ASSESSING PHYSICAL ACTIVITY, FRUIT AND VEGETABLE INTAKE AND SUGAR-SWEETENED BEVERAGE CONSUMPTION PATTERNS OF COLLEGE STUDENTS

by

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Abstract

Objective: The aims of this study were to test the effectiveness of a 15-month intervention in reducing sugar-sweetened beverage (SSB) consumption among college students and to assess fruit and vegetable intake and physical activity habits and their relationship to SSB consumption in order to improve health outcomes.

Design: Randomized, controlled study.

Participants: One hundred and fifty-six college students (18-24 y) from a Midwestern university, primarily female (72%), white (89%) and freshmen (51%).

Intervention: Participants were randomized to control and intervention groups. Participants in the control group received no information on healthful behaviors. The intervention occurred in two stages: 1) Participants received three stage-tailored messages on healthful behaviors weekly for 10 weeks; 2) After the 3-month physical assessment, participants received 3 stage-tailored messages monthly and one email encouraging them to visit the portal page.

Main Outcome Measure(s): Stages of Change for physical activity and fruit and vegetable intake; self-reported physical activity scores, self-reported fruit and vegetable intake and SSB consumption habits.

Analysis: Changes in SSB consumption patterns were determined using generalized linear mixed models and linear regression models tested associations between fruit and vegetable intake, physical activity and SSB consumption. Linear mixed models were used to explore relationship between stage of change and fruit and vegetable intake and physical activity.

Results: The 15-month intervention did not significantly reduce SSB consumption in the intervention group ($p > 0.05$). Participants recorded low fruit and vegetable intake and moderate physical activity scores.

Conclusions and Implications: The high SSB consumption and low fruit and vegetable intake observed could increase students' risk for weight gain and obesity-related conditions. Thus, college campuses can help student maintain physical activity behavior while helping them to improve their eating habits.

Keywords: college students, overweight, dietary habits, physical activity habits

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Acknowledgements

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Dedication

This thesis is dedicated to the memory of my beloved cousin, Eileen Esinam Atayi, who passed away a few months prior to thesis completion and to my Mom, Christiana Kotchoe Hammond, who made the ultimate sacrifice to support me through this final phase of my Master's program. I am grateful, *Mama!*

Chapter 1 - Introduction

The obesity epidemic is a cause for concern because it is associated with major health conditions such as type 2 diabetes, cardiovascular diseases (hypertension, stroke and coronary heart diseases), certain types of cancers and gall bladder diseases. Psychological effects of obesity include social bias, prejudice, discrimination, low body/self-image and eating disorders (example, binge-eating).[1] In adults, obesity is measured based on the body mass index [BMI, a ratio of one's weight in kilograms (kg) to the square of his/her height in meters (m^2)]. A BMI below 18.5 kg/m^2 is classified as underweight; BMI of 18.5-24.99 kg/m^2 represents normal weight; BMI of 25-29.99 kg/m^2 represents overweight and a BMI $\geq$30 kg/m^2 is considered obese.[1]

Obesity rates in the United States (U.S.) have been rising. For instance, the obesity rates of both adult males and females between 2007 and 2008 were 32.2% and 35.5%, respectively. Between 2009 and 2010, the prevalence of obesity in adults (35.7%) was almost twice that of children and adolescents (16.9%).[2]

Coupled with increased obesity rates are the increased economic costs to overweight or obese individuals. These economic costs may be direct (medical costs associated with seeking medical attention and treatment of obesity-related conditions) or indirect costs (non-medical costs associated with the obesity-related condition, such as absenteeism, disability and lost productivity).[3] Estimated annual health care costs increase with an increase in BMI. In the U.S., an obese male and female annually pay an excess of $2,646 and $4,879, respectively, in health costs compared to a normal weight individual. For obese males and females, it costs six and nine times more, respectively, in annual health costs than for overweight men and women ($432 & $524, respectively).[4]

The factors identified as causes of current obesity trends are increased amount of fat and energy content of foods and decreased physical activity levels.[1] The consumption of sugar-sweetened beverages (SSB) has also been partially implicated in the rising obesity rates as SSB contributes approximately 13% of total daily energy intake.[5] Thus, understanding the interplay of

these factors in promoting obesity and its related conditions will be useful in obesity prevention efforts or strategies.

Problem Statement

Nearly 34% of college students have BMI greater than 25 kg/m^2 and approximately 94% of college students eat less than 5 servings of fruit and vegetables daily.[6] National data suggest that only 14% of adults are meeting public health recommendations for fruit and vegetable intakes.[7] Furthermore, only about half (48.8%) of adults meet daily public health recommendations for physical activity (PA).[6]

The period between adolescence and adulthood has been identified as an important stage for health promotion because individuals at this stage are likely to gain weight.[8,9] Furthermore, new college students are at an exploratory phase in their lives because they are now adjusting to their independence and the new environments they are exposed to. This may lead to the development of unhealthy eating and PA habits.[8] For example, increased SSB consumption, lack of regular exercise and poor healthy eating habits have been reported in college students, especially in the first two years of college, placing them at a potential risk for overweight and obesity. This creates a need for more studies to identify behavioral patterns of college students to improve and help promote long-term healthy lifestyles.[9-13]

Justification

Exploring factors that impact dietary and physical activity behaviors in college students will enable the designing of suitable interventions that will encourage healthy lifestyles in this population.[8,14] Cason and Wenrich[15] suggest that identifying the needs of college students, while considering all factors (social, environmental and personal) likely to affect their habits will help improve their dietary and physical activity habits. However, research on college students' physical activity behavior is inadequate due to little focus on college students' PA behaviors, examination of PA behavior at single levels and variation in measures of PA in this population.[16] Currently, research on the impact of the college environment on obesity in college students is inconclusive.[17]

Purpose of Study

A healthful diet and moderate PA may reduce the incidence of obesity-related diseases and deaths[18] and subsequently, reduce the financial costs associated with these conditions. Thus, the primary aim of this study was to test the effectiveness of a 15-month intervention in reducing SSB consumption among college students. The secondary aim was to assess fruit and vegetable intake and physical activity habits and their relationship to SSB consumption in order to improve health outcomes. Data for the current study were obtained from the Young-Adult Eating and Active for Health (YEAH) Study, a fourteen-state randomized, controlled study designed to control weight gain in young adults (18-24 years). The study outcomes of the YEAH study was evaluated with the Transtheoretical model of behavior change (TTM)[18] because this model acknowledges behavior change as a gradual process and helps determine one's readiness to adopt a behavior.[19]

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Chapter 2 - Literature Review

The American Heart Association (AHA) has identified obesity as a primary risk factor for coronary heart disease (CHD).[1] CHD is the narrowing of the arteries resulting from a build-up of plaque. In adults, obesity is determined by the body mass index [BMI, a ratio of one's weight in kilograms (kg) to the square of his/her height in meters (m^2)]. A BMI below 18.5 kg/m^2 is classified as underweight; BMI of 18.5-24.99 kg/m^2 represents normal weight; BMI of 25-29.99 kg/m^2 represents overweight and a BMI $\geq$30 kg/m^2 is considered obese.[2] The downside to the BMI measurement is that it does not factor into its calculation, the distribution of body fat (adiposity). That notwithstanding, BMI is used for classifying overweight and obesity in individuals or populations.[1]

Two-thirds of U.S. adults are overweight and obese and it is estimated that the proportion of obese adults will increase by 50% in 2030.[3] It is also estimated that by 2030, 65 million more American adults will be obese; 37% of which will be older than 60 years. The high obesity rates in the U.S. have been attributed to high caloric intake and decreased physical activity levels in most Americans.[2,4]. Coupled with the increased obesity rates are increased medical costs to obese individuals. Annually, it costs an obese individual 42% ($1,429) more in medical costs than a person of normal weight.[5] It is further estimated that by 2030, expected rising obesity trends will lead to an annual increase of $48-66 billion in total medical costs.[6] Thus, intensive efforts to reduce obesity will help decrease the health costs associated with obesity.[5]

Obesity treatment and prevention is very challenging due to the complex factors that regulate weight. Thus, the AHA proposes that an understanding of both behavioral and biochemical factors affecting weight control will help develop preventive measures for obesity.[1] A weight reduction as low as 5-10% is enough to improve blood pressure and total blood cholesterol; glucose tolerance; and decrease severity of obstructive sleep apnea.[1] Some strategies that can help maintain a healthy weight are reducing fat intake and consuming more fruits and vegetables. Fruits and vegetables, unlike high-fat foods, help attain satiety and also serve as good sources of essential micronutrients such as folate and vitamins B_6 and B_{12}, required for the

function of the cardiovascular system.[1] Fruits and vegetables also contain bioactive compounds (phytochemicals) that decrease the risks for chronic diseases.[7]

Decreasing caloric intake may also help maintain a healthy body weight. Generally, energy taken into the body is expended through basal metabolism (energy required to keep body alive and at rest); the thermic effect of food (10% of total energy spent on processing ingested food) and physical activity (PA).[4] However, weight reduction studies have shown that compared to dietary intake, PA alone has a marginal effect on weight reduction. The greatest weight reduction is achieved by regulating both dietary intake and PA.[8]

Healthy eating guidelines for Americans

According to the U.S. Department of Agriculture (USDA)'s 2010 *Dietary Guidelines for Americans,* healthy eating involves consuming "foods and beverages that help achieve and maintain a healthy weight, promote health, and prevent disease." Healthful eating encourages the reduction of foods high in sodium, solid fats, added sugars and refined grains while increasing intake of nutrient-rich foods and beverages, such as fruits, vegetables, fat-free or low fat milk and milk products.[9]

The USDA further provides daily recommendations for fruit and vegetable through its tool, MyPlate, while considering an individual's gender, age and physical activity level (sedentary or active) [http://www.choosemyplate.gov/food-groups/]. MyPlate uses a place setting to guide the selection of food from five food groups – fruits, vegetables, grains, protein foods and dairy. MyPlate also encourages Americans to eat healthy and be physically active.

Current daily fruit and vegetable recommendations for sedentary young adults (19-30 years) are 2 and 2.5 cups, respectively for females, and 2 and 3 cups, respectively for males.[10] However, most Americans (75%) consume less than the daily fruit and vegetable recommendations. The mean total fruit intakes for male and female adults (19-30 years) are 0.9 and 0.8 cup equivalent, respectively. The mean total vegetable intakes (excluding cooked dry beans and peas) for male and female adults (19-30 years) are 1.7 and 1.4 cup equivalents, respectively (1 cup equivalent of fruit = 1 cup cut-up raw/cooked fruit; ½ cup dried fruit or 1 cup juice; 1 cup equivalent of vegetable = 1 cup cut-up raw/cooked vegetables; ½ cup dried vegetables; 1 cup juice; 2 cups raw leafy greens; 1 cup cooked dry beans or peas).[11]

Due to relatively low diet quality, Americans are also encouraged to improve their fruit and vegetable intake, as well as to choose nutrient-dense foods.[12] Thus, in order to monitor the diet quality of Americans, the USDA has implemented the Healthy Eating Index (HEI). The HEI is a scoring tool and its current version (HEI-2010) consists of 12 components, including Total Fruit, Whole Fruit, Total Vegetable, Greens and Beans and Empty calories. Scores usually range from 0 to 100, depending on the component being assessed; the higher the score, the higher the quality of the food.[13]

Physical activity guidelines for Americans

American adults are encouraged to participate in a minimum of 150 minutes of moderate-intensity per week, or 75 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of both moderate- and vigorous-intensity aerobic activity for optimal health benefits.[14] Aerobic physical activity is defined as one that involves the movement of the body's large muscles for an amount of time, often resulting in the heart beating faster than normal. This involves brisk walking, running, cycling and swimming.[15]

Regular physical activity decreases the risk for chronic health conditions; reduces premature deaths; ensures maintenance of a stable body weight; and improves functional capacity and mental health. These health benefits are independent of an individual's body weight, but depends on three main factors, namely the intensity (how hard a person works to do activity), the frequency (how often a person does the activity) and duration (how long a person does activity) of the physical activity.[14]

The intensity of physical activity is determined by metabolic equivalents (METs); a MET compares rate of energy spent on an activity with that spent during rest.[15] For instance, 1 MET is equivalent to the energy spent during quiet sitting.[16] If an individual performs a 4 MET activity for 30 minutes, then he/she does an equivalent of 120 (4 x 30) MET-minutes of physical activity.[15] Total weekly energy spent on walking or doing a moderate or vigorous physical activity can be calculated using the conversion factors, 3.3, 4.0 and 8.0 METs, respectively.[16] The health benefits of physical activity are determined by the total amount of energy spent on physical activity and this may range from 500 to 1,000 MET-minutes per week. Values above this range provides significant health benefits.[15]

Generally, females are less physically active than males; currently, according to accelerometer assessments, only 9.5% of male and 7.0% of female adults meet public health recommendations for physical activity.[17-19] The level of physical activity decreases with age in both genders, with a significant reduction during the transition from adolescence to adulthood.[20]

Health promotion among college students

The transition from adolescence to adulthood has been identified as a critical stage for the development of unhealthy eating and physical activity habits because students are unable to manage the independence that comes with entering college and end up adopting new behaviors as a result of their new friends and environments.[18] The transition period is therefore crucial in initiating positive dietary and physical activity behavior changes in college students to encourage the persistence of these habits into their adult years.[17] Even though approximately 58% of surveyed college students perceive themselves as being in good or excellent health, 22% and 12% of them were classified as being overweight and obese, respectively. Furthermore, only half of them meet the daily public health recommendations for physical activity.[21]

Of all the factors that cause obesity (biological, social, behavioral and physiological processes), dietary and physical activity are the most modifiable ones because people have some degree of control over them.[2] Food choice is influenced by a host of factors, ranging from individual to macro-systems factors, with the food and beverage industries being highly influential. College students are often targets of soft drinks companies, thereby promoting consumption of SSB.[18,22,23] SSB consumption is associated with unhealthy behaviors such as intake of high-fat foods, fast foods and snacks.[24] Other less healthy dietary behaviors observed in college students are decreased fruit and vegetable and low fiber intake.[25] For example, in 2009, approximately 37% of college graduates consumed fruits at least twice a day and 32% of them consumed vegetables more than three times daily.[26] Currently, only 6% of college students eat at least 5 cups of fruit and vegetable daily.[21]

Unhealthy dietary habits and inactivity are two of the six major health risk behaviors identified in college students.[27] Thus, understanding the factors that affect dietary intake and physical activity is essential in designing and implementing successful interventions.[28] However, most public health interventions on obesity have proven futile because they focus on nutrition education rather than exploring the role of environmental factors in promoting obesity.[29]

Most college students consume less fruit and vegetable but report high intake of fried and fast foods.[30] Low fruit and vegetable consumption and high SSB intake is associated with increased risk for the metabolic syndrome.[31] The metabolic syndrome is a condition characterized by the presence of at least 3 of the following symptoms - abdominal obesity: waist circumference >102 cm (>40 in) in men and >88 cm (>35 in) in women; hypertriglyceridemia (high levels of triglycerides): ≥150 mg/dL; low high-density lipoprotein (HDL) cholesterol: <40 mg/dL in men and <50 mg/dL in women; high blood pressure: ≥130/85 mm Hg; high fasting glucose: ≥110 mg/dL.[32]

Even though declining physical activity has been observed in college students,[18,25] few studies have investigated longitudinal changes in physical activity and sedentary habits and their impacts on promoting long-term physical activity behavior.[20,27,33] Studies conducted on college populations have individually explored dietary and physical habits or SSB consumption of college students but a study linking all three behaviors is lacking. For instance, Huffman and West (2007)[22] investigated nutritional knowledge and consumption patterns of college students and their readiness to change SSB intake. They found that college students consumed at least one SSB daily and therefore proposed that more studies evaluate SSB consumption patterns among college students.

Huang et al.[25] observed a high incidence of overweight, decreased fruit and vegetable and fiber intake and physical activity in college students.[17] Decreased physical activity has also been associated with weight gain in freshman college students. For instance, Butler et al.[28] studied college freshmen in their first semester and found a significant increase in body weight as a result of decreased physical activity. They concluded that interventions that will increase PA and fruit and vegetable consumption in college students are needed. A study exploring weight management goals and practices among college students found that moderate physical activity and daily consumption of at least 5 servings of fruit and vegetable were not common practices used by college students to achieve weight loss.[34]

Kubik et al.[35] suggest that studies exploring norms and opportunities to practice a health behavior will encourage healthy behavior change in students. Furthermore, interventions promoting long-term behavioral changes in college students are sorely needed.[36]

Dietary and physical activity correlates of SSB consumption have been examined in middle school and high school children.[37] A similar study on college students will help identify

the factors that influence college students' desire for less healthy behaviors or habits. Gender, age and ethnicity have been shown to be correlated to PA but to further understand the factors affecting PA in youth, more research on other correlates of PA is needed.[38]

Health behavior theories

Effective interventions are informed by relevant theory and be based on pertinent issues or scenarios.[39] The essential components of behavior models are the mediating variables because they predict behavioral change. In other words, the mediating variables modulate the recommended health behavior.[40] Four common theories that have been used in studying and promoting healthy behaviors are the Health Belief Model (HBM)[41], the Social Cognitive Theory (SCT)[42], the Social Ecological Model (SEM)[43,44] and the Transtheoretical Model of behavior change/ Stages of Change (TTM)[45].[46]

Hochbaum's HBM[41] proposes that people's decision to modify their behaviors is based on their knowledge of the risks associated with the severe disease and their perceived benefits from the intended change. HBM has six main constructs, namely, perceived susceptibility (beliefs of one's chances of getting a condition); perceived severity (beliefs of the consequences of the condition); perceived benefits (belief that acting will reduce one's susceptibility and severity to a condition); perceived barriers (beliefs of costs and obstacles associated with intended action); cues to action (factors that promote the intended action); and self-efficacy (one's confidence in his/her ability to perform the intended action) [Figure 2.1].[47] Perceived threat is the main motivation to change in the HBM and self-efficacy aids in the change in behavior. Despite its successful application in lifestyle behaviors modification, HBM may not be a useful model for interventions in college students because college students do not perceive themselves as being at risks for obesity.[40]

Bandura's SCT[42] posits that an individual's behavior results from the interplay of personal factors, environmental factors/influences and human behavior (reciprocal determinism) [Figure 2.2]. The main constructs of SCT are behavioral capability (having the knowledge and skill to perform a behavior), expectations (outcomes one hopes to achieve from a behavior), self-efficacy (belief in one's ability to act and overcome challenges associated with a behavior), observational learning (adopting a behavior by watching others do it) and reinforcements (factors that promote or hinder the reoccurrence of a behavior).[47] The main motivational variable in the

SCT is outcome expectancies (expectations) and the behavior change is achieved through skills and self-efficacy. Studies that have used SCT to model changes in dietary and physical activity behaviors have been somewhat successful. However, the predictability of some of its concepts with regards to obesity requires further testing.[40]

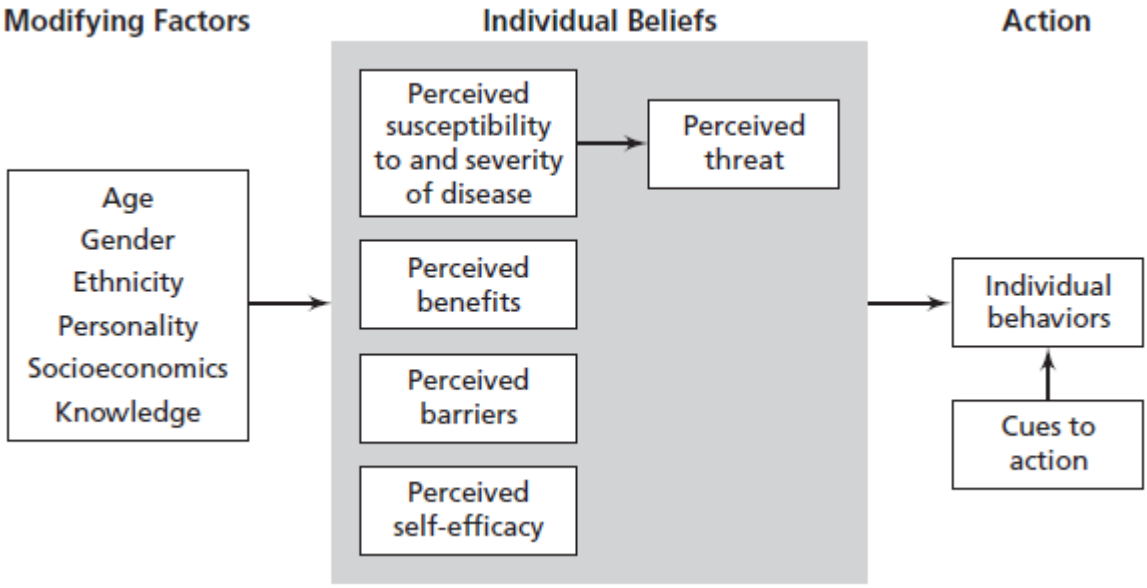

Figure 2.1 HBM components and linkages

Source: Glanz, Rimer and Viswanath, 2008[48]

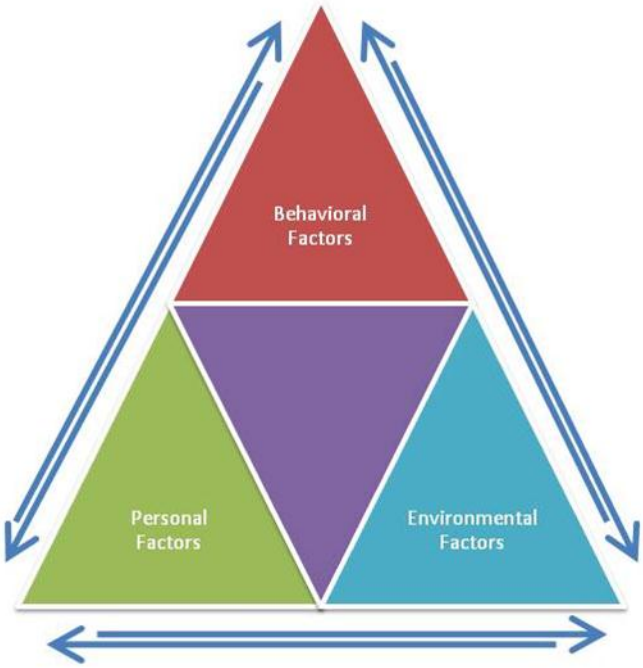

Figure 2.2 Bandura's triadic reciprocal determinism

(Available at https://wikispaces.psu.edu/display/PSYCH484/7.+Self-Efficacy+and+Social+Cognitive+Theories)

Stokols' SEM[43] considers the interaction of all levels of societal influences in modeling behavior changes (Figure 2.3). These levels include individual (knowledge, attitude and skills), interpersonal (social network), organizational (environment, ethos), community (cultural values and norms) and public policy.[47] Due to a similarity in the premise of both SCT and SEM, one study combined these two models to study how 4 levels of influence (individual, social, environment and physical environments) interact and impact adolescent eating behaviors. They concluded that interventions aimed at addressing all factors of influence should consider both behavior and environmental change.[49]

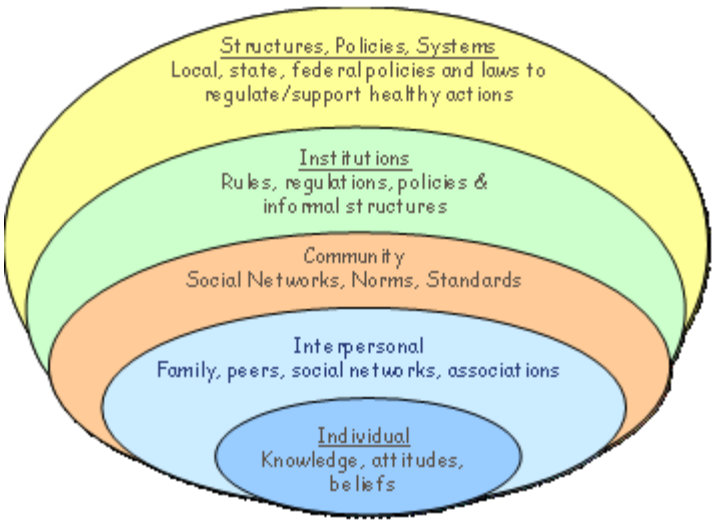

Figure 2.3 Levels of influence in the SEM
(Available at http://depts.washington.edu/waaction/plan/append/a.html)

Prochaska and DiClemente's TTM[45] models behavioral change as a progression through five sequential stages, namely precontemplation, contemplation, preparation, action and maintenance (Figure 2.4).[47]

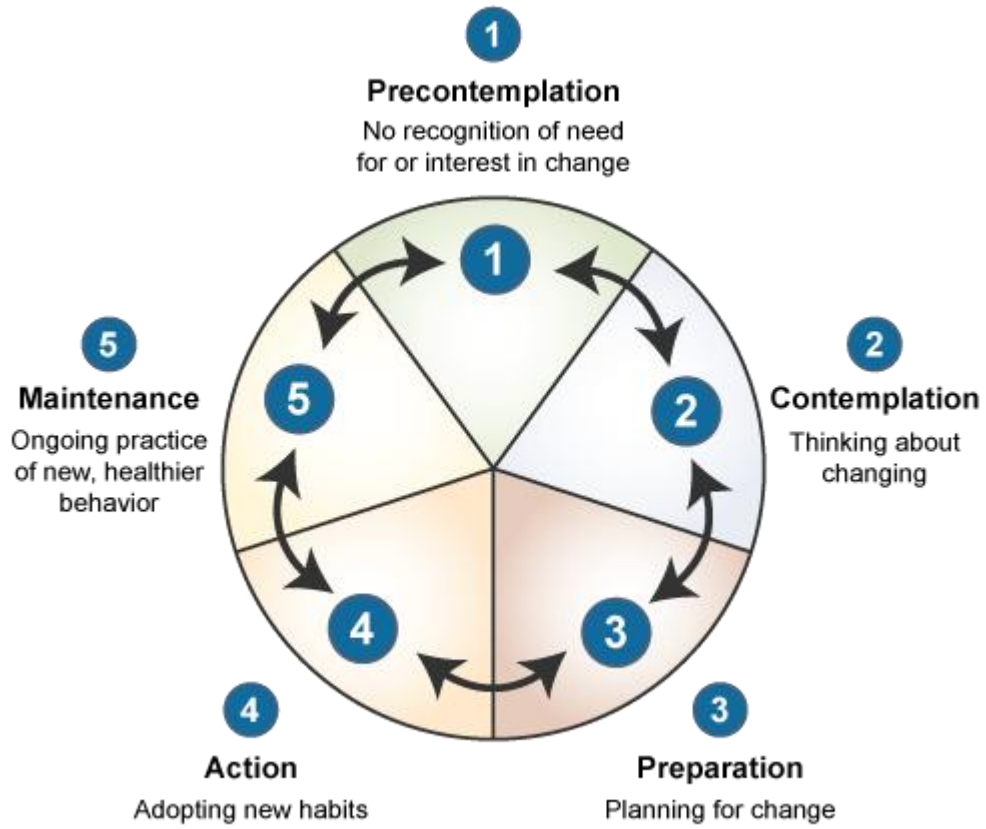

Figure 2.4 Stages of change construct of the TTM
(Available at http://www.esourceresearch.org/Default.aspx?TabId=738)

Of the four discussed models, Prochaska and DiClemente's TTM[45] has been used extensively in designing strategies to effect dietary behavior changes because it focuses on acquiring and retaining of a behavior.[50-52] For this same reason, it was chosen to guide the current study. The four main constructs of the TTM are:

1. Stage of Change (SOC): This is the most important construct of the TTM; it acknowledges that people adopt changes differently and the adoption occurs through a series of 5 steps/stages – Pre-contemplation, Contemplation, Preparation, Action and Maintenance.[46] SOC is useful in assessing and improving multiple behaviors, including healthy eating, exercise and emotional stress.[53,54] Topp et al.[55] used the SOC in an intervention to improve physical activity, physical fitness, body weight, dietary intake, and perceptions of exercise and diet in healthy college freshmen.

2. Processes of Change: This involves one's progression from one stage to another based on experiential and behavioral activities. There are a total of ten such processes – i) consciousness raising (heightened knowledge on causes, consequences and cures of specific behavior); ii) dramatic relief (begins with increased emotional experiences and ends with improved emotions if the needed action is taken); iii) environmental reevaluation (considers both affective and cognitive impacts of one's behavior on his/her social environment); iv) self-reevaluation (considers both affective and cognitive impacts of one's specific behavior on his/her self-image); v) self-liberation (one's belief to change a behavior and his/her commitment/recommitment to follow it through); vi) social liberation (requires increased social opportunities or alternatives to support the behavior change); vii) counterconditioning (requires learning of healthy behaviors to substitute the unwanted ones); viii) helping relationships (supporting a behavior change using care, trust, openness and acceptability); ix) reinforcement management (informing individuals about the effects of taking positive steps); and x) stimulus control (removes factors promoting unhealthy behaviors and adds those that support the change).[56]
3. Decisional balance: This is the process of considering and weighing the pros (potential gains) and cons (potential losses) associated with a behavior change. Ideally, an individual will change a behavior if he or she benefits greatly than he loses from making that change.[56] Research has shown that a direct link exists between decisional balance and the stages of change.[52] In early stages like the pre-contemplation stage, the cons of dietary behavior change are greater than the pros, and vice versa in later stages like action and maintenance.[50]
4. Self-efficacy: This construct measures one's level of confidence in making and sustaining the required behavior change.[56] Self-efficacy and decisional balance are quite critical in sustaining a behavior change.[51]

Since SOC is a key construct of the TTM, the following section will elaborate on its five sequential stages. The uniqueness of the TTM lies in this construct, which acknowledges change as a gradual process and helps determine one's readiness to adopt any behavior; one's readiness to change increases as he/she progresses through the stages.[56]

1. Pre-contemplation: In this stage, an individual has no plans of taking action in the foreseeable future (within the next 6 months) either due to lack of information on

consequences of the behavior or lack of confidence due to fruitless initial attempts. Individuals at this stage were often neglected in interventions since they lack motivation to change a behavior.[52]

2. Contemplation: An individual at this stage is considering taking action within the next 6 months. He/she is often ambivalent because he is aware of the consequences (pros and cons) of the behavior change. Such an individual may not be ready for action-oriented programs.[52,56]
3. Preparation: In this stage, an individual plans to take immediate action, usually within the next month. He or she may have previously attempted taking action and often has a plan of action. It is encouraged that such individuals be targeted for action-oriented programs.[52]
4. Action: A person at this stage would have made a significant change in his or her behavior within the last 6 months. It should be noted that in this model, a complete behavior change but not a partial change is considered an action; the recommended behavior is the benchmark of behavior change.[56]
5. Maintenance: This stage involves an individual making conscious efforts not to revert to the old behavior after he or she has taken action; this stage may range from 6 months to 5 years.[52]

The pre-contemplation, contemplation and maintenance stages are constant whereas preparation and action stages are less constant because in the latter groups, individuals are less likely to oscillate between stages, partly due to information they receive. This is why information about the pros and cons of a given behavior is vital for an individual to move from one stage to the other.[52] Identifying the various stages at which target audience are at in a particular health intervention is also important in determining its success. The greatest challenge is how to help people adopt and sustain a health behavior. For as long as people are encountering challenges while making a recommended behavior change, being knowledgeable about all the benefits associated with this change will not be enough to sustain the new behavior.

Some studies have used TTM to assess fruit and vegetable intake, dietary fiber intake, exercise habits and SSB intake in college students.[22,53,54,57,58] In one study, college students' dietary fat intake was monitored for a period of 18 months, using the SOC construct of the TTM.[57] The study showed a relationship between stage progression and dietary fat reduction.

The current study uses the SOC construct of the TTM to explore physical activity and fruit and vegetable consumption habits and their relationship to SSB consumption in college students. Students were self-staged based on their physical activity, and fruit and vegetable intake. Students' self-reported physical activity levels (scores) and fruits and vegetables intake were examined to determine concordance between these measures. Knowing the stages at which college students currently are will enable public health practitioners to adequately meet their needs when promoting healthy behaviors.

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Chapter 3 - Manuscript

Assessing Physical Activity, Fruit and Vegetable Intake and Sugar-Sweetened Beverage Consumption Patterns of College Students

Section of Journal: Review article

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Introduction

The American Heart Association (AHA) has identified obesity as a primary risk factor for coronary heart disease (CHD).[1] CHD is the narrowing of the arteries resulting from a build-up of plaque. Other physiological conditions associated with obesity include type 2 diabetes, cardiovascular diseases (hypertension, stroke and coronary heart diseases), certain types of cancers and gallbladder diseases. Psychological effects of obesity include social bias, prejudice, discrimination, low body/self-image and eating disorders (example, binge-eating).[2] In adults, obesity is determined by the body mass index [BMI, a ratio of one's weight in kilograms (kg) to the square of his/her height in meters (m^2)]. A BMI below 18.5 kg/m^2 is classified as underweight; BMI of 18.5-24.99 kg/m^2 represents normal weight; BMI of 25-29.99 kg/m^2 represents overweight and a BMI $\geq$30 kg/m^2 is considered obese.[2]

Two-thirds of U.S. adults are overweight and obese and it is estimated that the proportion of obese adults will increase by 50% in 2030.[3] Compounding the increasing obesity rates is the economic burden of treating the condition. Estimated annual health care costs increase with an increase in BMI. For example, in the U.S., an obese male and female annually pay an excess of $2,646 and $4,879, respectively, in health costs compared to a normal weight individual. For obese males and females, it costs six and nine times more, respectively, in annual health costs than for overweight men and women ($432 & $524, respectively).[3] It is further estimated that by 2030, expected rising obesity trends will lead to an annual increase of $48-66 billion in total medical costs.[4] Thus, intensive efforts to reduce obesity will help decrease the health costs associated with obesity.[5]

The factors identified as causes of current obesity trends are increased amount of fat and energy (caloric) content of foods and decreased physical activity levels.[2] The excess caloric intake is partially attributed to the increased consumption of sugar-sweetened beverages (SSB), especially among college students.[6,7] SSB provide low satiety and have high glycemic load (the available amount of carbohydrate in a food item to raise one's blood glucose level).[8,9] Consumption of SSB has also been associated with unhealthy behaviors such as the intake of high-fat foods, fast foods and snacks.[10] Current data suggests that approximately 6% of college

students eat at least 5 servings of fruit and vegetable daily and only half of them meet the daily public health recommendations for physical activity.[11]

Of all the factors that cause obesity (biological, social, behavioral and physiological processes), dietary and physical activity factors are the most modifiable ones because people have some degree of control over them.[2] Thus, focusing on these factors is essential in designing and implementing successful interventions. Studies conducted on college populations have individually explored dietary and physical habits or SSB consumption of college students but a study linking all three behaviors is lacking. Dietary and activity correlates of SSB consumption have been examined in middle school and high school children.[12] A similar study on college students will help identify the factors that encourage college students to desire less healthy behaviors or habits. Initiating positive physical activity and dietary behavior changes in college students will help establish healthy lifestyle behaviors that can persist into their adult years.[13]

Theoretical framework

The Transtheoretical Model of behavior change (TTM) has been extensively used to understand and design strategies to influence dietary behavior changes because it focuses on behavior acquisition and retention.[14-16] The uniqueness of the TTM lies in the fact that it acknowledges change as a gradual process and helps determine one's readiness to adopt any behavior; one's readiness to change increases as he/she progresses through the 5 stages of change (SOC)[17]:

1. Pre-contemplation: The individual has no plans of changing his/her physical activity (PA) and fruit and vegetable (F/V) consumption behaviors in the foreseeable future (within the next 6 months) either due to lack of information on consequences of the behavior or lack of confidence due to fruitless initial attempts.[16]
2. Contemplation: The individual is considering changing the two behaviors within the next 6 months and is often aware of the consequences (pros and cons) of the behavior change. Such an individual may not be ready for action-oriented programs.[16,17]
3. Preparation: The individual plans to change these two behaviors, usually within the next month. He or she may have previously attempted taking action and often have a plan of action. It is encouraged that such individuals be targets of action-oriented programs.[16]

4. Action: A person at this stage would have made a significant change in his or her PA and F/V consumption behaviors within the last 6 months. It should be noted that in this model, the achievement of the recommended behavior but not a partial behavior change is considered an action.[17]
5. Maintenance: This stage involves an individual making conscious efforts not to revert to the old PA and F/V behaviors after he or she has taken action; this stage may range from 6 months to 5 years.[16]

This study uses the SOC construct of the TTM to explore physical activity and fruit and vegetable consumption habits of college students. The primary aim of this study was to test the effectiveness of a 15-month intervention in reducing SSB consumption among college students. The secondary aim was to assess fruit and vegetable intake and physical activity habits and their relationship to SSB consumption in order to improve health outcomes. The main outcomes measures were stages of change for physical activity and fruit and vegetable intake; physical activity levels (scores); fruit and vegetable intake; and SSB consumption. The following hypotheses were tested:

- Hypothesis 1 (H1): At the end of the study (15 months), participants in the intervention group will consume less SSB than those in the control group.
- Hypothesis 2 (H2): Participants who report high fruit and vegetable intake will report low SSB intake.
- Hypothesis 3 (H3): Participants who report high physical activity scores will report low SSB intake.
- Hypothesis 4 (H4): Participants who self-stage themselves into the action/maintenance stage will report higher fruit and vegetable intake than participants who self-stage themselves into the precontemplation stage.
- Hypothesis 5 (H5): Participants who self-stage themselves into the action/maintenance will report higher physical activity scores than participants who self-stage themselves into the precontemplation stage.

Methodology

Study design & participants

Study participants were from the Young-Adult Eating and Active for Health (YEAH) study. The YEAH study is a completed, 15-month, multistate randomized controlled trial designed to control weight gain in young adults (18-24 years). The study involved fourteen states, however, only data from one state were analyzed in the current study. The stages of change (SOC) construct of the Transtheoretical model of behavior change (TTM)[18] was used to evaluate study outcomes. TTM was chosen because it acknowledges behavior change as a gradual process and helps determine one's readiness to adopt a behavior.[17]

The inclusion criteria used were students between 18 and 24 years of age, in their first, second or third year of school, with body mass index $\geq$ 18.5, with no life-threatening illness or conditions and with regular access to computer and internet connection. Students who were majors in nutrition, exercise science, and/or health promotion or enrolled in a nutrition course at the time of study were excluded as their health habits may not be representative of the general college population. Recruitment methods included departmental announcements and campus flyers. Prior to enrollment into the study, each participant signed an informed consent form approved by the university's institutional review board (IRB). The final sample size used in this study was 156 participants.

Assessments were made at baseline (0 months), 3 months and 15 months. Upon completion of baseline physical activity assessments, participants were stratified by university and gender, then randomized to control or intervention group from a list of random digits, using an even and odd number group assignment scheme. The control group received no information on healthful behaviors that support physical activity, fruit and vegetable intake nor stress-coping strategies. The intervention occurred as follows: 1) Participants received 3 stage-tailored messages (nudges)/week for 10 weeks, focusing on tips to encourage healthful behaviors that support physical activity, fruit and vegetable intake, and stress coping strategies through email message. 2) After the 3-month physical assessment, participants received 3 stage-tailored messages (nudges)/month and one email encouraging them to visit the portal page. Only data from one of the fourteen states were used in the current study.

Survey instrument

All participants completed a 13-section online survey instrument (see Appendix A), which ranged from items on demographic, readiness to change behavior (exercise, fruit and vegetable intake and stress management), SSB intake, physical activity behavior, and fruit and vegetable consumption habits. The demographic section included age, gender, ethnicity, year in school, residence and hours worked per week during school year.

The section of the survey that assessed readiness to change physical activity habits, and fruit and vegetable intake used the staging methods in the TTM.[16,17] Participants were asked to endorse the statements, 'Do you exercise 3-5 times per week for 30 minutes per session?' and 'Do you eat 5 or more cups of fruits and vegetables a day?' to assess their current level of physical activity and fruit and vegetable intake. Response options for either questions were 'No, and I do not intend to in the next 6 months', 'No, but I intend to in the next 6 months', 'No, but I intend to in the next 30 days', 'Yes, I have been for less than 6 months' and 'Yes. I have been for more than 6 months'.

The section on SSB consumption (including soda, fruit drinks, energy drinks and specialty coffee) assessed participants' consumption habits (frequency & serving sizes) within the past month, using a non-validated questionnaire adapted from West et al.[19] Frequency categories ranged from never or less than one per month to four or more per day. Response options for serving size ranged from 'I have not had a non-diet sugared soft drink in the last month' to '2-liter bottle'. The serving size options of 'Restaurant glass or cup' and '2-liter bottle' were assumed to be 16 ounces and 67.63 ounces, respectively, for calculation purposes.

The section on physical activity asked participants to report their frequency (days/ week) and duration (minutes spent) of walking, moderate and vigorous physical activities performed in the last 7 days, using the International Physical Activity Questionnaire (IPAQ, available at http://www.ipaq.ki.se). IPAQ is a valid and reliable tool for measuring physical activity levels for diverse 18-65 year old adult populations.[20]

The section on fruit and vegetable intake was adapted from the National Cancer Institute (NCI)'s Fruit and Vegetable screener used in the Eating At America's Table Study (available at http://appliedresearch.cancer.gov/diet/screeners/fruitveg/allday.pdf). This questionnaire collected information on the frequency (per month, week or day) and amount of various forms of fruits and vegetables participants ate within the past month.

Outcome measures

Participants' readiness to change their physical activity and fruit and vegetable intake were coded as follows: The response option, 'No, and I do not intend to in the next 6 months' was coded as '2'. Study evaluators did not observe any significant differences between participants who responded 'No, but I intend to in the next 6 months' and 'No, but I intend to in the next 30 days'. Thus, they merged both responses into one and coded them as '3'. The same principle was applied to the responses 'Yes, I have been for less than 6 months' and 'Yes. I have been for more than 6 months'; both responses were merged and coded as '4'. Overall, coding of the responses resulted in identification of three stages, namely 'Precontemplation' (2 - 'No, don't intend to in the next 6 months'), 'Contemplation/Preparation' (3 -'No, intend to in the next 6 months') and 'Action/Maintenance' (4 -'Yes').

The amount of each type of SSB consumed (ounces/day) was calculated as a product of frequency of consumption and serving size for each category of SSB. Since the frequency of SSB consumption was reported in different categories (daily, weekly, monthly), the data were standardized by transforming them into frequency per day. For responses that included ranges, they were first transformed into the midpoint of the range. For example, the midpoint value for 'One to four per month' is 2.5 per month. Based on the assumption that there are 30 days in each month, this value becomes 0.0833 per day. Finally, the total amount of SSB consumed (ounces/day) was calculated as amount of soda + amount of fruit drinks + amount of energy drinks + amount of coffee.

The frequency and minutes spent on walking, moderate and vigorous physical activity were converted into MET scores (MET-minutes per week) using the conversion factors 3.3, 4.0 and 8.0, respectively (1 MET refers to the energy spent during quiet sitting).[21,22] Sitting was not included in physical activity calculations because it was considered a sedentary activity. Participants were classified into three groups as defined by the IPAQ questionnaire scoring sheet– low (those not meeting requirements for the second or third group), moderate (Total physical activity ≥ 600 METs-minutes/week) and high (Total physical activity ≥ 3,000 METs-minutes/week).[21]

Frequencies of fruit and vegetable intake were first converted into monthly averages by standardizing the midpoint of each frequency category to frequency per month. For example, '1-3 times per month' becomes 2 times per month. The monthly averages were then transformed

into daily values, following similar procedures for SSB calculations. Fruit and vegetables intake were calculated separately as a product of daily average and amount eaten, and then summed up to obtain the daily total fruit and vegetable intake.

Data Analysis

Descriptive statistics (percentages, means and standard errors) were used to summarize the demographic variables from the survey. Tests of analysis of variance were used to determine differences between groups. Changes in SSB consumption over time were determined using SAS PROC GLIMMIX (generalized linear mixed models), assuming a gamma distribution and using a log link function. This procedure was chosen because the SSB data was non-normally distributed. Linear regression models were used to test associations between fruit and vegetable intake and physical activity with SSB intake. Group (Control or Intervention) and fruit and vegetable intake or physical activity scores were used as predictor (independent) variables. Linear mixed models were used to analyze associations between stage of change (SOC) and self-reported fruit and vegetable intake and physical activity levels because analyzed variables were both categorical (SOC) and continuous variables (fruit and vegetable intake and physical activity levels)

Generalized linear mixed models were performed with SAS 9.3 software (2000-2010, SAS Institute Inc., Cary, NC) and all other analyses were performed with SPSS 19.0 software (2010, IBM Company,). A critical value of $\alpha = 0.05$ was used to determine statistical significance for all tests.

Results

The total number of participants at baseline, 3 and 15 months was 156, 135 and 108, respectively; the retention rate for the study was 69.2%. The demographic characteristics of participants over the period of study are presented in Table 3.1. Participants were predominantly females, 18-20 years old and white. No significant group differences were observed at baseline ($p > 0.05$). The mean intakes of SSB, F/V and weekly physical activity levels are presented in Table 3.2.

Changes in Sugar-Sweetened Beverage Consumption

Generally, participants in the intervention group consumed more SSB than the control group (Table 3.2). Further statistical tests, however, showed that there were no significant differences in SSB consumption between the control and intervention groups at the end of the study ($p > 0.05$).

Relationship between Fruit and Vegetable Intake, Physical Activity and Sugar-Sweetened Beverage Intake

Results from the regression analysis used to examine the relationship between fruit and vegetable intake and SSB indicated that neither fruit and vegetable intake nor group could predict SSB intake at baseline, 3 and 15 months (Table 3.3, $p > 0.05$).

In testing the association between physical activity and SSB consumption, only results at 3 months were statistically significant ($p \leq 0.05$); weekly physical activity scores significantly predicted SSB consumption ($\beta=0.230$, $p \leq 0.05$; Table 3.3). The regression coefficient, β, represents the average change in SSB consumption (oz./d) expected per average fruit and vegetable intake or physical activity score at each time point. The adjusted R^2 indicates the amount of variation in SSB consumption that is explained by either fruit and vegetable intake or physical activity scores. Group was not a significant predictor of SSB consumption in testing both hypotheses ($p > 0.05$).

Comparing Fruit and Vegetable Intake and Physical Activity Levels Based on Stage of Change Groupings

In assessing participants' readiness to change fruit and vegetable intake and physical activity habits, it was observed that more participants self-staged themselves into the contemplation (C) and action/ maintenance (A/M) stages for both fruit and vegetable intake and physical activity behavior (Table 3.4). Generally, the number of participants at each stage of change (SOC) for physical activity decreased across time.

Results from the linear mixed model analyses are summarized as means and standard errors in Table 3.5. There was a significant association between self-reported fruit and vegetable (F/V) intake and SOC for F/V intake at months 3 and 15 (3 mo.: $F(2,118) = 16.60$, $p \leq 0.05$; 15 mo.: $F(2,95) = 4.444$, $p \leq 0.05$). This means that participants in the precontemplation stage had lower fruit and vegetable intake than their colleagues in the action/ maintenance stage. The differences in mean F/V intake between the two stages were -1.760 and -1.321 at 3 and 15

months, respectively. For physical activity (PA), there was a significant association between self-reported PA scores and SOC for PA at baseline and at month 15 (0 mo.: $F(2,144) = 22.209$, $p \leq 0.05$; 15 mo.: $F(2,91) = 5.346$, $p \leq 0.05$). This implies that at month 3, participants in the precontemplation and action/ maintenance stages had quite similar physical activity scores. However at baseline and 15 months, participants in the latter group were more involved in physical activity than those in the precontemplation stage. The differences in mean PA scores between both groups at baseline and 15 months were -1441.24 and -1100.96, respectively ($p \leq 0.05$).

Discussion, Conclusions and Implications for Research

This study tested the effectiveness of a 15-month intervention in reducing SSB consumption among college students, and assessed students' fruit and vegetable intake and physical activity habits and their relationship to SSB consumption in order to improve health outcomes.

The results indicated that at the end of the study, both the control and intervention groups consumed similar amount of SSB. Thus, the hypothesis that at the end of the study (15 months), participants in the intervention group will consume less SSB than the control group was not supported. This was an unexpected finding mainly because participants in the intervention group regularly received information, prompting them to minimize SSB consumption while improving their healthy eating behaviors. This finding contradicts the study by Ha et al.[23] in which soft drink consumption significantly decreased following a 15-week class-based nutrition intervention. The inconsistencies in findings may be due to methodological and analytical differences, such as the use of only one group of participants in the study by Ha et al. In the current study, the average daily intake of SSB was approximately 6 servings/d (assuming a typical serving size of 12 oz.); this amount is quite similar to the 4-5 servings/d observed by West et al.[24] and further confirms that SSB consumption is common among college students.

Frequent SSB consumption is associated with increased weight gain and higher risk for type 2 diabetes due to high content of calories and simple sugars in SSB.[25] The form (liquid or solid) and chemical characteristics (only sugar or mixed nutrients) of sugared foods influences short-term energy intake and metabolism. For example, a study has shown that compared to a beverage containing mixed nutrients, a sugar-only beverage may promote unintentional weight

gain in healthy adults by increasing energy intake without improving satiety.[26] Increased SSB consumption may decrease milk intake[27] and consequently lead to decreased intake of essential micronutrients such as calcium, vitamins A and D and phosphorus since milk is a major source of these nutrients. Consequently, this may increase one's risk for osteoporosis (bone disease arising from poor absorption of calcium from diets) as adequate intake of these micronutrients promotes bone health.[28] Some lifestyle changes recommended to decrease osteoporosis risk are increased physical activity levels, low sodium intake, high fruit and vegetable intake and maintenance of healthy body weight.[29] The potential health risks associated with excess caloric intake from SSB emphasizes the need to discourage their consumption among college students.

Another finding from this study was that SSB consumption was not associated with physical activity nor fruit and vegetable intake. This finding does not provide support for the two hypotheses: - participants who report high fruit and vegetable intake will report low SSB intake and participants who report high physical activity scores will report low SSB intake. This implies that students may not necessarily change their SSB consumption patterns just because they are consuming more fruit and vegetables or are involved in more physical activity than they usually do. A plausible explanation for the lack of a statistically significant relationship between SSB and these two variables is the combination of all four categories of SSB. For example, the consumption of soda has been shown to be negatively correlated with physical activity and fruit and vegetable intake whereas flavored and sports beverages (FSBs) was positively correlated with physical activity and fruit and vegetable intake.[30] This suggests that the type of SSB may elucidate the relationship between either fruit and vegetable intake or physical activity and SSB consumption in college students. Even though only month 3 results showed a possible association between physical activity and SSB consumption, it is noteworthy because it is consistent with findings from a previous study that investigated the relationship between stage of change and self-reported vigorous physical activity scores.[31] Exploring other factors such as age, ethnicity, year in school and other types of foods eaten in future studies may help to ascertain such an association.

The finding that at two out of the three time points, there were statistically significant differences between self-reported fruit and vegetable intake and stage of change (SOC) for fruit and vegetable intake provided support for the hypothesis: - participants who self-stage themselves into the action/maintenance stage will report higher fruit and vegetable intake than

those who self-stage themselves into precontemplation stage. The hypothesis that participants who self-stage themselves into action/maintenance stage will report higher physical activity scores than those who self-stage themselves into precontemplation stage was not supported. Even though there were differences in fruit and vegetable intake and physical activity between the two groups, the differences were not so great; this may be because there were fewer participants in the precontemplation stage than the action/ maintenance stage.

As previously mentioned, the criteria for staging for fruit and vegetable intake and physical activity habits were eating at least 5 cups of fruit and vegetables a day and exercising 3-5 times per week for 30 minutes per session, respectively. The results indicated that participants in all three identified stages consumed less than 5 cups of fruit and vegetable daily. This implies that participants, particularly those in the action/maintenance stage may have overestimated their fruit and vegetable intake. This is consistent with a previous study which found differences between self-staged fruit and vegetable behavior and self-reported fruit and vegetable intake.[32] This misclassification has been attributed to social factors and a misunderstanding of serving sizes and food label servings. It may be possible that the surveyed students inaccurately staged themselves because they perceive themselves to be eating more fruit and vegetable than they actually do. Adequate intake of fruit and vegetable reduces the risk for cardiovascular diseases as they contain phytochemicals (bioactive non-nutrient chemicals found in plants), potassium and fiber.[7] Phytochemicals and most vitamins found in fruits and vegetables possess antioxidant properties which help prevent oxidative damage to body cells.[33] Fiber also regulates serum cholesterol levels and facilitates bowel movements.[34] Since the surveyed students reported low fruit and vegetable intake, they might be at a risk for chronic diseases.

Mean physical activity scores (MET-minutes/week) for participants in the precontemplation, contemplation and action/maintenance stages ranged from 1,267.98 (~317 minutes/week) to 2,735.14 (~684 minutes/week) over the three time points. These values are about twice and four times the recommended daily physical activity level for an adult. It indicates that college students are involved in adequate physical activity. However, both balanced diet and adequate physical activity are required for general health. If students are participating in moderate-intensity physical activity without eating healthy, it is likely some body functions or mechanisms may be impaired. Furthermore, since physical activity habits decrease

as one gets older, there is a likelihood of these students compromising their health if their fruit and vegetable intake does not improve.

This study adds to the growing literature on stage-specific dietary and physical activity interventions in college students. A major strength of this study is that it was a randomized control trial which assessed behaviors at regular time points; randomization of participants reduced the occurring of errors by chance to aid in determining the effect of the intervention. The study also involved community participation which aided in the design of a suitable intervention for the participants. Finally, the target population chosen for the study was appropriate because previous studies have shown that healthy behaviors developed in young adults are likely to persist into adulthood. This makes the promotion of healthy behaviors in this group a priority. However, there are some limitations to this study. First, findings from this study are not generalizable to other college students because it only focused on one university. Second, the analyses was not adjusted for gender, age, ethnicity, BMI, hours worked per week or residence so findings may not be generalizable to all sectors of the population. Third, this study used dietary recall measures to investigate participants' fruit and vegetable intake, SSB consumption and physical activity levels. The problem with such a measure is that participants may have difficulty recalling all they ate within the past month. In addition, these measures are based on self-report, so there is a likelihood of under-reporting or over-reporting of behaviors. Fourth, the combining of two stages of change groups may have influenced results obtained. Finally, there were an imbalanced number of male and female participants in both groups. Regardless of these limitations, our findings suggest low fruit and vegetable intake in participants may pose a health risk to college students.

The SOC construct of the TTM was useful in determining students' readiness to change fruit and vegetable intake and physical activity behavior.

Conclusion and implications for research

This study further emphasizes the need for more interventions to improve healthy behaviors in college students, particularly their fruit and vegetable intake. Future studies could explore ways to increase fruit and vegetable consumption in this age group in order to reduce their risk for chronic diseases. This could be achieved by exploring environmental factors such as cost and availability of healthy foods, particularly fruits and vegetables, on campus. Students'

perceptions about college campuses and their role in promoting consumption of fruit and vegetable intake should be investigated to guide future interventions. The use of only one construct of the TTM in this study may have affected the findings from this study. Thus, future studies could include other TTM constructs such as decisional balance, processes of change and self-efficacy to aid in accurate staging of behaviors and also provide insight into which factors strongly predict students' behaviors.

Furthermore, ways of promoting the consumption of healthy beverage alternatives, such as plain water and low-fat or fat-free milk, in college students should also be explored. Positive changes in students' health behaviors will lead to improved well-being and help prevent obesity. Consequently, the financial burden of obesity and its related conditions may be reduced.

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Table 3.1 Characteristics of Participants over Period of Study

	Baseline		3-month		15-month	
Characteristics	**Control (N= 76)**	**Interv. (N= 79)**	**Control (N= 73)**	**Interv. (N= 62)**	**Control (N= 60)**	**Interv. (N= 48)**
Gender	%	%	%	%	%	%
Male	27.6	27.8	27.4	29.0	23.3	22.9
Female	72.4	72.2	72.6	71.0	76.7	77.1
Age (y)						
18 – 20	88.2	88.6	83.3	87.3	63.2	61.7
≥21	11.8	11.4	16.7	12.7	36.9	38.3
Ethnicity						
White	87.8	89.6	88.1	89.3	82.5	93.6
Non-White	12.2	10.4	11.9	10.7	17.5	6.4
Year in school						
Freshman	53.9	47.4	58.2	48.2	0.0	0.0
Sophomore	25.0	30.8	19.4	33.9	49.1	46.8
Junior	18.4	19.2	20.9	16.1	28.1	31.9
Senior & higher	2.6	2.6	1.5	1.8	22.8	21.3
Residence						
On-campus housing	81.5	77.2	83.6	82.1	47.4	53.1
Off-campus housing	18.4	22.8	16.4	17.9	52.7	46.8
Hours worked per week for pay during school year						
I do not work	51.3	51.9	50.7	44.6	24.6	29.8
1-19 hours	44.8	39.2	38.8	46.5	54.4	53.2
≥ 20 hours	3.9	8.9	10.5	9.0	21.1	17.0

Table 3.2 Mean (SE) Intake of Beverage, Fruit and Vegetable and Physical Activity Levels over Time

	Group	0-month	3-month	15-month
Sugar-sweetened beverage intake (oz./d)				
	Control (N=51)	307.83 (64.65)	439.66 (127.76)	269.02 (50.27)
	Intervention (N=43)	319.95 (70.41)	331.37(139.14)	283.74 (54.74)
Fruit and vegetable intake (total cup equivalents/d)				
	Control (N=49)	2.33 (0.26)	2.56 (0.28)	2.75 (0.39)
	Intervention (N=41)	2.58 (0.29)	2.67 (0.30)	2.61 (0.42)
Physical activity level (MET-minutes/week)				
	Control (N=48)	2259.79 (205.97)	2099.00 (220.73)	2474 (208.91)
	Intervention (N=41)	2452.00 (222.86)	2086.00 (238.83)	2059.00 (226.04)

Table 3.3 Predicting Sugar-Sweetened Beverage Consumption

Predictor	Adjusted R^2	Standardized β	p-value
Fruit and vegetable intake			
Baseline	0.003	0.128	0.134
3-month	-0.007	-0.005	0.959
15-month	-0.021	-0.001	0.992
Weekly physical activity level			
Baseline	-0.013	0.010	0.907
3-month	0.037	0.230*	0.012
15-month	-0.010	0.100	0.336

*shows significance at $p \leq 0.05$

Table 3.4 Stage Distribution of Students for Physical Activity and Fruit and Vegetable Intake

	Baseline		3 mo.		15 mo.	
	Con (N)	**Int** (N)	**Con** (N)	**Int** (N)	**Con** (N)	**Int** (N)
Stage of Change -Physical Activity						
Precontemplation	2	1	2	1	1	3
Contemplation/Preparation	24	29	22	17	18	12
Action/Maintenance	51	48	42	42	37	30
Stage of Change -Fruit and Vegetable						
Precontemplation	9	12	7	1	3	3
Contemplation/Preparation	42	37	33	25	23	19
Action/Maintenance	25	29	26	34	30	23

(Con = Control group, Int = Intervention group)

Table 3.5 Mean Fruit and Vegetable Intake and Physical Activity Scores by Stage of Change Grouping

Stage of Change	Baseline	3 mo.	15 mo.
	Mean (SE)	Mean (SE)	Mean (SE)
Fruit and vegetable intake (total cup equivalents)			
Precontemplation	1.459 (1.014)[a]	0.886 (0.650)[a]	1.116 (0.992)[a]
Contemplation/Preparation	1.626 (0.968)	1.815 (0.246)	1.897 (0.375)
Action/Maintenance	3.821 (0.976)[a]	3.576 (0.243)[b]	3.218 (0.344) [b]
Weekly physical activity level (METS-minutes/week)			
Precontemplation	2409.33 (713.91)[a]	1587.00 (1307.03)[a]	2364.25 (731.95)[a]
Contemplation/Preparation	1267.98 (174.87)	1387.67 (1040.16)	1634.19 (281.73)
Action/Maintenance	2709.22 (127.54)[b]	2451.43 (1024.84)[a]	2735.14 (184.43) [b]

Columns with different letters indicate statistical significance ($p \leq 0.05$)

Chapter 4 - Discussion, Conclusion and Implications for Future Research

This study tested the effectiveness of a 15-month intervention in reducing SSB consumption among college students, and assessed students' fruit and vegetable intake and physical activity habits and their relationship to SSB consumption in order to improve health outcomes.

The results indicated that at the end of the study, both the control and intervention groups consumed similar amount of SSB. Thus, the 15-month intervention did not have any visible effects on participants' SSB consumption. This was an unexpected finding mainly because participants in the intervention group regularly received information, prompting them to minimize SSB consumption while improving their healthy eating behaviors. This finding contradicts the study by Ha et al.[1] in which soft drink consumption significantly decreased following a 15-week class-based nutrition intervention. The inconsistencies in findings may be due to methodological and analytical differences, such as the use of only one group of participants in the study by Ha et al. In the current study, the average daily intake of SSB was approximately 6 servings/d (assuming a typical serving size of 12 oz.); this amount is quite similar to the 4-5 servings/d observed by West et al.[2] and further confirms that SSB consumption is common among college students.

Frequent SSB consumption results in increased weight gain and higher risk for type 2 diabetes due to high content of calories and simple sugars in SSB.[3] The form (liquid or solid) and chemical characteristics (only sugar or mixed nutrients) of sugared foods influences short-term energy intake and metabolism. For example, a study has shown that compared to a beverage containing mixed nutrients, a sugar-only beverage may promote unintentional weight gain in healthy adults by increasing energy intake without improving satiety.[4] Increased SSB consumption may decrease milk intake[5] and consequently lead to decreased intake of essential micronutrients such as calcium, vitamins A and D and phosphorus since milk is a major source of these nutrients. Consequently, this may increase one's risk for osteoporosis (bone disease arising from poor absorption of calcium from diets) as adequate intake of these micronutrients promotes bone health.[6] Some lifestyle changes recommended to decrease osteoporosis risk are

increased physical activity levels, low sodium intake, high fruit and vegetable intake and maintenance of healthy body weight.[7] The potential health risks associated with excess caloric intake from SSB emphasizes the need to discourage their consumption among college students.

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The finding that at two out of the three time points, there were statistically significant differences between self-reported fruit and vegetable intake and stage of change (SOC) for fruit and vegetable intake provided support for the hypothesis: - participants who self-stage themselves into the action/maintenance stage will report higher fruit and vegetable intake than those who self-stage themselves into precontemplation stage. However, the hypothesis that participants who self-stage themselves into action/maintenance stage will report higher physical activity scores than those who self-stage themselves into precontemplation stage was not supported.

The criteria for staging for fruit and vegetable intake and physical activity habits were eating at least 5 cups of fruit and vegetables a day and exercising 3-5 times per week for 30

minutes per session, respectively. The results indicated that participants in all three stages consumed less than 5 cups of fruit and vegetable daily. This implies that participants, particularly those in the action/maintenance stage may have overestimated their fruit and vegetable intake. due to social factors and a misunderstanding of serving sizes and food label servings.[10] It is also be possible that the surveyed students inaccurately staged themselves because they perceive themselves to be eating more fruit and vegetable than they actually do. Adequate intake of fruit and vegetable reduces one's risk for cardiovascular diseases as they contain phytochemicals (bioactive non-nutrient chemicals found in plants), potassium and fiber.[7] Phytochemicals and most vitamins found in fruits and vegetables possess antioxidant properties which help prevent oxidative damage to body cells.[11] Fiber also regulates serum cholesterol levels and facilitates bowel movements.[12] Since the surveyed students reported low fruit and vegetable intake, they might be at a risk for chronic diseases.

Mean physical activity scores (MET-minutes/week) for participants in the precontemplation, contemplation and action/maintenance stages ranged from 1,267.98 (~317 minutes/week) to 2,735.14 (~684 minutes/week) over the three time points. These values are about twice and four times the recommended daily physical activity level for an adult. It indicates that college students are involved in adequate physical activity. However, both balanced diet and adequate physical activity are required for general health. If students are participating in moderate-intensity physical activity without eating healthy, it is likely some body functions or mechanisms may be impaired. Furthermore, since physical activity habits decrease as one gets older, there is a likelihood of these students compromising their health if their fruit and vegetable intake does not improve.

This study adds to the growing literature on stage-specific dietary and physical activity interventions in college students. A major strength of this study is that it was a randomized control trial which assessed behaviors at regular time points; randomization of participants reduced occurrence of errors by chance to aid in determining the effect of the intervention. The study also involved community participation which aided in the design of a suitable intervention for the participants. Finally, the target population chosen for the study was appropriate because previous studies have shown that healthy behaviors developed in young adults are likely to persist into adulthood. This makes the promotion of healthy behaviors in this group a priority. However, there are some limitations to this study. First, findings from this study are not

generalizable to other college students because it only focused on one university. Second, the analyses was not adjusted for gender, age, ethnicity, BMI, hours worked per week or residence so findings may not be generalizable to all sectors of the population. Third, this study used dietary recall measures to investigate participants' fruit and vegetable intake, SSB consumption and physical activity levels. The problem with such a measure is that participants may have difficulty recalling all they ate within the past month. In addition, these measures are based on self-report, so there is a likelihood of under-reporting or over-reporting of behaviors. Fourth, the combining of two stages of change groups may have influenced results obtained. Finally, there were an imbalanced number of male and female participants in both groups. Regardless of these limitations, our findings suggest low fruit and vegetable intake in participants may pose a health risk to college students.

The SOC construct of the TTM was useful in determining students' readiness to change fruit and vegetable intake and physical activity behavior.

Conclusions and Implications for Research

In summary, this study suggests that the 15-month intervention was not effective in reducing SSB intake among participants. Secondly, there was no association between students' fruit and vegetable intake nor physical activity and the SSB consumption. Findings also indicate that students are involved in moderate physical activity levels. The high SSB consumption and low fruit and vegetable intake observed could increase students' risk for weight gain and obesity-related conditions. Thus, college campuses can help student maintain physical activity behavior while helping them to improve their eating habits.

Study findings further emphasize the need for more interventions to improve college students' fruit and vegetable intake. Future interventions could explore environmental factors such as cost and availability of healthy foods in the campus environment. Students' perceptions about college campuses and their role in promoting consumption of fruit and vegetable intake should be investigated to guide future interventions. Future studies could include other TTM constructs such as decisional balance, processes of change and self-efficacy to aid in accurate staging of behaviors and also provide insight into which factors strongly predict students' behaviors.

Furthermore, ways of promoting the consumption of healthy beverage alternatives, such as plain water and low-fat or fat-free milk, in college students could also be explored. Positive changes in students' health behaviors will lead to improved well-being and help prevent obesity. Consequently, the financial burden of obesity and its related conditions may be reduced.

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Appendix A - Protocol and Survey

Screening Questions

Thank you for your interest in this study. To find out whether you are eligible to participate, please answer the following questions:

1. Are you between the ages of 18 and 24?
() Yes
() No

2. Are you a full-time student?
() Yes
() No

3. Are you a first, second, or third year college student?
() Yes
() No

4. Do you have a life threatening illness or other conditions such as pregnancy or diet- and/or activity-related medical restrictions that would prevent participation in an online nutrition and fitness program and/or prevent accurate physical assessments?
() Yes
() No

5. Do you have regular access to a computer with internet connection?
() Yes
() No

6. Are you a current nutrition, exercise science and/or health promotion major?
() Yes
() No

7. What is your Body Mass Index (BMI)? To determine your BMI, please enter your height and weight into the BMI calculator (**NEED ITT TO PUT ONE IN**) at the right. After you calculate your BMI, please select whether your BMI is greater or less than 18.5.
() less than 18.5
() greater than or equal to 18.5

8. Please select the university you are attending:
-- Select a University --

9. Are you currently enrolled in a nutrition course?
Yes
No

10. Please select your gender:
() Male
() Female (if female, additional question pops up: Are you pregnant or lactating?)

Check Eligibility (button)

Additional Questions for Intervention (not Pilot)
Did you participate in the Y.E.A.H. project online study last spring 2010?
() Yes
() No

Questionnaire 1 of 13

*****Not enough time to finish this survey now? You can come back later and finish, just remember to finish this page and click next at the bottom to save this page. When you return, you will start with the next survey.***

Exercise
Regular exercise is any *planned* physical activity (e.g., brisk walking, aerobics, jogging, bicycling, swimming, rowing, etc.) performed to increase physical fitness. Such activity should be performed *3 to 5 times* per week for *30 minutes* per session. Exercise does not have to be painful to be effective but should be done at a level that increases your breathing rate and causes you to break a sweat.

1) Do you exercise regularly according to that definition?
(1) No, and I do NOT intend to in the next 6 months
(2) No, but I intend to in the next 6 months
(3) No, but I intend to in the next 30 days
(4) Yes, I have been for LESS than 6 months
(5) Yes, I have been for MORE than 6 months

Fruit/Vegetable Intake
When considering the amount of a food eaten, a cup is about the size of a baseball. US Dietary Guidelines define 1 cup of fruits and vegetables as equal to:
1 cup cooked or raw fruits or vegetables
2 cups of lettuce salad
A piece of fruit about the size of a small apple or large banana
½ cup of dried fruit like raisins, or
1 cup (8 ounces) of 100% fruit juice

2) Do you eat 5 or more cups of fruits and vegetables a day?
(1) No, and I do NOT intend to in the next 6 months
(2) No, but I intend to in the in the next 6 months
(3) No, but I intend to in the next 30 days
(4) Yes, but I have been for LESS than 6 months
(5) Yes and I have been for MORE than 6 months

Stress Management
Stress management includes regular relaxation and physical activity, talking with others and/or making time for social activities.

3) Do you effectively practice stress management in your daily life?
(1) No, and I do NOT intend to in the next 6 months
(2) No, but I intend to in the in the next 6 months
(3) No, but I intend to in the next 30 days
(4) Yes, but I have been for LESS than 6 months
(5) Yes and I have been for MORE than 6 months

Questionnaire 6 of 13

***Not enough time to finish this survey now? You can come back later and finish, just remember to finish this page and click next at the bottom to save this page. When you return, you will start with the next survey.*

NCI Fruit and Vegetable Screener
Available at: **http://riskfactor.cancer.gov/diet/screeners/fruitveg/allday.pdf**

Think about what you usually ate last month. Please think about all the fruits and vegetables that you ate last month. Include those that were:

- ***Raw and cooked,***
- ***Eaten as snacks and at meals***
- ***Eaten at home and away from home (restaurants, friends, take-out), and***
- ***Eaten alone and mixed with other foods.***

Report how many times per month, week, or day you ate each food, and if you ate it, how much you usually had.
If you mark "never" for a question, follow the "Go to" instruction.
Choose the best answer for each question. Mark only one response for each question.

1) Over the last month, how many times per month, week, or day did you drink **100% juice** such as orange, apple, grape, or grapefruit juice? **Do not count** fruit drinks like Kool-Aid, lemonade, Hi-C, cranberry juice drink, Tang, and Twister. Include juice you drank at all mealtimes and between meals.
(1) never (go to question 3)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

2) Each time you drank **100% juice**, how much did you usually drink?
(1)Did not drink 100% juice
(2) Less than ¾ cup (less than 6 ounces)
(3) ¾ to 1¼ cup (6 to 10 ounces)
(4) 1¼ to 2 cups (10 to 16 ounces)
(5) More than 2 cups (more than 16 ounces)
(6) Choose not to answer

3) Over the last month, how many times per month, week, or day did you eat **fruit?** Count any kind of fruit—fresh, canned, and frozen. **Do not count** juices. Include fruit you ate at all mealtimes and for snacks.
(1) never (go to question 5)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

4) Each time you ate **fruit,** how much did you usually eat?
(1) Did not eat fruit
(2) Less than 1 medium fruit (less than ½ cup)
(3) 1 medium fruit (about ½ cup)
(4) 2 medium fruits (about 1 cup)
(5) More than 2 medium fruits (more than 1 cup)
(6) Choose not to answer

5) Over the last month, how often did you eat **lettuce salad (with or without other vegetables)?**
(1) never (go to question 7)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

6) Each time you ate **lettuce salad**, how much did you usually eat?
(1) Did not eat lettuce salad
(2)About ½ cup
(3) About 1 cup
(4) About 2 cups
(5) More than 2 cups
(6) Choose not to answer

7) Over the last month, how often did you eat **French fries** or **fried potatoes?**
(1) never (go to question 9)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

8) Each time you ate **French fries** or **fried potatoes,** how much did you usually eat?
(1) Did not eat French fries or fried potatoes
(2)Small order or less (About 1 cup or less)
(3) Medium order (About1½ cups)
(4) Large order (About 2 cups)
(5) Super-Size order or more (About 3 cups or more)
(6) Choose not to answer

9) Over the last month, how often did you eat **other white potatoes?** Count **baked, boiled,** and **mashed potatoes, potato salad,** and **white potatoes that were not fried.**
(1) never (go to question 11)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

10) Each time you ate **these potatoes,** how much did you usually eat?
(1) Did not eat these types of potatoes
(2)1 small potato or less (1/2 cup or less)

(3) 1 medium potato (1/2 to 1 cup)
(4) 1 large potato (1 to 1½ cups)
(5) 2 medium potatoes or more (1½ cups or more)
(6) Choose not to answer

11) Over the last month, how often did you eat **cooked dried beans?** Count **baked beans, bean soup, refried beans, pork and beans** and **other bean dishes.**

(1) never (go to question 13)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

12) Each time you ate **these beans,** how much did you usually eat?
(1) Did not eat cooked dried beans
(2)Less than ½ cup
(3) ½ to 1 cup
(4) 1 to 1½ cups
(5) More than 1½ cups
(6) Choose not to answer

13) Over the last month, how often did you eat **other vegetables?**

DO NOT COUNT:

- Lettuce salads
- White potatoes
- Cooked dried beans
- Vegetables in mixtures, such as in sandwiches, omelets, casseroles, Mexican dishes, stews, stir-fry, soups, etc.
- Rice

COUNT: All other vegetables—raw, cooked, canned, and frozen

(1) never (go to question 15)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**

(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

14) Each of these times that you ate **other vegetables,** how much did you usually eat?

(1) Did not eat these vegetables
(2)Less than ½ cup
(3) ½ to 1 cup
(4) 1 to 2 cups
(5) More than 2 cups
(6) Choose not to answer

15) Over the last month, how often did you eat **tomato sauce**? Include tomato sauce on pasta or macaroni, rice, pizza and other dishes.
(1) never (go to question 17)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

16) Each time you ate **tomato sauce,** how much did you usually eat?
(1) Did not eat tomato sauce
(2)About ¼ cup
(3) About ½ cup
(4) About 1 cup
(5) More than 1 cup
(6) Choose not to answer

17) Over the last month, how often did you eat **vegetable soups?** Include tomato soup, gazpacho, beef with vegetable soup, minestrone soup, and other soups made with vegetables.
(1) never (go to question 19)
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**

(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

18) Each time you ate **vegetable soup,** how much did you usually eat?
(1) Did not eat vegetable soup
(2)Less than 1 cup
(3) 1 to 2 cups
(4) 2 to 3 cups
(5) More than 3 cups
(6) Choose not to answer

19) Over the last month, how often did you eat **mixtures that included vegetables?** Count such foods as sandwiches, casseroles, stews, stir-fry, omelets, and tacos.
(1) never
(2) 1-3 times last **month**
(3) 1-2 times per **week**
(4) 3-4 times per **week**
(5) 5-6 times per **week**
(6) 1 time per **day**
(7) 2 times per **day**
(8) 3 times per **day**
(9) 4 times per **day**
(10) 5 or more times per **day**
(11) Choose not to answer

20) Including snacks, how many cups of fruit and 100% fruit juice do you usually eat each day?
(1) Less than ½ cup
(2) ½ cup
(3) 1 cup
(4) 1 ½ cups
(5) 2 cups
(6) 2 ½ cups
(7) 3 cups
(8) 3 ½ cups
(9) 4 cups
(10) 4 ½ cups
(11) 5 cups
(12) 5 ½ cups
(13) 6 cups or more
(14) Choose not to answer

21) Including snacks, how many cups of vegetables do you usually eat each day?
(1) Less than ½ cup
(2) ½ cup

(3) 1 cup
(4) 1 ½ cups
(5) 2 cups
(6) 2 ½ cups
(7) 3 cups
(8) 3 ½ cups
(9) 4 cups
(10) 4 ½ cups
(11) 5 cups
(12) 5 ½ cups
(13) 6 cups or more
(14) Choose not to answer

The next 2 questions are about grains.

22) How many servings of <u>grains</u> do you eat on average per day?

From Healthy Eating Index

NOTE: Any food made from wheat, rice, oats, cornmeal, barley or another cereal grain is a grain product. Bread, pasta, oatmeal, breakfast cerals, tortillas and grits are examples of grain products.

Examples: 1 serving = 1 slice of bread; 1 cup of ready-to-eat cereal; ½ cup cooked rice or pasta

1) Less than one
2) 1
3) 2
4) 3
5) 4
6) 5
7) 6 or more
8) Choose not to answer

23) How many servings of <u>whole grains</u> do you eat on average per day?

NOTE: All grains begin as whole grains; however, if after milling they keep all the parts of the original grain in their original proportions they are still considered a whole grain. Whole grains should be the first ingredient listed on the label.

Examples: 1 serving = 1 slice whole wheat bread; 5-6 whole grain crackers; ½ cup cooked brown rice; ½ cup oatmeal

1) Less than one
2) 1
3) 2
4) 3
5) 4
6) 5
7) 6 or more
8) Choose not to answer

Questionnaire 7 of 13

From West et al. Obesity 2006 14:1825

*****Not enough time to finish this survey now? You can come back later and finish, just remember to finish this page and click next at the bottom to save this page. When you return, you will start with the next survey.***

1) On average, how often in the past month did you consume a non-diet, sugar-sweetened soft drink (pop)? (For example, Coke, Sprite, Dr. Pepper, Pepsi, Mountain Dew, Orange Crush, Mr. Pibb, 7-Up, Fanta, root beer)
(1) Never or less than one per month
(2) One to four per month
(3) Two to six per week
(4) One per day
(5) Two per day
(6) Three per day
(7) Four per day or more
(8) Choose not to answer

2) If you consumed any non-diet, sugar-sweetened soft drinks last month, what was the typical serving size you consumed?
(1) I have not had a non-diet sugared soft drink in the last month
(2) 12-ounce can
(3) Restaurant glass or cup
(4) 20-ounce bottle
(5) 2-liter bottle
(6) Choose not to answer

3) On average, how often in the past month did you consume fruit drinks or other sugar sweetened beverages? (For example, Hawaiian Punch, Hi-C, Kool-Aid, Ocean Spray cranberry juice cocktail, Snapple, Sunny Delight, Country Time Lemonade, Sobe, Arizon Ice Tea, sugar sweetened tea, etc.)
(1) Never or less than one per month
(2) One to four per month
(3) Two to six per week
(4) One per day
(5) Two per day
(6) Three per day
(7) Four per day or more
(8) Choose not to answer

4) If you consumed any fruit drinks last month, what was the typical serving size you consumed?
(1) I have not had a fruit drink in the last month
(2) 11.5-ounce can or less
(3) 20-ounce bottle
(4) 64-ounce bottle
(5) Choose not to answer

Note: The following energy drink and coffee drink items were designed by Mallory Koenings, Susan Nitzke, Beatrice Phillips.

5) On average, how often in the past month did you consume non-diet (**NOT** sugar-free) energy drinks (For example, RockStar, Red Bull, Monster, Full Throttle)?

(1) Never or less than one per month
(2) One to four per month
(3) Two to six per week
(4) One per day
(5) Two per day
(6) Three per day
(7) Four per day or more
(8) Choose not to answer

6) If you consumed any non-diet energy drinks last month, what was the typical serving size you consumed?
(1) I have not had a non-diet energy drink in the last month
(2) 2-6 oz. (energy shot)
(3) between 6 and 16 oz.
(4) more than 16 oz.
(5) Choose not to answer

7) On average, how often in the past month did you consume sugar-sweetened specialty coffee drinks (For example, Frappuccino, flavored latté/cappuccino)?
(1) Never or less than one per month
(2) One to four per month
(3) Two to six per week
(4) One per day
(5) Two per day
(6) Three per day
(7) Four per day or more
(8) Choose not to answer

8) If you consumed any sugar-sweetened specialty coffee drinks last month, what was the typical serving size you consumed?
(1)I have not had a sugar-sweetened specialty coffee last month
(2)12 oz. or less
(3) more than 12 oz.
(4) Choose not to answer

Questionnaire 8 of 13

International Physical Activity Questionnaire (IPAQ)
(used in Project WebHealth & named in proposal) http://www.projectwebhealth.com/lesson/survey.php?sid=76
Not enough time to finish this survey now? You can come back later and finish, just remember to finish this page and click next at the bottom to save this page. When you return, you will start with the next survey.

How Active Are You?
We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal or make your heart beat much harder than normal. Think only about those vigorous physical activities that you did for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate.

1) During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?
(1) 0 days (Skip to question 3)
(2) 1 day
(3) 2 days
(4) 3 days
(5) 4 days
(6) 5 days
(7) 6 days
(8) 7 days
(9) Choose not to answer

2) How much time did you usually spend doing vigorous physical activities on one of those days?
(1) Did not do vigorous physical activities
(2)10 minutes
(3) 20 minutes
(4) 30 minutes
(5) 40 minutes
(6) 50 minutes
(7) 60 minutes
(8) 70 minutes (1 hr 10 min)
(9) 80 minutes (1 hr 20 min)
(10) 90 minutes (1 hr 30 min)
(11) 100 minutes (1 hr 40 min)

(12) 110 minutes (1 hr 50 min)
(13) 120 minutes (2 hrs)
(14) 130 minutes (2 hrs 10 min)
(15) 140 minutes (2 hrs 20 min)
(16) 150 minutes (2 hrs 30 min)
(17) 160 minutes (2 hrs 40 min)
(18) 170 minutes (2 hrs 50 min)
(19) 180 + minutes (3 hrs or more)
(20) Don't know/not sure
(21) Choose not to answer

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal or make your heart beat somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes some increase in breathing or heart rate.

3) During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.
(1) 0 days (Skip to question 5)
(2) 1 day
(3) 2 days
(4) 3 days
(5) 4 days
(6) 5 days
(7) 6 days
(8) 7 days
(9) Choose not to answer

4) How much time did you usually spend doing moderate physical activities on one of those days?

(1) Do not do moderate physical activities
(2)10 minutes
(3) 20 minutes
(4) 30 minutes
(5) 40 minutes
(6) 50 minutes
(7) 60 minutes
(8) 70 minutes (1 hr 10 min)
(9) 80 minutes (1 hr 20 min)
(10) 90 minutes (1 hr 30 min)
(11) 100 minutes (1 hr 40 min)
(12) 110 minutes (1 hr 50 min)

(13) 120 minutes (2 hrs)
(14) 130 minutes (2 hrs 10 min)
(15) 140 minutes (2 hrs 20 min)
(16) 150 minutes (2 hrs 30 min)
(17) 160 minutes (2 hrs 40 min)
(18) 170 minutes (2 hrs 50 min)
(19) 180 + minutes (3 hrs or more)
(20) Don't know/not sure
(21) Choose not to answer

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise or leisure.

5) During the last 7 days, on how many days did you walk for at least 10 minutes at a time?
(1) 0 days (Skip to question 7)
(2) 1 day
(3) 2 days
(4) 3 days
(5) 4 days
(6) 5 days
(7) 6 days
(8) 7 days
(9) Choose not to answer

6) How much time did you usually spend walking on one of those days?

(1) Did not walk
(2)10 minutes
(3) 20 minutes
(4) 30 minutes
(5) 40 minutes
(6) 50 minutes
(7) 60 minutes
(8) 70 minutes (1 hr 10 min)
(9) 80 minutes (1 hr 20 min)
(10) 90 minutes (1 hr 30 min)
(11) 100 minutes (1 hr 40 min)
(12) 110 minutes (1 hr 50 min)
(13) 120 minutes (2 hrs)
(14) 130 minutes (2 hrs 10 min)
(15) 140 minutes (2 hrs 20 min)
(16) 150 minutes (2 hrs 30 min)
(17) 160 minutes (2 hrs 40 min)

(18) 170 minutes (2 hrs 50 min)
(19) 180 + minutes (3 hrs or more)
(20) Don't know/not sure
(21) Choose not to answer

This question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television.

7) During the last 7 days, how much time did you spend sitting on a week day?
(1) 10 minutes
(2) 20 minutes
(3) 30 minutes
(4) 40 minutes
(5) 50 minutes
(6) 60 minutes
(7) 70 minutes (1 hr 10 min)
(8) 80 minutes (1 hr 20 min)
(9) 90 minutes (1 hr 30 min)
(10) 100 minutes (1 hr 40 min)
(11) 110 minutes (1 hr 50 min)
(12) 120 minutes (2 hrs)
(13) 130 minutes (2 hrs 10 min)
(14) 140 minutes (2 hrs 20 min)
(15) 150 minutes (2 hrs 30 min)
(16) 160 minutes (2 hrs 40 min)
(17) 170 minutes (2 hrs 50 min)
(18) 180 + minutes (3 hrs or more)
(19) Don't know/not sure
(20) Choose not to answer

Think about the time you spent doing any physical activities specifically designed to strengthen your muscles such as lifting weights, push-ups or sit-ups. Include all such activities even if you have reported them before.

8) During the last 7 days, how many days did you do any physical activities designed to strengthen muscles such as lifting weights, push-ups or sit-ups?
(1) 0 days (Skip to question 68)
(2) 1 day
(3) 2 days
(4) 3 days
(5) 4 days
(6) 5 days
(7) 6 days
(8) 7 days

(9) Choose not to answer

9) How much time did you usually spend doing <u>strength training activities</u> on one of those days?
(1) Did not do strength activities
(2)10 minutes
(3) 20 minutes
(4) 30 minutes
(5) 40 minutes
(6) 50 minutes
(7) 60 minutes
(8) 70 minutes (1 hr 10 min)
(9) 80 minutes (1 hr 20 min)
(10) 90 minutes (1 hr 30 min)
(11) 100 minutes (1 hr 40 min)
(12) 110 minutes (1 hr 50 min)
(13) 120 minutes (2 hrs)
(14) 130 minutes (2 hrs 10 min)
(15) 140 minutes (2 hrs 20 min)
(16) 150 minutes (2 hrs 30 min)
(17) 160 minutes (2 hrs 40 min)
(18) 170 minutes (2 hrs 50 min)
(19) 180 + minutes (3 hrs or more)
(20) Don't know/not sure
(21) Choose not to answer

Questionnaire 13 of 13

*****Not enough time to finish this survey now? You can come back later and finish, just remember to finish this page and click next at the bottom to save this page. When you return, you will start with the next survey.***

Source: Lucia L Kaiser, Marilyn S Townsend, Hugo R Melgar-Quin˜onez, Mary L Fujii, and Patricia B Crawford. Choice of instrument influences relations between food insecurity and obesity in Latino women. *Am J Clin Nutr* 2004;80:1372– 8.

1) How old are you?
(1) Less than 18 years old
(2) 18
(3) 19
(4) 20
(5) 21
(6) 22
(7) 23
(8) 24
(9) More than 24 years old
(10) Choose not to answer

2) What is your gender?
(1) Male
(2) Female
(3) Choose not to answer

3) Are you Hispanic or Latino?
(1) Yes
(2) No
(3) Don't know / Not sure
(4) Choose not to answer

4) Which one or more of the following would you say is your race?
(1) White
(2) Black or African American
(3) Asian
(4) Native Hawaiian or Other Pacific Islander
(5) American Indian or Alaska Native
(6) Other [specify]_____

5) What is your year in school?
(1) Freshman
(2) Sophomore
(3) Junior
(4) Senior
(5) Graduate
(6) Choose not to answer

6) Where do you live?
(1) Campus residence hall
(2) Sorority or fraternity
(3) Other university/college housing
(4) Off campus housing
(5) Parent or guardian's home
(6) Other, specify ____

7) Where is the university you attend?
(1) Alabama
(2) Florida
(3) Maine
(4) Kansas
(5) Indiana
(6) Michigan
(7) New Hampshire
(8) New Jersey

(9) New York
(10) North Carolina
(11) Rhode Island
(12) South Dakota
(13) Wisconsin
(14) West Virginia
(15) Choose not to answer

8) How would you define your current relationship status?
(1) Single
(2) In a committed relationship
(3) Choose not to answer

9) What is your height?
**(If you choose *not to answer*, please type CNA in the box)
Feet _____
Inches _____

10) What is your weight (in pounds)?
**(If you choose *not to answer*, please type CNA in the box)
_____

11) How much do you want to weigh (in pounds)?
**(If you choose *not to answer*, please type CNA in the box)
_____

12) How would you describe your weight?
(1) Very Underweight
(2) Slightly Underweight
(3) About The Right Weight
(4) Slightly Overweight
(5) Very Overweight
(6) Choose not to answer

13) Are you trying to do any of the following about your weight?
(1) I am not trying to do anything
(2) Stay the same weight
(3) Lose weight
(4) Gain weight
(5) Choose not to answer

14) Do you participate in…? (Check all that apply)
(1) Intercollegiate sports team (varsity)
(2) Club sports team

(3) Intramurals
(4) None

15) How many hours a week do you work for pay during the school year?
(1) I do not work
(2) 1 to 9 hours
(3) 10 to 19 hours
(4) 20 to 29 hours
(5) 30 to 39 hours
(6) 40 hours
(7) More than 40 hours
(8) Choose not to answer

16) Are you an international student?
(1) Yes
(2) No
(3) Choose not to answer

Appendix B - Stage Distribution by Physical Activity and Fruit and Vegetable Intake

Table B.1 Stage Distribution by Total Physical Activity (PA) Levels - Baseline

Group				IPAQ Category (MET-mins/week) < 600	IPAQ Category (MET-mins/week) 600 - 2999	IPAQ Category (MET-mins/week) 3000+	Total
Intervention	PA Stage	Precontemplation	Count	0_a	1_a	0_a	1
			% within stage	.0%	100.0%	.0%	100.0%
		Contemplation/ Preparation	Count	6_a	**22_b**	**0_c**	28
			% within stage	21.4%	78.6%	.0%	100.0%
		Action/ Maintenance	Count	0_a	**32_b**	**14_c**	46
			% within stage	.0%	69.6%	30.4%	100.0%
	Total		Count	6	55	14	75
			% within stage	8.0%	73.3%	18.7%	100.0%
Control	PA Stage	Precontemplation	Count	0_a	1_a	1_a	2
			% within stage	.0%	50.0%	50.0%	100.0%
		Contemplation/ Preparation	Count	3_a	18_a	**1_b**	22
			% within stage	13.6%	81.8%	4.5%	100.0%
		Action/ Maintenance	Count	0_a	**$32_{a, b}$**	**16_b**	48
			% within stage	.0%	66.7%	33.3%	100.0%
	Total		Count	3	51	18	72
			% within stage	4.2%	70.8%	25.0%	100.0%

Each subscript letter denotes a subset of IPAQ Category (MET-mins/week) categories whose column proportions do not differ significantly from each other at the .05 level.

Table B.2 Stage Distribution by Total Physical Activity (PA) Levels – Month 3

Group				IPAQ Category (MET-mins/week) < 600	600 - 2999	3000+	Total
Intervention	PA stage	Precontemplation	Count	0_a	1_a	0_a	1
			% within stage	.0%	100.0%	.0%	100.0%
		Contemplation/ Preparation	Count	3_a	$10_{a, b}$	1_b	14
			% within stage	21.4%	71.4%	7.1%	100.0%
		Action/ Maintenance	Count	1_a	$31_{a, b}$	9_b	41
			% within stage	2.4%	75.6%	22.0%	100.0%
	Total		Count	4	42	10	56
			% within stage	7.1%	75.0%	17.9%	100.0%
Control	PA stage	Precontemplation	Count	1_a	1_a	0_a	2
			% within stage	50.0%	50.0%	.0%	100.0%
		Contemplation/ Preparation	Count	6_a	$14_{a, b}$	2_b	22
			% within stage	27.3%	63.6%	9.1%	100.0%
		Action/ Maintenance	Count	1_a	24_b	15_b	40
			% within stage	2.5%	60.0%	37.5%	100.0%
	Total		Count	8	39	17	64
			% within stage	12.5%	60.9%	26.6%	100.0%

Each subscript letter denotes a subset of IPAQ Category (MET-mins/week) categories whose column proportions do not differ significantly from each other at the .05 level.

Table B.3 Stage Distribution by Total Physical Activity (PA) Levels – Month 15

Group				IPAQ Category (MET-mins/week) < 600	600 - 2999	3000+	Total
Intervention	PA Stage	Precontemplation	Count	1_a	2_a	0_a	3
			% within stage	33.3%	66.7%	.0%	100.0%
		Contemplation/ Preparation	Count	2_a	$9_{a, b}$	0_b	11
			% within stage	18.2%	81.8%	.0%	100.0%
		Action/ Maintenance	Count	0_a	$21_{a, b}$	8_b	29
			% within stage	.0%	72.4%	27.6%	100.0%
	Total		Count	3	32	8	43
			% within stage	7.0%	74.4%	18.6%	100.0%
Control	PA Stage	Precontemplation	Count	0_a	0_a	1_a	1
			% within stage	.0%	.0%	100.0%	100.0%
		Contemplation/ Preparation	Count	4_a	$8_{a, b}$	4_b	16
			% within stage	25.0%	50.0%	25.0%	100.0%
		Action/ Maintenance	Count	1_a	20_a	13_a	34
			% within stage	2.9%	58.8%	38.2%	100.0%
	Total		Count	5	28	18	51
			% within stage	9.8%	54.9%	35.3%	100.0%

Each subscript letter denotes a subset of IPAQ Category (MET-mins/week) categories whose column proportions do not differ significantly from each other at the .05 level.

Table B.4 Stage Distribution by Fruit and Vegetable (F/V) Intake - Baseline

Group				Total F/V Intake (cup equivalents)			Total
				≤ 4.99	5.00 - 8.99	9.00+	
Intervention	F/V Stage	Precontemplation	Count	11_a	0_a	0_a	11
			% within stage	100.0%	.0%	.0%	100.0%
		Contemplation/ Preparation	Count	33_a	0_b	$0_{a, b}$	33
			% within stage	100.0%	.0%	.0%	100.0%
		Action/ Maintenance	Count	17_a	10_b	$1_{a, b}$	28
			% within stage	60.7%	35.7%	3.6%	100.0%
	Total		Count	61	10	1	72
			% within stage	84.7%	13.9%	1.4%	100.0%
Control	F/V Stage	Precontemplation	Count	9_a	0_a	0_a	9
			% within stage	100.0%	.0%	.0%	100.0%
		Contemplation/ Preparation	Count	38_a	1_a	0_a	39
			% within stage	97.4%	2.6%	.0%	100.0%
		Action/ Maintenance	Count	19_a	2_a	1_a	22
			% within stage	86.4%	9.1%	4.5%	100.0%
	Total		Count	66	3	1	70
			% within stage	94.3%	4.3%	1.4%	100.0%

Each subscript letter denotes a subset of Total F/V intake (cup equivalents) categories whose column proportions do not differ significantly from each other at the .05 level.

Table B.5 Stage Distribution by Fruit and Vegetable (F/V) Intake – Month 3

Group				Total F/V Intake (cup equivalents)			Total
				≤4.99	5.00 - 8.99	9.00+	
Intervention	F/V Stage	Precontemplation	Count	1_a	0_a	0_a	1
			% within stage	100.0%	.0%	.0%	100.0%
		Contemplation/ Preparation	Count	24_a	**0_b**	**$0_{a, b}$**	24
			% within stage	100.0%	.0%	.0%	100.0%
		Action/ Maintenance	Count	22_a	**8_b**	**$1_{a, b}$**	31
			% within stage	71.0%	25.8%	3.2%	100.0%
	Total		Count	47	8	1	56
			% within stage	83.9%	14.3%	1.8%	100.0%
Control	F/V Stage	Precontemplation	Count	7_a	0_a	0_a	7
			% within stage	100.0%	.0%	.0%	100.0%
		Contemplation/ Preparation	Count	32_a	0_a	0_a	32
			% within stage	100.0%	.0%	.0%	100.0%
		Action/ Maintenance	Count	20_a	5_b	**$1_{a, b}$**	26
			% within stage	76.9%	19.2%	3.8%	100.0%
	Total		Count	59	5	1	65
			% within stage	90.8%	7.7%	1.5%	100.0%

Each subscript letter denotes a subset of Total F/V intake (cup equivalents) categories whose column proportions do not differ significantly from each other at the .05 level.