AN EXAMINATION OF COLLEGE FRESHMEN'S FOOD CHOICES

by

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B.S., North Dakota State University, 2005
M.S., North Dakota State University, 2007

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics
College of Agriculture

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Manhattan, Kansas

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Abstract

The prevalence of obesity and overweight has heightened over the last 40 years. Over two thirds of the US adult population is overweight or obese. Further, 18% of adolescents, ages 12 to 19, are obese, which is an increase of over 13% since the late 1970's. Food environment and peer influence have been emerging areas of study and are thought to be catalysts to unhealthy eating choices. College students present a unique opportunity to look at the impact of a changing food environment, including changes in peer groups.

This study is concerned with how students' peers impact their food consumption and ultimately weight. College freshmen were recruited during their first month on campus at Kansas State University. The students participated in a year-long, three-part study to track their eating habits, weight and height. The students' parents were also asked to participate by filling out a survey on eating habits. The students also asked one friend they ate with at least once a week to fill out a food record with them.

The collected information was transformed into daily average calories for each of six food groups and for macronutrients. A peer ratio was created from the parents and friends calorie intakes to determine the similarity in consumption by each food group or macronutrient. A system of equations was specified and estimated for both food groups and macronutrients.

For the food group model, beverages were the only food group with a statistically significant peer ratio term. The coefficient on the ratio was positive, indicating that students would consume more calories from beverages, as their college friends consumed more calories from beverages relative to the students' parents at home. In the macronutrient model, protein had a statistically significant and positive peer ratio. An examination of the impacts of predicted calories consumed from food groups, along with other individual characteristics, on student's

BMI in the spring term, indicated that increasing snack consumption led to an increase in BMI while increasing bread consumption caused a decrease. Eating more meals at the university dining center also increased BMI. An analysis for the predicted macronutrient values revealed a similar relationship with eating more meals at the dining center, but the predicted macronutrients did not have statistically significant impacts on BMI.

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Dedication

To my loving husband, Brandon. Thank you for supporting me during this process.

CHAPTER 1 - Introduction

1.1 The Obesity Epidemic and Its Consequences

The World Health Organization (WHO) estimated that in 2005, at least 400 million adults in the world were obese (about 6.2% of the population) and about 1.6 billion or 24.7% of the population were overweight (WHO, 2008). Obesity is most commonly gauged using body mass index (BMI). BMI is measured by dividing a person's weight in kilograms by their height in meters squared. A higher BMI means a larger body mass or weight given their current height. As a person gains weight holding height constant, their BMI will increase. A person is considered obese if they have a BMI over 30, and overweight if they have a BMI between 25 and 30. The WHO also predicted that by 2015, there will be more than 700 million obese adults in the world and about 2.3 billion adults overweight.

While obesity and overweight are great concerns in many parts of the world, the prevalence of obesity in the United Sates (US) is most prominent and significantly higher than most parts of the world. There has been a sharp rise in obesity in the US since 1980. The Centers for Disease Control and Prevention (CDC, 2009) estimates that the prevalence of obesity jumped from about 15% in the late 1970's to about 32.9% in the 2003-2004 survey. Table 1.1 shows how BMI has changed over time in the US. It is clear that the percentage of overweight adults in the US has remained fairly steady from the early 1960's up through the mid 2000's. However, the percentage of the population that is obese and extremely obese (BMI greater than or equal to 40) has been increasing over time in the US.

Table 1.1. Age-adjusted* Prevalence of Overweight, Obesity and Extreme Obesity among US Adults, age 20-74 years.**

	NHES I 1960-62 n=6,126	NHANES I 1971-74 n=12,911	NHANES II 1976-80 n=11,765	NHANES III 1988-94 n=14,468	NHANES 1999-2000 n=3,603	NHANES 2001-02 n=3,916	NHANES 2003-04 n=3,756	NHANES 2005-06 n=3,835
Overweight (BMI greater than or equal to 25.0 and less than 30.0)	31.5	32.3	32.1	32.7	33.6	34.4	33.4	32.2
Obese (BMI greater than or equal to 30.0)	13.4	14.5	15.0	23.2	30.9	31.3	32.9	35.1
Extremely obese (BMI greater than or equal to 40.0)	0.9	1.3	1.4	3.0	5.0	5.4	5.1	6.2

Source: NCHS-CDC

***Age-adjusted by the direct method to the year 2000 US Bureau of the Census estimates using the age groups 20-39, 40-59, and 60-74 years.**

****NHES: National Health Examination Survey; NHES included adults 18-79 years, NHANES I & II did not include individuals over 74 years of age, thus trend estimates are based on age 20-74 years. Pregnant females were excluded from analyses.**

It is easy to understand how weight gain occurs: burning fewer calories than the amount consumed. There are many reasons for this imbalance. Long before we worry about the size of our waist lines, genetics pre-determine a person's body type to a certain degree. Genes also play an important role in determining the speed of weight gain and loss in humans or the ability of cells to favor fat accumulation (CDC, 2009). While genetics are an important part of weight outcomes, changes in genes occur too slowly to be the scapegoat of rising rates of obesity. For this reason, my efforts will be focused on

the other factors that can help determine weight, such as lifestyle, food choice and environment.

Cutler et al. (2003) bring to light that technology and mass food production have changed time cost for consumers causing them to do fewer physical activities and eat more calorie dense foods. Cutler also states that if rational utility maximizing consumers are choosing these allocations, then it must make them happier and therefore be the correct outcome. Why intervene if the outcome is efficient?

Increases in obesity rates have been pegged to higher incidences of chronic diseases related to weight gain such as heart disease, diabetes, high blood pressure, arthritis, and various types of cancer. Strum (2002) estimated that obesity is associated with an average increase in inpatient and outpatient health care costs of $395 per person per year, while the increased cost for smoking is $230 per person per year and that for problem drinking is $150 per person per year. The cost of obesity is greater than the costs of heavy drinking and smoking combined. Finkelstein, Fiebelkorn and Wang (2003) estimated that 9.1% of the total health care spending in the US was attributable to problems related to obesity and overweight. In addition to the increasing costs of health care, higher rates of absenteeism in the workforce are reported because of greater number of sick days being used by the obese and overweight population (Tucker and Friedman, 1998).

Some researchers believe that the statistics about increases in obesity in the last few decades have been blown out of proportion and are just media hype. Campos et al. (2006) argued that the statistics have been presented in a way that is more alarming, but the fact is that we are seeing only a slight shift in the distribution of weights of the

population. We can see their argument in figure 1.1 below. It is also noted by Campos et al. (2006) that the link between nutrition/exercise and health outcomes is fairly straight forward. However, the link between excess adipose tissue and weight-related health outcomes is less clear. If the link between nutrition and health is much stronger, it should be the focus instead of weight.

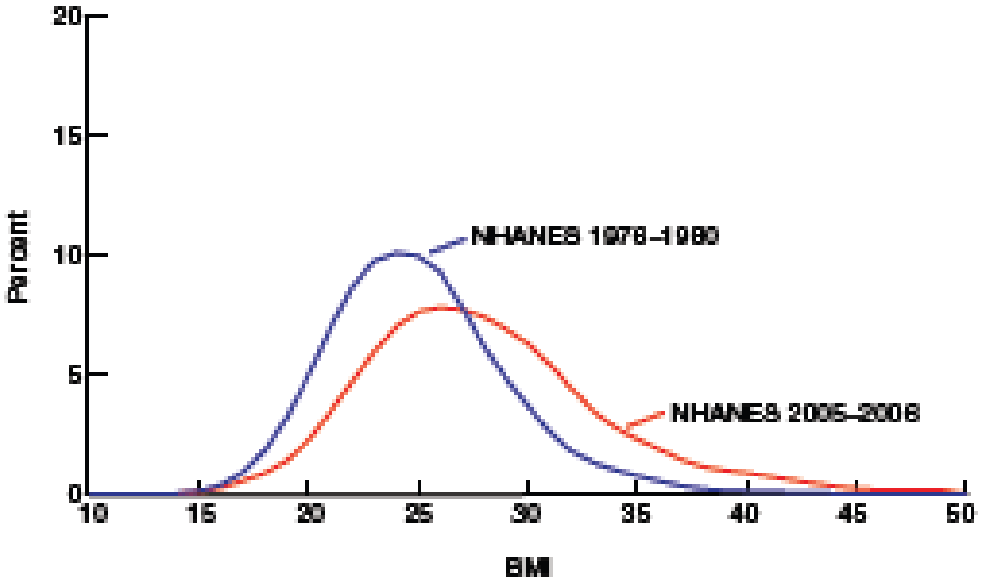

Figure 1.1. Distribution of BMI of the Adult Population (20-74 years) in the US from 1978-1980 and 2005-2006.

***Source CDC/NCHS, National Health and Nutrition Examination Survey (NHANES)**

Despite the disputability of this "epidemic", policies to combat obesity are already being enabled. Several states have already been taxing candy and sugary beverages. According to Eidson et al. (2007), 34 states already had taxes on soda in 2007 and of those 34 states, 19 of them were taxing soda at a higher rate than other foods. In 2006, New York City, NY passed a measure to phase out the use of trans-fatty acids or trans-

fats for cooking in city restaurants by July 2008 (NYC Department of Health and Mental Hygiene, 2006). Policies are moving forward even though some studies have shown they will not accomplish the desired goal (Miljkovic, Nganje and de Chastenet, 2008; Chouinard et al., 2005; Schmidhuber, 2004).

1.2 Food Prices: A Look at Monetary Incentives and the Shortcomings of Price Policy

As mentioned, price has been one factor that researchers have looked at as a cause and a potential means for cure. Miljkovic, Nganje and Chastenet (2008) used a rational addiction type of framework to look at consumer price response to certain types of food. They found that increasing prices of foods like sugar may deter "normal" weight people but that overweight and obese people were shown to increase sugar consumption when the future price of sugar increased, indicating an addictive response. This could mean that a policy aimed at taxation of bad foods may not lead to less consumption by those overweight and obese individuals if they are addicted. Beghin and Jensen (2008) studied farm and price policies for sugar in other countries and found that the other countries with very dissimilar policies to the US were also experiencing great increases in obesity. They conclude that these farm and price policies should not be under fire because their link to obesity is thin.

Drewnowski and Darmon (2005) hypothesized that diet cost and diet energy density should be inversely related. They found consumers on limited budgets will ultimately end up with a more energy dense diet, but consumers that purposefully selected an energy dense diet may not have a lower diet cost. This is important because if some people are selecting an energy dense diet by choice, it could have important

implications for the policies that are targeting price responsiveness. What we need to understand is why people are specifically choosing these energy dense diets; it is clearly about more than just price.

Reprimands are not only being placed on fatty and sugary foods, but also on people who are obese and overweight. California health insurance companies are penalizing or denying coverage for overweight and obese people (ABC 7 News, 2007). There is a bill being pushed in South Carolina that will allow similar repercussions for state employees (Associated Press, 2009). These policy changes have come about without a full understanding of the underlying behavioral decision making of food consumption. It is paramount that we understand eating behaviors before we attempt to change them. Trying to alter consumer food preferences will likely take more than just price changes; it will take education, attitude changes and time. One might equate it to smoking secession; we found it had adverse health outcomes, people were told to quit, but they were addicted. So, it took decades and lots of programs to help people quit and to prevent people from starting.

1.3 Food Environment and Choice: A New Direction for Policy

If altering food price is a relatively ineffective means of getting the result that society desires (i.e., lower BMI of the overall population), then where should we go from here? If foods are addictive like some researchers suggest, the issue becomes one of either, a) altering external factors, like food environment or b) altering internal factors, like food choice.

Food environment is thought to be a major influence on obesity by affecting physical activity and diet trends (Sallis and Glanz, 2006). Environment includes the

external forces and influences that affect the way people make decisions about food and physical activity. This can also include the people with whom you eat. Wansink (2006) has done much research on how even small factors, such as lighting, music and mental perception of how a meal will taste can greatly alter the amount of food eaten in one sitting. Altering the food environment, or the things around a person that cause them to eat more or less, could be a far more effective policy than changing food prices.

Food choice relates back to Drewnowski and Darmon (2005), in that sometimes consumers will purposefully choose the less healthy diet even if we have income to support the more healthful alternatives. Drewnowski and Darmon relate this to palatability of the calorie dense foods, but it could also be due time cost, peer influences and other factors effecting individuals decision making processes. Learning more about the underlying aspects of food choices of people will give some insight to potential ways to increase healthful choices when it comes to eating.

In this study, the focus will be on determining what some of the significant underlying factors are affecting food choice, in hopes of learning important information regarding eating behavior as it relates to weight gain prevention. Hopefully, one broad outcome from this undertaking will be to cultivate different discussions about policy options that may be more effective than the taxation policies that are being implemented currently.

1.4 Interdependent Preferences and Group Choice

In most economic models, we assume that individuals are acting in their own self-interest and that the choices they are making are dependent only on prices and income. Along with that we are capturing their individual preferences. In many cases this may be

true, but some studies, especially those involving children and teenagers, are normally highly dependent on their parents. There is a large body of literature on interdependent preferences and group choice. Some theories suggest that peoples' choices are partly due to their preferences and the preferences of some group or some social influence. Most commonly, we think of households, work groups or couples as entities in which preferences become interdependent on each other (Yang and Allenby, 2003).

Group choice happens when more than one person is involved in the decision making process and so the preferences of more than one person affect the purchase/activity decision. It is commonly thought that the preferences of the individual members of the group exert power in the final decision; in some settings, researchers can determine which individual in the group has high influence over the end decision and which ones have low influence (Arora and Allenby, 1999). We might expect for parents to exert high influence over decisions made in the family setting, but some studies have shown that children will actually exert more influence, especially when it comes to purchase decisions (Caruana and Vassallo, 2003).

1.5 Objectives and Goals

The transition out of one's initial environment could be best reflected by college freshmen acting on their own for the first time away from home. Suddenly, they are placed in a setting where they are responsible for food shopping, choice, and preparation on most occasions. Some studies have shown that weight gain in college is significant (Suzuki, Murashima and Hoerr, 2007) and that the transition between living at home and at college is an amplification of what is happening with society and the obesity epidemic (Levitsky, Halbmaier and Mrdjenovic, 2004). What remains unclear is the mechanism by

which behavior and choices change, sparking changes in food and activity habits. Could it be that a change in weight, health and activities is primarily brought upon by making the change from a household choice setting to a setting of individual choice? Or is social influence acting upon their choices and changing their preference and choice structure?

I hypothesize that the structure of food choices of college students changes when they transition away from an environment of household choice. Testable hypotheses are whether or not there is influence exerted by parents over the group decision making for food choice and whether or not they are influencing healthy or unhealthy eating habits. I further hypothesize that eating behaviors and weight outcomes differ when choices are made under the circumstance of living at home as compared to being made by the individual in a social setting such as college.

The overall objectives of this study are to determine choices that affect nutrition of college freshman and use this information to help formulate policies directed at young adult populations in order to prevent the adoption of habits that are detrimental to the healthfulness. More specifically, this study aims to:

1.) Compare the food and activity behaviors chosen by college freshmen when they lived in a household setting with their parents to how they are living while in college.

2.) Analyze the peer effects on the eating behavior of college freshmen. This will also involve defining a measure of the peer effect.

3.) Determine the impact of food consumption changes and other eating behaviors on weight in the first year of college.

Completing these goals will give some direction for policy makers. Analyzing college freshmen food behaviors is expected to help paint a clearer picture of how and when to alter consumer behavior. In essence, if we find parents are a driving force behind food choices made before and after their child goes to college, it could signal the need for nutrition education for parents and teenagers, prior to children leaving home. However, if we see that parental influence on food choices dies out after their child gets to college; it would show a greater need for nutrition education and improved food environment in a college setting. Primary data will be collected to accomplish these goals. Information about the students' eating habits before and after coming to college will be gathered and analyzed from freshman at Kansas State University. Also, to help determine peer effect, food diaries with one of the friends they eat with at college will be collected, along with information about the environment they are eating in, for a three-day period.

This dissertation is laid out in a traditional format. Chapter two reviews some literature on college freshman weight gain and also on peer influence and weight gain and consumption of foods. Next a conceptual model is defined in chapter three; followed by a detailed description of the data collection methods and a summary of the responses in chapter four. Chapter five sets up the empirical model, and chapter six discussed the results. Finally, a summary and conclusions are presented in chapter seven along with possibilities for future research.

CHAPTER 2 - Review of Literature

2.1 Literature on Weight Gain in College Students

The "freshman fifteen" is a popular terminology in the US for the expectation about weight gain of college students in their first year on campus. Not surprisingly, it has been studied by many nutritionists. Some studies have proven that weight gain in college students exists, while others have not. Those studies that have confirmed significant weight gain found gains of anywhere between 1.5 kilograms per semester and 5 kilograms per semester.

Brunt, Rhee and Zhong (2008) studied the health and lifestyle habits of college students at a Canadian University. Their main objective was to determine if there were significant differences in dietary intake of students in different BMI categories and to assess the relationship between BMI and dietary intake. A dietary variety questionnaire was used to collect information about the students' food intake over a period of three days. Heights and weights were self-reported and BMI was calculated. They found that the male students were more likely to be overweight or obese than females and also that students living off-campus were more likely to have a higher BMI.

As expected, overweight and obese students reported eating more meats, while underweight students were more likely to report eating leafy greens and cheese. Yet interestingly, there were very few significant differences in the variety of foods consumed among the BMI categories. Finally, Brunt, Rhee and Zhong suggest that healthful nutrition promotion should be targeted towards first year college students because it is typically their first year living away from home and making food choices.

This is a good idea, but it is not clear from this study if the unhealthy eating is caused by the new college environment or if the students had bad habits prior to going to college.

Levitsky, Halbmaier and Mrdjenovic (2004) verified the "freshman fifteen." They studied incoming freshmen to Cornell University. The students were recruited from introductory human development and nutrition courses and weighed at the beginning of their first semester and then again after twelve weeks. The students were also given a questionnaire at the beginning of the study to capture information about their lifestyle and eating habits in high school and a second questionnaire at twelve weeks asking similar questions about their habits during their first semester in college.

The average weight gain of the students was about 1.9 kilograms and was significant at the 1% level. They used regressions to determine the variance in the weight gain. Consumption of junk foods explained about 24% of the variance in weight gain and consumption of evening snacks explained 6%. The number of meals eaten on the weekend was also significant and explained 17% of the variance in weight gain. The authors share their belief that college students are an 'amplification' of what is going on in the real world with society and that preventing weight gain has potential to reverse the obesity epidemic.

Pliner and Saunders (2008) studied two groups of freshman, one group that lived at home while attending college and one group that lived on campus. The students were from a Canadian University and were recruited from an introductory psychology class. The students were weighed in October and March and also given questionnaires. A food frequency questionnaire was developed and given to the students to fill out. The

Herman/Polivy Restraint Scale was also used to categorize students into groups of restrained and unrestrained eaters.

From the sample of 113 students, it was found that the students living on campus gained more weight than those still living at home. They also found that students with highly restrained eating habits still living at home did not have a significant increase in BMI but both highly restrained and unrestrained eaters living on campus both had significant increases in BMI. Finally, Pliner and Saunders also regressed the change in different food groups on BMI to see if there was any significant increase in weight based on eating habits. The only significant factor attributed to increased weight was a decreased consumption of the fruits and vegetables group. The authors finally point out that not all college students are vulnerable to weight gain and that the gain depends heavily on living arrangements and eating restraint.

These studies all support the idea of the "freshman fifteen" and are similar to the analysis conducted in this study. However, there are several critiques. Brunt, Rhee and Zhong (2008) use self-reported weight and heights, which can be unreliable. Levitsky, Halbmaier and Mrdjenovic (2004) and Pliner and Saunders (2004) both used food frequency questionnaires (FFQ) that appear to not be validated instruments for collecting dietary intake. Their collection methods may be unreliable, because components could be missing from the respondents' typical diets. In addition, all of these studies have treated food choice as an individual choice, ignoring possible effects of choices made in group settings.

2.2 Group Choice and Peer Effects Literature

Group choice and social interactions have been studied since the 1970's. Schelling (1973) showed several applications in which individuals' would conform to the behavior of a reference group. Burke and Heiland (2007) proposed an agent based model asserting individuals compare their weight to their peer group and consider their peer group's weight as their "desired" weight. In other words, people are not aiming for their weight to conform to a particular number per se, but rather they wish to be slightly thinner than their peers. They begin by expressing that individuals maximize utility of food and non food consumption given their weight in the previous period. They also include a loss function for deviating from their peer group's reference weight. The model is:

$$U_{it}\left[F_{it}, C_{it} \mid W_{i,t-1}\right] = G_i[F_{it}, C_{it}] - J\left(W_{it}\left[F_{it}, W_{i,t-1}, \varepsilon_i\right] - M_{i,t-1}\right)^2 \tag{2.1}$$

where U_{it} is the utility function for individual i in time t, F_{it} is food consumption in period t, C_{it} is non food consumption, $W_{i,t-1}$ is the individual's weight in the previous period, G_i is the component of utility that is independent of weight, $J(.)$ is the social interaction component of the utility, ε_i is a term including basal metabolism to capture individual heterogeneity and $M_{i,t-1}$ is reference weight of the individual's peer group at the end of the last time period.

Trogdon, Nonnemaker and Pais (2008) followed the model by Burke and Heiland and used data from the National Longitudinal Study of Adolescent Health which was collected in 1994 and 1995. The surveys were conducted at schools with grades 7-12 and the unique part of the study is that the students were asked to list up to 10 of their closest friends, so the friends could be matched with at least one peer to conduct the analysis.

The adolescents were grouped by school. The friends' parents' BMI and the friends' birth weight were available in the data set and used as an instrumental variable for the friends' BMI.

The authors found that the BMI of the adolescents was correlated to the BMI of their peers. The marginal effect was 0.3 BMI units, indicating that as the adolescent's peers gain an additional BMI unit, the adolescent will gain an extra 0.3 BMI units. It was found that students on the higher end of the BMI distribution were likely to be more influenced by their friends' BMI. Also, females were more sensitive to peers' BMI than their male counterparts.

Halliday and Kwak (2009) did an almost identical study using the National Longitudinal Study of Adolescent Health data. They believed that a fixed effects model would better suit the data, instead of using instrumental variables as Trogdon, Nonnemaker and Pais did in 2008. To do this, they also include the data from the 1996 survey of adolescents. They found the marginal effect to have a magnitude of 0.19, slightly smaller than the estimate by Trogdon, Nonnemaker and Pais. Again, they found that students with higher BMIs tended to 'cluster' together or be in each other's peer groups. There was also a large variation in the data across survey years due to height and the authors found that there was clustering by height as well. These findings are similar to previous studies on peer effects, but the authors' admit it does not tell us whether overweight and obese adolescents are choosing their friends based on weight or if overweight students are influencing their friends.

De la Haye et al. (2010) used social networks to look at adolescents' friendship ties. The main purpose of the study was to determine what obesingenic behaviors might

be impacted by a child's peers. Using social network analysis and exponential random graph models, the authors were able to control for various types of social relationships among the adolescents in the study. The cohort consisted of male and female students from two different middle schools in a major Australian city, all about the ages of 13 to 14 years. Students were given a questionnaire and height and weight were measured to calculate BMI. The questionnaire included inquiries about friendship ties within their own school, assessment of high calorie foods eaten, physical activity and 'screen time' where time is spent on activities such as watching television and playing video games.

The hypothesis that peers will have similar weight-related behaviors was supported for high calorie food consumption and organized physical activities in males and for the amount of 'screen time' in females. However, it is noted that behaviors associated with popularity or social-like, organized physical activities such as participating in sports, may signal social pressure on students to adopt the 'socially valued' behavior.

These studies all show that there are peer effect relationships among adolescents. The first two specifically look at weight and find that students' with similar BMI measures are likely to be friends. However, this does not explain the causality of the relationship. It could be that friendships are formed first and then when one student gains weight, the other friends follow suit. But, it could also be that friendships are formed based on looks. That is, students become friends because they are not intimidated to approach others that look similar to them. De la Haye et al. (2010) was interested in the peer effects on behaviors that could potentially lead to or prevent obesity. While the data set was rich with many details on relationships between the adolescents and their friends,

the parent side of the influence was missing. In addition, the snack consumption was only a proxy based on a few foods and not a comprehensive measure of calorie intake.

CHAPTER 3 - Conceptual Model

One purpose of my study is to determine if students are closely following their parents and/or friends eating habits. Redefining the Burke and Heiland model slightly, the function $J(.)$ can be specified to determine how closely the student is matching his/her eating habits to the eating habits of his/her peers. This relies on the assumption that people that eat together will eat similarly. This assumption is likely reasonable in the family setting, as it is easier to make the same meal for everyone in the household instead of separate meals for its members. It could also be reasonable given that previous studies have found that people tend to mimic others' behavior and actions in a variety of examples.

Food consumption can be divided into groups, in order to better observe what types of foods students are eating more or less of, much like in previous studies (e.g., Brunt, Rhee and Zhong, 2008; Pliner and Saunders, 2004). Because many foods are substitutes or complements to one another, it is likely that consumption of one group of foods will be dependent on the amounts of the other groups consumed.

One assumption of Burke and Heiland's model is that weight in prior periods determines food consumption in the current period. For college freshman, this may not be the case. It is more likely, at this stage of their lives, that food consumption is determining weight because they are still maturing and learning about themselves. By letting food consumption determine weight, we can drop weight from the utility function in Burke and Heiland's model.

Individual heterogeneity may still be an issue in food consumption, because different people have different tastes for food and non food consumption and different

pre-existing health issues. In this model, instead of individual reasons directly associated with weight differences, such as basal metabolism, factors such as living arrangements and special diets will be included. After these simplifications, the model becomes:

(3.1) $$U_{ik}\left(\left[F_{ik}, C_i \mid Pf_{qik}\right]\right) = G_i(F_{ik}, C_i, Z_i) + J\left(F_{ik}, F_{i,j-k}, Pf_{qik}, Z_i\right)$$

where F_{ik} and C_i are the choice variables for food and non food consumption, k is a subscript for the food group, Pf_{qik} is the food consumption of the individual's peer q (either parents or friends) of food group k, $F_{i,j-k}$ is food consumption from all other food groups but k, C_i is the non food consumption and Z_i is the individual heterogeneity in consumption of the goods, both food and non food.

In order to account for an individual's physical and monetary limits on food consumption, two constraints are added to the model.

(3.2) $$\left(\sum_{j=1}^{K} F_{ik} - H_i\right) \leq M_i$$

Equation (3.2) represents the fact that, at some point, total calorie consumption is limited. In other words, it is physically impossible to eat more after a certain point. This ceiling denoted as M_i is the maximum amount of calories that are physically possible to be consumed by individual i, H_i is a measure of calories expended through the individual's physical activity and ΣF_{ik} is the total calories consumed from all the food groups. The budget constraint is seen in equation (3.3)

(3.3) $$(D + rC_i + Q_i w) \leq I_i$$

where D is the price of the meal plan, Q_i is the total calories consumed by the individual in addition to the college meal plan, r is the price of non food goods, w is the price per calorie of the additional food and I is the individual's income. Because there is a distinction made between foods consumed through the meal plan and additional food, the

following identity should hold: $\Sigma_k F_{ik}=\Sigma_k d_{ik}+Q_i$, where d_{ik} represents the calories consumed by the individual from each food group through the meal plan. Combining these constraints with the utility function yields the utility maximization problem in equation (3.4).

(3.4) $$\text{Max}_{Fik,Ci}\, U_{ik}\left(\left[F_{ik}, C_i \mid Pf_{qik}\right]\right) = G_i(F_{ik}, C_i, Z_i) + J\left(F_{ik}, F_{i,j-k}, Pf_{qik}, Z_i\right)$$
$$+\lambda\left(M_i - \sum_{j=1}^{K} F_{ik} + H_i\right) + \mu(I_i - D - rC_i - \sum_{j=1}^{K}(F_{ik} - d_{ik})\, w_k)$$

where λ and μ are lagrange multipliers. To look at this problem for an individual for a single food group, let's suppress subscripts *i* and *k*. Also, the price of the non food good be normalized to equal 1, i.e., $r = 1$. Then, Lagrangian is shown in equation (3.5).

(3.5) $$\mathcal{L} = G(F, C, Z) + J(F, Pf_q, Z) + \lambda(M - \sum F + H) + \mu(I - D - C - \sum w(F - d))$$

From here, first order conditions can be derived as:

(3.6) $$\frac{\partial \mathcal{L}}{\partial F} = \frac{\partial G}{\partial F} + \frac{\partial J}{\partial F} - \lambda - \mu w = 0$$

(3.7) $$\frac{\partial \mathcal{L}}{\partial C} = \frac{\partial G_i}{\partial C} - \mu = 0$$

(3.8) $$\frac{\partial \mathcal{L}}{\partial \lambda} = M - F + H = 0$$

(3.9) $$\frac{\partial \mathcal{L}}{\partial \mu} = I - D - C - wF = 0$$

Solving equations (3.6) through (3.9) simultaneously would yield solutions for F^* and C^*, optimal measures of food and non food consumption as functions of income, the price of meal plans, maximum calories consumed, physical activity, prices of food and non food goods, food consumption of peers and the individual heterogeneity term.

CHAPTER 4 - Data Collection and Description

4.1 Overview of the Data Collection Instruments and Process

College freshmen in the College of Agriculture at Kansas State University were recruited to participate in a year-long, three-part study while earning $30. In early September 2009, the students were asked to fill out a survey about their demographics, lifestyle, eating habits and also a food frequency questionnaire (FFQ) pertaining to their eating habits in high school. The students also agreed to have their height and weight recorded and sent a similar FFQ to their parents to fill out, at this stage the students were paid $5 for their time. The second stage of the survey occurred in November 2009 and involved the students filling out a food record with a college friend they ate meals with at least once a week. The food records were to be filled out for three days and they were asked to include what they ate, whom they were with, what other activities they were doing at the time, the time of day and to rate their hunger on a hunger/fullness scale before they began eating. When the journals were submitted the students had their height and weight taken for the second time and their friends also were measured; the student was paid $10 and their friend was also paid $10 as an incentive for their participation. The third and final step, in April 2010, involved the students coming in for a final FFQ to capture their eating habits after eight months in college and one final measurement collection. The students were paid their final installment of $15 at that time. The next sections will describe the FFQs, the food records, the parents' survey and the demographic information collected.

4.2 Weight and Height Measures

The student's height and weight were measured at each collection period, because some students were still growing taller. Weights were recorded to the tenth of a kilogram and height to the half inch. Students were asked to remove jackets, sweatshirts and shoes and also to take anything heavy out of their pockets before getting on the scale. Also, heights were measured without shoes.

BMI was calculated using the height and weight measures. A person's BMI is not a perfect proxy for health. Ideally, it would be better to capture other measures, such as blood glucose, blood pressure, or cholesterol, which have more direct links to health outcomes. However, BMI is relatively easier to collect because it does not involve a blood draw or the help of any skilled professionals. For the purposes of this study, the focus was on the changes in eating habits that may ultimately cause weight gains and unhealthy lifestyles. The benefit of using BMI is that it takes height into account. Because college age students, particularly male students, may still be growing, BMI is one way to take their growth into consideration. Some studies that collected more rigorous measurements have shown that weight gain in the first year of college predominately comes from gain in fat, associated with increased waist circumference (Hoffman et al., 2006; Gropper et al., 2009).

4.3 The Food Frequency Questionnaire

The instrument used to collect food intake is critical. This is not a nutrition study, but in order to be as accurate as possible in the reporting of foods consumed by each individual, it is essential to use a validated instrument (Willett, 1998), which means that

the responses from the questionnaire have been compared to observed and measured consumption, suggesting that it covers almost all of the foods that people actually eat. This would be a difficult task if the instrument was to be originally developed and validated by researchers each time they desired to collect food intake data. Fortunately, there are several resources in the nutrition field that offer FFQs to be utilized for research purposes. While FFQs are typically an overestimation of food intake, they capture a wide variety of foods in most diets so their responses may be slightly more representative of usual food intake than those based on a 24-hour food recall or food record (Willett, 1998). Even though some accuracy in measurement may be sacrificed, more information is collected about an extended period of time.

The Nurses' Health Study (NHS) is one FFQ that is available for public use. This FFQ was originally developed in 1976 and has since been revamped to include lifestyle changes. The NHS FFQ questionnaire has been validated in various groups, including men, women and young adults. The NHS questionnaire includes various questions about family history, physical and personal characteristics and physical activity along with the FFQ. For this study, we chose to use only the FFQ portion of the NHS.

Following the NHS FFQ, the FFQ used in this study was divided into eight categories of food: beverages, dairy, main dishes (which include meat and fish), breads/grains/cereals, fruits, vegetables, condiments, and snacks/desserts. Each category contains a list of several foods and a unit of measure. The respondents are asked to check how frequently they eat these foods. The frequency scale is given by: "Never, or less than once per month", "1-3 per month", "1 per week", "2-4 per week", 5-6 per week", "1 per day", "2-3 per day", "4-5 per day" and "6+ per day".

To aid the students in determining how much of the foods they typically ate, they were given a portion-size-comparison conversion scale. This scale allowed the students to think about portions that are harder to measure. For example, one apple or one banana is an easy thing to measure, but a 4-ounce serving of meat or a half cup of vegetables is more challenging to visualize. This scale makes associations between less intuitive units of measure and everyday objects (and the objects were on display for them as they filled out the FFQ); for instance, one pancake is about the circumference of a compact disc or a 4-ounce serving of meat is about the size of a deck of playing cards. The entire conversion scale is attached in appendix A.1.

The FFQ also included specific questions from the NHS about food consumption, including the fat content of milk normally used, how often excess visible fat was cutoff of meats instead of consumed, vitamin supplements taken, and brands of margarine and cereal normally eaten. The entire FFQ appears in appendix A.2 in the parent survey.

4.4 The Food Records

Food records are commonly used by doctors or nutritionists to track how much of what items people are eating. There seems to be no standard format for how this information is collected except that it should be very detailed. Typically, it is recommended that the food record cover a minimum of three days, but more days are preferred if it is feasible (Buzzard, 1998). If a whole week is not being covered by the journal, it is also recommended that one weekend day be recorded. However, it is likely that a good portion of the students participating in this study may travel home to visit their family on a given weekend because many of the students are Kansas natives. Because this study is focused on students' eating habits when they are away from

parental influences, three weekdays and no weekend days were captured. The students were asked to fill out the journals on a Tuesday, Wednesday and Thursday during November 2009, but prior to Thanksgiving week, so that we would not get inflated food consumption records.

The students were given a page of instructions on how to appropriately fill out the food records. This included information stressing how important it was that they record everything eaten and drunk, even a piece of chewing gum and water. It was also emphasized that they fill out the chart immediately after eating something so as not to forget the details. A sample of the food record is in appendix A.3. The portion-size-comparison scale was also attached so they could estimate the amounts of foods they ate more accurately.

The journals were in table format with column headings pertaining to the specific things we wanted them to record. They were asked to fill out the journals so that each row corresponded to a specific food item. The information collected for each food item consumed were: time of day, description and amount of the item (including brand), if they considered the food item part of a specific meal or a snack, whom they were with, where they were, other activities they might have been doing (such as watching TV, reading, and talking), and a rating of their hunger/fullness at the time they began eating. The first three pieces of information are common to all food records. We included the last bits of information to help us identify the peer influence, determine if they were distracted while eating, and whether or not they were eating when they were hungry or not. The hunger/fullness scale used was taken from the US Department of Veterans

Affairs as part of their weight management program for Veterans (USDVA, 2009) and is also included in appendix A.4.

Typically, food records or 24-hour food recalls are used to validate FFQs. So, this method of collecting food intakes is considered a benchmark. However, it is still prone to error (Buzzard, 1998). Some participants may not accurately estimate portion sizes or describe the type or brand of food they ate. Of course, there is potential for behavior to change when participants know they are under observation

4.5 The Parents' Survey

At the time of the first weight collection, the students were asked to address an envelope to their parents. The envelopes were stuffed with surveys and sent to their parents in early October and asked for them to be completed and returned by November 12th, 2009. A letter included with the survey explained that their child was participating in our study and was being paid and asked if they could take the time to complete the questionnaire. The main food preparer in the household was asked to complete a FFQ similar to the ones their children filled out. They were asked to fill out the FFQ for themselves only, so we would specifically capture the eating habits of the main food preparer in the household. They were also provided a portion-size-comparison scale.

In addition to the FFQ, they were asked demographic questions and questions about their eating habits. This questionnaire is included in appendix A.2. Parents were given open-ended questions on their relationships to the students, their age, the number of children they had, the number of children that live with them, and the person who is primarily responsible for food shopping and meal preparation at their home.

4.6 Descriptive Statistics

This section lays out statistics from the observations collected from various questionnaires and from various stages of the study. Each heading will indicate the instrument or format used and the questions used to obtain the responses will be described in detail in that section.

4.6.1 Demographics

4.6.1.1 September Student Demographics

Some of the demographics were only collected in September because of their static nature. All of the descriptive statistics on participants from the September and April surveys can be seen in table 4.1 below. These statistics, and all of the statistics in the following sections, represent the students that remained in the study for the full duration. Gender is accounted for by the variable *female*: 33 (73.3%) of the participants were female and twelve (26.7%) were male. When asked about race, respondents were allowed to select more than one ethnicity if they felt they identified with more than one. In the sample, 43 participants selected "White", two said they identified as "African-American", zero identified as "Asian", two identified as "Native American" and three identified as "Hispanic". These variables are labeled as *r_white*, *r_black*, *r_asian*, *r_native*, and *r_hispanic*, respectively. The variable *sib* is a measure of the number of siblings the student has. On average, the response was 2.31 siblings with a standard deviation of 1.29. The minimum and maximum values were two and six siblings, respectively.

Table 4.1. Demographics of Students.

Demographics		September 2009		April 2010	
Variable	**Description of Variable**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
age	Age (years)	18.09	0.29	18.69	0.60
children	Has children (1 =has one or more child; 0 = has no children)	0.02	0.15	0.02	0.15
female	Gender (1 = female; 0 = male)	0.73	0.45		
oncampus	Lives on campus (1 = on-campus housing; 0 = off-campus housing)	0.89	0.32	0.82	0.39
Preg	Female student was pregnant at the time the survey was given (1=yes;	-	-	0.04	0.21
r_asian	Identifies as Asian (1 = Asian; 0 = otherwise)	0.00	0.00	-	-
r_black	Identifies as Black (1 = Black; 0 = otherwise)	0.04	0.21	-	-
r_hispanic	Identifies as Hispanic (1 = Hispanic; 0 = otherwise)	0.07	0.25	-	-
r_native	Identifies as Pacific Islander or Native American (1 = Pacific Islander or Native American; 0 = otherwise)	0.04	0.21	-	-
r_white	Identifies as White (1 = White; 0 = otherwise)	0.93	0.25	-	-
roommates	Number of roommates			2.27	0.69
sib	Number of siblings	2.31	1.29		
smoke	Currently smokes (1 = yes; 0 = no)	0.00	0.00	0.00	0.00
tuition	Method of paying for college expenses (1=parental support; 2=scholarships/grants; 3=loans; 4=out of pocket; 5=combination of above)		Freq. of response	Freq. of response	
		1	26	26	
		2	41	35	
		3	27	20	
		4	11	14	
		5	0	3	

*n=45 for both September and April.

The average age of the student was 18.09 years with a standard deviation of 0.29 years (*age*). The minimum and maximum values were eighteen and nineteen years, respectively, as is expected from a group of college freshmen. One participant indicated that they had at least one child and this is represented in the variable *children*. None of the students in the sample were smokers (*smoke*). The variable *oncampus* is a binary variable indicating whether the student lives on campus (dormitory, Greek housing, etc.) or off campus (apartment or still at home). Of the 45 respondents, 40 indicated that they lived on campus and the remaining five said they lived off campus.

The students were also asked how they were paying for their tuition and college expenses. They were given a list of five choices: "Parents are helping defray costs", "I have scholarships/grants", "I am taking out loans", "I am paying out of my own pocket", or "other". The students were asked to check all that applied. Of the responses, 26 said they had parental support, 41 had scholarships and grants, 27 were taking out loans, eleven were paying out of their own pocket and none said other. Looking at the combinations, four students selected all four options, and six students selected only one of the options. Of those six students, all were being fully funded by scholarships and grants. The tuition payment options could be divided in terms of the student baring all costs (e.g., selecting only the taking out loans and/or paying out of own pocket options), the student not having any tuition costs (e.g., selecting the parents helping and/or the scholarship options), or somewhere in between. Of the 45 students, fifteen were having parents and scholarships pay for tuition, none were baring all the tuition cost alone and the remaining 30 were baring some of the costs while getting help from other sources.

4.6.1.2 April Student Demographics

The average age of the student increased slightly to 18.69 years with a standard deviation of 0.60 years. The minimum and maximum values were eighteen and 20 years, respectively. In April, the same one participant indicated having at least one child. Every student in the sample remained a non-smoker. The female students were asked if they were pregnant, this is captured by the variable *preg*. Of the 33 females in the sample, two indicated that they were currently pregnant, although not visibly pregnant at the time April information was collected.

The *oncampus* variable shifted slightly. Of the 45 respondents, now 37 indicated that they lived on campus, and the remaining eight said they lived off campus. As compared to September, three students switched from on campus housing to off campus housing. Students were also asked about the number of roommates living with them (*roommates*). On average, the participants had 2.27 roommates with a standard deviation of 0.69. The minimum and maximum values were one and four roommates, respectively.

The students were again asked how they were paying their tuition and college expenses. Of the responses, the same 26 said they had parental support, while 35 (six fewer than in September) reported having scholarships and grants, 20 (seven fewer) said they were taking out loans and three more were paying out of their own pocket and three said other. Those that choose other explained that other family members were helping pay or there was a split between tuition and books agreed upon by them and their parents.

Looking at the combinations, the same four students selected all four options, but now eleven (five more) students selected only one of the options as compared to September. Of those eleven students, five were being fully funded by scholarships and grants as compared to six in September. The remaining six were having their parents

defray all cost. Of the 45 students, five more were having parents and scholarships pay for tuition than in September, two students (compared to none) were baring all the tuition cost alone and the remaining 23 were baring some of the costs and getting help from another source.

4.6.1.3 Parent Demographics

Parents were asked a series of questions about their demographics. Results can be seen in table 4.2. First, they were asked to state their relationship to the student (*relation*). Of the 45 usable responses, 37 surveys were filled out by the student's mother, five were filled out by the father, and three were filled out by both parents. The average age of the parent was 48.4 years old with a standard deviation of 3.9 years; minimum and maximum ages were 41 and 59 years, respectively.

The variable *child* measures how many children the parent had. On average the response was 2.96 children with a standard deviation of 1.17. The minimum and maximum values were one child and six children, respectively. The discrepancy between the student and parent responses are likely due to the counting (or not counting) of step siblings and/or half siblings. The variable *childhome* is a measure of the number of children that still live at home with the parent. The average response was 1.18 with a standard deviation of 1.09. The minimum and maximum values were zero and four, respectively.

Table 4.2. Demographics of Parents

Variable	Description of Variable	Mean	Std Dev
age	Age of parent	48.40	3.94
child	Number of children	2.96	1.17
childhome	Number of children still living at home	1.18	1.09
house	Type of housing (1=rental apartment; 2=rental house; 3=own house)		Frequency of response
		1	0
		2	1
		3	44
income	Annual household income *before tax* (1=less than 10,000; 2=10,000-14,999; 3=15,000-24,999; 4=25,000-34,999; 5=35,000-49,999; 6=50,000-74,999; 7=75,000-99,999; 8=100,000-149,999; 9=150,000-199,999; 10=200,000 or more)		Frequency of response
		1	0
		2	0
		3	1
		4	2
		5	4
		6	6
		7	7
		8	17
		9	6
		10	1
relation	Parent who filled out the survey (1=Mom; 2=Dad; 3=both)		Frequency of response
		1	37
		2	5
		3	3
rural	Live outside of city limits (1=yes; 0=no)	0.50	0.50

The variable *income* represents the range of the household's annual before tax income. Of the 45 respondents, one declined to answer the question, but on average the household fell into the $75,000 to $99,999 range. Of the 44 parents that did respond, one (2.3%) chose "$15,000 to $24,999", two (4.5%) chose "$25,000 to $34,999", four (9.1%)

chose “$35,000 to $49,999”, six (13.6%) chose “$50,000 to $74,999”, seven (15.9%) chose “$75,000 to $99,999”, 17 (38.7%) chose “$100,000 to $149,999”, six (13.6%) chose “$150,000 to $199,000” and one (2.3%) chose “more than $200,000”. No one chose the ranges below $15,000. According to the US distribution of inflation adjusted household incomes from the American Community Survey (ACS, 2008), 7.2% of household fall into the “less than $10,000” category, 5.5% in the “$10,000 to $14,999”, 10.6% in the “$15,000 to $24,999”, 10.6% in the “$25,000 to $34,999”, 14.2% in the “$35,000 to $49,999”, 18.8% in the “$50,000 to $74,999”, 12.5% in the “$75,000 to $99,999”, 12.2% in the “$100,000 to $149,999”, 4.3% in the “$150,000 to $199,000” and 4.2% in the “more than $200,000”. The median annual income for the US is $52,175 and the sample median income is in the $100,000 to $149,999 range. The sample is skewed towards the higher end of this income distribution when compared to the US, which may be expected given that they are sending their children to universities.

The variable *house* is an indicator of the family’s type of housing. Of the 45 respondents, none responded “rental apartment”, one said “rental house”, and the remaining 44 selected “own house”. The variable *rural* is a measure of whether or not the family lived within the city limits. The response was nearly evenly split with 23 of the 45 respondents living within city limits and 22 living outside the city limits. This can be misleading because some of the cities where the participating families reside are still likely considered to be rural in the sense of development. Thus, the respondent’s zip codes were used to associate their location with state and county (counties) according to one of the Economic Research Service’s definitions of rural or urban. If the county was considered to be in a metropolitan statistical area as defined by the US Office of

Management and Budget, they were marked "0" for urban, otherwise "1" for rural. A metro area in this case was defined as being "one or more counties containing a core urban area of 50,000 or more people, together with any adjacent counties that have a high degree of social and economic integration with the urban core" (ERS-USDA, 2010). When looking at the results of zip code analysis, there is a nearly even split between rural and urban. About 24 live in metro counties and about 21 live in non metro counties. Compared with the original measure, 34 were classified the same, six lived within the city limit of their town, but were classified rural by the second method and five did not live with their town limits but were classified urban.

4.6.2 Body Mass Index

Table 4.3 includes the final BMI calculations from the height and weight data. The final sample included 45 students. As the school year progressed, the average BMI increased and three more students joined the obese and overweight categories. In September, the rates of obesity and overweight were 2.2% and 28.9%, respectively. The rates were stagnant in November, but in April they increased to 4.4% for obesity and 35.6% for overweight. The Behavioral Risk Factor Surveillance System (BRFSS) of the CDC estimated obesity and overweight rates were 17.8% and 29.1%, respectively, in the state of Kansas for young adults ages 18-24 (BRFSS, 2009). The national rates of obesity and overweight for the same year and age group were 17.7% and 25.3%, respectively. This sample is similar in terms of overweight adults, but not in terms of obese adults. This could be due to the fact that the age range of this sample is at the low end of the state and national ranges described above. It could also be related to the fact

that participation in the study was voluntary and students that were more interested in food choice (i.e., more conscious eaters) opted to join the study.

Table 4.3. Student's BMI Statistics.

	Average	Std. Dev.	Max	Min	# Underweight	# Normal Weight	# Overweight	# Obese
Sept.	23.464	2.797	30.376	18.217	1	30	13	1
Nov.	23.527	2.850	30.348	18.372	1	30	13	1
April	24.130	3.090	32.046	17.925	1	26	16	2

*n=45

Initially, 60 students completed the survey and height and weight measurements in September. In November and April, 45 of those students were retained for the final sample. Table 4.4, shows a comparison of the September demographics for the students that dropped from the study and those that participated for the remainder. Almost all of the variables are statistically equivalent, with the exception of *bmi* and *r_hispanic*. The *r_hispanic* variable was significant because there were no students who identified as Hispanic that left the study. The students that dropped from the study had a slightly larger BMI at the 10% significance level than those that were retained for the entire duration. This suggests that heavier students may have self-selected out of the study.

4.4. Demographics Compared to Students that Dropped from the Study after September.

		September 2009		Dropped Students	
Variable	**Description of Variable**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
age	Age (years)	18.09	0.29	18.00	0.38
bmi	BMI (kg/m2)	23.46	2.80	25.38*	3.98
children	Has children (1 =has one or more child; 0 = has no children)	0.02	0.15	0.00	0.00
gender	Gender (1 = female; 0 = male)	0.73	0.45	0.60	0.51
oncampus	Lives on campus (1 = on-campus housing; 0 = off-campus housing)	0.89	0.32	0.73	0.46
r_asian	Identifies as Asian (1 = Asian; 0 = otherwise)	0.00	0.00	0.07	0.26
r_black	Identifies as Black (1 = Black; 0 = otherwise)	0.04	0.21	0.13	0.35
r_hispanic	Identifies as Hispanic (1 = Hispanic; 0 = otherwise)	0.07	0.25	0.00*	0.00
r_native	Identifies as Pacific Islander or Native American (1 = Pacific Islander or Native American; 0 = otherwise)	0.04	0.21	0.00	0.00
r_white	Identifies as White (1 = White; 0 = otherwise)	0.93	0.25	0.80	0.41
sib	Number of siblings	2.31	1.29	3.40	2.50
smoke	Currently smokes (1 = yes; 0 = no)	0.00	0.00	0.00	0.00
		n=45		n=15	

*indicates the mean of the dropped student sample is statistically different from the retained September sample at the 10% level

4.6.3 FFQs and Food Records

Food intake data were converted to calorie values using the USDA's online search tool "What's in the Foods You Eat" (USDA, 2009). The average daily calorie intake of each food group was calculated for each participant filling out either an FFQ or a food record. The eight categories were merged into six, where condiments and meats/main dishes were combined, and the fruit and vegetables categories were combined. To obtain the daily averages, FFQ totals for each food group were divided by 28 (the number of

days in 4 weeks) and the food record totals for each group were divided by three (for the number of days the record was filled out). The descriptive statistics for the average daily intakes of each food group are shown in table 4.5.

Table 4.5. Average Daily Calorie Intake by Food Group and Participant.

		Beverages	Dairy	Meats & Main Dishes	Breads & Grains	Fruits & Veggies	Snacks & Desserts	Total Calories
Sept.	Student	124.09	421.54	1302.23	672.43	454.01	839.63	3815.99
		(145.75)	(229.44)	(1378.11)	(490.47)	(404.34)	(684.62)	(2878.22)
		3%[a]	11%	34%	18%	12%	22%	
	Parent	157.19	335.19	788.05	413.95	267.72	397.32	2359.40
		(248.23)	(666.50)	(315.54)	(192.35)	(151.53)	(207.80)	(1004.65)
		0.07	0.14	0.33	0.18	0.11	0.17	
Nov.	Student	182.80	215.46	991.15	423.72	127.81	611.67	2552.87
		(207.23)	(181.25)	(507.68)	(260.21)	(113.26)	(558.76)	(849.34)
		7%	8%	39%	17%	5%	24%	
	Friend	165.64	169.99	908.25	414.04	94.73	437.92	2190.57
		(191.94)	(182.70)	(355.10)	(24.70)	(103.48)	(256.2)	(593.7)
		8%	8%	41%	19%	4%	20%	
April	Student	233.68	296.98	999.94	501.85	322.23	516.80	2871.61
		(216.26)	(201.95)	(622.14)	(271.89)	(217.58)	(394.96)	(1462.13)
		8%	10%	35%	17%	11%	18%	

September and April values are from FFQs, November values are from food journals.
Standard deviations in ().
[a] percent of total calories

It seems that the students increased their average daily intake of beverages over the seven month period, while seemingly decreasing consumption of the other food groups for an overall reduction in total calories from September to April. This result is consistent with Jung, Bray and Ginis (2008), who also found an overall reduction in calories from the beginning of students' freshmen year to the beginning of their

sophomore year, but still observed an average weight gain in their cohort. As compared to their parents, in September, the students recorded taking in more calories than their parents in every category except beverages. By April, they might have adjusted to imitate their peers' consumption habits, assuming the peers' consumption is constant. As compared to their friends, the students' seemed to be eating in similar proportions to their friends, but their friends were consuming fewer calories on average in terms of average daily intake across all categories.

The USDA dietary guidelines (2005) recommend that females in the fourteen to eighteen year age group consume 1,800 calories daily if they are relatively sedentary, 2,000 if they are moderately active and 2,400 calories daily if they are very active. For males in the same age group, it is recommended to get 2,200 calories daily if they are sedentary, about 2,600 calories daily if moderately active and 3,000 calorie if they are very active. A look at the breakdown of total calories by gender in table 4.6, shows that students are consuming well more than what an active person needs. In September, you can see that on average, regardless of gender, more than 3,000 calories are being consumed. By November, both groups decrease calorie intake. The females however, are still eating enough calories for a very active woman and the males are getting calories for somewhere in between a moderately and very active person on average. In April, both groups see spikes in their calorie totals again. Females are consuming more than the 2,400 calories recommend by the USDA for a very active person, but the males are still in between the moderately active and very active ranges. Even though the students calories are reduced by April, they still are consuming more than what they need, unless

they are very active. If the student's are not active or are much less active than they were in high school, weight gain is imminent.

Table 4.6. Average Daily Calorie Intake by Gender.

	September		November		April	
	Female[a]	Male[b]	Female	Male	Female	Male
Mean	3097.12	4983.26	2480.22	2752.63	2874.54	2863.56
St. Dev	1151.11	4365.18	692.73	1195.89	1640.85	847.83
Min.	1642.51	2407.08	1468.94	1327.09	1193.36	1853.34
Max	7013.7	12812.5	4125.75	5437.6	9950.41	4421.61

[a] n=33 for females

[b] n=12 for males

Correlations between the students, parents and friends by food group are shown in table 4.7. In terms of total calories, none of the correlations are very strong, but the student-to-parent and the student-to-friend correlations on total calories are statistically different. However, the student-to-parent and student-to-friend correlations are statistically equivalent for all groups except fruits and vegetables and meats and main dishes. Overall, the students and their friends are most similar in bread/grain consumption and meat consumption. The student-to-parent correlations are most similar in beverage consumption, although this value is not different from zero. When comparing correlations from the student responses in September and April, beverage intake is most highly correlated with a positive correlation of 0.254, while bread and grain consumption is the least similar with a negative correlation of 0.249. The friend-to-parent correlations are negative for fruit and veggie consumption and of a similar

magnitude to the student-to-parent correlation of fruit and veggies, but correlation of meats and main dishes is statistically different from zero and positive.

Table 4.7. Correlations of Calories by Food Group and Participants.

	Beverages	Dairy	Meats & Main Dishes	Breads & Grains	Fruits & Veggies	Snacks & Desserts	Total Calories
Student/Friend	-0.084 [a]	-0.068 [a]	0.167 [a]	0.259 [ab]	0.012 [ab]	-0.029 [ac]	0.160 [a]
Student/Parent	0.194 [ab]	0.093 [a]	-0.306* [b]	0.053 [a]	-0.299* [c]	-0.179 [a]	-0.170 [b]
Student (Sept/Apr)	0.254 [b]	-0.013 [a]	-0.045 [ab]	-0.249	0.131 [a]	0.078 [ab]	-0.027 [ab]
Friend/Parent	-0.230 [a]	-0.136 [a]	0.038 [a]	0.370* [b]	-0.223 [bc]	0.135 [bc]	-0.100 [ab]

*indicates the correlation is statistically different from zero.
For each column, shared letter superscripts indicate statistical equivalence at the 10% level.

The breakdown of food groups was also compared by separating the students into those that gained weight from September to April (an increase in BMI) and those that did not gain or lost (no change in BMI or decrease in BMI). These statistics can be seen in table 4.8. For this table, beverages were also disaggregated into alcoholic and non alcoholic. Those that maintained or lost weight increased alcoholic beverage consumption less than those that gained, but increased non alcoholic beverage consumption more than those that gained, consuming more total beverage calories on average in April.

Table 4.8. Breakdown of Food Groups by Gainers (Change in BMI>0) and Maintainers/Losers (Change in BMI< or=0)

			Total Beverages	Non-Alcoholic Beverages	Alcoholic Beverages	Dairy	Meats & Main Dishes	Breads & Grains	Fruits & Veggies	Snacks & Desserts
Sept.	Gainers	Avg.	131.355	126.926	4.429	402.536	1352.400	717.511	469.968	898.466
		St. Dev	153.831	152.214	10.279	224.834	1510.420	522.989	442.966	750.782
		Min	0.000	0.000	0.000	136.963	377.471	176.475	55.609	23.632
		Max	800.573	790.287	41.143	1177.440	8714.940	3033.700	2108.100	3576.260
	Losers	Avg.	105.169	102.598	2.571	497.544	1101.530	492.108	390.165	604.294
		St. Dev	119.130	117.032	5.143	245.486	638.676	284.064	187.095	184.273
		Min	0.000	0.000	0.000	124.669	557.954	150.566	82.182	388.749
		Max	339.825	339.825	12.857	860.093	2601.970	1065.200	728.915	911.567
April	Gainers	Avg.	228.142	186.037	42.106	291.020	1006.190	485.193	310.088	527.587
		St. Dev	219.710	229.656	78.394	201.796	668.879	277.274	195.967	395.179
		Min	0.000	0.000	0.000	31.621	294.023	40.240	50.357	69.817
		Max	1222.960	1222.960	360.200	752.062	4156.150	1247.120	859.443	1862.640
	Losers	Avg.	255.831	240.187	15.644	320.805	974.926	568.487	370.783	473.672
		St. Dev	212.923	212.882	27.985	212.980	412.982	252.934	298.416	414.859
		Min	14.743	3.459	0.000	96.250	386.427	216.632	49.717	71.359
		Max	644.671	644.671	85.800	733.259	1563.880	955.711	855.033	1335.770

Looking across all food groups, those that increased BMI were consuming more of each food group in September than those that maintained or decreased BMI with the exception of dairy. Both groups consumed fewer calories from all food groups except beverages, and those that maintained or decreased BMI increased their intake of breads and grains from September to April. Those that gained had decreased the amount of fruits and vegetables by more on average than their counterparts.

In addition to the food groups, the breakdown of total calories from macronutrients was also calculated for the students, parents and friends. Again the USDA's search tool (USDA, 2009) was used to calculate calories coming from fats, proteins and carbohydrates. Those numbers are shown in table 4.9. It is easy to see that the students are consuming far more of all three nutrients than their parents. However, in November and April all of their levels of intake go down to levels that are more similar to what their parents were consuming. This could simply indicate a response by the students to compensate for a less active lifestyle or it could signify the peer effect. It is also possible that in April, the students are better at completing the FFQ and survey. The 45 students that were in the study for the entire duration completed the FFQ and survey with an average time of 22 minutes and four seconds and a standard deviation of nine minutes. In April, the same students had an average completion time of seventeen and a half minutes with a standard deviation of four minutes and six seconds. This was significantly lower than the September completion time at the 1% level.

The USDA recommendations on the intake of the macronutrients is that 45%-65% calories come from carbohydrates, 10%-35% of calories come from protein and 20%-35% of calories come from fat. When comparing these recommendations to the

percentage of total calculations in table 4.9, the percentage of daily fat intake is consistently above or at the high end of the recommended range for all participants in all time periods. Protein intakes are inside the recommended range for all participants and time periods as well, but they are closer to the low end of the range. Finally, percent daily values of carbohydrate intake are in the middle of the recommended range for all participants and time periods. Overall, it seems as though the structure of the dietary intake did not change much, but decreasing fat intake by only two percent from September to April is a change of just over 400 calories a day.

Table 4.9. Average Daily Nutrient Intakes by Participant.

		Fat	Protein	Carbohydrates	Total Calories
September	Student	1337.290 (1129.290)* 36%**	578.804 (509.866) 16%	1782.860 (1302.920) 48%	3698.954 (2878.22)
	Parent	791.458 (277.054) 35%	386.152 (142.486) 17%	1090.820 (623.106) 48%	2268.431 (1004.65)
November	Student	825.234 (328.460) 33%	400.580 (188.625) 16%	1259.230 (429.061) 51%	2485.044 (849.34)
	Friend	660.196 (280.495) 33%	333.712 (150.278) 17%	1021.580 (438.237) 51%	2015.488 (810.57)
April	Student	930.094 (509.748) 34%	438.601 (238.613) 16%	1394.670 (744.468) 50%	2763.365 (1462.13)

September and April values are from FFQs, November values are from food journals.
*Standard Deviation in parentheses
**percent of total

Macronutrient correlations are presented in table 4.10. The correlations of total calories by macronutrients between students and their friends are highest for carbohydrates. Both protein and fat have very small correlations and protein is negative. Student-to-parent correlations are highest for protein and again very low for fat and carbohydrates. Not surprisingly, correlations between September and April food intakes of the students are all positive and statistically different from zero. The correlations between students and parents, students and friends and parents and friends are all statistically equivalent for fat and protein, but they are not different from zero. For carbohydrates, student to friend and friend to parent correlations were statistically equivalent but again, not different from zero.

Table 4.10. Correlations of Macronutrients by Group and Participant.

	Fat	Protein	Carbohydrates
Student/Friend	0.021 [a]	-0.005 [a]	0.250 [a]
Student/Parent	0.028 [a]	0.219 [a]	-0.030
Student (Sept/Apr)	0.571*	0.465*	0.527*
Friend/Parent	0.130 [a]	0.169 [a]	0.276 [a]

*indicates the correlation is statistically different from zero.
For each column, shared letter superscripts indicate statistical equivalence at the 10% level.

The macronutrients were also examined by separating the students into those that gained weight from September to April (an increase in BMI) and those that maintained or lost (no change in BMI or decrease in BMI). These statistics can be seen in table 4.11 below. It is clear that both groups decreased average intake of all macronutrients from September to April. Those that lost or maintained weight had lower average intakes of

all macronutrients in September, but in April, those that gained had a lower average intake of carbohydrates.

Table 4.11. Breakdown of Macronutrients by Gainers (Change in BMI>0) and Maintainers/Losers (Change in BMI< or=0)

			Fat	Protein	Carbohydrates	Total Calories
September	Gainers	Avg.	1401.820	606.480	1848.580	3972.570
		St. Dev	1242.190	557.943	1431.430	3168.42
		Min	450.894	238.900	606.626	1642.51
		Max	7124.620	3374.910	7954.740	12812.50
	Losers	Avg.	1079.160	468.097	1519.950	3189.670
		St. Dev	411.870	225.008	524.658	1044.55
		Min	695.758	272.614	1010.240	2025.90
		Max	1873.260	939.197	2692.580	4830.68
April	Gainers	Avg.	959.375	464.617	1391.450	2848.340
		St. Dev	556.206	254.411	782.132	1526.87
		Min	321.673	159.254	593.569	1193.36
		Max	3280.200	1585.330	4982.880	9950.410
	Losers	Avg.	812.971	334.532	1407.590	2964.700
		St. Dev	237.428	121.440	609.691	1243.51
		Min	540.881	206.529	880.766	1227.97
		Max	1173.420	556.580	2705.150	4811.88

4.6.4 Eating Habits

This section describes the various questions related to eating habits of the respondents of the surveys. Each subsection highlights a different group and time frame in which the information was collected. September and April statistics can be seen in tables 4.12 and 4.13.

4.6.4.1 September Student Surveys

The variable *brkfst* is a measure of how many times per week the student ate breakfast when they were living with their parents in high school. Of the 45 responses,

one said “none”, six responded “one to two per week”, nine said “three to four per week”, nine said “five to six per week and 20 said “everyday”.

Table 4.12. Eating Habits of Students.

Variable	Description of Variable	September 2009		April 2010	
brkfst	Number of breakfasts eaten per week (0=none; 1=1 to 2 per week; 2=3 to 4 per week; 3=5 to 6 per week; 4=Everyday)		Freq. of response		
		0	1	5	
		1	6	13	
		2	9	5	
		3	9	10	
		4	20	12	
eatout	Number of meals per week eaten outside of the home/dormitory/apartment (0=none; 1=1 to 3 per week; 2=4 to 5 per week; 3=6 to 8 per week;4= more than 8 per week)		Freq. of response		
		0	4	3	
		1	21	29	
		2	13	10	
		3	3	2	
		4	4	1	
eatroom	Number of meals per week the student ate with their roommate(s) (0=never; 1=once or twice a week; 2=a few times a week; 3=once a day; 4=at every meal)		Freq. of response		
		0	-	14	
		1	-	8	
		2	-	12	
		3	-	6	
		4	-	5	
		Mean	**Std Dev**	**Mean**	**Std**
mealplan	Student is on a meal plan (1=yes; 0=no)	0.84	0.37	0.76	0.43
mealtype	Type of meal plan purchased (10= 10 meals per week plan; 15=15 meals per week plan; 20=20 meals per week plan)	-	-	12.44	7.66

The number of meals per week a student eats that are prepared outside of the home is captured by the variable *eatout*. The respondents were asked to exclude meals eaten at the school cafeteria from their response. Of the 45 responses, four said "none", 21 responded "one to three per week", 13 said "four to five per week", three indicated "six to eight per week" and four said "more than eight meals per week".

Students were asked if they currently had a campus meal plan. Of the 45 students, 38 said "yes" and the remaining seven said "no". The students were also asked if they were on any kind of special diet and to describe that diet. However, in September, none of the students were on a special diet.

The variable s*chef* indicates which member of the family was primarily responsible for food preparation in the household. Of the 45 responses, 36 said "mother", two said "father", five responded "themselves", and two said "combination of everyone in household". The variable s*foodshop* indicates which member of the family is primarily responsible for food shopping in the household. Of the 45 responses, 37 said "mother", four responded "father", two said "themselves", none said "another sibling" and two responded "other". The selection of "other" referred to some combination of themselves and/or a parent or sibling.

Number of days per week the student's family ate *at least one* meal together is captured by the variable *seatfam*. Of the 45 responses, one said "none", fourteen responded "one to three days per week", 22 responded "four to six days per week", and eight responded "seven days per week". The variable s*eattv* is a measure of the number of meals a family eats while watching television during a typical week. Of the 45 responses, eleven said "Never", thirteen said "at one to two meals a week", nine indicated

"at three to five meals a week", six responded "at one meal a day" and six said "at almost every meal".

4.6.4.2 April Student Surveys

In response to how many times per week the student ate breakfast now, five said "none", thirteen responded "one to two per week", five said "three to four per week", ten said "five to six per week and twelve said "everyday". Comparing this to September, four more students said "none" and seven more said "one to two per week" and one more said "five to six per week", but 4 fewer said, "three to four per week" and eight fewer said "everyday". So it seems that more students are opting out of eating breakfast in college.

The respondents were asked to exclude meals eaten at the school cafeteria in their response to the number of meals per week a student eats that are prepared outside of the home (*eatout*). Of the 45 responses, three said "none", 29 responded "one to three per week", ten said "four to five per week", two indicated "six to eight per week" and one said "more than eight meals per week". Comparing these responses to September, eight more students said "one to three meals per week", but 3 fewer students reported "more than eight meals per week", one fewer reported "six to eight meals per week", 3 fewer said "four to five meals per week" and one fewer responded "none". Overall, the shift seems to be toward eating fewer meals prepared outside of the home or dining center.

Number of meals per week the student ate with one or more of their roommates is captured by the variable *eatroom*. Of the 45 responses, fourteen said "never", eight responded "once or twice per week", twelve responded "a few times per week", six responded "once per day" and five said "at every meal".

Table 4.13. Eating Habits of Students (continued).

Variable	Description of Variable	September 2009		April 2010	
schef	Person who primarily prepares meals (*Sept* : 1=student; 2=mother; 3=father; 4=another sibling; 5=combination. *April* : 1=student; 2=roommates; 3=dining center; 4=combination)		Freq. of response		
		1	5	9	
		2	36	2	
		3	2	30	
		4	0	3	
		5	2	-	
seatfam	Number of meals per week the student's family eat together (0=none; 1=1 to 3 meals a week; 2=4 to 6 mealsmeals a week; 3=at almost every meal)		Freq. of response		
		0	1	-	
		1	14	-	
		2	22	-	
		3	8	-	
seattv	Approximate number of meals eaten while watching televison (0=Never; 1=once or twice a week; 2=a few times a week; 3=once a day; 4=at every meal)		Freq. of response		
		0	11	10	
		1	13	12	
		2	9	10	
		3	6	12	
		4	6	1	
sfoodshop	Person who primarily does food shopping (*Sept* : 1=student; 2=mother; 3=father; 4=another sibling; 5=combination. *April:* 1=student; 2=roommate; 3= both student and roommate; 4=other)		Freq. of response		
		1	2	32	
		2	37	0	
		3	4	9	
		4	0	4	
		5	2	-	
		Mean	**Std**	**Mean**	**Std**
spdiet	Follows special diet (1 = diet; 0=otherwise)	0.00	0.00	0.02	0.15

Students again were asked if they currently had a campus meal plan. Of the 45 students, 34 said "yes" and the remaining eleven said "no". Comparing this to September, there are now 4 fewer students on meal plans. If the student responded "yes" to being on a meal plan, they were given a follow up question about the type of meal plan they had purchased. Of the 35 on a meal plan, three selected the "ten meals per week plan", eighteen said the "fifteen meals per week plan" and the remaining thirteen said "the 20 meals per week plan". "The students were also asked if they were on a special diet and to describe that diet. One student of the 45 participating indicated that they were on a special diet and described that diet as a high calorie. This student was a member of the rowing team.

In April the variable s*chef* indicates which person or facility or family member is primarily responsible for food preparation in the dormitory or apartment or household. Of the 45 responses, nine said "themselves", two said "roommate", 30 responded "dining center on campus", and four said "a combination of those three". In April the variable s*foodshop* indicates which person or member of the family is primarily responsible for food shopping in the dormitory or apartment or household. Even if the student relied on the campus dining center for most meals, they were asked to respond in the case of buying snacks or other extra meals in addition to their meal plan. Of the 45 responses, 32 said "themselves", zero responded "roommate", nine said "both themselves and their roommate" and four responded "other". Other refers to some combination of themselves and/or a parent or sibling.

The variable s*eattv* is a measure of the number of meals the student eats while watching television during a typical week. Of the 45 responses, ten said "Never", twelve

said “at one to two meals a week”, ten indicated “at three to five meals a week”, twelve responded “at one meal a day” and one said “at almost every meal”.

4.6.4.3 Parent Surveys

Responses from the parent’s surveys on eating habits are summarized in table 4.14. The variable *chef* indicates which member of the family is primarily responsible for food preparation in the household. Of the 45 responses, 35 said “mother”, four said “father”, one responded “child” and five said “both mother and father”. These are quite similar to the student responses on food preparation and cooking in the household. The bulk of the responses indicated that their mother was responsible for cooking. The responses that were different were, one more student said mother, two fewer said “father”, four more said “child” and three more said combination of those in the household.

The variable *eatfam* is a measure of the number of days per week the family ate *at least one* meal together. Of the 45 useable responses, one indicated “none”, four responded “one to two days per week, seventeen said “three to four days per week, eleven said “five to six days per week” and twelve responded “seven days per week”. These responses are fairly consistent with the student’s responses; observations that do differ seem to be off only by one or two meals per week.

The variable *eattv* is a measure of the number of meals a family eats while watching television during a typical week. Of the 45 responses, nine said “Never”, twelve said “at one to two meals a week”, ten indicated “at three to five meals a week”, three responded “at one meal a day” and eleven said “at almost every meal”.

Table 4.14. Eating Habits of Parents.

Variable	Description of Variable	Mean	Std Dev
chef	Person in household primarily responsible for preparing meals(1=mom; 2=dad; 3=child; 4=both parents)		Frequency of response
		1	35
		2	4
		3	1
		4	5
eatfam	Number of meals per week the student's family eat together (0=none; 1=1 to 2 meals a week; 2=3 to 5 mealsmeals a week; 3=1 to 3 meals a day; 4=at almost every meal)		Frequency of response
		0	1
		1	4
		2	17
		3	11
		4	12
eattv	Approximate number of meals eaten while watching televison (0=Never; 1=once or twice a week; 2=a few times a week; 3=once a day; 4=at every meal)		Frequency of response
		0	9
		1	12
		2	10
		3	3
		4	11
foodshop	Person in household primarily responsible for food shopping (1=mom; 2=dad; 3=child; 4=both parents)		Frequency of response
		1	36
		2	7
		3	0
		4	2

The variable *foodshop* indicates which member of the family is primarily responsible for food shopping in the household. Of the 45 responses, 36 said “mother”, seven responded “father”, zero said “child” and two responded “both mother and father”.

These were also very close to the student responses on food shopping in September. Those responses differ slightly in that, one more student said “mother”, three fewer said “father” and two more said “child”.

4.6.4.4 November Eating Habits

Information collected in November was slightly different than the September and April surveys, because of the way the food record were set up. Through breaking up the journals into days and deciphering the handwriting of the students, the numbers of meals and snacks they ate were determined. Other information, such as how many meals they ate alone or with somebody, number of meals at the dining center and how many of the days they ate breakfast, was also deciphered from the journals. The following sub sections and table 4.15 below describes the eating habits found from the student’s and their friend’s food records.

4.6.4.4.1 Student’s Food Records

The total number of meals the student ate over the three day period was counted. Meals were defined based on them consuming a substantial quantity of food in one sitting (based on times they recorded). For example, eating a burrito and rice at 1:00pm would be a meal, but eating a brownie at 1:00pm would not. On average, the students ate 7.66 meals over the three day period with a standard deviation of 1.35 (*meals*). The minimum and maximum values were four and nine, respectively. Of the total meals eaten, the number of meals eaten alone and meals eaten with at least one other person were also tallied. For the number of meals eaten alone, the average was 2.25 meals with a standard deviation of 1.63 (*mealself*). The minimum and maximum values were zero and seven,

respectively. The number of meals eaten with at least one other person, had an average of 5.29 meals with a standard deviation of 1.74 (*mealfriend*). The minimum and maximum values were zero and nine, respectively. The average number of meals the students ate in a dining center was 4.40 meals with a standard deviation of 2.32 (*mealDC*). The minimum and maximum values were zero and nine, respectively.

Table 4.15. Eating Habits from November Food Records.

November		Student		Friend	
Variable	Description of Variable	Mean	Std Dev	Mean	Std Dev
eatwatch	Approximate number of meals eaten while watching televison (9 is maximum)	1.59	1.67	1.93	2.07
latesnack	Number of nights a snack was eaten after 9pm (3 is maximum)	1.25	0.87	0.93	1.03
nbreak	Number of breakfasts eaten (3 is maximum)	2.13	1.13	1.95	1.19
meals	*Total number of meals eaten during the three day period (9 is max)*	7.66	1.35	7.56	1.4
mealDC	number of meals at campus dining center (max 9)	4.40	2.32	4.52	2.87
mealfriend	Number of meals eaten with another person	5.29	1.74	5.24	2.28
mealself	Number of meals eaten alone	2.25	1.63	2.12	1.78

The number of breakfasts the student ate over the three day period was counted. A food item was counted as breakfast if it was eaten prior to 10:30am and was substantial (i.e., a cup of coffee was not counted as breakfast, but toaster pastries or granola bars were). On average, the students ate 2.13 breakfasts over the three day period with a standard deviation of 1.12 (*nbreak*). The minimum and maximum values were zero and three, respectively. The variable *snack* was a measure of the number of days the student

had at least one snack after 9:00pm. The overall average was 1.25 days with a standard deviation of 0.87. The minimum and maximum values were zero and three, respectively. The variable *eatwatch* was a measure of how many meals the student ate while engaged in distracting activities like watching television, doing homework, using the computer, or reading. On average the student ate 1.59 meals while engaging in these activities with a standard deviation of 1.67. The minimum and maximum values were zero and six, respectively.

4.6.4.4.2 Friend's Food Records

The same information was collected from the friend's food records. For all of these measures, the differences in the means between the student's and the friend's responses were not statistically different, validating the consistency in the data collected. On average, the students' friends ate 7.56 meals over the three day period with a standard deviation of 1.40 (*meals*). The minimum and maximum values were five and nine, respectively. For the number of meals eaten alone, the average was 2.12 meals with a standard deviation of 1.78 (*mealself*). The minimum and maximum values were zero and seven, respectively. The number of meals eaten with at least one other person, had an average of 5.24 meals with a standard deviation of 2.28 (*mealfriend*). The minimum and maximum values were zero and nine, respectively. The average number of meals the students' friends ate in a dining center was 4.52 meals with a standard deviation of 2.87 (*mealDC*). The minimum and maximum values were zero and nine, respectively.

On average, the students' friends ate 1.95 breakfasts over the three day period with a standard deviation of 1.19 (*nbreak*). The minimum and maximum values were zero and three, respectively. The variable *snack* had an average of 0.93 days with a

standard deviation of 1.03. The minimum and maximum values were zero and three, respectively. The variable *eatwatch* had an average of ate 1.93 meals for the students' friends with a standard deviation of 2.07. The minimum and maximum values were zero and six, respectively.

4.6.5 Physical Activities

The students were asked to give information about their physical activities in September and April. The responses to those survey questions are presented in the subsections below and the statistics from September and April can be seen in table 4.16.

4.6.5.1 September Physical Activities

Students were asked to give the average number of days in a week that they were physically active. The students were instructed that physically active meant doing enough of an activity to "at least break a sweat". On average, they were active 2.44 days with a standard deviation of 0.99 (*dayex*). The minimum and maximum values were zero and five days, respectively. The students were then asked to give an estimate of the average minutes they were physically active on those days. The average response was 75.45 minutes with a standard deviation of 46 minutes (*minex*). The minimum and maximum responses were zero and 180 minutes, respectively. Finally the students were asked if they participated as an athlete in a high school sport. Of the 45 students responding, 36 said "yes" and the remaining nine said "no".

Table 4.16. Physical Activities of Students.

		September 2009		April 2010	
Variable	**Description of Variable**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
dayex	Average number of days per week the student would be physically active	2.56	0.99	3.16*	0.95
intramur	Participates in intramural sports (April only)			0.49	0.51
minex	Average minutes of physical activity on days when student was physically active(dayex)	75.45	46.00	55.63*	29.81
sport	Participated(s) as an athlete (HS is sept measure, college is april	0.80	0.40	0.04*	0.21

**indicates April value is statistically different from the September value*

4.6.5.2 April Physical Activities

Students were again asked to give the average number of days in a week that they were involved in physical activities that made them "at least break a sweat". On average, they were active 3.16 days with a standard deviation of 0.95 (*dayex*). The difference from the September mean value was statistically different at the 1% level. The minimum and maximum values were one and five days, respectively. The students were again asked to give an estimate of the average minutes they would exercise on the days they were physically active. The average response was 55.95 minutes with a standard deviation of 29.28 minutes (*minex*). This was statistically fewer than the September average at the 1% level, suggesting that students were spreading their physically active minutes across more days. The minimum and maximum responses were zero and 160 minutes, respectively. Students were additionally asked if they participated in any intramural sports. Of the 45 students, 22 said "yes" and the remaining 23 said "no" (*intramur*). Finally the students were asked if they participated as an athlete in a college

sport. Of the 45 students responding, 2 said "yes" and the remaining 43 said "no" (*sport*). The difference in the average of those participating in high school sports versus those participating in college sports is statistically significant at the 1% level.

4.6.6 Student Perceptions of Weight and Health

In the April survey, students were asked a series of questions about how they perceived themselves and their health since attending college. These responses are shown in table 4.17. One question listed some main symptoms of depression per the Mayo Clinic (2010) and the students were asked to check all boxes that they felt they had experienced them on a regular basis over the last three to six months (since they have been away at college). The symptoms included were: fatigue or loss of energy, changes in appetite (loss of or increase in), agitation or restlessness, trouble concentrating, loss in interest of activities once enjoyed, insomnia or excessive sleeping, feelings of worthlessness, unexplained physical pains (like neck or back pains). There was also a comment box for the students to note other symptoms or explain. Also, the student had the option to indicate that they did not experience any of these symptoms. The variable *depress* was a way to measure if the student was experiencing at least a mild form of depression. If the student admitted to having experiencing three or more of the symptoms, the value of 1 was assigned to *depress*. But if the student checked they had experienced two or fewer of the symptoms listed, *depress* was set to 0. Overall, eleven students checked three or more symptoms. However, two explained reasons in the comment section for experiencing some of their symptoms. One student indicated their changes in sleeping and eating were due to an aggressive exercise regimen and the other student indicated that their trouble concentrating and restlessness were due to an attention

deficit hyperactivity disorder (ADHD) diagnosis. In sum, nine (20%) students of the 45 were assigned the value of 1 for the variable *depress*.

Table 4.17. Self Perceptions of Students in April.

Variable	Description of Variable	Mean	Std Dev
depress	Is student experiencing 3 or more depression symptoms (1=yes; 0=no)	0.20	0.41
dpercep	Perception of eating healthly after coming to college (1 = healthier; 0 = no change; -1 = less healthful)	-0.27	0.65
dphys	Perception of being physically active in college (1=more active; 0=no change; -1=less active)	-0.33	0.83
dweightpercep	Perception of weight gain/loss in college (2=gained more than 15 lbs.; 1= gained 5 to 15 lbs.; 0=no change; -1=lost 5 to 15 lbs; -2=lost more than 15 lbs.)	0.53	0.87

Other variables related to their self and weight perceptions included *dphys*, which was a measure of whether the student thought they were more physically active in college or less physically active than in high school. If the student indicated "more" the variable was assigned the value of 1, if they thought themselves to be "less physically active" in college the assigned value was -1, and if they felt there was "no change" in their activity level, the value of 0 was assigned. On average, the response by the students was -0.33 with a standard deviation of 0.83, indicating that on average students felt they were less active. Comparing this to their reported physical activity levels in September and April, we can see that they report exercising more days in April than September, however they length of the time spent exercising is less in April than September. If these reported

averages are multiplied out to find the minutes per week of exercise, it shows that they are getting about 175.79 minutes of exercise in April as compared to 193.15 minutes in September. So their perceptions of getting less exercise since coming to college are consistent with their responses about activity levels in April and September.

Students were also asked if they thought they were eating healthier in college than in high school (*dpercep*). The students were given three choices to respond, either "I eat much healthier in college", "I eat about the same" or "I eat much worse in college". If the student indicated that they ate "healthier", the variable was assigned the value of 1, if they indicated "about the same" it was assigned as 0, and if they said "worse" the value of -1 was assigned. Overall the average response was -0.27 with a standard deviation of 0.65, indicating that students on average feel they are eating worse since they have been in college.

The final variable about self perceptions is labeled *dweightpercep*. The students were asked if they felt that they gained or lost weight since they started college. In this question, they were given five options and asked to pick the most appropriate. The options were: "gained more than fifteen pounds", "gained five to fifteen pounds", "about the same", "lost about five to fifteen pounds" and "lost more than fifteen pounds"; these responses were scored 2, 1, 0, -1 and -2, respectively. The overall average response was 0.53 with a standard deviation of 0.87, indicating that on average students felt they have gained weight. Of the 45 responses, three students thought they had "gained more than fifteen pounds", 25 students chose "gained five to fifteen pounds", eleven students said "about the same", five students thought they had "lost about five to fifteen pounds" and one student chose "lost more than fifteen pounds".

When comparing the students' perceptions of weight to what they actually gained/lost, most had the correct perception. Classifying their actual weight loss by the same scale as *dweightpercep*, two students gained more than fifteen pounds, nineteen students gained five to fifteen pounds, 22 students stayed about the same and two students lost five to ten pounds. When comparing this with the category the student perceived to be in, 24 had the correct perception about their weight, nine underestimated their gain (or overestimated their loss), and twelve overestimated their gain (or underestimated their loss).

Many of the students in the study had gains or losses in their weight over the semester and many also experience great changes in the eating and activity behaviors, especially with a large portion of the sample no longer participating in high school sports and then not picking up a new regular activity. While the statistics on these students are quite interesting, the averages and frequencies hide some of the diversity of each student's experience as a college freshman living away from their parents for the first time. To help paint a picture of what this transition might look like, appendix B presents a brief student profile. This profile highlights the changes occurring from high school to college in one selected participant. This participant was chosen based on meeting many of the sample averages, although she has more siblings than average and gained slightly more weight than average.

CHAPTER 5 - Empirical Model

Optimal food consumption (F^* from Chapter 3) can be modeled in various ways. Below, it is specified by food groups (six groups described Chapter 4) and by macronutrients (fat, protein and carbohydrates). Both approaches will be explored and compared in the following analysis.

In either model, there are multiple F^*s to explain. It is highly likely the optimal food consumption levels among food groups or macronutrients will be interdependent; that is, eating more of one group could lead to eating lead of another group and vice versa or eating more carbohydrates could lead to eating less protein and so on. Thus it is likely the errors of the equations will be correlated, and these equations will be estimated in a system using seemingly unrelated regression (SUR) estimation.

In order to capture the peer effect, a ratio of friend to parent consumption will be used. After the food consumption model systems are estimated, predicted values will be used in an OLS equation with BMI as a dependent variable. This chapter is constituted as follows. First, the peer ratio is described. Next, the food group model and then, the nutrient model are discussed. Finally, the BMI equations are described.

5.1 Peer Ratio

For both models, the peer effect is captured by a ratio of the participant's friend's consumption over the participant's parent's consumption, respectively standardized by its standard deviation. For the food group models, the ratio is:

$$PR_{i,k} = \frac{Pf_{f,i,k} / StDev(Pf_{f,i,k})}{Pf_{p,i,k} / StDev(Pf_{p,i,k})} \quad (5.1)$$

where *PR* is the peer ratio, *k* denotes the food groups (e.g., breads, dairy, fruits and vegetables), *i* denotes the individual, $Pf_{f,i,k}$ is the friend's daily calorie consumption of group *k*, and $Pf_{p,i,k}$ is the parent's daily calorie consumption of group *k*. Defining this as a ratio helps compare between parent and friend consumption. The ratio will always be positive and one becomes our benchmark for friend and parent having similar consumption. Thus, if the ratio is close to 1, the parent and friend are eating similarly. The greater the ratio is over 1, the more the friend is consuming relative to the parent, and smaller the ratio is than 1, then the parent is consuming relatively more. One problem with specifying the ratio this way, come into play if one of the parent's observations for a food group is zero. In this case, there will be division by zero and there will be a missing observation. In my sample this happens with one observation for the dairy food group.

The averages of the peer ratios of each food group can be seen in table 5.1 below. The first noticeable thing is that, on average, the student's friends are getting more calories from dairy and beverages than the parents. Both of these ratios are statistically different from one. Also, the fruits and vegetables group is the only group for which the parent's consumption exceeds the friend's on average, but that ratio is statistically equivalent to one.

Table 5.1. Descriptive Statistics for the Food Group Peer Ratios.

Peer Ratio	Mean	St. Dev.
Beverages	5.787*	10.558
Dairy	3.452*	4.111
Meats/Main Dishes	1.174	0.676
Breads/Grains	1.308	2.174
Fruits/Vegetables	0.772	1.040
Snacks/Desserts	1.229	1.572

*indicates the mean is statistically different from 1 at the 10% level using a Chi-squared test.

Similarly, the peer ratios for the fat, protein and carbohydrate breakdown are calculated as in equation (5.1). To distinguish from food groups, the subscript *n* will be used in place of *k* to refer to the macronutrients (fat, protein or carbohydrate). The averages of this peer ratio are shown in table 5.2 below. Interestingly, the student's friends are consuming less protein relative to the parents, even though the friends were getting a much greater amount of dairy foods, which are a good source of protein and fat. However, the ratio on fat and protein were statistically equivalent to one, so on average the friends are parents are consuming similar amounts of fats. It follows suit that the friends are likely consuming more calories from carbohydrates since they are eating more breads and grains and more snacks relative to the parents. This ratio is statistically different from one.

Table 5.2. Descriptive Statistics for the Nutrient Peer Ratios.

Peer Ratio	Mean	St. Dev.
Fat	0.909	0.518
Protein	0.871	0.449
Carbohydrate	1.497*	0.817

*indicates the mean is statistically different from 1 at the 10% level.

5.2 Food Group Model

As previously mentioned, the data from the FFQ's were categorized into six food groups, primarily based on the NHS questionnaire: beverages, dairy, meats/main dishes, breads/grains, fruits/vegetables and snacks/desserts. It is highly likely the optimal food consumption levels will be interdependent, that is, eating more of one group could lead to eating more (or less) of another group and vice versa. Because of this, it is likely the errors of the equations will be correlated, so these six equations will be estimated in a system using SUR estimation. Using notation from Chapter 3, $F_{i,k,t}$ will be food consumption by individual *i* from group *k* in time *t*, $PR_{i,k}$ will be the peer ratio of group *k* for individual *i*. The following system is estimated:

(5.2)

$$F_{i,1,t} = \beta_o + \beta_1 F_{i,1,t-1} + \beta_2(F_{i,2,t} - F_{i,2,t-1}) + \beta_3(F_{i,3,t} - F_{i,3,t-1}) + \beta_4(F_{i,4,t} - F_{i,4,t-1}) + \beta_5(F_{i,5,t} - F_{i,5,t-1}) + \beta_6(F_{i,6,t} - F_{i,6,t-1}) + \beta_7 PR_{i,1} + \varphi_1$$

$$F_{i,2,t} = \beta_8 + \beta_9 F_{i,2,t-1} + \beta_{10}(F_{i,1,t} - F_{i,1,t-1}) + \beta_{11}(F_{i,3,t} - F_{i,3,t-1}) + \beta_{12}(F_{i,4,t} - F_{i,4,t-1}) + \beta_{13}(F_{i,5,t} - F_{i,5,t-1}) + \beta_6(F_{i,6,t} - F_{i,6,t-1}) + \beta_{14} PR_{i,2} + \varphi_2$$

$$F_{i,3,t} = \beta_{15} + \beta_{16} F_{i,3,t-1} + \beta_{17}(F_{i,1,t} - F_{i,1,t-1}) + \beta_{18}(F_{i,2,t} - F_{i,2,t-1}) + \beta_{19}(F_{i,4,t} - F_{i,4,t-1}) + \beta_{20}(F_{i,5,t} - F_{i,5,t-1}) + \beta_{21}(F_{i,6,t} - F_{i,6,t-1}) + \beta_{22} PR_{i,3} + \varphi_3$$

$$F_{i,4,t} = \beta_{23} + \beta_{24} F_{i,4,t-1} + \beta_{25}(F_{i,1,t} - F_{i,1,t-1}) + \beta_{26}(F_{i,2,t} - F_{i,2,t-1}) + \beta_{27}(F_{i,3,t} - F_{i,3,t-1}) + \beta_{28}(F_{i,5,t} - F_{i,5,t-1}) + \beta_{29}(F_{i,6,t} - F_{i,6,t-1}) + \beta_{30} PR_{i,4} + \varphi_4$$

$$F_{i,5,t} = \beta_{31} + \beta_{32} F_{i,5,t-1} + \beta_{33}(F_{i,1,t} - F_{i,1,t-1}) + \beta_{34}(F_{i,2,t} - F_{i,2,t-1}) + \beta_{35}(F_{i,3,t} - F_{i,3,t-1}) + \beta_{36}(F_{i,4,t} - F_{i,4,t-1}) + \beta_{37}(F_{i,6,t} - F_{i,6,t-1}) + \beta_{38} PR_{i,5} + \varphi_5$$

$$F_{i,6,t} = \beta_{39} + \beta_{40} F_{i,6,t-1} + \beta_{41}(F_{i,1,t} - F_{i,1,t-1}) + \beta_{42}(F_{i,2,t} - F_{i,2,t-1}) + \beta_{43}(F_{i,3,t} - F_{i,3,t-1}) + \beta_{44}(F_{i,4,t} - F_{i,4,t-1}) + \beta_{45}(F_{i,5,t} - F_{i,5,t-1}) + \beta_{46} PR_{i,6} + \varphi_6$$

where *t* denotes observations from April data collection, *t*-1 denotes September observations, φ is the error term and the food groups 1 through 6 correspond to beverages, dairy, meats/main dishes, breads/grains, fruits/vegetables, and snacks/desserts, respectively. Elasticities can be calculated using the formula: $\varepsilon_{j,k} = \beta_k * (F_{k,t} - F_{k,t\text{-}1})/F_{j,t.}$ So a percent change in food group *j* can be evaluated by a one percent change in the September-April difference in food group *k*.

5.3 Macronutrient Model

The model for the macronutrient breakdown is similar to the food group model with three equations in the system for the macronutrients: fat, protein and carbohydrates. Again, using similar notation the system will be:

(5.3)

$$F_{i,1,t} = \beta_{47} + \beta_{48}F_{1,t-1} + \beta_{49}(F_{i,2,t} - F_{i,2,t-1}) + \beta_{50}(F_{i,3,t} - F_{i,3,t-1}) + \beta_{51}PR_{i,1} + \theta_1$$

$$F_{i,2,t} = \beta_{52} + \beta_{53}F_{2,t-1} + \beta_{54}(F_{i,1,t} - F_{i,1,t-1}) + \beta_{55}(F_{i,3,t} - F_{i,3,t-1}) + \beta_{56}PR_{i,2} + \theta_2$$

$$F_{i,3,t} = \beta_{57} + \beta_{58}F_{3,t-1} + \beta_{59}(F_{i,1,t} - F_{i,1,t-1}) + \beta_{60}(F_{i,2,t} - F_{i,2,t-1}) + \beta_{61}PR_{i,3} + \theta_3$$

where *F*, *PR*, *F*, *t* and *t*-1 are as previously defined, but now subscripts 1-3 refer to fats, protein and carbohydrates, respectively. Similar to the food group model, elasticities can be calculated for macronutrient from the parameter estimates to reveal the percent change in macronutrient *j* associated with a one percent change in the difference of macronutrient from September to April.

5.4 Impact of Food Consumption on BMI

Predicted values from the food and nutrient consumption systems estimation can be used to help determine their impacts on weight. BMI will be used as a proxy for weight. Because average food consumption levels are predicted from the April time period, April BMI is specified as the dependent variable. In addition to the predicted April food intakes, other demographic and eating habit variables will be included as control variables in the BMI equation, as well as the lagged or September BMI measure. A separate equation will be estimated with the predicted April values from the food group system and the nutrient system. Each equation will have the same demographic and eating habit variables along with the September BMI.

The demographic variables include a dummy variable for gender (*female*) equaling 1 if the respondent is a female and 0 if a male, a measure for depression (*depress*) as described in chapter 4, and a dummy for whether the participant was pregnant in April (*preg*). The eating habit variables include a dummy equaling 1 if the student has a meal plan through the campus dining center (*mealplan*), an interaction term with the meal plan dummy and the variable measuring how many meals daily the student eats at the dining center (*mdc*). Finally, a dummy variable for whether or not the student was an athlete in high school (*athlete*) will be included (this is the September observation of the variable *sport* in chapter four).

The equation with the predicted April food group consumption is defined by:

$$bmi_{Apr} = \delta_0 + \delta_1 pbev + \delta_2 pdairy + \delta_3 pmeat + \delta_4 pbread + \delta_5 pveg + \delta_6 psnack + \delta_7 female + \delta_8 preg + \delta_9 depress + \delta_{10} mealplan + \delta_{11} mealplan * mdc + \delta_{12} athlete + \delta_{15} bmi_{Sept} + \varepsilon_i \tag{5.4}$$

where the eating habit and demographic variables are as labeled above, the predicted food group variables are *pbev*, *pdairy*, *pmeat*, *pbread*, *pveg* and *psnack* and ε_i is the error term. Similarly, the BMI equation with the predicted macronutrient values is defined by:

$$bmi_{Apr} = \delta_{16} + \delta_{17}pfat + \delta_{18}pprotein + \delta_{19}pcarb + \delta_{20}female + \delta_{21}preg + \delta_{22}depress + \delta_{23}mealplan + \delta_{24}mealplan * mdc + \delta_{25}athlete + \delta_{28}bmi_{Sept} + \gamma_i \tag{5.5}$$

where *pfat*, *pprotein* and *pcarb* are the predicted macronutrient values, γ is the error term and the other variables are as previously defined.

CHAPTER 6 - Results

This chapter will discuss the results from both systems estimations and BMI equations. All the estimation was done in SAS version 9.1. The chapter is set up as follows: first results from the food group systems estimation are presented and discussed followed by results from the nutrient equations system. Next, the BMI equation results from the food group model and the nutrient model are discussed, respectively.

6.1 Results from the Food Group Systems Estimation

As mentioned in Chapter 5, the food group system was estimated using SUR estimation. A White test for heteroskedasticity was conducted for each equation and the test statistics indicated a failure to reject the null hypothesis of homoskedasticity. Estimation results are shown in table 6.1 and 6.2 below.

Of the six peer ratios, the beverage peer ratio is positive and significant at the 10% level. This indicates that as the peer ratio increases, the student will increase their beverage consumption. In other words, if the student's friend consumes more calories from beverages than the student's parent, the student will also increase caloric intake from beverages. The magnitude of the peer ratio coefficient is 4.875, meaning as that peer ratio increases by one unit, the student will consume 4.875 more calories from beverages, all else equal. This may signify the relationship between peer pressure and consuming alcohol in college. It could also be attributed to other means of socializing over beverages such as coffee drinks. However, this magnitude is small, increasing calories from beverages by more than 5 calories a day would likely have to come about large differences between the friend and parent consumption.

Table 6.1. Results from the Food Group Systems Estimation for Beverages, Meats/Main Dishes and Fruits/Vegetables.

Equation: April Beverages				
	R^2	Adj. R^2		
	0.2235	0.0726		
Variable	**Coefficient**	**St. err**		**Elasticity[1]**
Intercept	189.083	49.177	***	
Lagged Beverages	0.150	0.281	*	
Change in Dairy	0.286	0.121	**	0.001
Change in Meats	0.025	0.040		0.000
Change in Breads	-0.060	0.087		0.000
Change in Fruits/Veg	-0.316	0.137	**	-0.001
Change in Snacks	0.165	0.073	**	0.001
Beverage Peer Ratio	4.875	2.874	*	
	White's Statistic	43.61		
Equation: April Meats/Main Dishes				
	R^2	Adj. R^2		
	0.6198	0.5458		
Variable	**Coefficient**	**St. err**		
Intercept	834.695	167.700	***	
Lagged Meats/Dishes	0.106	0.077		
Change in Beverages	0.199	0.270		0.000
Change in Dairy	1.611	0.345	***	0.002
Change in Breads	0.158	0.173		0.000
Change in Fruits/Veg	-0.281	0.305		0.000
Change in Snacks	0.367	0.139	**	0.000
Meat Peer Ratio	-32.441	99.393		
	White's Statistic	33.75		
Equation: April Fruits/Vegetables				
	R^2	Adj. R^2		
	0.4073	0.292		
Variable	**Coefficient**	**St. err**		
Intercept	313.306	66.854	***	
Lagged Fruits/Veggies	0.250	0.129	*	
Change in Beverages	0.272	0.110	**	0.001
Change in Dairy	-0.082	0.040	**	0.000
Change in Meats	0.161	0.071	**	0.000
Change in Breads	-0.068	0.144		0.000
Change in Snacks	0.167	0.066	**	0.001
Fruit/Veggie Peer Ratio	-6.804	26.369		
	White's Statistic	32.11		

[1] Elasticities are evaluated at the sample means.

*** sig. at 1% level, ** sig. at 5% level, * sig. at 10% level

Table 6.2. Results from the Food Group Systems Estimation for Dairy, Breads/Grains and Snacks/Desserts.

Equation: April Dairy				
	R^2	Adj. R^2		
	0.162	-0.0009		
Variable	**Coefficient**	**St. err**		**Elasticity[1]**
Intercept	169.447	84.589	*	
Lagged Dairy	0.080	0.171		
Change in Beverages	0.463	0.152	***	0.002
Change in Meats	0.013	0.041		0.000
Change in Breads	0.020	0.085		0.000
Change in Fruits/Veg	0.242	0.138	*	0.001
Change in Snacks	-0.157	0.071	**	-0.001
Dairy Peer Ratio	7.038	7.461		
	White's Statistic	40.62		
Equation: April Breads/Grains				
	R^2	Adj. R^2		
	0.3008	0.1649		
Variable	**Coefficient**	**St. err**		**Elasticity**
Intercept	533.055	85.290	***	
Lagged Breads/Grains	-0.024	0.123		
Change in Beverages	-0.050	0.151		0.000
Change in Dairy	-0.040	0.051		0.000
Change in Meats	0.352	0.205	*	0.001
Change in Fruits/Veg	0.394	0.161	**	0.001
Change in Snacks	0.034	0.087		0.000
Bread Peer Ratio	-17.894	16.806		
	White's Statistic	36.63		
Equation: April Snacks/Desserts				
	R^2	Adj. R^2		
	0.3811	0.2608		
Variable	**Coefficient**	**St. err**		**Elasticity**
Intercept	134.610	129.600		
Lagged Snacks	0.306	0.126	**	
Change in Beverages	0.775	0.256	***	0.001
Change in Dairy	-0.183	0.212		0.000
Change in Meats	0.171	0.061	***	0.000
Change in Breads	-0.135	0.145		0.000
Change in Fruits/Veg	0.129	0.235		0.000
Snack Peer Ratio	54.191	42.059		
	White's Statistic	41.28		

[1] Elasticities are evaluated at the sample means.

*** sig. at 1% level, ** sig. at 5% level, * sig. at 10% level

The lagged variables of September calorie intakes from each group were significant in 3 of the 6 equations. The beverage, fruits/vegetables and meats/main dishes equations all had significant and positive lagged terms, as expected for habitual consumption. This indicates that as past consumption increases, future consumption will increase as well. The coefficient on the beverage lagged term is 0.15, so for each calorie increase in September, they will consume 0.15 more calories in April. This is potentially a signal of addition to sugary beverages like soda or an increase in alcohol intake in college, which can also be addictive. The lagged coefficient on fruits and vegetables is smaller at 0.25. So for each additional calorie in September, they will consume 0.25 more calories from vegetables or fruits in April. It is not surprising that the magnitude is smaller, given that fruits and vegetables are not the type of foods we consider to be addictive. Finally, the lagged variable from the meats equation is also significant with a magnitude of 0.106.

In addition to the peer ratio and the lagged term, changes in calories consumed from dairy, fruits and vegetables and snacks were significant in the beverage equation. A one calorie increase in the change in dairy consumption and snack consumption increased April beverage consumption by 0.286 calories and 0.165 calories, respectively. These coefficients are both significant at the 5% level. However, a one calorie increase in the change in fruit and vegetable consumption decreased April beverage intake by 0.316 calories, again this result is significant at the 5% level. This negative relationship could be due to the fact that fruit and vegetable juices appear in the fruit and vegetable category and these are substitutes for the student's beverage intake. The elasticities reported in tables 6.1 and 6.2 help compare which group has the largest impact in each equation.

Note that these elasticities are small, because a 1% change in many of the food groups is anywhere from two to eight calories on average. In the case of the beverage equation, it seems that the impacts are equal for all significant food groups, just that the fruit and vegetables group has a negative impact while the others are positive.

Consumption of meats and main dishes in April was correlated to consumption changes in dairy and snacks. An increase in the change in snack and dairy food intake by one calorie increased April meat and main dish consumption by 0.367 and 1.611 calories, respectively. In the meats equation, dairy has the largest elasticity, again a 1% change in dairy group leads to 0.002% change in April meat/main dish consumption.

Many of the food group changes affected the consumption of fruits and vegetables. However, only an increase in dairy foods negatively impacted fruit and vegetable consumption. A one calorie increase in the change in dairy foods decreased April fruit and vegetable intake by 0.082 calories. The remaining groups were all complements for fruits and vegetables except breads and grains, which were insignificant. An increase in the change in beverages by one unit increased April fruit and vegetables intake by 0.272 calories. A one calorie increase in the change in meat and main dish consumption increased April fruit and vegetable intake by 0.161 calories. Finally, a one calorie increase in the change in snacks increased April fruits and vegetable consumption by 0.167 calories. In terms of elasticities, snacks and desserts and beverages had the largest impact on consumption of fruits and vegetables.

April dairy consumption is also increased by changes in beverage consumption. An increase in one calorie from the change in beverages increased April dairy consumption by 0.463 calories. A one calorie increase in the change in fruits and

vegetables also increase April dairy consumption by 0.242 calories. Increasing calories from snacks by one unit decreased calories consumed from dairy in April by 0.157. This goes against the classic example of 'milk and cookies' we tend to think of as complements. However, it could signal a trade-off. For example, various yogurt brands have been marketing their products as a nutritious healthy snack. So instead of a brownie, they encourage people to eat their yogurt. It could also be a sign of students making calorie trade-off. That is they are conscious of their calorie intake and they are saying to themselves, "I want this brownie, but it's full of fat. But maybe if I skip the glass of chocolate milk after dinner, it will be okay." Looking at the elasticities, the beverage group makes the largest impact on dairy, a 1% change in the beverage group leads to 0.2% change in April dairy consumption.

For the breads/grains equation, changes in meats and changes in fruits and vegetables were significant and positive. A one calorie increase in the change in meat/main dish consumption increased April bread consumption by 0.352 calories. An increase in the change in fruit and vegetable consumption by one calorie increased April bread and grains consumption by 0.394 calories.

Snack and dessert consumption was positively impacted by meats and beverages. A one calorie increase in the change in beverage intake will increase snack consumption by 0.775 calories. A one calorie increase in the change of meat/main dish consumption increased April snack consumption by 0.171 calories. The elasticities on the beverage group were the only elasticity that had impact. A 1% change in the beverage group increased snack consumption by 0.1%.

6.2 Results from the Nutrient Systems Estimation

The nutrient system was also estimated using SUR. A White test for heteroskedasticity was conducted and the test statistic indicated a rejection of the null hypothesis of homoskedasticity for the fats equation, but not for the protein or carbohydrates equations. So, the generalized method of moments (GMM) estimation was used. In the presence of heteroskedasticity, GMM is preferred for consistency of standard error estimates. Estimation results are shown in table 6.3 below.

Again, there was one statistically significant peer ratio in the system. The protein peer ratio is positive and significant at the 10% level. This indicates that as the peer ratio increases, the student will increase their protein consumption. In other words, if the student's friend consumes more calories from protein relative to the student's parent, the student will increase caloric intake from protein. The magnitude of the peer ratio coefficient is 37.311, meaning as that peer ratio increases by one unit, the student will consume 37.311 more calories from protein per day, all else equal.

All lagged variables of September calories intakes from each nutrient were positive and significant at the 1% level. This is as expected. The magnitudes are higher as compared to the lagged terms in the food group model. An increase in fat intake in September of one calorie will lead to an increase of fat intake in April of 0.784 calories. The protein and carbohydrate lags are both almost one. A one calorie increase in protein in September will increase April protein intake by 0.997 calories and a one calorie increase in carbohydrates in September will increase April carbohydrate intake by 0.933 calories.

Table 6.3. Results from the Nutrient Systems Estimation.

Equation: April Fats				
	R^2	Adj. R^2		
	0.9121	0.9033		
Variable	**Coefficient**	**St. err**		**Elasticity[1]**
Intercept	101.287	35.699	***	
Lagged Fats	0.784	0.022	***	
Change in Protein	1.073	0.070	***	0.001
Change in Carbohydrates	0.218	0.038	***	0.000
Fats Peer Ratio	22.670	36.086		
	White's Statistic	26.970		
Equation: April Proteins				
	R^2	Adj. R^2		
	0.7474	0.7221		
Variable	**Coefficient**	**St. err**		**Elasticity**
Intercept	12.161	27.276		
Lagged Protein	0.997	0.048	***	
Change in Fats	0.452	0.056	***	0.001
Change in Carbohydrates	0.014	0.036		0.000
Protein Peer Ratio	37.311	20.447	*	
	White's Statistic	13.020		
Equation: April Carbohydrates				
	R^2	Adj. R^2		
	0.7553	0.7309		
Variable	**Coefficient**	**St. err**		**Elasticity**
Intercept	93.894	124.400		
Lagged Carbohydrates	0.933	0.050	***	
Change in Fats	0.987	0.217	***	0.001
Change in Protein	0.148	0.354		0.000
Carbohydrate Peer Ratio	23.564	59.672		
	White's Statistic	14.390		

[1] Elasticities are evaluated at the sample means.

*** sig. at 1% level, ** sig. at 5% level, * sig. at 10% level

April Fat consumption was impacted by both changes in protein and carbohydrate consumption. An increase in the change of protein consumption by one calorie increased fat consumption in April by 1.073 calories. This is not surprising, because many main

sources of protein (like meats and dairy) also contain fat. An increase in the change in carbohydrate intake by one calorie increased fat consumption by 0.218 calories.

Protein consumption in April was affected by the change fat consumption but not by carbohydrate consumption. Again it is easy to see the link between fat and protein consumption. A one calorie increase in the change in fat consumption increased April protein intake by 0.452 calories.

Aside from the lagged term, carbohydrate intake in April was only affected by the change in fat consumption. An increase in the change in fats by one calorie would increase the April carbohydrate consumption by 0.987 calories. This also seems reasonable, because it seems that in snacking, it is easy to consume much food high in carbohydrates and fats, like potato chips and cakes.

6.3 Results from the BMI Equations

The estimated coefficients from the food group model and macronutrient models were used to generate predicted values for April calorie consumption for each food group or macronutrient, respectively. The OLS estimation results from the BMI equations with the predicted food group values and the predicted macronutrient values can be seen in tables 6.4 and 6.5, respectively. Apart from one model incorporating the predicted April food group calorie values and the other using the predicted April macronutrient values, the models have identical independent variables. Before the results are discussed, it might be useful to put some magnitudes into perspective. BMI is commonly described in units of kilograms per square meters (kg/m^2), but it is difficult to think about in terms of pounds or other units we associate with in daily calculations. Thus, consider an average height male (about 5 feet 9 inches) of a normal weight status (according to BMI) and an

average height female (about 5 feet 4 inches) of a normal weight status. Adding an extra BMI point or 1 kg/m^2 would add an extra 7 pounds to the male and about an extra 5.5 pounds to the female described above.

Table 6.4. Regression Results from BMI Equation with Predicted April Food Groups.

Variable	Estimate		St. Err.
Intercept	0.489		1.207
Predicted April beverages	-0.001		0.001
Predicted April dairy	0.002		0.002
Predicted April meats/main dishes	-0.001		0.001
Predicted April breads/grains	-0.003	**	0.001
Predicted April fruits/veggies	0.003	*	0.002
Predicted April snacks	0.003	***	0.001
September BMI	1.055	***	0.047
Meal plan (y=1, no=0)	-1.888	***	0.518
Meal plan* # meals eaten at dining center (per day)	0.500	**	0.230
Female(y=1, no=0)	0.009		0.283
Pregnant(y=1, no=0)	-0.327		0.682
Athlete in high school (y=1, no=0)	-0.661	**	0.313
Depression (y=1, no=0)	-0.253		0.316
R-square	0.959		
Adj R-square	0.9413		
*** sig. at 1% level			
** sig. at 5% level			
* sig. at 10% level			

First, results from the BMI equation with the predicted April food group values are discussed (table 6.4). Changes in the predicted April calories from breads and grains and snacks and desserts were all significant. The results suggest that increasing bread/grain consumption had a negative impact on BMI, while fruit and snack consumption had a positive impact. The magnitudes on all these coefficients are small. An increase of predicted April bread consumption by one calorie will decrease BMI by

0.003 kg/m^2, holding everything else constant. To put this in a more tangible form, multiply by 100, so that increasing April bread consumption by 100 calories per day on average will increase BMI by 0.3 kg/m^2. In other words, that average male described above was about 2 pounds lighter in April by increasing bread/grain intake by 100 calories per day from September.

Increases in predicted April fruit and vegetable consumption increased BMI. For an additional 100 calories from fruits and veggies, there was an increase in BMI of 0.3 kg/m^2 or an extra two pounds gained by that average female described above. This is somewhat surprising, as we tend to think of fruits and vegetables consumption as healthy and good for weight loss. However, studies have found links between excess consumption of fruit juices to be associated with increases in weight (Faith et al., 2006; Dennison, Rockwell and Baker, 1997).

Increases in predicted April snacks positively impacted BMI. For an additional 100 calories from snack food, there was an increase in BMI of 0.3 kg/m^2 or an extra pound gained by that average female described above. This is not a surprising result because most of the foods in this category are the types of foods that are high in fat and sugar, or exactly what the food pyramid guide says we should not eat. Also, this result is in line with the finding of Levitsky, Halbmaier and Mrdjenovic (2004).

Naturally, September BMI contributes much toward explanatory power in the model and is highly significant. Obviously, a person's weight today can be largely explained by how much they weighed several months ago. The coefficient is positive with a magnitude of 1.055. This indicates that increasing September BMI by 1 kg/m^2 increased April BMI by 1.055 kg/m^2.

The binary variable *meal plan* was statistically significant at the 1% level. The value of 1 indicated that the student was on a meal plan. All students that live in dormitories on campus were required to have one of the meal plans offered. Others may opt to buy them as well, but this was usually not the case. Thus, the variable *meal plan* also conveys another important piece of information, that is, it also accounts for living situation. So the interaction term, *meal plan*mdc*, was also included to help separate the 'living environment' factor from the actual 'having a meal plan' factor.

Both the *meal plan* and the *meal plan*mdc* variables were significant. The *meal plan* variable itself was negative, but the interaction term was positive. Thus, when the student eats four or more meals at the dining center under the meal plan, each additional meal would increase BMI by 0.5 kg/m^2. According to the results in table 6.4, there is something about living on campus that decreases weight. This is contrary to the findings by Pliner and Saunders (2008). It could be greater walking distance to classes in addition to exercising or something fundamentally different between the university their study was conducted at and Kansas State University or the sample of students themselves.

The variable *female* was not significant in the model, although other studies suggest differences between male and female weight gain (Nelson et al., 2007). The variable *preg* was also not significant, but this is not surprising being that the two students in the sample who were pregnant in April were likely at early stages of pregnancy. Student's depression status was insignificant as well.

Finally, if the student was an athlete in high school, it impacted BMI negatively. This result was significant at the 5% level. Being an athlete in high school reduced April BMI by 0.661 kg/m^2. This could be due to developing a good exercise or conditioning

routine that was maintained through the transition from high school. It could be a sign of desire to be physically active; if they wanted to be physically active in high school, it is likely they would also want to be active in college.

For the second BMI equation results presented in table 6.5, none of the predicted macronutrient values were statistically significant. In some ways this is not surprising, given that in the BMI/food group equation, predicted snacks were significant which were mainly comprised of fats, sugars and other carbohydrates (corresponding to two macronutrients). However, predicted breads and grains were significant and a majority of the foods in those groups would be carbohydrate content, so I might have expected carbohydrates to significantly impact BMI.

Table 6.5. Regression Results from BMI Equation with Predicted April Macronutrients.

Variable	Estimate		St. Err.
Intercept	0.597	*	1.200
September BMI	1.019	***	0.047
Predicted April fat	0.000		0.000
Predicted April protein	0.000		0.001
Predicted April carbohydrates	0.000		0.000
Meal plan (y=1, no=0)	-1.846	***	0.549
Meal Plan* # meals eaten at dining center (per day)	0.507	**	0.246
Female(y=1, no=0)	0.076		0.328
Pregnant(y=1, no=0)	0.720		0.669
Athlete in high school (y=1, no=0)	-0.378		0.344
Depression (y=1, no=0)	-0.032		0.321
R-square	0.9482		
Adj R-square	0.933		
*** sig. at 1% level			
** sig. at 5% level			
* sig. at 10% level			

Again, September BMI is a major explanatory factor of April BMI. The coefficient is positive with a magnitude of 1.019. This indicates that increasing September BMI by 1 kg/m^2 increased April BMI by 1.019 kg/m^2. This is very similar to the coefficient on the BMI/food group equation, which is not surprising.

The *mealplan* variable and the interaction term *mealplan*mdc* were significant in this model as well. Again, the signs and magnitudes are quite similar to those in the predicted food group BMI equation. Increasing the number of meals eaten at the dining center increased April BMI by 0.507 kg/m^2. The *mealplan* variable alone had a negative impact on BMI in April. In this model, being an athlete in high school did not have significant explanatory power towards BMI but the estimated impact was negative, consistent with the food groups model. Also, the *preg*, *female* and *depress* variables were not significant.

Conclusions

To conclude my research, I will briefly summarize the study and discuss some shortcomings. Next, I will discuss the role of policy intervention in obesity prevention in general and specifically to college students. Finally, I outline potential future research to build on this study and also in the areas of food consumption and peer influence.

7.1 Summary of the Study

Obesity and overweight is a complex problem with many forces acting upon the outcome. It is a problem that has taken shape over the last 40 years. Increasingly, the US and the world are becoming concerned with the growing epidemic. One particular area of concern is the overwhelming increases in childhood obesity since the late 1970's. It is known that 80% of obese children become obese adults (CDC, 2010) and ultimately are at risk for type II diabetes, heart disease and other chronic diseases.

This study aimed to further our understanding of the motivations for overeating or not eating healthfully. College students were selected as a prime sample of young adults who are changing their environment and shaping their eating and activity behaviors. In particular, this study set out to determine how students' peers impacted their food consumption and ultimately their weight. To address this, college freshmen at Kansas State University were recruited to provide information three distinct times throughout the school year using validated survey instruments. The collected information included demographics, lifestyle, eating habits, two FFQ pertaining to their eating habits in high school and in college, and a food record. Height and weight measurements were

collected at each data collection stage. Their parents completed a FFQ and a friend completed a food record for each student.

Data collected from the FFQ were transformed into daily average calorie values for each of six food groups and also for the macronutrients. Parents' and friends' food consumption data were used to calculate a ratio of their calories intake from each food group and macronutrient. A system of equations was modeled to predict the calories per day from each food group consumed in April based on the peer ratio, their consumption of the food group in September and the change in consumption of other food groups. This was modeled similarly for the macronutrients.

For the food group models, the beverage group was the only food group with a statistically significant peer ratio term. The coefficient on the ratio was positive, indicating that students would consume more calories from beverages as their friends consumed more calories from beverages relative to their parents. However, the magnitude of the coefficient was small and perhaps not meaningful relative to weight. Past consumption caused a rise in April consumption for beverages, fruits and vegetables, and meats and main dishes. Impacts between the food groups were very inelastic.

The protein peer ratio was significant and positive in the macronutrient models. Fat consumption was positively impacted by changes in protein and carbohydrate consumption. Changes in fat consumption positively affected protein and carbohydrate consumption. For each of the macronutrients, increases in September consumption caused April consumption to rise.

When using predicted April food groups in the BMI equation, higher snack and dessert consumption increased BMI, but higher consumption of breads and grains

decreased it. BMI was significantly impacted by student's having a meal plan and positively by increasing the number of meals they ate at the dining center. However, having a meal plan was also capturing the student living on campus, so its marginal impact was negative. This is slightly puzzling because a variety of studies have found living on campus to be a cause of weight increases (Vella-Zarb and Elgar, 2010; Pliner and Saunders, 2008). However, these studies did not include controls for meal plans or meals eaten.

Interestingly, none of the predicted macronutrients were significant when used in the BMI equation. As in the predicted food group BMI equation, having a meal plan and eating more meals at the dining center were significant with similar signs and magnitudes. However, being an athlete in high school was not statistically significant in this model.

7.2 Shortcomings of the Study

This study is a broader look at eating habits of college freshmen than previous studies, which have stopped collecting data after the first semester or have used self-reported heights and weights or have used dietary questionnaires that may not have been validated. The study was designed to bridge those gaps in the research. However, the FFQ's are only as accurate as the memory of the person filling them out and some students may feel self conscious about their eating habit and alter their food records. This can mean inaccuracy in the calorie values.

Another troubling shortfall is the use of BMI as a measure of healthfulness. Ideally, it would be best to combine BMI with other useful information like waist-to-hip

ratios, cholesterol levels, or other blood work. However, the limited budget did not allow for collecting more extensive measures of health at the time of data collection.

The hardest part about modeling food choice is the fact that many people wildly differ in choices for unobservable reasons. Many factors affect what is eaten, including availability of food, season, allergies and other preferences. Some of these things can be captured in research studies, while others are trickier. Specifically, college students pose an interesting challenge because of the parental influence on many decisions such as purchasing meal plans, living in on campus and paying for college expenses in general. Clearly, there is work to be done on strengthening the conceptual model itself. The link between the conceptual model and the empirical work is rather thin. An examination of the impacts of heterogeneity terms, income and prices of food and meal plan on the optimal levels of food consumption is needed.

In analyzing the observations, the model assumes that the peer effect will only manifest itself through changes in food consumption or calorie intake. But in reality, the peer effect can also be manifested in other eating habits, such as eating and watching television at the same time. It also can present itself in the form of exercising or participation in team sports. Thus, this study only captures one facet of peer influence.

7.3 Policy Implications

The results of this study support that weight gain is brought upon by changes in eating and exercise, through their environment (living and eating environments). Thus, how do we get people to exercise more and eat a little better? More factors are likely important to weight gain than what is captured in this study. This and the small sample size of the study make it difficult to infer what steps should be taken to improve society's

overall health. Specific pieces of advice could sound as simple as "don't eat at the dining as much" and "go to the recreation center more" but it is likely more complex.

Specifically, college is an opportunity to encourage a population of young people to adopt good habits before the bad ones are developed. College years are influential in shaping the lifetime habits of young adults (Racette et al., 2005). Some young adults might learn good habits from their parents, provided their parents have good habits, but not all of them do. Some might learn the habits, but throw them to the wayside once they get to college and become bogged down with school work and socializing. Giving college students the skills to create these lifelong habits might be as simple as offering a class for freshman to take that introduces them to campus and campus life. They could spend a few weeks talking about nutrition and making healthy choices in the dining center or healthy choices when eating out. They could spend time getting an introduction to the recreation complex and learning about what those facilities have to offer, so as to increase the likelihood the students would use the facilities. Of course, they could also learn about different places in the community to go hiking or bicycling or just be outside in general.

Matvienko, Lewis and Schafer (2001) studied a control group and a group of freshmen that took a basic nutrition course. They found the nutrition education to be beneficial at preventing weight gain in at-risk female students. It might seem like a simple solution; it could even be an 8 week course. But if colleges around the country started offering courses like this or requiring freshman to take a course like this, it could go a long way in developing good habits for a lifetime. The dining center could also be involved by using labels to denote 'low-fat' or 'high fiber', 'smart choice', or other

simple logos. Barreiro-Hurle, Gracia and de-Magistris (2010) found that consumers view these healthy labels positively. Another study on the "Traffic Light System" used in the UK, where a "green" light on the label relates to a healthy choice and "yellow" and "red" light correspond to less healthy choices, found consumers had mixed responses to this type of labeling (Balcome, Fraser and Di Falco, 2010).

7.4 Future Research

One way to extend this research would be to resolve some of the shortcomings and to increase the cohort size. Ideally, this would involve getting a more accurate measure of physical activity. Having students wear pedometers or keep activity journals are some of the ways this could be accomplished. Also, collecting other measures at the beginning and end of the study, such as blood draws, waist circumference or physical fitness tests (e.g., measuring heart rates after designated physical activity) may provide insights to health implications. Of course, extra information usually will cost extra money, not only in terms of researcher time cost but also supplies for collecting blood and finding/hiring someone to do it. In addition, extra burden on the participant will likely require higher compensation for them, and become costly for a larger sample. Also, fitness tests might detract certain types of people from joining the study or cause them to withdraw.

Another extension of interest involves trying to get additional information about how peers are impacting the students. This would entail looking at the impacts, not only from a food perspective, but also from activity and weight perceptions perspective. These peer interactions could yield useful relationships related to weight gain. Other studies have shown peer behaviors of activities and weight perceptions to be linked in

adolescents (de la Haye et al., 2010; Dohnt and Tiggmann, 2006), but it is possible that the link is stronger in junior high or high school than college.

The switch from high school to college is a fascinating one. The connection between the two environments could be made stronger by studying the student for a year prior to entering college and then for their entire first year of college. This would give an entire year of eating habits before coming to college. To date, I am not aware of any studies that employ data sets to include both high school and college observations for the same individual. In addition, it would be even more exciting to also recruit a second group of high school students that are not planning on attending college as a proxy 'control' group. It would be interesting to see if this 'freshman 15' is not restricted to those attending college. This group could also be gaining weight if they move out of their parent's house but not into university housing. Much of the literature on this phenomenon is isolated to only college students, but the major assumption is that 18 to 19 year olds in college, especially a 4 year university, are the only demographic susceptible to weight gain. What about those 18 to 19 year olds not in college or those at trade schools? It is time that this 'control' group is examined as well.

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Appendix A - Survey Documents

. A sample of the survey instruments are presented in this section.

A.1 Food Portion Size Comparisons

Respondents were asked to read the comparisons and think about them when they responded to the FFQs and Food records. The actual 3-D objects were also on display.

Here are some items that may help you determine what the portion sizes listed in the survey might look like:

2 Tbsp of peanut butter or some other condiment = a ping pong ball

½ cup of veggies or fruits = a baseball

1 medium baked potato = computer mouse

1 pancake = the circumference of a compact disc (CD)

4 oz. serving of meat = a deck of playing cards

3 oz. serving of fish = a checkbook

A.2 Parent Survey

Changes in Food Choice, Dietary Habits and Physical Activities of College Freshman

~Food Environment Prior to College Life~

Please write in or circle your answers. We ask that the main food preparer in the household fill out this survey. Your answers are completely anonymous. A prepaid envelope is enclosed for your use. Please return the completed survey by November 12th, 2009.

1. What is your relationship to the student?

   _____

2. What is your age?

   _____

3. What type of housing do you live in?

   A. Rental apartment
   B. Rental house
   C. Own house
   D. Other_____

4. What is your 5-digit zip code?

5. Do you live within the city limits?

   A. Yes
   B. No

6. How many children do you have?

   _____

7. How many of these children currently live at home with you?

_____

8. What is your *annual* household income (before tax)?

    A. Less than $10,000
    B. $10,000-$14,999
    C. $15,000-$24,999
    D. $25,000-$34,999
    E. $35,000-$49,999
    F. $50,000-$74,999
    G. $75,000-$99,999
    H. $100,000-$149,999
    I. $150,000-$199,999
    J. $200,000 or more

9. Who is primarily responsible for food shopping in your home?

    _____

10. Who is primarily responsible for cooking meals in your home?

    _____

11. How many days in a typical week does your family eat *at least one meal* together?

    A. Never
    B. 1 to 2 days per week
    C. 3 to 4 days per week
    D. 5 to 6 days per week
    E. 7 days per week

12. How often is the TV on while your family is eating in a typical week? (Please select the frequency that most closely corresponds to your situation.)

    A. Never
    B. At 1 to 2 meals a week
    C. At 3 to 5 meals a week
    D. At 1 out of 3 meals a day
    E. At almost every meal

The following questions pertain to your individual food intake (not your family's). Please refer to the enclosed food comparison sizes.

Food Frequency-Beverages

13. For each item listed, select the circle indicating how often *on average* ***you*** have consumed the amount specified *during the last 6 months*.

(1) Never, or less than once per month | (2) 1-3 per month
(3) 1 per week | (4) 2-4 per week | (5) 5-6 per week | (6) 1 per day
(7) 2-3 per day | (8) 4-5 per day | (9) 6+ per day

Diet Soda with caffeine, e.g., Tab (1 can)	1	2	3	4	5	6	7	8	9
Diet Soda without caffeine, e.g., Diet 7-UP (1 can)	1	2	3	4	5	6	7	8	9
Soda with caffeine, e.g., Coke (1 can)	1	2	3	4	5	6	7	8	9
Iced tea (1 glass)	1	2	3	4	5	6	7	8	9
Hot tea (1 cup)	1	2	3	4	5	6	7	8	9
Coffee-not decaf. (1 cup)	1	2	3	4	5	6	7	8	9
Other sugared beverages: punch, lemonade, Sports drinks (1 glass or bottle)	1	2	3	4	5	6	7	8	9
Beer, regular (1 can or glass)	1	2	3	4	5	6	7	8	9
Light Beer (1 can or glass)	1	2	3	4	5	6	7	8	9

Red wine (5 oz. glass)	1	2	3	4	5	6	7	8	9
White wine (5 oz. glass)	1	2	3	4	5	6	7	8	9
Liquor, e.g., vodka, gin, etc. (1 drink or shot)	1	2	3	4	5	6	7	8	9
Plain water: bottled, sparkling or tap (8 oz. glass)	1	2	3	4	5	6	7	8	9

14. What *type* of milk did you usually drink during the last 6 months?

    A. Whole milk
    B. Powdered milk
    C. Lowfat milk
    D. Skim/nonfat milk
    E. Don't know
    F. Don't drink milk

Food Frequency-Dairy Products

15. For each item listed, select the circle indicating how often *on average* ***you*** have consumed the amount specified *during the last 6 months*.

(1) Never, or less than once per month | (2) 1-3 per month
(3) 1 per week | (4) 2-4 per week | (5) 5-6 per week | (6) 1 per day
(7) 2-3 per day | (8) 4-5 per day | (9) 6+ per day

Chocolate milk (8 oz. glass)	1	2	3	4	5	6	7	8	9
Milk (8 oz. glass)	1	2	3	4	5	6	7	8	9
Instant breakfast drink	1	2	3	4	5	6	7	8	9
Yogurt (1 cup)	1	2	3	4	5	6	7	8	9

Cottage or ricotta cheese (1 cup)	1	2	3	4	5	6	7	8	9
Cheese, include grilled cheese sandwich, cheeseburgers, etc. (1 slice or 1 oz.)	1	2	3	4	5	6	7	8	9
Cream cheese (1 oz.)	1	2	3	4	5	6	7	8	9
Butter (1 pat or 1 tbsp) – NOT margarine	1	2	3	4	5	6	7	8	9
Margarine (1 pat or 1 tbsp) – NOT butter	1	2	3	4	5	6	7	8	9

16. What type of fat did you typically use for frying and sautéing at home during the last 6 months?

    A. Real butter
    B. Margarine
    C. Olive oil
    D. Vegetable oil
    E. Vegetable shortening (Crisco)
    F. Lard
    G. Other _____

17. What form and brand of margarine did you typically use during the last 6 months?

    A. None
    B. Stick
    C. Tub
    D. Don't know

    Brand:_____

Food Frequency-Meats/Main Dishes

18. For each item listed, select the circle indicating how often *on average* ***you*** have consumed the amount specified *during the last 6 months*..

(1) Never, or less than once per month | (2) 1-3 per month
(3) 1 per week | (4) 2-4 per week | (5) 5-6 per week | (6) 1 per day
(7) 2-3 per day | (8) 4-5 per day | (9) 6+ per day

Eggs, including yolk (1)	1	2	3	4	5	6	7	8	9
Chicken or turkey, fried roasted or baked (4 to 6 oz.)	1	2	3	4	5	6	7	8	9
Chicken or turkey as a sandwich or mixed dish, e.g., chicken salad, sliced turkey, chicken casserole)	1	2	3	4	5	6	7	8	9
Bacon (2 slices)	1	2	3	4	5	6	7	8	9
Hot dogs (1)	1	2	3	4	5	6	7	8	9
Processed meats, e.g., "Spam", salami, bologna, sausage, etc. (1 piece or slice)	1	2	3	4	5	6	7	8	9
Hamburger (1)	1	2	3	4	5	6	7	8	9
Meatloaf (1 slice)	1	2	3	4	5	6	7	8	9
Beef or lamb as main dish, e.g., steak or roast (4 to 6 oz.)	1	2	3	4	5	6	7	8	9
Pork as a main dish, e.g., ham or chops (4 to 6 oz.)	1	2	3	4	5	6	7	8	9
Beef, pork or lamb as a sandwich or mixed dish, e.g., stew, "Hamburger Helper", lasagna, meatballs, chili, tacos	1	2	3	4	5	6	7	8	9

Pasta (such as macaroni and cheese, spaghetti) (1 cup)	1	2	3	4	5	6	7	8	9
Pizza (2 slices)	1	2	3	4	5	6	7	8	9
Canned tuna fish (3 to 4 oz.)	1	2	3	4	5	6	7	8	9
Dark meat fish, e.g., mackerel, salmon, sardines, bluefish, swordfish (3 to 5 oz.)	1	2	3	4	5	6	7	8	9
Breaded fish cakes, pieces, or fish sticks (store bought - 1 serving)	1	2	3	4	5	6	7	8	9
Other fish (3 to 5 oz.)	1	2	3	4	5	6	7	8	9
Shrimp, lobster, scallops as a main course (1 serving)	1	2	3	4	5	6	7	8	9
Chowder or cream soup (1 bowl)	1	2	3	4	5	6	7	8	9

19. How often did you typically eat deep fried chicken, fish, shrimp or clams away from home during the last 6 months?

    A. Less than once a week
    B. 1-3 times per week
    C. 4-6 times per week
    D. Daily

20. How much of the visible fat on your beef, pork or lamb did you typically remove before eating during the last 6 months?

    A. Removed all visible fat
    B. Removed most
    C. Removed small part of fat
    D. Removed none
    E. Didn't eat meat

21. How often *on average* did you consume beef, calf or pork liver (4 oz.) during the last 6 months?

    A. Never

B. 1-2 times
C. 3-5 times
D. Once per month
E. Twice per month
F. Once per week or more

22. How often *on average* did you consume turkey or chicken liver (1 oz.) during the last 6 months?

A. Never
B. 1-2 times
C. 3-5 times
D. Once per month
E. Twice per month
F. Once per week or more

Food Frequency-Breads/Grains

23. For each item listed, select the circle indicating how often *on average* ***you*** have consumed the amount specified *during the last 6 months*.

(1) Never, or less than once per month | (2) 1-3 per month
(3) 1 per week | (4) 2-4 per week | (5) 5-6 per week | (6) 1 per day
(7) 2-3 per day | (8) 4-5 per day | (9) 6+ per day

Cold breakfast cereal (1 bowl)	1	2	3	4	5	6	7	8	9
Hot breakfast cereal, like oatmeal, grits (1 bowl)	1	2	3	4	5	6	7	8	9
White bread (include bread for sandwiches, toast, french toast, etc) (1 slice)	1	2	3	4	5	6	7	8	9
Dark Bread (1 slice)	1	2	3	4	5	6	7	8	9
English muffins or bagels (1)	1	2	3	4	5	6	7	8	9
Muffin (1)	1	2	3	4	5	6	7	8	9

Cornbread, corn toasties (1 square)	1	2	3	4	5	6	7	8	9
Biscuit/roll (1)	1	2	3	4	5	6	7	8	9
Rice (1 cup)	1	2	3	4	5	6	7	8	9
Tortilla (1)	1	2	3	4	5	6	7	8	9
Pancakes (2) or Waffles (1)	1	2	3	4	5	6	7	8	9
French fries (1 serving)	1	2	3	4	5	6	7	8	9
Other Potatoes (1 baked, 1 boiled or 1 cup mashed)	1	2	3	4	5	6	7	8	9

24. Which cold breakfast cereal did ***you*** eat most often during the last 6 months (specify type and brand)? (If you don't eat cold breakfast cereal write "N/A".)

    _____

Food Frequency-Fruits

25. For each item listed, select the circle indicating how often *on average* ***you*** have consumed the amount specified *during the last 6 months.*

(1) Never, or less than once per month | (2) 1-3 per month
(3) 1 per week | (4) 2-4 per week | (5) 5-6 per week | (6) 1 per day
(7) 2-3 per day | (8) 4-5 per day | (9) 6+ per day

Raisins (small pack or 1.5 oz.)	1	2	3	4	5	6	7	8	9
Grapes (bunch)	1	2	3	4	5	6	7	8	9
Bananas (1)	1	2	3	4	5	6	7	8	9

Apples (1)	1	2	3	4	5	6	7	8	9
Applesauce (1/2 cup)	1	2	3	4	5	6	7	8	9
Cantaloupe, melons (1/4 melon)	1	2	3	4	5	6	7	8	9
Pears (1)	1	2	3	4	5	6	7	8	9
Oranges (1)	1	2	3	4	5	6	7	8	9
Grapefruit (1/2)	1	2	3	4	5	6	7	8	9
Strawberries (1/2 cup)	1	2	3	4	5	6	7	8	9
Peaches, plums, apricots (1)	1	2	3	4	5	6	7	8	9
Pineapple, fresh or canned (1/2 cup)	1	2	3	4	5	6	7	8	9
Orange juice (6 oz.)	1	2	3	4	5	6	7	8	9
Apple juice (6 oz.)	1	2	3	4	5	6	7	8	9
Other fruit juices (6 oz.)	1	2	3	4	5	6	7	8	9

Food Frequency-Vegetables

26. For each item listed, select the circle indicating how often *on average* ***you*** have consumed the amount specified *during the last 6 months*.

(1) Never, or less than once per month | (2) 1-3 per month
(3) 1 per week | (4) 2-4 per week | (5) 5-6 per week | (6) 1 per day
(7) 2-3 per day | (8) 4-5 per day | (9) 6+ per day

Tomatoes (1)	1	2	3	4	5	6	7	8	9
Tomato sauce (1/2 cup) e.g., spaghetti sauce	1	2	3	4	5	6	7	8	9
String beans (1/2 cup)	1	2	3	4	5	6	7	8	9
Beans/lentils (1/2 cup) include beans in chili, burritos, etc.	1	2	3	4	5	6	7	8	9
Broccoli or brussel sprouts (1/2 cup)	1	2	3	4	5	6	7	8	9
Cauliflower (1/2 cup)	1	2	3	4	5	6	7	8	9
Corn (1/2 cup or 1 ear)	1	2	3	4	5	6	7	8	9
Peas or lima beans (1/2 cup)	1	2	3	4	5	6	7	8	9
Mixed vegetables (1/2 cup)	1	2	3	4	5	6	7	8	9
Spinach, raw (1 cup)	1	2	3	4	5	6	7	8	9
Spinach, cooked (1/2 cup)	1	2	3	4	5	6	7	8	9
Mustard/kale/chard greens (1/2 cup)	1	2	3	4	5	6	7	8	9
Green peppers (3 slices or 1/4 cup)	1	2	3	4	5	6	7	8	9
Eggplant, zucchini or other									

summer squash (1/2 cup)	1	2	3	4	5	6	7	8	9
Yams/sweet potatoes (1)	1	2	3	4	5	6	7	8	9
Carrots, cooked (1/2 cup)	1	2	3	4	5	6	7	8	9
Carrots raw (1/2 cup or 2-4 sticks)	1	2	3	4	5	6	7	8	9
Celery (4" stalk)	1	2	3	4	5	6	7	8	9
Radish (2)	1	2	3	4	5	6	7	8	9
Lettuce/tossed salad (1 cup)	1	2	3	4	5	6	7	8	9

Food Frequency-Snacks/Desserts

27. For each item listed, select the circle indicating how often *on average* ***you*** have consumed the amount specified *during the last 6 months*.

(1) Never, or less than once per month | (2) 1-3 per month
(3) 1 per week | (4) 2-4 per week | (5) 5-6 per week | (6) 1 per day
(7) 2-3 per day | (8) 4-5 per day | (9) 6+ per day

Potato chips (small bag or 1 oz.)	1	2	3	4	5	6	7	8	9
Corn chips/Doritos (small bag or 1 oz.)	1	2	3	4	5	6	7	8	9
Popcorn (small bag or 1 cup)	1	2	3	4	5	6	7	8	9
Pretzels (small bag									

or 5 large twist)	1	2	3	4	5	6	7	8	9
Peanuts (small bag or 1 oz.)	1	2	3	4	5	6	7	8	9
Other nuts (small bag or 1 oz.)	1	2	3	4	5	6	7	8	9
Seeds (1 oz. or 1/2 cup) e.g., Sunflower or pumpkin	1	2	3	4	5	6	7	8	9
Graham crackers (2 big or 4 small)	1	2	3	4	5	6	7	8	9
Crackers, like "Wheat Thins" or "Ritz" (5)	1	2	3	4	5	6	7	8	9
Poptarts (1)	1	2	3	4	5	6	7	8	9
Danish, sweetrolls, pastry (1)	1	2	3	4	5	6	7	8	9
Donuts (1)	1	2	3	4	5	6	7	8	9
Snack cakes, like "Twinkies" (1 package)	1	2	3	4	5	6	7	8	9
Cake (1 slice)	1	2	3	4	5	6	7	8	9
Cookies (1)	1	2	3	4	5	6	7	8	9
Brownies (1)	1	2	3	4	5	6	7	8	9
Pie (1 slice)	1	2	3	4	5	6	7	8	9

Chocolate (1 bar or packet) e.g., Hershey's" or "M&M's"	1	2	3	4	5	6	7	8	9
Other candy bars (1 bar) e.g., "Milky Way" or "Snickers"	1	2	3	4	5	6	7	8	9
Candy without chocolate (1 pack) e.g., "Sweet Tarts" or "Skittles"	1	2	3	4	5	6	7	8	9
Jello (1/2 cup)	1	2	3	4	5	6	7	8	9
Pudding (1/2 cup)	1	2	3	4	5	6	7	8	9
Sherbert (1/2 cup)	1	2	3	4	5	6	7	8	9
Ice cream (1 cup)	1	2	3	4	5	6	7	8	9
Milkshake or frappe (1)	1	2	3	4	5	6	7	8	9

Food Frequency-Condiments/miscellaneous

28. For each item listed, select the circle indicating how often *on average* ***you*** have consumed the amount specified *during the last 6 months*.

(1) Never, or less than once per month | (2) 1-3 per month
(3) 1 per week | (4) 2-4 per week | (5) 5-6 per week | (6) 1 per day
(7) 2-3 per day | (8) 4-5 per day | (9) 6+ per day

Brown gravy	1	2	3	4	5	6	7	8	9
Ketchup (1 tbsp)	1	2	3	4	5	6	7	8	9

Mayonnaise (1 tbsp)	1	2	3	4	5	6	7	8	9
Salad dressing (1 tbsp)	1	2	3	4	5	6	7	8	9
Peanut butter (1 tbsp)	1	2	3	4	5	6	7	8	9
Jams, jellies, syrup, honey, or Fluff (1 tbsp)	1	2	3	4	5	6	7	8	9
Garlic (1 clove or 4 shakes)	1	2	3	4	5	6	7	8	9

29. Are there any other foods you typically ate at least more than once a week during the last 6 months? Please list them below.

    _____

    _____

    _____

30. What do you think will change about your son or daughter's eating habits and physical activities while they are attending college?

Thank you so much for your time and participation! We appreciate it

A.3 Food Record Instructions

You are asked to keep a food record for ***three consecutive days***. In order to complete the food record thoroughly, **you must make a note of all food and beverages consumed** during the days you have been assigned.

It is also important to note the ***method of preparation*** (e.g., fried, baked, broiled, etc.) and ***all condiments*** (ketchup, mustard, mayonnaise, sauces, etc.) ***or other additives*** (salt, butter, sugar, Nutrasweet®, etc.) that are consumed with the food. So, if you have eggs for breakfast, you need to record the amount of eggs, how it was prepared (fried, poached, etc.), what it was fried with (vegetable oil, butter, etc.), anything you may have put on the eggs (ketchup, Tabasco sauce, salt, pepper, etc.), and the time you ate. Also, reporting the brand of food item is very helpful and the name of the restaurant if you ate out.

Please do not overlook the importance of reporting the serving size or amount eaten, as this is the most important piece of information for us when calculating your dietary intake. Do not hesitate to use comparisons such as equating the size of the serving to a deck of cards if you do not know the exact portion size. Any information that would allow us to get good ideas about the amounts you consumed will be very helpful, because we understand that most people do not measure their food to the nearest gram.

Over the days when you are keeping your food record, you must tell us everything you eat and drink, even water and diet sodas. Don't forget about breath mints, gum, tobacco products, and vitamins/supplements. All these items contribute to your daily intake of nutrients and that is what we are interested in knowing – regardless of what it might be. Please print extra log sheets for each day if you need them.

If you ever have any questions regarding your food record, please contact Linda by email at lehrkel@ksu.edu. We will be more than happy to help – it is in everyone's best interest to keep accurate food records for the success of this scientific study. Please do not forget to schedule an appointment for you and your friend to drop off your food diary and get weighed and measured (Waters 331J).

Thank you very much for your cooperation and dedication. You participation will not only provide information for you, but will also benefit science.

EXAMPLE						
Time	**Food or Item Eaten**	**Amount**	**Who was with you?**	**What actvities were going on at the time? (TV on, radio, reading, etc)**	**Where were you?**	**How hungry were you on a scale of 1-10?**
8:30am	Yoplait yogurt (keylime flavor)	1-6oz container	Alone	surfing the internet	at home	3
8:30am	Banana	1	Alone	Surfing the internet	At home	3
8:30am	Coffee	2 cups	Alone	Surfing the internet	At home	3
11:30AM	Subway meatball sub with lettuce, onions, pickles, cheese, olives, ranch dressing	1-6 inch sub	Beth	Talking	The union	1
11:30am	subway macadamia nut cookie	1	Beth	Talking	The union	1
11:30am	Diet Coke	1-20oz bottle	Beth	Talking	The union	1
4:00pm	Totinos Pizza rolls (baked)	7 pizza rolls	Alone	watching tv	at home	3
4:00pm	water	2-16oz glasses	Alone	Watching tv, talking	At home	3
6:00pm	DaVinci brand spaghetti	2 cups	Brandon	Watching tv, talking	at home	6
6:00pm	Kroger brand spaghetti sauce (meat flavor)	1/2 cup	Brandon	Watching tv, talking	At home	6
6:00pm	water	2-16oz glasses	Brandon	Watching tv, talking	At home	6
9:00pm	HyVee Brand Cookie dough Ice cream (ate out of carton)	2 spoonfuls	Alone	standing in kitchen	at home	9

A.4 Hunger and Fullness Scale

10=Uncomfortably full or “sick” – “Thanksgiving full”

9=Stuffed and uncomfortable

8=Too full, somewhat uncomfortable

7=Full, but not yet uncomfortable – hunger is gone

6=Filling up, but still comfortable – could definitely eat more

5=Neutral – neither hungry nor full

4=Slightly hungry, faint signals that your body needs food, but you can still wait to eat

3=Hungry, not yet uncomfortable, clear signals that your body needs food

2=Very hungry, irritable or anxious – you want to eat everything in sight

1=Starving, feeling weak, lightheaded, dizzy, or other extremely uncomfortable symptoms of hunger

Appendix B - Student Profile—"Mary Brown"

Mary Brown was raised rural Colorado. She attended high school there and was very active in sports throughout her youth. She competed in volleyball, basketball and track, so she was busy year round conditioning and practicing for these sports. Her parents' income is well above the average household income in their geographical area however, that income goes fast with a relatively large number of children. Mary is one of six children and the Browns' will have only 3 children living at home once Mary goes off to college.

Mary's mother Clara does most of the food shopping and cooking in the household. Typically, the Browns' try to eat 3 to 4 meals together a week. The TV is usually off for the family meals, but once or twice a week, the Browns will watch TV while they dine. Mary usually eats breakfast 3 mornings per week. She usually has quick things for breakfast like yogurt, bagels or cold cereal. For lunch, Mary utilizes the high school cafeteria. Because Mary is an athlete, she is usually at practice late or participating in sports frequently, she will grab some food in town on the way home from practice or she and her family will go out for meals after her games. Having a larger family means that supper is usually a mixed dish like tacos, lasagna or maybe "Hamburger Helper", but also being a rural family, some meals are still the classic meat and potatoes. A wide variety of fruits and vegetables are consumed in the home as well. Mary, however, is not as big a fan of vegetables as she is fruits. A large portion of her vegetables come from peas, corn or lettuce. The family also keeps a lot snacks like chips and crackers and sweets like cookies on hand to munch on. Since Mary is at school a lot and has access to vending machines for snacks during the day has quite a bit of packaged candy and

chips. The family drinks a lot of milk, coffee and iced tea, but they are not soda drinkers at all, just maybe on a rare occasion.

Clara doesn't think that Mary's eating habits will change much. She worried that Mary won't exercise as much. Clara is worried that Mary will go from "participating in sports year round to not having any set physical activity". This is viewed as a big challenge for Mary by her mother. Mary on the other had is worried to about eating healthy. She is also worried about not having time to exercise because she may be busy studying. However, she does speculate that she will not get extra calories from drinking like many freshmen do. Mary states, "I'm not big into drinking, so that won't be an issue."

As Mary transitions into college, she sees some of these changes take place. She has some scholarships to help her defray tuition and book cost and the rest she is paying for by herself. Mary lives in the dorms and has 2 other roommates. She has a meal plan through the school, which allows her the total 20 meals per week offered. She eats breakfast more often now about 5 to 6 times a week, but eats in her dorm room alone, forgoing the meals she paid for, because she has to be up early for class. Otherwise, Mary eats on the schedule of the campus dining center and usually eats with her roommates at least once a day. Now that the dining center is part of her life, Mary eats out a lot less. When she and her roommates do prepare meals, in their dorm room, all of the girls share responsibilities of food shopping and cooking, but mainly the dining center is there source for meals.

Most noticeably, Mary drinks almost no iced tea now but more water and about 10 times more milk (both regular and chocolate). Interestingly, she begins drinking whole milk instead of the low-fat milk that was available at her parents' house. Mary's predictions about drinking alcohol turn out to be wrong. She does indeed get many extra calories from drinking light beer

and liquor. Overall, she consumes about 2 to 4 shots of liquor per week and 5 to 6 light beers. This may be mild for some students, but it is a large increase given that she used to not consume any alcohol. Mary also starts consuming twice the amount of sugared fruit juices now than she did at home. Aside from drinking milk, Mary eats about 50% fewer calories from dairy products like yogurt and cottage cheese, than she once did. Mary eats the same amount of meats, relative to when she lived at home. She consumes twice as much pizza and less than half as much of the mixed dishes. Mary consumes 3 to 4 times as much wheat breads and twice as many potatoes, but eats about 75% fewer bagels than she did before. Across the board, Mary consumes about half the servings of fruits and vegetables per week than she did at home, with the exception of applesauce, tomatoes and spaghetti sauce. Mary also, consumes fewer sweets and snacks. The main foods she cuts from her diet are nuts and crackers, probably because they are expensive to purchase for snacking. She also eats about half as many baked goods like cake, cookies and brownies.

Mary has one roommate she eats with most often, Donna. They always eat their evening meals together and will eat lunch together on Tuesdays and Thursdays, when their class schedules allow. Not only do Mary and Donna eat many meals together, they also eat very similar amounts of meats and main dishes and breads and grain. In fact, they both typically have the same evening meal at the dining center. Mary drinks soda pop more frequently than Donna; Mary drinks about one can of soda a day and Donna doesn't drink any. Donna hardly eats fruits and vegetables; she might consume occasional pieces of lettuce on a sandwich or vegetables in a mixed dish or on pizza. However, Mary eats much more snacks than Donna. Typically, Mary eats snacks during the day and not in the evening, but Mary gets about twice as many calories from snacks and desserts than Donna. Even though both girls eat similarly, Mary still consumes

about 350 more calories per day than Donna. Most of these extra calories come from snacks, fruits and beverages.

Mary tried to get in some physical activity during the year. She participated in an intramural basketball league over the winter. But she is still exercising a lot less than when she was involved in sports year round. Overall, Mary perceives that she eats fewer vegetables, which she claims is due to "mom not being around". Accurately, she knows that she eats breakfast more now than before. She thinks that she eats more fruits and fewer desserts, though. Even though she admits these changes she feels that she is just as active as she was in high school and eats almost the same too. However, she believes that she has gained about 5 to 15 pounds in college. This perception is correct, by April, she had gained almost 10 pounds.