The Effect of Personalized Online Nutritional Analysis on the Diets of College Students

Team Dietary Information and Evaluation Technologies

Team Research Proposal Draft

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Abstract

Obesity in the United States is often referred to as an epidemic, and countless nutrition intervention studies have been done to examine possible preventative measures. Most of these studies involve self-reporting by participants, and many suggest that the best age to target eating habits is college since these students are just beginning to live on their own. We seek to examine how a nutritional intervention without self-reporting will affect the eating habits of our student participants by developing and implementing an interactive diet tracking tool in the form of a website. The website will use the student ID swipe system in the diner to record individual food purchases, and report the healthfulness of the student's choices on a daily basis. We hope to find that our research will contribute to the literature of the field through testing the impact of a new type of intervention on a fairly unexplored demographic.

The Effect of Personalized Online Nutritional Analysis on the Diets of College Students

One of the most significant health issues in modern America is obesity (Mokdad, 1999). With 68% of the population classified as obese, it is the second leading cause of preventable death in America (Wardlaw & Smith, 2011). College students are especially at risk of weight gain and obesity because time constraints, varying schedules, and the high availability of fast food options make maintaining a balanced diet difficult (Haberman & Luffey, 1998). As poor diets have been linked to cardiovascular disease, hypertension, diabetes, cancer, and osteoporosis, college students have cause for concern (Wardlaw & Smith, 2011). In fact, it has been shown that most students gain weight in their first year in college. One study found that 74% of the participating students gained some weight during their freshman year, and 33% of the participants gained at least five pounds (Anderson, Shapiro, & Lundgren, 2003).

The weight gain that most students experience in college can be partially attributed to poor eating habits, such as excessive intake of fatty foods and alcohol (Lowe et al., 2006). The United States Department of Agriculture (USDA) recommends a diet that is high in fruits, vegetables, whole grains, and milk according to its Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans (2010). In addition, the USDA suggests diets low in saturated fat, sodium, and calories from solid fats and sugars. A study by Richard Lowry (2000) found that college students, however, usually do not eat according to these standards. In a survey of 4,838 students from 136 colleges and universities, only 26% of students reported eating the recommended five or more servings of fruits and vegetables. As there are about 20 million students attending universities in the United States, 15 million of these students are lacking important nutrients in their diet (National Center for Education Statistics, 2009).

Students tend to eat poorly because they are often unaware of what constitutes a healthy diet, or they do not know the importance of good eating habits. For example, in Lowry's study (2000), both female and male students associated vigorous physical activity with weight loss, while ignoring the effect of consumption of five or more servings of fruits and vegetables. In addition, only one in three respondents reported receiving information about dietary behaviors and nutrition from their college (Lowry et al., 2000). When students have difficulty accessing nutritional information, it leads to ignorance about dietary choices which makes it harder to maintain a healthy diet (Deshpande, Basil, & Basil, 2009).

By collecting data about our participants' eating habits based on their dining hall purchases, we will provide personalized nutritional analysis to our participants based on the guidelines set forth by the USDA and nutritional information provided by Dining Services. To this end, we will create a website that participants can access to view their dietary history. For our experimental group, the website will also provide a score based on the Healthy Eating Index (HEI) developed by the USDA. The HEI assigns point values for adherence to the Dietary Guidelines for each food group and, from these component scores, calculates an overall point score indicating the quality of a person's diet. Our control participants will be able to see their eating histories, but instead of receiving a calculated HEI score, they will be directed to the University of Maryland Dining Services' nutritional information website, which is currently the only means provided by Dining Services to students at the university for assessing their dietary habits. Our experiment will address the question: is there a relationship between access to an interactive and accessible nutritional information tracking tool based on students' dining hall purchases and the nutritional habits of students?

We hypothesize that there is a significant positive correlation between change in student diet based on the HEI and access to a nutritional information tracking system in the form of a website. We predict a significant positive correlation because it has been shown in multiple studies that after a nutritional intervention, college students tend to improve their diets (Ha & Caine-Bish, 2009; Ha, Caine-Bish, Holloman, & Lowry-Gordon, 2009; Peterson, Duncan, Null, Roth, & Gill, 2010). In addition, we hope to convey to our experimental group the benefits of a good diet and the dangers of an unhealthy one. According to the health belief model, when an individual believes that there is a risk of disease he or she will take preventative measures to avoid disease (Deshpande, et al., 2009). In other words, if participants believe that poor eating habits increase their risk of disease, then they will eat more healthily in order to avoid illness.

Literature Review

The Importance of Healthy Eating

Healthy eating is a positive behavior that has many concrete benefits, and offers protection from the epidemic of obesity and the array of health problems associated with this disease. America's poor diet and sedentary lifestyle have caused a veritable public health crisis. 15% of adolescents and 25% of adults are obese, and many more are overweight (Kolodinsky, Green, Michahelles, & Harvey-Berino, 2008). Weight is not the only factor in measuring dietary health; people who are not overweight but make poor dietary choices are also at risk of developing health problems (Haberman & Luffey, 1998). The United States Dietary Guidelines Advisory Committee (2010) has taken a grave interest in the issue and warns that everyday choices, particularly macronutrient intake, have a critical effect on the risk of developing adult-onset diabetes and cardiovascular diseases including atherosclerosis and hypertension.

Cardiovascular disease can lead to heart attack and stroke, which are leading causes of death in this country (United States Dietary Guidelines Advisory Committee, 2010).

Fortunately, even with moderate positive changes in diet and physical activity, a wide range of benefits can occur, from improved self-esteem to higher resistance to illness, better academic performance, healthier weight, and reduced risk of life-threatening cardiovascular disease (Richards, 2009; Behrman, 1996; United States Dietary Guidelines Advisory Committee, 2010). Making these changes can help to prevent and treat obesity (Wardlaw & Smith, 2011). Specifically, the American diet needs to contain more fruits, vegetables, and whole grains and reduce the intake of sugar and solid fats (United States Dietary Guidelines Advisory Committee, 2010).

Experts agree that in order to improve the American diet in the long term and curb the rate of obesity, it is essential to encourage healthy eating in young people (Behrman, 1996; United States Dietary Guidelines Advisory Committee, 2010; Wardlaw & Smith, 2011). Adolescence is a key period for the formation of life-long health behaviors, so it is advantageous to establish them early (Wardlaw & Smith, 2011; Anderson, et al., 2003). Furthermore, studies have linked a healthy diet with success in school, and a poor diet with substandard academic performance (Behrman, 1996; Kobayashi, 2009). These positive effects of good nutrition, along with the direct health benefits, show that it is critical to improve one's eating habits as early as possible.

College Students Nutritional Studies

For many students, leaving home for college means they must begin making their own dietary choices for the first time. Suddenly, they have complete control over what they eat at every meal, every day. Unfortunately, it may be difficult for these students to maintain a healthy diet considering their lack of experience, their busy lifestyles and preoccupation with their studies, and the limited nutritional choices available to them in student dining halls (Eves, Kipps, & Parlett, 1995). Like other Americans, most college students do not consume enough fruits and vegetables, but over-satisfy their daily meat requirement (DeBate, Topping, & Sargent, 2001). Only about one-fourth of college students eat enough fruits and vegetables (Lowry, et al., 2000). The three dietary ills most common among college students were meal skipping (particularly breakfast), frequent and regular consumption of fast foods, and consistent failure to meet the recommended intake of all food groups except meat (DeBate, et al., 2001). The effect of overconsumption of meat is that too much of college students' energy comes from fat rather than complex carbohydrates and protein which can lead to problems with obesity, diabetes, and cardiovascular disease (Eves, et al., 1995). The most fundamental change that must be made in the diets of young adults in college is supplementing the increased intake of vegetables and fruits with less frequent consumption of carbonated beverages and high fat combination dishes (Huang, Song, Schemmel, & Hoerr, 1994). Unfortunately, even if students eating at a dining hall manage to consume a balanced diet, their nutrition may suffer for lack of variety; 76% of students said that they eat the same food every day (Haberman & Luffey, 1998).

Besides their actual dietary intake, it is important to analyze how knowledgeable college students are about their nutrition. Only one in three reported that their university attempted to inform them about this issue. Few students connected the consumption of more fruits and vegetables with managing their weight, suggesting some gaps in their nutritional knowledge (Lowry, et al., 2000). Therefore, there is room for improvement in college students' diets and this is achievable by filling the gaps in their understanding of nutrition and educating them about the importance of this issue.

The Theory of Planned Behavior

In order to positively influence the everyday dietary choices of college students, we must first understand what factors affect their behavior. According to the theory of planned behavior, the three main determinants of human action are the consequences that students expect to result from their behavior, their perception of social pressure regarding this behavior, and their evaluation of the impediments to this behavior (Pawlak, Malinauskas, & Rivera, 2009). Therefore, by informing students of the benefits of healthy eating, the pressure from doctors and experts towards improving their diets, and the ease with which this can be accomplished using our website, we will have addressed each of the respective foundations for planned behavior and increased the chance of effecting a lasting positive change. Other behavioral research has shown that the most important influences on students' everyday dietary choices are taste, time, convenience, and budget, in that order (Huang et al., 1994). Concern for their health becomes a significant factor once they are informed about the risks of poor nutrition (Deshpande, et al., 2009). Studies show that the more informed students are about the nutritional content of their food, the healthier their choices will be (Butler, Black, Blue, & Gretebeck, 2004; Cousineau, Franko, Ciccazzo, Goldstein, & Rosenthal, 2006; Ha & Caine-Bish, 2009; Ha, Caine-Bish, Holloman, & Lowry-Gordon, 2009; Hawks, Madanat, Smith, & De La Cruz, 2008; Kolodinsky et al., 2008; Peterson et al., 2010)

Website Design

Providing students nutritional information is critical to dietary change, but what is equally important is choosing the most effective distribution channel. The World Wide Web, convenient to use and capable of reaching a broad audience, is a top choice in this era of digital technology. To design a web application, the first step is to decide which platform to use, that is, what programming language and methodology to use. Three of the most widely used platforms are J2EE, .NET, and Ruby on Rails, according to a study done by Stella, Jarzabek, and Wadhwa (2008). This study tested the maintainability of these three platforms in four areas: modifiability, testability, understandability, and portability, and rated Ruby on Rails as having the best performance out of the three. Since our website will host participants' personal information, security will be a major concern. However, researchers in the University of Maryland's Computer Science Department have looked into this matter and have outlined several methods of analyzing and assessing security vulnerabilities of applications developed with Ruby on Rails (Chaudhuri & Foster, 2010).

In addition, there are many types of features which must be considered in order to appeal most to our potential users. Studies identify four key features: personalized and tailored information, adequate reading level, credibility, and aesthetic appeal (De Angeli, Sutcliffe, & Hartmann, 2006; Fogg et al., 2001).

A survey of college students regarding their preferences of what a web nutrition program must have reveals that many college students are most interested in nutrition sources that target their unique needs, particularly when that information is individually tailored (Alexander et al., 2010).

Researchers Neuhauser, Rothschild, and Rodriguez (2007) questioned the reasons as to why people avoided using USDA's MyPyramid despite the fact that the website has a great deal of valuable nutritional information. They used various literacy tests to assess the usability of the site and found that the reading level of MyPyramid was ranked well above the national average reading level (Neuhauser, Rothschild, & Rodríguez, 2007).

In addition to maintaining an appropriate reading level, it is also extremely important to gain users' trust. A report from a large quantitative study at Stanford University identified several important factors to help increase users' perception of a website's credibility. Those factors include quick response to customer service questions, listing of contact information, letting users search past content, and providing links to reputable websites (Fogg, et al., 2001).

According to De Angeli, Sutcliffe, and Hartmann's study (2006), design features and interaction styles are also critical to a website's success. The results from this study show that between two websites with identical content, users gave higher ratings to the site with more aesthetic appeal, as defined by the study's participants, using such qualities as pleasantness, clarity, neatness, symmetry creativity, originality, sophistication, attractiveness and use of special effects (De Angeli, et al., 2006).

Healthy Eating Index - Nutrition Standard

In an informational intervention, the outcome is highly dependent on the kind of information provided to participants. We want to provide them with constant feedback and analysis on their diets, so it is important to choose the most appropriate of the various nutrition standards available. The literature leads us to the Healthy Eating Index, which is "a measure of diet quality that assesses conformance to Federal dietary guidance" developed by the USDA in 1995 (Guenther et al., 2008). The Dietary Guidelines provide "science-based advice to promote health and reduce risk of major chronic diseases through optimal diet and regular physical activity…[and] form the basis of Federal food, nutrition education, and information programs" (United States Dietary Guidelines Advisory Committee, 2010). Since the creation of HEI, studies have been done to test the effectiveness of following the HEI guideline in preventing chronic diseases. Although two studies found that following the HEI guidelines does not prevent chronic diseases, many have shown that the HEI is still a valid dietary evaluation tool (McCullough et al., 2000; Willett & McCullough, 2008). Another study tested the correlation between HEI score and obesity based on thousands of participants and concluded that the HEI is a reliable measure in identifying obesity and poor eating (Guo, Warden, Paeratakul, & Bray, 2004).

Methodology

Research Design

Our research study will use a mixed method correlational research design because we seek to investigate whether there is a relationship between accessibility of dietary information and changes in dietary behavior. By manipulating our participants' access to the nutritional analysis of their diets, we will attempt to determine the impact and influence of our website. The availability of our website as a resource for nutritional information is our independent variable, and our dependent variable is the change in HEI component scores as a measure of healthiness of students' diets. Since the HEI standard that we will use is based on an average daily caloric consumption between 1200 and 2400 calories, our target population is defined as University of Maryland students in their freshmen and sophomore years with meal plans who eat most of their meals at the diner, excluding students who eat more than the maximum caloric intake covered by the HEI, such as varsity and recreational athletes, students with eating disorders and others who do not fall within this caloric range (Guenther, et al., 2008).

Procedure

Database and website design. Our database will be hosted on a computer owned by our team and provided by mentor Dr. Bruce Jacob, and will contain both the nutrition information from Dining Services' FoodPro database, including nutritional information and recipes for all meals served at University cafeterias, and the individual users' personal information, such as student identification number and meal purchases. We plan on using the relational database management system MySQL for our database design, because it is free to use while still retaining the specific requirements we need for a relational database. The website will integrate analysis software from the USDA dietary assessment tool MyPyramid Tracker. The website will require each participant to log in with a user name and password that will link to the user's personal identification number in the database so he or she can access and view his or her dietary history. The website will provide students with a record of their purchases and an overall letter grade for the healthiness of their diet. This letter grade will also be broken down to include sub-scores for individual categories of food. A web application overview schematic, a database conceptual schematic and a website design and use flowchart are included as Appendices A, B and C, respectively. We have contacted Dr. Jim Purtilo, a computer science professor at the University of Maryland, who has agreed to help guide us in our database and website development. He does not believe that our team will require extensive help in developing our database system; however he does suggest that assistance from a paid graduate student might prove helpful.

Institutional Review Board (IRB) approval. Once our website and database are fully functional and our thesis proposal is accepted, we will seek the IRB's approval to work with human participants. In the time leading up to application submission, we will draft consent forms, flyers, scripts and protocols for interaction with our participants for inclusion in our application. We will also conduct a pilot study on ourselves in order to ensure that our data collection and analysis systems are functioning properly.

Participant recruitment. We will recruit participants from our target population by any means available to us. Possible recruiting outlets include email listservs, posters and tables near the dining halls and around campus, the New Resident Orientation program, university tours, UNIV100, HONR100, and GEMS100 introductory classes, the Department of Resident Life, summer orientation programs, Facebook and other social media. Since we have already defined our target population to exclude students outside of the HEI calorie range, as well as students who do not have a school meal plan, our recruitment will be a convenience sample, and it is also subject to volunteer bias because students will have to agree to participate in our study. We plan to offer small incentives, possibly cash prizes, to students for signing up for the study, but we will not be offering incentives to log onto the website, because it would confound our results since logging onto the website is our independent variable. Once we recruit our participants, they will complete a modified version of the Eating Attitudes Test (EAT), a questionnaire developed in the 1970s which has been shown to be a valid measure of eating disorders, in order to screen for eating disorders, determine how often the student eats off campus, asses the student's general physical activity level, and gauge his or her general caloric range (Garner & Garfinkel, 1979). We will then obtain informed consent to allow us to access each participant's personal dietary information when he or she initially registers on the website. At this point, the participants will no longer be required to actively participate in our study; we can continue to gather the necessary data and evaluate their diets whether or not they visit the website.

Data collection. We will randomly divide our participants into two groups: control and experimental. In order to randomly divide the groups, we will assign numbers to each participant. Then, using a random number generator, we will be able to separate the numbered participants into the two groups. The study will take place over a period of nine weeks that will be separated into three phases. Each participant, regardless of his or her group assignment, will have an account on our website that will contain his or her personal information, such as age, height, weight and dietary record. Data will be collected in the form of specific foods purchased at the dining hall and analyzed as HEI scores calculated from these specific foods. Our database will automatically calculate the HEI score using the source code provided by the USDA's Center for Nutrition Policy and Promotion, which is given in Appendix D (Kahle, 2005). Using these HEI scores, we will calculate descriptive statistics on our data to determine whether there was a change in eating patterns from pretest to posttest.

Phase I. During this first stage, we will begin tracking all of our participants' food choices in the diner. We will be using the University of Maryland's Dining Services database which links student ID cards used to make purchases to inventory information, from here referred to as the swipe system. The swipe system will be used to send information regarding each student's purchases to our website for a period of two weeks. This period is the pretest portion of our study and will be used to establish a baseline for each participant; no nutritional analysis will be provided to students during this initial phase. We will analyze HEI data from the second week of collection. We have elected to consider only the last week of the period for several reasons. First, we want to use the first two weeks to ensure that our data collection system is functioning properly on a large scale. Second, since we expect that most of our participants will be freshmen, we want to allow them some time to adjust to college life and eating in the dining halls. Third, we want to control for any confounding effects of increased student awareness arising at the start of the study. Ideally, the two-week period before analyzing the data for our results will account for any confounding variables due to the social desirability bias where participants may strive to eat a certain way for the sake of appearances (Graziano & Raulin, 2009).

Phase II. The intervention will occur throughout this phase of the experiment. For the next five weeks, the experimental group will be provided with online dietary analysis which will score their daily intake in accordance with the HEI, while the control group will only be given a link directing them to nutritional information on Dining Services' website. The control group will be given the link three times, once at the beginning of each phase. Average HEI scores of each group from this time will not be included in our analysis. Instead, we will track how often the participants view our website in order to see if there is a correlation between use of the tool during the intervention phase and change in average HEI score at the end of the study.

Phase III. During this final two-week session, the posttest portion of our study, the experimental group will still have access to analysis from our website, and the control group will still be directed to the dining services nutrition information available online. Depending on how many participants we are able to recruit, we can then decide whether or not to further divide the experimental group into two subgroups: one that will continue to receive nutrition analysis during this phase and one that will not. In order to be consistent with Phase I of the experiment, we will only use data from the last week of this phase for our data analysis.

Analysis. At the end of the nine weeks, we will compare overall and component HEI scores for each participant before and after the intervention. The HEI, as shown on the fact sheet in Appendix E, measures an individual's diet quality in conformance to federal dietary guidance based on 12 components: total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meat and beans, oils, saturated fat, sodium, and solid fats, alcoholic beverages and added sugars (Guenther, et al., 2008). We will calculate descriptive statistics from all our data and test to find whether there is any statistically significant difference in mean HEI scores from pretest to posttest for each individual as well as between the control and experimental groups.

Extraneous and Confounding Variables

As with any research project, we need to consider potential confounding variables when attempting to generalize our results beyond our sample population. Some of the confounding variables and biases that could affect our results may come from our participant selection process. Due to the limitations imposed by the specifications of our study, we cannot randomly select participants from the student body. After freshman and sophomore years, many students do not have dining plans and their involvement in the study would require the majority of their nutritional analysis to come from self-reporting. Therefore, we will have to recruit volunteers with meal plans. Since we are offering a method that could potentially improve the diets, and therefore the health of the participants, those who are interested in having healthier lifestyles will be more likely to volunteer than those with no real interest in their diets. We hope to account for this volunteer bias through the use of incentives for participation in the study, but even so, our results will be more applicable to health-minded students than to the student population at large.

Maturation is another confounding variable that may affect our results. Students new to the dining halls may not be familiar with the menu options available on a day-to-day basis. Over time, the participants may incorporate new foods into their diets as they learn about their options. Therefore, some observed dietary changes may result from this natural maturation, not access to nutritional information on our website. Also, participants may choose to change the food they eat based on price or other factors. Any changes that take place cannot be necessarily attributed to our tracking system because, in reality, the alteration in food intake might have happened over time even without the system. We will account for this is by having a control group which has no access to the analysis system.

A third confounding variable could be regression toward the mean. In the initial stages of data collection, students might eat extremely healthily or extremely unhealthily. This could be due to chance, personal goals or time constraints for a new semester or, for freshmen, the new environment. As our data collection stage progresses, we might observe that students are exhibiting different habits simply due to adjustment and regressing toward a mean in HEI scores with no relation to the information with which we provide them.

A final confounding variable that could potentially affect our project is attrition. Although our study will eliminate most of the self-reporting typically involved in nutritional intervention studies, we will allow participants to self-report foods eaten outside of the diner since we do not have the capability to track them using the swipe system (Butler, et al., 2004). Participants may find this extra aspect of the study too difficult to remember or too demanding. As a result, we could lose participants before the study is completed. Most likely, however, attrition will not be a large problem because the participants are not required to use the tool if they do not wish to and may simply stop logging onto the website if they so choose. Students may also be embarrassed to report everything they eat, so it is possible that any self-reported information may not be completely accurate, leading to response bias.

Anticipated Results

We anticipate that having access to the online nutrition evaluation will have some effect on students' diets, but we cannot predict whether access to this information will have a positive or negative effect. This is the first study to utilize the student ID swipe system as a tracking method, minimizing the self-reporting generally required by intervention studies in the field of nutrition, to provide students with access to a comprehensive nutritional evaluation of their diets

(Butler et al., 2004). Thus, we hope to find that personalized online nutrition analysis will be effective as a new method of intervention.

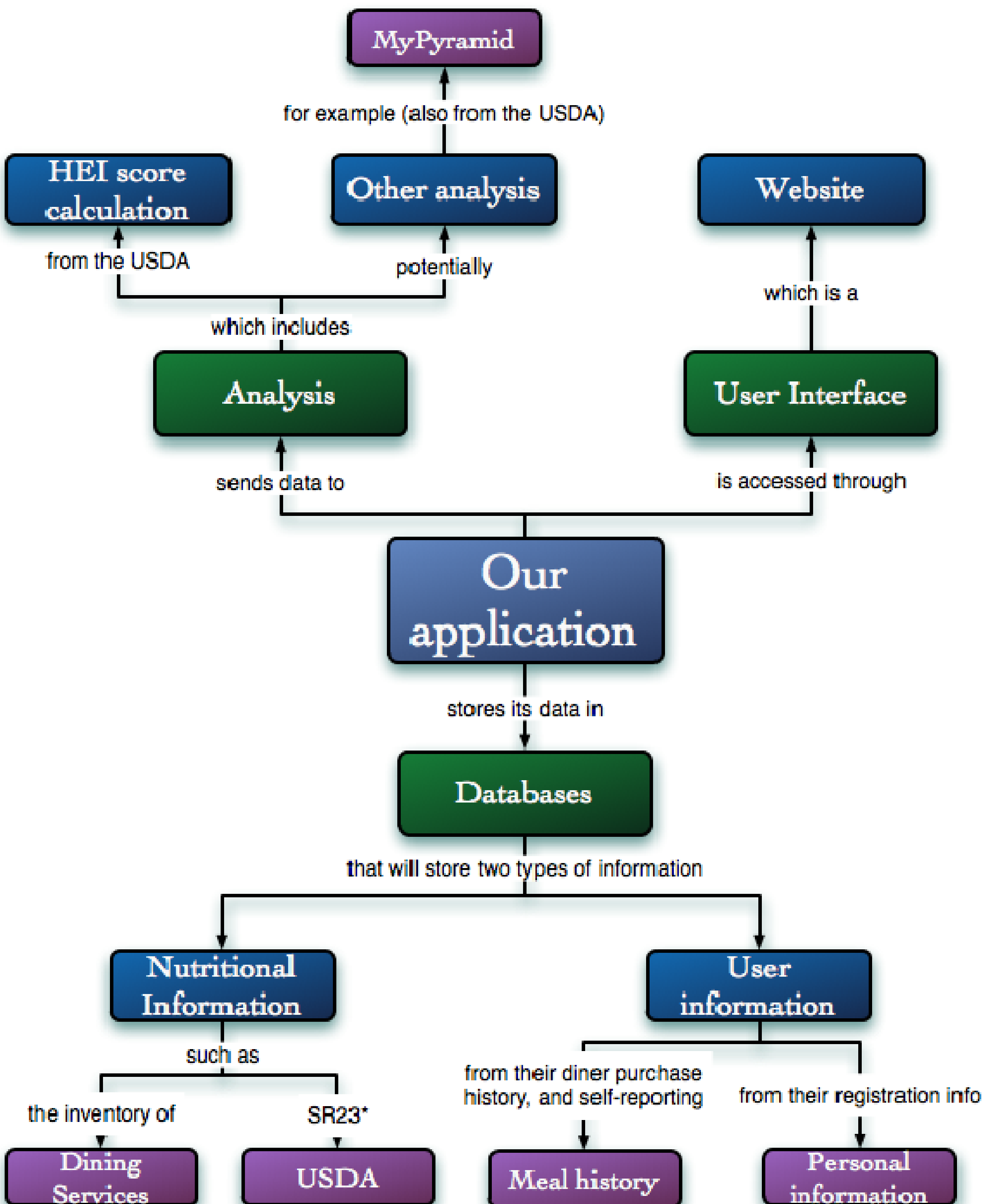
Important Contributions to the Research Field

Team DIET will contribute to the literature gauging the best way to construct an online nutritional tracking system. Although there are several confounding variables to overcome in using groups of college students in our sample, our research will allow future studies to employ our methods to better understand how college students interact with various online services. If we are successful, we believe that we can contribute significantly to the body of knowledge regarding the way in which a student-tailored online nutritional tracking system affects the nutritional habits of the students.

Since Team DIET seeks to investigate whether accessibility of dietary information is correlated with change in dietary behavior, our results could have important implications for future nutritional interventions on college campuses if our research shows that creating an accessible, non-self-reporting nutrition tracking and evaluation program can affect students' eating habits. Furthermore, if our results suggest that access to this information causes students to make positive changes to their diets, our new knowledge will ideally influence integration of personal online nutrition analysis into existing campus services at the University of Maryland. Regardless of whether or not our hypothesis is correct, our research will contribute to knowledge regarding the integration of technology with dietary intervention.

Appendix A

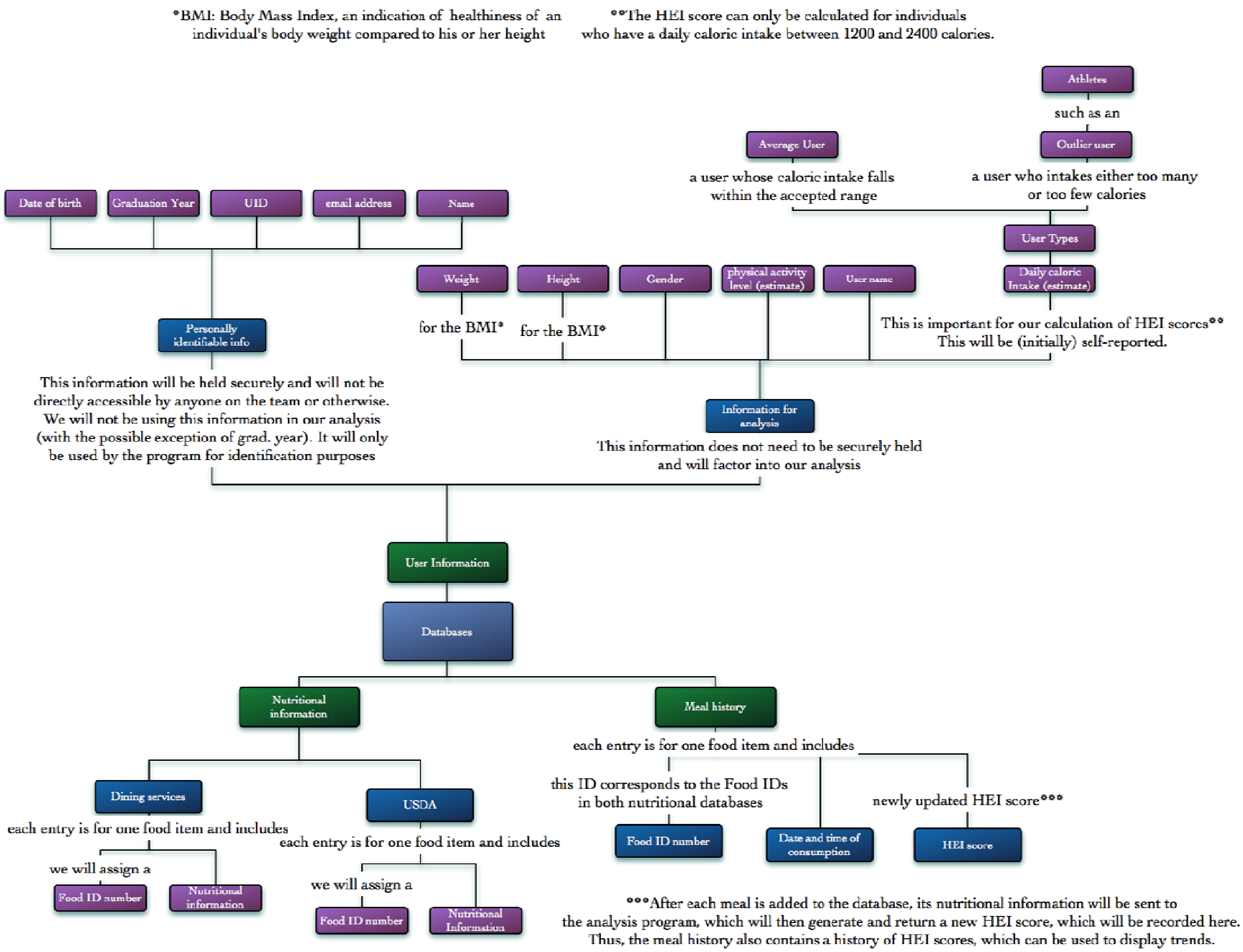
Web Application Overview Schematic



*the USDA National Nutrient Database for Standard Reference, Release 23

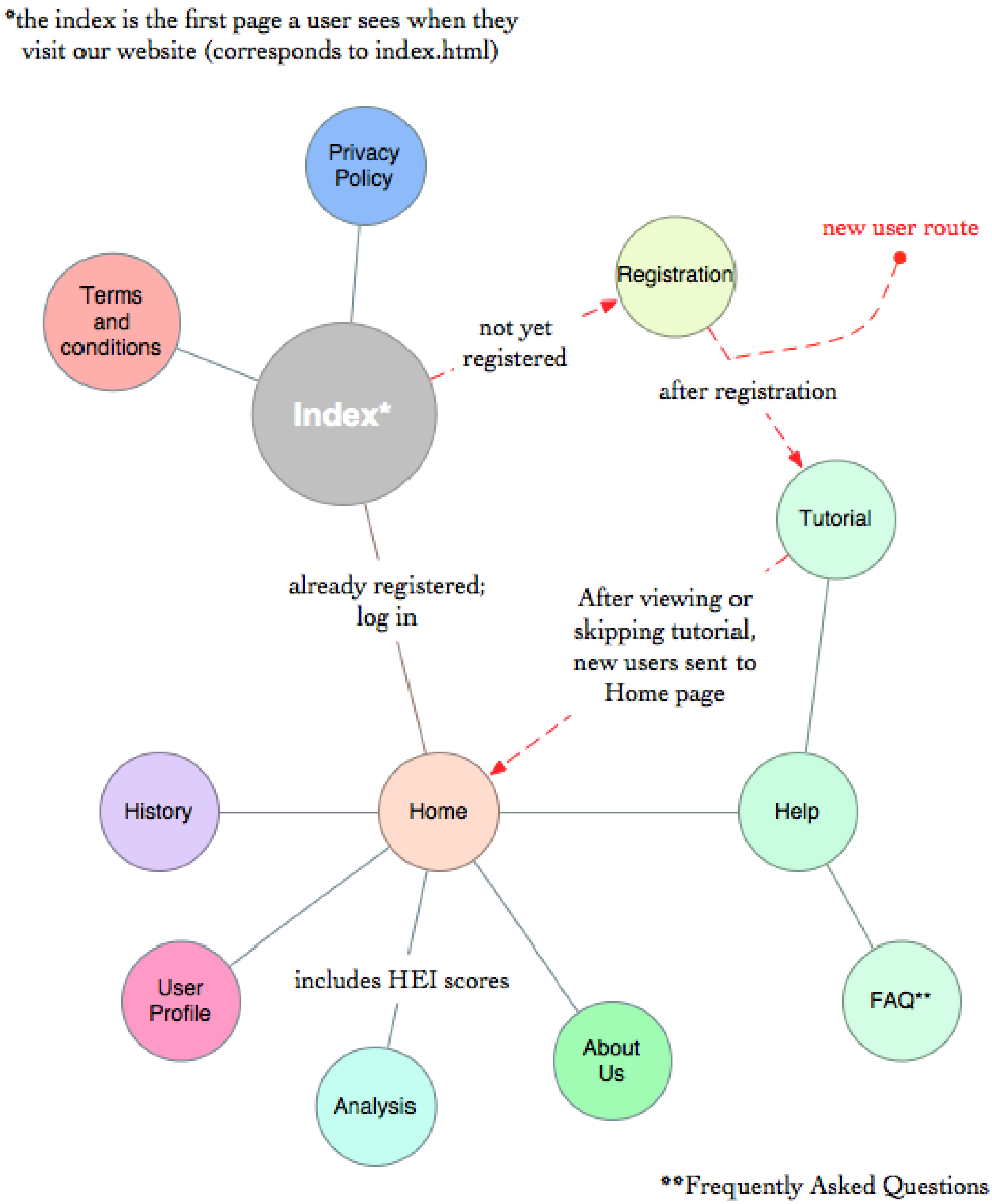
Appendix B

Database Conceptual Schematic



Appendix C

Website Design and Use Flowchart



Appendix D

HEI Calculator: SAS Program Code (Kahle, 2005)

```
*****************************************************************************
*The SAS program (HEI2005_NHANES0102.SAS):                                  *
*                                                                  *
*This program creates the component and total scores for the HEI-2005.       *
*The 12 components include: Total Fruit, Whole Fruit,                        *
*Total Vegetables, Dark Green and Orange Vegetables and Legumes,             *
*Total Grains, Whole Grains, Milk, Meat and Beans, Oils,                     *
*Saturated Fat, Sodium, and                                        *
*Calories from Solid Fat, Alcohol, and Added Sugar (SoFAAS).                 *
*Please see readme file at http://www.cnpp.usda.gov/HealthyEatingIndex.htm  *
*****************************************************************************;

/* Libname is the location of the input datasets.
See http://www.sas.cc.vt.edu/faqlib/libname.html
for more information*/

LIBNAME HEI "C:\";

TITLE 'HEI-2005, NHANES 2001-2002, Age 2+, Reliable Diets, Exclude Pregnant and
Lactating Women';

OPTIONS LINESIZE=79;

/*Step 1: locate required datasets*/
/*MyPyrEquivDB_v1: From MyPyramid Equivalents Database (from
MyPyrEquivDB_v1/data/equiv0102) for USDA Survey Food Codes Version 1.0
CNPPMyPyrEquivDB_v1_WJFRT: CNPP MyPyramid Equivalent Database for Whole Fruit and
Fruit Juice
drxiff_b: NHANES 2001-2002 individual food intake data in 1 day
drxtot_b: NHANES 2001-2002 individual nutrient intake data in 1 day
demo_b: NHANES 2001-2002 individual demographic and survey sampling information
rhq_b: NHANES 2001-2002 reproductive health questionnaire information
*/

data MPED;
 set HEI.MyPyrEquivDB_v1;

  /*In the HEI-2005, soy beverages are counted as part of the Milk component.
 Convert the four soy beverage codes in the MPED from M_SOY oz equivalents to D_TOTAL
cup
 equivalents using the following conversion process*/
```

```
  /*FOODCODE=11310000, MILK, IMITATION, FLUID, SOY BASED (1 cup=244 grams)
    FOODCODE=11320000, MILK, SOY, READY-TO-DRINK, NOT BABY (1 cup=245 
grams)
    FOODCODE=11321000, MILK, SOY, READY-TO-DRINK, NOT BABY'S, CHOCOLATE 
(1 cup=240 grams)
    FOODCODE=11330000, MILK, SOY, DRY, RECONSTITUTED, NOT BABY (1 cup=245 
grams)*/

  IF FOODCODE=11310000 THEN DO;
     M_SOY=0;
            D_TOTAL=ROUND(100*(1/244),.001);
            END;
  ELSE IF FOODCODE=11320000 THEN DO;
     M_SOY=0;
            D_TOTAL=ROUND(100*(1/245),.001);
            END;
  ELSE IF FOODCODE=11321000 THEN DO;
     M_SOY=0;
            D_TOTAL=ROUND(100*(1/240),.001);
            END;
  ELSE IF FOODCODE=11330000 THEN DO;
     M_SOY=0;
            D_TOTAL=ROUND(100*(1/245),.001);
            END;
run;
PROC SORT DATA=MPED;
  BY FOODCODE;
run;

DATA CNPPMPED_WJFRT;
  SET HEI.CNPPMyPyrEquivDB_v1_WJFRT;
run;
PROC SORT DATA=CNPPMPED_WJFRT;
  BY FOODCODE;
run;

DATA Food;
  SET HEI.drxiff_b;
  FOODCODE=1*DRDIFDCD; /*convert variable name and type*/
  if DRDDRSTZ=1; /*reliable dietary recall status*/
RUN;
PROC SORT DATA=Food;
  BY FOODCODE;
run;
```

```
DATA Nutrient (keep=SEQN DRXTKCAL DRXTCARB DRXTSFAT DRXTALCO
DRDTSODI);
  SET HEI.DRXTOT_b;
  if DRDDRSTZ=1; /*reliable dietary recall status*/
run;
PROC SORT DATA=Nutrient;
  BY SEQN;
run;

DATA demo (keep=SEQN RIDAGEYR SDDSRVYR RIDPREG WTMEC2YR SDMVPSU
SDMVSTRA);
  SET HEI.demo_b;
run;
PROC SORT DATA=demo;
  BY SEQN;
run;

DATA rhq (keep=SEQN RHQ200);
  SET HEI.rhq_b;
run;
PROC SORT DATA=rhq;
  BY SEQN;
run;

/*Step 2: Combine required datasets and calculate NHANES 2001-2002 individual food and
nutrient intakes*/
/*Please note: The CNPP whole fruit and fruit juice database is only created for NHANES 2001-
2002*/

DATA PYR;
  MERGE MPED(IN=S) CNPPMPED_WJFRT(IN=N);
  BY FOODCODE;
  IF S AND N;
run;

DATA FDPYR;
  MERGE Food (IN=S) PYR (IN=N);
  BY FOODCODE;
  IF S AND N;
run;

/*Convert NHANES 01-02 individuals' food intake amounts from grams to MyPyramid
equivalents*/

DATA FDPYR;
  SET FDPYR;
```

```
/* calculate intake for MyPyramid food groups*/

 ARRAY PYRVAR F_TOTAL WHOLEFRT V_TOTAL V_DRKGR V_ORANGE
                                LEGUMES G_TOTAL G_WHL D_TOTAL M_MPF
                                M_EGG M_NUTSD M_SOY DISCFAT_OIL DISCFAT_SOL
                                ADD_SUG;

 DO OVER PYRVAR;
   PYRVAR=PYRVAR*(DRXIGRMS/100);
 END;

run;

PROC SORT DATA=FDPYR;
  BY SEQN;
run;

/*Calculate individual's food intake amounts for MyPyramid food groups in 1 day*/
PROC MEANS DATA=FDPYR NOPRINT;
  BY SEQN;
  VAR F_TOTAL WHOLEFRT V_TOTAL V_DRKGR V_ORANGE LEGUMES G_TOTAL
G_WHL D_TOTAL M_MPF
         M_EGG M_NUTSD M_SOY DISCFAT_OIL DISCFAT_SOL ADD_SUG;
  OUTPUT OUT=PYRCALC SUM= ;
run;

/*Calculate individual's nutrient intake (DRXICARB, carbohydrate; DRXIALCO, alcohol) from
beer, wine
and distilled spirits, but exclude cooking wine*/
DATA BWLNUT (KEEP=SEQN DRXICARB DRXIALCO DRXILINE THREED);
  SET food;
  THREED=INT(FOODCODE/100000);
  IF (931 <= THREED <= 935);      /*alcoholic beverages of beer, wine, and distilled spirits*/

  IF FOODCODE=93401300 THEN DELETE; /*Remove cooking wine*/
run;
PROC SORT DATA=BWLNUT;
  BY SEQN DRXILINE;
run;

/*Identify Added Sugar intake from beer, wine
and distilled spirits, but exclude cooking wine*/
DATA BWLPYR (KEEP=SEQN ADD_SUG DRXIGRMS DRXILINE THREED);
  SET FDPYR;
  THREED=INT(FOODCODE/100000);
```

```
  IF (931 <= THREED <= 935);        /*alcoholic beverages of beer, wine, and distilled spirits*/

  IF FOODCODE=93401300 THEN DELETE; /*Remove cooking wine*/
run;
PROC SORT DATA=BWLPYR;
  BY SEQN DRXILINE;
run;

DATA BEERWINE;
  MERGE BWLNUT BWLPYR;
  BY SEQN DRXILINE;
run;

/*Exclude calories from Added Sugars food group in alcoholic beverages*/
DATA BEERWINE;
  SET BEERWINE;
  BY SEQN;

  SUGGRAM=ADD_SUG*4;          /*convert from teaspoons to grams of added sugars=grams
of carbohydrate from added sugars*/
  NOSCARB=DRXICARB-SUGGRAM;     /*subtract grams of carbohydrate from added sugars
from the total carbohydrate*/
  IF THREED IN (931,932,934) THEN BWCARBC=NOSCARB*4;        /*SoFAAS calories
from carbohydrate in alcoholic beverages*/
  ETHCAL=DRXIALCO*7; /*SoFAAS calories from alcohol (ethanol) in alcoholic beverages*/
run;

/*Calculate individual's SoFAAS calories from carbohydrate and alcohol (enthanol) in alcoholic
beverages in 1 day*/
PROC MEANS DATA=BEERWINE NOPRINT;
  BY SEQN;
  VAR BWCARBC ETHCAL;
  OUTPUT OUT=BEERWINE SUM=BWCARBC ETHCAL;
run;

/*Combine all required datasets*/
/*Only include individuals who are age 2 years and older and exclude pregnant and lactating
women*/
DATA BOTH;
  MERGE Nutrient (IN=F) BEERWINE PYRCALC(IN=P) DEMO rhq;
  BY SEQN;
  IF F AND P;
  IF RIDAGEYR >= 2;                  /*individuals age 2 and older*/
  IF RIDPREG=1 THEN DELETE; /*exclude pregnant women*/
  IF RHQ200=1 THEN DELETE; /*exclude lactating women*/
run;
```

```
/*Step 3: Calculate nutrient density per 1000 calories and
then calculate HEI-2005 component and total scores*/

/*Please note: MyPyramid equivalent values for total vegetable intake (V_TOTAL) in the HEI-2005
  may be different from V_TOTAL in the MPED because legumes may be counted as vegetables or meat
  in the HEI-2005; and total dairy intake (D_TOTAL) in the HEI-2005 may be different from D_TOTAL
  in the MPED because soy beverages are counted as milk in the HEI-2005.*/

DATA HEI2005;
  SET BOTH;
  BY SEQN;

/**Calculate HEI-2005 TOTAL FRUIT component score**/
/*Standard for maximum score is >=0.8 cup equiv/1000 kcal, Maximum score is 5;
  no Fruit intake, minimum score is zero*/
FRTDEN=F_TOTAL/(DRXTKCAL/1000);
HEI1=5*(FRTDEN/.8);
IF HEI1 > 5 THEN HEI1=5;
IF F_TOTAL=0 THEN HEI1=0;

/**Calculate HEI-2005 WHOLE FRUIT component score**/
/*Standard for maximum score is >=0.4 cup equiv/1000 kcal, Maximum score is 5;
  no Fruit intake, minimum score is zero*/
WHFRDEN=WHOLEFRT/(DRXTKCAL/1000);
HEI2=5*(WHFRDEN/.4);
IF HEI2 > 5 THEN HEI2=5;
IF F_TOTAL=0 THEN HEI2=0;

/**Calculate HEI-2005 Total Grains component score**/
/*Standard for maximum score is >=3.0 ounce equiv/1000 kcal, Maximum score is 5;
  no Total Grains intake, minimum score is zero*/
GRNDEN=G_TOTAL/(DRXTKCAL/1000);
HEI5=5*(GRNDEN/3.0);
IF HEI5 > 5 THEN HEI5=5;

/**Calculate HEI-2005 Whole Grains component score**/
/*Standard for maximum score is >=1.5 ounce equiv/1000 kcal, Maximum score is 5;
  no Whole Grains intake, minimum score is zero*/
WGRNDEN=G_WHL/(DRXTKCAL/1000);
HEI6=5*(WGRNDEN/1.5);
IF HEI6 > 5 THEN HEI6=5;
```

```
IF G_TOTAL=0 THEN DO;  /*no reported Total Grains intake, Total Grains and Whole Grains
component scores are zero*/
  HEI5=0; HEI6=0;
END;

/**Calculate HEI-2005 Milk component score**/
/*Standard for maximum score is >=1.3 cup equiv/1000 kcal, Maximum score is 10;
  no Milk intake, minimum score is zero*/
DAIRYDEN=D_TOTAL/(DRXTKCAL/1000);
HEI7=10*(DAIRYDEN/1.3);
IF HEI7 > 10 THEN HEI7=10;

/**Calculate HEI-2005 Meat and Beans component score**/
/*Standard for maximum score is >=2.5 oz equiv/1000 kcal, Maximum score is 10;
  no Mean or Beans intake, minimum score is zero*/

ALLMEAT=M_MPF+M_EGG+M_NUTSD+M_SOY;       /*Calculate total meat intake from
meat, poultry, & fish; egg; nuts and seeds; soy products*/
MBMAX=2.5*(DRXTKCAL/1000); /*Create the Meat and Beans standard*/

 /*Legumes intake calculation*/
 /*Legumes intake counts as Meat and Beans until the standard is met, then the rest count as
Total Vegetables*/

/*(1) If total meat intake is less than the Meat and Beans standard, then: */

IF ALLMEAT < MBMAX THEN DO;
   MEATLEG=LEGUMES*4;           /*Convert cup equivalents of Legumes to oz equivalents of
Meat and Beans*/
   NEEDMEAT=MBMAX-ALLMEAT;

  /*(a) all Legumes go to Meat and Beans*/
   IF MEATLEG <= NEEDMEAT THEN DO;
      ALLMEAT=ALLMEAT+MEATLEG;
      V_TOTAL=V_TOTAL;
      V_DOL=V_ORANGE+V_DRKGR;
   END;

  /*(b) Some Legumes go to Meat and Beans and the rest goes to Total Vegetables*/
   ELSE IF MEATLEG > NEEDMEAT THEN DO;
      EXTRMEAT=MEATLEG-NEEDMEAT;
      EXTRLEG=EXTRMEAT/4;       /*Convert oz equivalents of Meat and Beans from Legumes
back to cup equivalents*/
              ALLMEAT=ALLMEAT+NEEDMEAT;
              V_TOTAL=V_TOTAL+EXTRLEG;
              V_DOL=V_ORANGE+V_DRKGR+EXTRLEG;
```

```
    END;
END;

/*(2) If total meat intake exceeds the Meat and Beans standard, then all Legumes count as Total
Vegetables*/
ELSE IF ALLMEAT >= MBMAX THEN DO;
   V_TOTAL=V_TOTAL+LEGUMES;
         V_DOL=V_ORANGE+V_DRKGR+LEGUMES;
END;

      /*Calculate HEI-2005 Meat and Beans component score*/
MEATDEN=ALLMEAT/(DRXTKCAL/1000);
HEI8=10*(MEATDEN/2.5);
IF HEI8 > 10 THEN HEI8=10;

/**Calculate HEI-2005 Total Vegetable component score**/
/*Standard for maximum score is >=1.1 cup equiv/1000 kcal, Maximum score is 5;
  no Vegetable intake, minimum score is zero*/
VEGDEN=V_TOTAL/(DRXTKCAL/1000);
HEI3=5*(VEGDEN/1.1);
IF HEI3 > 5 THEN HEI3=5;

/**Calculate HEI-2005 Dark Green and Orange Vegetables and Legumes component score**/
/*Standard for maximum score is >=0.4 cup equiv/1000 kcal, Maximum score is 5*/
DGVDEN=V_DOL/(DRXTKCAL/1000);
HEI4=5*(DGVDEN/.4);
IF HEI4 > 5 THEN HEI4=5;

/**Calculate HEI-2005 Oils component score**/
/*Standard for maximum score is >=12 grams/1000 kcal, Maximum score is 10*/
OILDEN=DISCFAT_OIL/(DRXTKCAL/1000);
HEI9=10*(OILDEN/12);
IF HEI9 > 10 THEN HEI9=10;

/**Calculate HEI-2005 Saturated Fat component score**/
/*Standard for maximum score is <=7% total kcal, Maximum score is 10;
 10% total kcal, score is 8; >=15% total kcal, minimum score is zero*/

  IF DRXTKCAL > 0 THEN PCTSFAT=100*(DRXTSFAT*9)/DRXTKCAL; /*Calculate
percent of calories from Saturated Fat*/

IF PCTSFAT >= 15 THEN HEI10=0;
  ELSE IF PCTSFAT <= 7 THEN HEI10=10;
  ELSE IF PCTSFAT > 10 THEN
      HEI10= 8 - ( 8 * (PCTSFAT-10)/5 );
  ELSE HEI10= 10 - (2 * (PCTSFAT-7)/3 );
```

```
/**Calculate HEI-2005 sodium component score**/
/*Standard for maximum score is <=0.7 grams/1000 kcal, Maximum score is 10;
  1.1 grams/1000 kcal, score is 8; >=2.0 grams/1000 kcal, minimum score is zero*/

  IF DRXTKCAL > 0 THEN SODDEN=DRDTSODI/(DRXTKCAL/1000); /*Calculate Sodium
density (mg/1000 kcal); sodium intake in mg*/
SODMAX=2000;
SODMED=1100;
SODMIN=700;
IF SODDEN >= SODMAX THEN HEI11=0;
  ELSE IF SODDEN <= SODMIN THEN HEI11=10;
  ELSE IF SODDEN >= SODMED THEN
      HEI11= 8 - ( 8 * (SODDEN-SODMED)/(SODMAX-SODMED) );
  ELSE HEI11= 10 - (2 * (SODDEN-SODMIN)/(SODMED-SODMIN) );

/**Calculate HEI-2005 Calories from SoFAAS component score**/
/*Standard for maximum score is <=20% total kcal, Maximum score is 20;
  >=50% total kcal, minimum score is zero*/

 /*Calculate SoFAAS Calories from Added sugars, Solid fat, and Alcoholic beverages*/
  ADDSUGC=16*ADD_SUG;          /*calories from added sugars*/
  SOLFATC=DISCFAT_SOL*9;       /*calories from solid fat*/

  IF ETHCAL < 0 THEN ETHCAL=0;
  IF BWCARBC < 0 THEN BWCARBC=0;
  EXFAAS=ADDSUGC+SOLFATC+ETHCAL+BWCARBC; /*total SoFAAS calories as in
kcal*/

  /*Calculate SoFAAS as in %kcal
  Note: This results in more than 100% of total caloric intake from SoFAAS in a few cases
          due to the use of the general factors, 4 kcal/gram of carbohydrate, 9 kcal/gram of fat,
          and 7 kcal/gram of alcohol*/

  IF DRXTKCAL > 0 THEN SOFA_PERC=100*(EXFAAS/DRXTKCAL);

SOFAMIN=20;
SOFAMAX=50;
IF SOFA_PERC >= SOFAMAX THEN HEI12=0;
  ELSE IF SOFA_PERC <= SOFAMIN THEN HEI12=20;
  ELSE HEI12= 20 - ( 20* (SOFA_PERC-SOFAMIN) / (SOFAMAX-SOFAMIN) );

/*For individuals with no reported total energy intake for the day,
  the HEI component and total scores are set to zero*/
IF DRXTKCAL=0 THEN DO;
  HEI1=0; HEI2=0; HEI3=0; HEI4=0; HEI5=0; HEI6=0; HEI7=0;
```

```
  HEI8=0; HEI9=0; HEI10=0; HEI11=0; HEI12=0;
  END;

/**Calculate HEI-2005 total score**/
/*total HEI-2005 score is the sum of 12 HEI component scores*/
HEI2005=HEI1+HEI2+HEI3+HEI4+HEI5+HEI6+HEI7+HEI8+HEI9+HEI10+HEI11+HEI12;

LABEL HEI2005='TOTAL HEI-2005 SCORE'
      HEI1='HEI COMPONENT TOTAL FRUIT'
              HEI2='HEI COMPONENT WHOLE FRUIT'
              HEI3='HEI COMPONENT TOTAL VEGETABLES'
              HEI4='HEI COMPONENT DARK GREEN & ORANGE VEG & LEGUMES'
              HEI5='HEI COMPONENT TOTAL GRAINS'
              HEI6='HEI COMPONENT WHOLE GRAINS'
              HEI7='HEI COMPONENT MILK'
              HEI8='HEI COMPONENT MEAT & BEANS'
              HEI9='HEI COMPONENT OILS'
              HEI10='HEI COMPONENT SATURATED FAT'
              HEI11='HEI COMPONENT SODIUM'
              HEI12='HEI COMPONENT CALORIES FROM SOLID FAT, ALCOHOL & ADDED
SUGAR (SoFAAS)';
run;

Proc sort data=HEI2005; by SEQN; run;

DATA HEI.HEI2005_0102 (KEEP=SEQN HEI1-HEI12 HEI2005);
  SET HEI2005;
  BY SEQN;
run;
```

Appendix E

HEI Fact Sheet

Healthy Eating Index–2005

USDA

Center for Nutrition Policy and Promotion

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CNPP
Fact Sheet No. 1

December 2006
Slightly Revised
June 2008

USDA is an equal opportunity provider and employer.

The Healthy Eating Index (HEI) is a measure of diet quality that assesses conformance to Federal dietary guidance. The original HEI was created by the U.S. Department of Agriculture (USDA) in 1995. Release of new Dietary Guidelines for Americans in 2005 motivated a revision of the HEI. The food group standards are based on the recommendations found in MyPyramid (see Britten *et al.*, *Journal of Nutrition Education and Behavior* 38(6S) S78-S92). The standards were created using a density approach, that is, they are expressed as a percent of calories or per 1,000 calories. The components of the HEI-2005 and the scoring standards are shown below .

Healthy Eating Index–2005 components and standards for scoring [1]

Component	Maximum points	Standard for maximum score	Standard for minimum score of zero
Total Fruit (includes 100% juice)	5	≥0.8 cup equiv. per 1,000 kcal	No Fruit
Whole Fruit (not juice)	5	≥0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total Vegetables	5	≥1.1 cup equiv. per 1,000 kcal	No Vegetables
Dark Green and Orange Vegetables and Legumes [2]	5	≥0.4 cup equiv. per 1,000 kcal	No Dark Green or Orange Vegetables or Legumes
Total Grains	5	≥3.0 oz equiv. per 1,000 kcal	No Grains
Whole Grains	5	≥1.5 oz equiv. per 1,000 kcal	No Whole Grains
Milk [3]	10	≥1.3 cup equiv. per 1,000 kcal	No Milk
Meat and Beans	10	≥2.5 oz equiv. per 1,000 kcal	No Meat or Beans
Oils [4]	10	≥12 grams per 1,000 kcal	No Oil
Saturated Fat	10	≤7% of energy [5]	≥15% of energy
Sodium	10	≤0.7 gram per 1,000 kcal [5]	≥2.0 grams per 1,000 kcal
Calories from Solid Fats, Alcoholic beverages, and Added Sugars (SoFAAS)	20	≤20% of energy	≥50% of energy

[1] Intakes between the minimum and maximum levels are scored proportionately , except for Saturated Fat and Sodium (see note 5).
[2] Legumes counted as vegetables only after Meat and Beans standard is met.
[3] Includes all milk products, such as fluid milk, yogurt, and cheese, and soy beverages.
[4] Includes nonhydrogenated vegetable oils and oils in fish, nuts, and seeds.
[5] Saturated Fat and Sodium get a score of 8 for the intake levels that reflect the 2005 Dietary Guidelines, <10% of calories from saturated fat and 1.1 grams of sodium/1,000 kcal, respectively .

Using data from the National Health and Nutrition Examination Survey , 2001-2002, a psychometric evaluation found the HEI-2005 to satisfy several types of validity tests. Reliability analyses suggest that the individual components provide additional insight to that of the summary score. The HEI-2005 is a standardized tool that can be used in nutrition monitoring, interventions, and research. Further details on the development and evaluation of the HEI-2005 and population scores are available at www.cnpp.usda.gov/HealthyEatingIndex.htm .

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Appendix F

Budget

Incentive Expense:		**Cost**
Registration Incentive		$50.00
Raffle expense (4 prizes of $50)		$200.00
Focus group incentive ($10 an hour, 10 people, two one hour sessions)		$200.00
	Subtotal:	$450.00
Computer Software Expense:		
SPSS software		$83.00
External hard drive		$50.00
Nutritional Analysis Software		$20.00
	Subtotal:	$153.00
Advertising Expense:		
300 color copies		$150.00
Poster board		$10.00
Markers		$10.00
	Subtotal:	$170.00
Miscellaneous Expenses:		
Travel Expenses		$200.00
Hiring Graduate Student for Tech Programming		$200.00
	Subtotal:	$400.00
	TOTAL:	$1173.00

Appendix G

Team DIET Timeline for Spring 2011-Spring 2013

Spring 2011
- Write and present thesis proposal
- Continue developing/finalize surveys, website, etc.
- Identify experts to provide feedback
- Write and submit IRB application by August
- Continue reviewing literature
- Begin applying for grants and developing a budget
- Design team website to be posted by end of semester

Fall 2011
- Select sample, do website registration
- Begin preliminary data collection according to finalized methodology design
- Implement various degrees of intervention according to design over the course of the semester
- Continue updating team website
- Develop outline of thesis chapters
- Continue to review literature to draft chapters one and two of thesis paper

Spring 2012
- Finish data collection and perform analysis
- Come up with initial draft of first three chapters of thesis and get feedback from mentors and librarian
- Make revisions to thesis draft
- Prepare for and present at undergraduate research day
- Continue making updates to the team website, looking into conferences and funding

Fall 2012
- Gemstone senior orientation in September
- Complete data analysis by November
- Draft chapters four and five of thesis and have full draft completed by the end of the semester
- Prepare presentation for Team Thesis Conference Rehearsal scheduled for February
- Submit list of five experts who have agreed to be reviewers/discussants at the thesis conference

Spring 2013
- Be ready for practice presentation in February
- Submit final team information to Gemstone staff
- Complete and submit completed thesis draft by late February/early March
- Present and defend thesis at Team Thesis Conference
- Revise and submit final thesis including the final thesis submission form completed by mentors

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