This may be tied to non-response bias since males may be more apathetic towards taking time to participate in surveys, especially those about health or diet.

Response bias is unlikely to affect the results given that the survey questions are not controversial nor highly personal, and since respondents were informed that the survey was completely anonymous and included many other respondents.

One minor weakness of the study arose from the response bias associated with the design of the survey. The survey tool used in the design of the survey did not allow for a question to be made mandatory for submission. Several questions had incomplete responses short of the total responses of one hundred for the entire survey.

A weakness of the study was the insufficient sample size needed to study the investigative variables in considerable detail. The counts were distributed too thinly for the data to comply with the conditions and be suitable for inference testing. This was because the sample size was too small. In other cases, the possible responses were limited to only a few, reducing the diversity of responses and the detail of the investigation.

Future Study

The investigation into variables such as race and age with regards to fruit and salad consumption were inconclusive. The number of possible categories in each of these variables meant that counts were distributed too thinly for the data to comply with the conditions and be suitable for inference testing. Further specific study of these variables with larger sample sizes would be necessary to understand the relationship between these variables. In the undertaking of this future study, a school population of larger than a few thousand students is necessary to allow for student samples of sizes sufficient to study the relationship between these variables in sufficient detail.

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[i] Obama, Michelle. "Remarks by the First Lady at Healthy Kids Fair." *The White House*. The Office of the First Lady, 29 Oct 2009. Web. 27 May 2010. <http://www.whitehouse.gov/the-press-office/remarks-first-lady-healthy-kids-fair>.

[ii] "Program Defintions." *Healthy Eating Research*. Robert Wood Johnson Foundation, 2010. Web. 19 May 2010. <http://www.healthyeatingresearch.org/resources-for-grantseekers/112>.

[iii] Paul, Maya, and Suzanne Barston. "Nutrition for Children and Teens." *Help Guide*. Rotary Club of Santa Monica, Apr 2010. Web. 27 May 2010. <http://helpguide.org/life/healthy_eating_children_teens.htm#authors>.