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The relationship between grocery store tours and fruit and vegetable consumption among undergraduate nutrition students.

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ACCEPTANCE

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ABSTRACT:

THE RELATIONSHIP BETWEEN GROCERY STORE TOURS AND FRUIT AND VEGETABLE CONSUMPTION AMONG UNDERGRADUATE NUTRITION STUDENTS.

Alyssa Strom

Introduction: College-aged students do not meet recommended intakes of fruits and vegetables, which over time can increase risk of chronic diseases. The purpose of this study is to investigate whether nutrition education on different forms of fruits and vegetables delivered during a grocery store tour impacted fruit and vegetable consumption among undergraduate students enrolled in introductory nutrition courses at Georgia State University (GSU).

Methods: Undergraduate students enrolled in introductory nutrition courses completed an initial fruit and vegetable consumption survey at the start of the semester. The experimental group (n=93) completed the grocery store tour, while the control group (n=51) did not. Both groups completed a final survey on fruit and vegetable consumption at the end of the semester. The survey investigated the following areas: daily fruit consumption; daily vegetable consumption; forms of fruits consumed; forms of vegetables consumed; reasons to consume fruits; reasons to consume vegetables; reasons to avoid fruit; reasons to avoid vegetables. Educational and interactive grocery store tours, led by GSU Coordinated Program students, focused on the following areas: fresh produce; dried fruits; canned fruits/vegetables; frozen fruits/vegetables; 100% juices. The percent of participants who increased fruit/vegetable consumption from ≤ 1 serving/day to ≥ 2 servings/day and the number of forms of fruits/vegetables consumed was calculated using descriptive statistics.

Results: Fruit consumption increased among participants in both the control and experimental group. However, the experimental group demonstrated a greater increase in number of participants increasing consumption to 2 or more servings per day for fruit (65.2% and 52.9%, respectively). Vegetable intake increased in the control group (49% of participants) after the nutrition course but no difference in vegetable consumption was observed in the experimental group. The grocery tour intervention did not increase the number of forms of fruits and vegetables consumed. The control group reported prevention of disease, while the experimental group reported good taste, as the most frequent reason to consume fruit both before and after the intervention. Both the control and experimental groups reported health as the most frequent reason to consume vegetables both before and after the intervention. The experimental group reported cost as the most frequent reason not to consume fruit before the intervention, but after the intervention, "other reasons" was the most frequently reported reason for not consuming fruits. These results indicate that the nutrition education may have impacted perceived barriers to fruit consumption.

Conclusion: Our data indicate grocery store tours increase fruit consumption among undergraduate students. Due to the increase in fruit and vegetable consumption between both groups, enrollment in a nutrition course may have influence consumption. Future studies are needed to investigate influence of nutrition courses and to quantify other reasons to consume fruits and vegetables as well as not to consume fruits and vegetables.

THE RELATIONSHIP BETWEEN GROCERY STORE TOURS AND FRUIT AND
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STUDENTS.

Alyssa Strom

A Thesis

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CHAPTER I. INTRODUCTION

According to the *2015-2020 Dietary Recommendations*, Americans fall short of the fruit and vegetable recommendations. Males between 19-30 years of age consumed an average of 1-2 cup equivalents of vegetables per day, compared to the recommended 3-4 cup-equivalents[1]. Although the dietary guidelines recommend females ages 19-30 consume between 2.5-3 cup-equivalents daily, this age group consumed an average of 1-2 cup-equivalents per day[1, 2]. The decreased intake of vegetable side items and 100% fruit juices during meals has majorly impacted fruit and vegetable intakes, resulting in many Americans falling short of many nutrient recommendations, such as Vitamin A, Vitamin K, and fiber, are found in a variety of fruits and vegetables[3, 4]. Rather than consuming a low energy, nutrient-dense diet, a growing number of Americans commonly follow patterns of a Western diet, which typically consists of refined and energy-dense foods high in fat and sugar[5]. These consumption tendencies may be due to many behavioral factors, including self-efficacy, self-management, the level of motivation, subjective perceptions of what constitutes a healthy diet and anticipated social, personal and economic barriers[3-5]. Despite a growing body of research indicating there are nutritional benefits to consuming non-fresh forms of fruits and vegetables, many Americans continue to leave out canned, frozen, juice and dried versions of fruits and vegetables from their diets[6-9]. The limited incorporation of various forms of fruits and vegetables not only restricts the overall variety of dietary intake, but also contributes to the cost, accessibility, and time barriers associated with making healthy lifestyle

choices[6]. Nutrition education, in the form of a community intervention, could be a relatively cost-effective way to establish informed decisions by consumers, promote healthy lifestyle choices, and increase the overall quality of life[5, 10].

Poor dietary choices and habitual inactivity levels are two major contributors towards incidences of obesity widely noted throughout the literature [11]. As of 2014 roughly 38% of adults and 20.5% of children ages 12-19 were obese[12]. The prevalence of type 2 diabetes and cardiovascular diseases has also increased[11]. When consumed in excess, 100% fruit juice, and dried fruits with added sugars—such as cranberries, may contribute to an increased risk of type 2 diabetes[13, 14]. The increased prevalence of obesity-related chronic diseases has created an increased caution among consumers for any foods containing sugars and sodium, regardless of the nutritional benefits[3, 4, 15]. A report published by the USDA, *Canned Fruit and Vegetable Consumption in the United States: An Updated Report to Congress*, revealed a seven-percent decreased consumption of canned fruit and a nine-percent reduced consumption of canned vegetables by American consumers between 2005-2008[9]. Instead of purchasing non-fresh forms of fruits and vegetables, such as canned or frozen, consumers buy high-calorie, high-fat, low-nutrient dense foods, such as sugar-sweetened beverages and processed snack items[16]. The *2015-2020 Dietary Guidelines* emphasizes meeting fruit and vegetable recommendations by consuming whole fruits and vegetables at peak ripeness. However, the concept of meeting daily recommendations by varying the forms of fruits and vegetables consumed is also noted in the guidelines and throughout the literature[1]. By eating numerous types of fruits and vegetables, consumers are more likely to obtain key components of a healthy diet, such as fiber, vitamins and minerals.[1, 3, 4, 15]. Depending upon the procedures used during food processing, freezing or canning of fruits and vegetables, nutrient losses are minimal. Therefore these forms of fruits

and vegetables are viable options to meet nutrient needs[17, 18]. Considering the duration spent shipping and transporting, fresh produce loses some nutritional value before reaching the store shelf, and eventually a consumer's home[19]. Studies have indicated frozen produce maintains a higher nutrient integrity compared to refrigerator-stored produce [20, 21]. By eliminating non-fresh options as a part of everyday meals, consumers may experience limited opportunities to reap the health benefits achieved by consuming fruits and vegetables[1, 3, 6, 22, 23]. Non-fresh forms of fruits and vegetables can alleviate not only nutritional deficiencies but also benefit consumers regarding cost, seasonality, storage, and transport[6].

Progressing from adolescence to adulthood, especially for those enrolled in a college or university, is often a dynamic time and establishing positive lifestyle choices is crucial for long-term health[5, 24]. Few studies have investigated fruit and vegetable consumption trends, barriers preventing intake, and overall motivation to meet dietary recommendations among college-aged individuals[15, 24]. As there is a strong correlation between fruit and vegetable consumption and decreased risk of disease[22, 25, 26], interventions promoting healthy eating habits catered toward the ambivalence of a college-aged (18-24-year-old) lifestyle need to be implemented[1, 5, 10, 15, 27]. Compared to studies specifically investigating the benefits of fruit and vegetable-focused nutrition interventions among college-aged individuals, even more, research studies have shown the benefits of general nutrition interventions among this population. These results justify the need for future programs catered towards personal needs[5, 15, 27]. Eating a variety of forms of fruits and vegetables may help college-aged individuals meet the daily recommendation of fruit and vegetable servings [6, 13, 14, 24]. The earlier people learn and implement healthy eating habits, the more likely these practices will continue

into adulthood and be passed onto future generations, thus promoting healthy lifestyle choices for generations to come[1, 5, 24, 27].

The Produce for Better Health (PBH) Foundation is a nonprofit organization whose goal is to increase fruit and vegetable consumption to promote overall health[28]. Through a partnership with the Center for Diseases Control and Prevention (CDC), the “Fruits & Veggies: More Matters” campaign was created to emphasize the nutritional benefits of all forms of fruits and vegetables to increase efficacy and consumption[3, 29]. Rather than focusing on the negative aspects consumers often associate with 100% fruit juice, dried, canned and frozen food, such as added sugars or high sodium content, PBH utilizes the “Fruits & Veggies: More Matters” campaign to address nutritional and educational shortcomings associated with decreased consumption[3, 29]. In 2015, PBH collaborated with Appalachian State University [30] and piloted a supermarket-training program focused on fruits and vegetables. ASU’s dietetic interns were trained to lead supermarket tours focused on fruit and vegetable consumption[15]. Undergraduate students at the University participated in the tours. This pilot program was the first of its kind and provided the basis for supermarket tours led by dietetic interns across the country. Programs similar to PBH that promote increased fruit and vegetable intakes among college-aged individuals need to be implemented[15, 24].

Purpose:

The purpose of this study was to investigate whether attending a grocery store tour focused on different forms of fruits and vegetables increased fruit and vegetable consumption among undergraduate students enrolled in introductory nutrition courses at Georgia State University.

Our hypothesis was that students who attended the grocery store tour would increase fruit and vegetable consumption compared to students who did not participate in the tours[15].

Undergraduate students enrolled in introductory nutrition courses at GSU were offered an initial survey at the start of the Fall 2016 semester regarding fruit and vegetable intake (Appendix 1).

Students were able to complete a grocery store tour at one of four local Kroger supermarkets during the Fall 2016 semester. Trained graduate students in GSU's coordinated program offered the tours, utilizing the curriculum developed by the PBH. Students completed the same survey regarding fruit and vegetable consumption at the end of the Fall 2016 semester. Students who participated in both surveys, but did not attend a grocery tour served as the control group.

CHAPTER II. REVIEW OF LITERATURE

Dietary Patterns and Disease Risks Among College-Aged Individuals

The transition between adolescence and adulthood allows freedom concerning lifestyle choices, resulting in a growing demand for these people for health promotion and disease prevention interventions[5, 15, 27, 31-34]. When obtaining more autonomy over their daily schedules, college students are at high risk of developing poor eating habits. As noted within the literature, many students willingly decrease their consumption of fruits and vegetables by replacing these foods with high calorie, high-fat alternatives[32]. Studies investigating changes in dietary habits when college students experience new lifestyle freedoms frequently report social pressures, eating out, and overeating while socializing as justification for choosing high calorie, high-fat foods over fruits and vegetables[32, 35, 36]. These dietary habits, when continued for an extended period, increase the risk of developing several chronic diseases[32, 37-39]. Although there are a plethora of studies focusing on diet quality compared to academic performance or anthropometric measures, few studies have focused on behavioral implications[5, 27]. The *2015-2020 Dietary Guidelines for Americans* reports boys ages 9-13 and girls ages 11-18 as the lowest vegetable consuming groups. Fruit consumption is the lowest among girls ages 14 to 18 and women ages 19 to 50[1]. These findings indicate a need for broad-based nutrition related interventions, as a vast majority of college-aged individuals are a part of low-consuming groups, and therefore would greatly benefit from basic nutrition education[1, 3].

The Tufts Longitudinal Health Study, a prospective cohort study, looked at dietary intake and dietary patterns of undergraduate students enrolled at Tufts University[5]. Based on the dietary patterns noted among the study participants, there were observable differences in select anthropometric and lipid biomarkers. Consumption of a plant-based diet was associated with body compositions within the healthy range of 18.4-24.9 BMI, whereas elevated LDL cholesterol, total cholesterol, and triglycerides correlate with the consumption of a Western diet[5]. Plant-based diets typically consist of fruits, vegetables, nuts, beans, and legumes while Western diets are usually high in red meats, fried foods, and refined grains. Body composition above the healthy range, elevated LDL cholesterol, decreased HDL cholesterol, elevated total cholesterol and triglycerides indicate an increased risk of the development of chronic diseases, such as obesity and cardiovascular diseases[5]. The results from the Tufts Study are consistent with a Lebanese study analyzing the dietary pattern differences of university students[5, 39]. Due to the frequent consumption of white bread and starches, fried potatoes, and sugary beverages, participants consuming a “westernized” diet were at an increased risk of developing type 2 diabetes[5, 39]. According to the *2015-2020 Dietary Guidelines for Americans*, saturated fat consumption should be less than ten percent of daily caloric intake. Replacing with saturated fats with unsaturated fats, and the inclusion of dietary fiber from fruits, vegetables and whole grains as a means to lower serum levels of total cholesterol and LDL, is widely accepted and noted throughout the literature[1, 40].

The *2015-2020 Dietary Guidelines for Americans* reports that 70% of the U.S population ages one year and older have saturated fat higher than the recommended daily allowances. 75% of this same population fails to consume the recommended number of fruit servings per day, and 90% of the population fails to eat the recommended number of vegetable servings per day[1].

Weight gain, related to the overconsumption of high-calorie, high-fat foods, lack of physical exercise, and decreased intake of fruits and vegetables, across the lifespan may increase the risk development of coronary disease and many other chronic diseases[38, 40]. Nutrition interventions designed to address consumption of foods associated with increased risk of comorbidities and to demonstrate strategies to limit consumption of these foods are necessary to promote positive lifestyle choices and improved health status. Dietary interventions to alleviate abnormal lipid panels and reduce body composition include adherence to a plant-based diet, or just to increase consumption of fruits and vegetables as well as whole grains[5]. Increasing the nutrition knowledge of high-risk individuals, such as college students, may increase self-efficacy and motivation to implement lifestyle changes associated with decreased risk of chronic disease[40]. Future studies incorporating a longitudinal component are needed to assess further the dietary patterns and nutrition related health beliefs among college-aged individuals. The accumulation of such data will allow greater outcomes when executing nutrition interventions[5, 27]. Future investigations evaluating the effectiveness of such interventions will allow for a deeper understanding of barriers and influential factors related to consumption of fruit and vegetable intake. Nutrition interventions modified to address and overcome the identified barriers among college students may help this population achieve recommended intake of fruits and vegetables.

Factors affecting fruit and vegetable consumption

Fruit and vegetable accessibility:

Dietary intake is a highly complex lifestyle component, influenced by numerous factors, such as taste, price, convenience, knowledge, and availability[41][42]. Many studies have investigated the correlation between availability of nutritious foods and prevalence of chronic

disease[1, 3, 41, 43-45]. A large number of studies indicate people who live in areas with more accessibility to fruits and vegetables are more likely to purchase fruits and vegetables, compared to individuals who live in areas with limited accessibility to fresh fruits and vegetables [41, 43, 45, 46]. These results should come as no surprise, as supermarkets stock considerable amounts of fruits and vegetables—especially when compared to convenience stores[6,48,107].

Convenience stores typically sell a wide variety of processed, high-calorie foods and are viewed as poor, undesirable store options to purchase healthy foods, such as fresh fruits and vegetables[48,107]. When convenience stores do offer fruits and vegetables, the selection is minimal, and the price per item is considerably higher compared to products offered at competing stores[45, 47]. Recognition of circumstances, which may impede members of a neighborhood from choosing healthier alternative foods for meals and snacks, will provide information for planning interventions to promote a community-wide improvement of health and nutrition[42].

In the United States and many countries around the world, low-income and diverse minority neighborhoods have a low, unequal access to healthy foods and high access to stores or restaurants selling unhealthy foods, compared to upscale neighborhoods[41, 45]. Within the current literature, there are a larger number of studies proposing physical access and proximity to healthy food as a key influential factor for consuming fruits and vegetables versus high-calorie, high-fat alternatives[43, 48, 49]. Studies investigating neighborhood environments and resident health have noted a correlation between income disparities and low intake of fruits and vegetables[49]. Low-income communities are more likely to have a larger proportion of convenience stores and fast-food restaurants compared to supermarkets[45]. Prevalence of convenience stores relates to a decreased intake of fruits and vegetables[41, 50]. As increased

availability of healthy foods enhances the likelihood of consuming healthy foods, without a reliable mode of transportation, these individuals have limited opportunity to eat a healthy diet[41, 45, 50]. There are mixed results within the literature related to the prevalence of fast-food restaurants and decreased intake of fruits and vegetables among lower income neighborhoods—even though these neighborhoods often have high access to these types of food items {Larson, 2009 #48}. Some studies indicate reduced consumption of fruits and vegetables among certain genders or races with increased access to fast-food restaurants, while other report opposing correlations[41, 50].

As incidences of overweight and obesity are higher among residents of low-income and diverse minority neighborhoods, research interest in these environments—which can be rural or urban—continues to grow[49]. Georgia State University is located in Atlanta, Georgia and has a diverse, urban campus with a diverse student body of over 50,000 students, representing fifty states and 160 countries from around the world[51]. A study of residents living in urban neighborhoods of Detroit, Michigan found an increased consumption of fruits and vegetables when participants lived within 0.5 miles of a large grocery store[43]. Barriers indicated in this study, such as low income and limited physical accessibility, may be the primary influential factors when purchasing food[43]. A study published in 2013 analyzing the dynamic of urban food environments and subsequent food behaviors in Philadelphia, Pennsylvania, found transportation barriers to be more influential on food purchasing behaviors, compared to proximity of large chain grocery stores and convenience stores[49]. With less than 25% of participants in the Detroit study earning an annual household income of \$35,000, and less than 35% owning a vehicle, these studies highlight barriers to meeting fruit and vegetable intake recommendations commonly associated with and reported by college and university students

[32, 34, 43, 52, 53]. These findings are consistent with many other studies investigating neighborhood environments, accessibility to healthy foods, and barriers to consuming fruits and vegetables [4,6,20,22,23,44,47-50]. Future research examining strategies to increase consumption of a healthy, well-balanced diet--with a variety of fruits and vegetables, among urban environments when accessibility to purchase these foods is limited is needed[43].

Time Constraints

As many students struggle to maintain copious amounts of academic and extra-circular activities, time is especially valuable during college. Circumstances in which one event must be chosen over another, time constraints coincide with many other barriers—such as prioritization of daily activities and finances. An increased realization and understanding of this multifactorial obstacle, obtained through a combination of focus groups, personal interviews, and self-report via survey, will allow the creation and implementation of nutrition interventions catered to the needs of this population[54]. In 2009, undergraduate students across eight different states participated in online focus groups to discuss barriers and enablers associated with maintaining a healthy weight[32]. Although these students frequently reported improving diet as a health goal for the 2009 fall semester, time limitations as a rationale to rely on precooked meals and unhealthy food choices was a frequently reported barrier preventing students from achieving this goal. Due inadequate knowledge to shop and prepare meals, time constraints inhibited students from efficiently planning healthy meals[32]. A 2012 study noted time, regarding the factors prompting the nutrition behaviors of non-traditional students, as a barrier. Non-traditional students include older adults returning to school for the first time or obtaining another degree, students attending a two-year college versus a traditional four-year university, or adults with families [34].

While students may have many opportunities to choose, purchase, and consume healthy foods, the process of obtaining these foods can quickly become overwhelming, especially with a busy schedule[32, 34]. Time availability between classes and extra-curricular activities may constrain a students' ability to locate, purchase and consume healthy foods[32, 34]. Some participants in the non-traditional student study noted leisure time availability as an influential factor for consuming healthy foods while on or off campus[34]. Students in the UK focus group study defended time as a notion relative to personal priorities. These students noted a higher prioritization to engage in alternative activities compared to cooking meals, especially when preparing meals for one person[31]. The difficulty with time management and scheduling of preparing healthy meals over other activities, such as sleeping—thus, often opting for quick meals, was frequently reported among the literature[55]. Preference of convenience meal options as the time to prepare and clean up meals, may cut into time spent on other important activities, such as social events, was also frequently noted[54].

To plan, purchase or prepare healthy meals, students must value these activities with a high priority compared to the alternative, and potentially unhealthy, activities. Students must not only be highly motivated to achieve academically but also in regards to maintaining their health. Due to the little concern about health and value of benefits from consuming healthy foods, students with a time limitations may opt for unhealthy on-campus options [32, 34]. The differences in results in the literature regarding the level in which time influences student choice of lifestyle behaviors may be due to the intervention design, population observed or level of self-efficacy before the intervention. Future investigations utilizing similar models are needed to analyze these differences and determine appropriate strategies for each barrier. Understanding the student beliefs, motivators, and barriers will allow nutrition professionals to develop and

implement more successful strategies[24, 27, 56]to increase fruit and vegetable consumption.

Future studies investigating these potential influencers are needed to be able to develop nutrition interventions appropriate for a particular campus' population[24].

Food Insecurity

According to the Household Food Security in the United States in 2015 report, 12.7%--or 15.8 million people, of households in the United States experienced food insecurity at some time during 2015[57]. The lack of consistent access to healthy, safe food, also known as food insecurity, is a problem for maturing adolescents, as this is a crucial time to establish healthy eating habits[58, 59]. Habitual food insecurity and hunger unfavorably impact the quality of diet and weight status[16]. Food insecurity has been associated with decreased intake of fruits and vegetables, particularly dark leafy greens, subsequently leading to inadequate intake of essential vitamins and minerals[30, 60]. Due to the insufficient of vitamin A, vitamin C, folate, calcium, magnesium and zinc, food insecurity relates to an increased risk and poor management of diet-sensitive chronic diseases, such as cardiovascular disease and diabetes[30]. Among the many stresses associated with the transition to college, food insecurity is one frequently experienced by many students but minimally explored for the correlation between fruit and vegetable consumption in current literature[58, 59]. An estimated 21-59% of college students experience some form of food insecurity during enrollment[61, 62]. Due to the data collection methods, population and environment observed, established rates of food insecurity among college students vary between studies[57, 59, 62].

The majority of the studies investigating food insecurity among college students have been conducted using students enrolled at large, urban university settings. This population is of particular interest due to the diversity of students enrolled[58]. While those who attend college

are usually of a higher socioeconomic status, college attendance is becoming more achievable for those falling into lower classes of socioeconomic status. Socioeconomically disadvantaged groups experience barriers to food security and a healthy diet particularly due to the negative impact of financial constraints, limited availability of fresh foods available or high costs of foods available[16, 45, 47]. These students are more likely to utilize government assistance programs, work multiple low-paying jobs, and suffer academically[27, 58]. Several studies show students receiving financial aid, in the form of federal assistance programs or loans, were more likely to report higher rates of food insecurity. The literature indicates students working ten hours or more per week are more likely to experience food insecurity. The likelihood of experiencing food insecurity increased when students lived on or off campus alone or with roommates. On the other hand, students living at home with their parents were the least likely to experience food insecurity. Of participants reporting food insecurity, they also reported low intake of fruit and vegetable, regarding the average number of daily servings, with increased intake of fast-food[58]. Due to the growing prevalence of food insecurity, increasing obesity rates, and the number of resources available to these students, future research investigating strategies to increase fruit and vegetable consumption is warranted. Providing students with the necessary educational and financial resources and tools to choose nutritious foods may promote fruit and vegetable consumption among college students, especially those frequently experiencing food insecurity [53, 56, 59].

Self-efficacy and Barriers to Change

One of the reasons many students experience stress due to their new found independence is the lack of previous experience or control over dietary choices[5]. A study of Canadian college freshmen students utilized the Theory of Planned Behavior [24] model to analyze the shift in

fruits and vegetable consumption when transitioning from high school to college[24]. Results indicated participants reported strong intentions to meet recommendations of 5 to 7 servings daily over a seven-day period. Although participants were relatively confident about consuming the recommended amounts of fruits and vegetables, the average consumption fell short at 2.8 servings per day. The intention to consume fruits and vegetables, rather than peer or outside influences, was found to be the primary indicator as to whether or not participants would achieve these recommendations. These results suggest other factors, such as campus environment, availability or accessibility, modestly influence fruit and vegetable consumption[24]. Other studies have also found low fruit and vegetable consumption among college-students due to a highly variable transitional period when moving away from home, adapting to a new physical and social environment, and adjusting to social or academic pressures associated with university coursework[27, 56, 58].

Although many studies investigating the various influences affecting dietary patterns among college students report similar factors, the students' perspective varies[32, 34, 54]. For example, there were conflicting views of the environment of dining halls and influence on consumption of a healthy diet[32, 34, 54]. Some identified the dining hall as a barrier to consuming healthy, nutritious foods as there were a plethora of high-calorie, high-fat options with minimal motivation to choose the healthy options[32, 34]. Participants in the 2011 focus group study reported similar opinions concerning barriers associated with the dining hall[54]. Some students in this study felt the need to over consume food when at the dining hall to maximize the benefit of an all-you-can-eat cafeteria[54]. Others from various focus groups felt empowered to choose healthier meals and snacks due to the wide variety, availability, and convenience of food options[32, 34, 54]. Many students identify taste preferences as both a

barrier and enabler. Food choices of high-calorie, high-fat foods prevented participants from choosing healthy options when available[32]. The perceptions of the same environmental influence may be different due to the social environment variances among study participants[31, 54]. Social or peer support was identified as an enabler to participate in group physical activities or choose healthy foods when eating at on-campus cafeterias[32]. On the other hand, social forces from peers were identified social pressures as a barrier to consume healthy foods, and an enable to choose high-calorie, high-fat options instead[32]. The dynamic levels of motivation, barriers, behavior change stage, and self-efficacy among large populations, such as colleges or universities, can limit the effectiveness of nutrition interventions or promotions. When examining nutrition interventions catered to the specific needs of participants, there are mixed results concerning goals outlined[5, 10, 27]. A study conducted at South Dakota State University provided educational materials to individuals in the intervention group regarding behavior change stage: pre-contemplation, contemplation, action, and maintenance. After the 4-month intervention period was complete, participants in the intervention group reported an increase in one fruit and vegetable serving per day compared to baseline consumption, whereas the participants in the control group increased fruit and vegetable consumption by half a serving per day. Through the use of newsletters, nutrition counseling, and the creation of a web site containing information related to particular behavior change stage, participants in the intervention group reported a significantly increased self-efficacy for fruit and vegetable consumption compared to the score reported by participants in the control group.

The American College Health Association-National College Health Assessment [63] Reference Group Data Report - Spring 2016 reports that 65.5% of college students are interested in receiving information on nutrition-related topics from respective colleges or universities[63].

These results, as well as the frequent indication of wanting to maintain a healthy weight, suggest college students may be receptive to nutrition information related to particular interests. The South Dakota study was an overall success regarding motivating college-aged individuals to increase their fruit and vegetable consumptions. However, the lack of long-term follow-up limits the effectiveness of the multicomponent interventions[27]. Assessment of all four aspects of the intervention—website, emails, counseling, and newsletters—may help to establish future educational interventions for a broad population, as it would be difficult to select a sample population randomly[10, 27]. Future studies are necessary to evaluate the overall effectiveness of nutrition interventions. By assessing both the short-term and long-term outcomes, improved nutrition interventions implemented, leading to more effective intervention and attainment of intervention goals [5, 10, 15, 27].

Nutrition Education

The increased obesity across all age groups has generated a particular interest in establishing evidence-based interventions to encourage healthy eating habits[64]. While there are numerous studies investigating nutrition education and promoting consumption of fruits and vegetables, very few studies achieve substantial consumption increases among participants[65]. Research regarding the effectiveness of nutrition education interventions varies due to many different circumstances and considerations, such as the type of teaching provided, the environment the intervention, the health status of participants, and overall efficacy to make long-term lifestyle changes[22, 65]. More Americans are eating foods away from home, often relying on convenience or high-calorie food items[66]. The average number of trips to a grocery store per week in the United States was 1.5 in 2015, compared to 2.2 trips per week in 2010. Several interventions have indicated a high practicability of food store interventions, but a limited

indication for capability in changing eating patterns[64]. Grocery store interventions are designed to educate consumers about the risks and benefits of food choices, as an effort to increase motivation and promote self-efficacy of shoppers to purchase healthier foods[66]. These interventions provide an opportunity for consumers to participate in hands-on learning experiences, such as reading nutrition labels[64, 66].

While there are a considerable number of published articles discussing grocery store interventions as an effective tool to promote behavior change, few focus on fruits and vegetables. Thompson et al. conducted a pilot program of grocery store tours for undergraduate university students facilitated by dietetic interns[15]. After being led through a one-hour grocery tour comprised of educational and interactive activities, 69% of participants indicated they intended to increase the number of servings of fruits and vegetables consumed on a daily basis[15]. Colapinto et al. analyzed the retention of identifying correct serving sizes and number of servings recommended for fruits and vegetables between participants engaging with an interactive display versus brochure information[67]. Participants were six times more likely to identify a fruit or vegetable serving and twenty-three times more likely to determine the correct number of servings recommended per day when engaging in the interactive display versus exclusively receiving a brochure with the same content[67]. Another study facilitated a one-hour interactive tour, with a taste-test of cheeses with different fat content and provided take-home materials after the tour[64, 68]. All participants significantly increased knowledge regarding fat content and intake between pre and post tour compared to the control group. At the five to seven-week follow-up, in addition to increased knowledge, 63% of students and 75% of adults reported decreased fat intake[64]. Other grocery store interventions focused on heart health, reading food

labels, and food preparation techniques, significantly improved skills and behaviors related to types of foods

purchased, information on nutrition labels, and food preparation practices compared to the control group at one month post-tour[64]. Although these results suggest interactive grocery stores and taste-testing foods related to the grocery store educational content could facilitate short-term behavior changes[64, 66], due to the lack of long-term follow-up testing, future studies will need to include these components to analyze program content and overall impact on behavior[15].

Although studies facilitating a one-hour interactive tour and taste-testing focused on reading nutrition labels and comparing unit costs, there were often minimal to no changes regarding fruit and vegetable consumption or use of unit price comparisons when purchasing foods[69]. These results suggest interactive grocery tours and taste testing can facilitate behavior change, but only of a select few topics[66, 69]. Grocery stores are a unique medium through which nutrition education and behavior change can be facilitated[66]. Due to the lack of long-term analysis of impact from information provided through grocery store interventions, future studies are needed to analyze the behavior changes and self-efficacy. Future tours should create educational content and take-home materials based on the needs of a particular population. These tours should be interactive and promote participation[15]. The educational content of a grocery store intervention should not only educate participants on the health benefits but also how to incorporate these recommendations into an everyday diet[69]. Teaching consumers how to purchase better foods through the use of comparing nutrition labels of similar products may increase knowledge of why and how some foods are healthier compared to others[66, 69]. Unit-cost comparison of various food items might increase the self-efficacy and facilitate a positive

attitude regarding recommendations[15, 69]. The inclusion of a taste test of different foods discussed throughout the tour may increase the likelihood of consumption of these foods[15].

CHAPTER III. METHODS AND PROCEDURES

Undergraduate students enrolled in Principles of Nutrition (NUTR 2100), and Nutrition and Health (NUTR 3100) at Georgia State University were the subjects for this study. Subjects were a minimum age of 18, and there is no maximum age limit set. Students participated in two surveys regarding fruit and vegetable consumption (Appendix 1). The same survey was offered at the beginning and again at the end of the semester (Fall 2016). Students had access to the survey through a link embedded in iCollege within their course. Extra credit was offered to those who completed the survey, and was independent of participation in the study. There were 394 students enrolled in Principles of Nutrition (NUTR 2100) and Nutrition and Health (NUTR 3100) during Fall 2016. Statistical power analysis, generated via G-Power Software, determined that 195 participants were needed.

All students enrolled received a syllabus outlining the extra credit opportunities in the class. Additionally, each student was notified and instructed to read the informed consent document before completing the online survey (Appendix 2). Students completing the survey before the approval of the informed consent document were sent an email requesting completion of a modified informed consent via a Qualtrics Survey. Qualtrics is a web-based research survey and analysis software available to Georgia State Students[70]. The students were emailed using the “Blind Copy Carbon” feature to protect anonymity. Additional information regarding the grocery tours and consumption surveys were available to students on iCollege (Appendix 3).

In addition to receiving extra credit for completing surveys regarding fruit and vegetable consumption, students were offered extra credit to attend a one-hour grocery tour hosted by a student in the Coordinated Program (CP) in Nutrition at Georgia State University (GSU). The GSU CP students were trained to lead the grocery tours during a four-hour session hosted by Jessica Todd, Coordinated Program Director. The training aligned with the PBH grocery store training guide. Student training focused on the following areas: fresh produce; dried fruit; canned fruit/vegetable; fruit/vegetable 100% juice; frozen fruit/vegetable; sampling. Each CP student was required to host two grocery store tours. Students enrolled in NUTR 2100/3100 signed up for the grocery tours through a SignUpGenius link embedded on iCollege. No more than ten students signed up for each of the 40 grocery tours offered between August 29th, 2016 and November 18th, 2016. The tours were hosted at one of four Kroger grocery store locations, all of which were within 6 miles of GSU's main campus. Approximately three to four tours were hosted per week.

During each of the tours, CP students walked NUTR 2100/3100 students through the grocery store, highlighting the fresh produce, dried fruit, canned fruits/vegetables, 100% fruit/vegetable juices, and frozen fruits and vegetables before participating in a sampling of items discussed during the tour. Tour hosts were provided a "Grocery Tour Cheat Sheet," highlighting the required areas to cover at each of the five tour stops and suggested interactive activities to help reinforce learning points (Appendix 4). Though each tour varied slightly, topics covered were the same. To ensure students were following guidelines and topics outlined in the "Grocery Tour Cheat Sheet," the CP director, GRA, or Instructors of Principles of Nutrition and Nutrition and Health conducted evaluations based on the criteria outlined in the grocery store training guide (Appendix 5). Each tour group participated in a sampling of various fruits and vegetables

(Appendix 6). During the sampling, the host probed attendees to suggest ways to incorporate the fruits and vegetables into their everyday diet. After participating in the sampling, tour participants were asked to complete the “Fruit & Vegetable Store Tour Survey” provided by PBH (Appendix 7).

Students completed the pre- and post-surveys online (Appendix 1) at a location of their choice. Each survey was expected to take no more than 20 minutes to complete. Data for the data analysis only included participants who completed the informed consent. Those students were de-identified by assigning them a number 01, 02, 03, etc. via Research Randomizer software. This software allowed the GRA to download the randomized numbers into an excel file, which allowed correlation to students’ names and will allow the investigators to differentiate between students who completed the pre and post surveys, who only completed one of the surveys, and who attended grocery tours[71]. The file was stored on a password-protected computer belonging to the Graduate Research Assistant, Alyssa Strom.

Grocery store tour attendance serves as the independent variable. Therefore, the experimental group consisted of undergraduate students who participated in the pre- and post-fruit and vegetable consumption surveys, as well as the grocery store tour. The control group consisted of undergraduate students who participated in the pre- and post- surveys but did not attend grocery store tours. The dependent variables include the quantity of fruit consumed, the quantity of vegetables consumed, the number of forms of fruit consumed, the number of forms of vegetables consumed, reasons/motivation to consume fruits, reasons/motivation to consume vegetables, reasons for avoiding eating fruit, and reasons for avoiding eating vegetables. Pre- and post- fruit and vegetable consumption differences between the control group and experimental group were assessed through a chi-square analysis[10, 37]. The pre and post differences among

the control and experimental survey responses regarding the number of forms of fruit consumed, the number of forms of vegetables consumed, reasons to consume fruit, reasons to consume vegetables, reasons for avoiding fruit, reasons to avoiding vegetables were analyzed through a descriptive analysis[10, 37].

CHAPTER IV: RESULTS:

Before the intervention, there was no significant difference among participants consuming at least two servings of fruit per day or fewer by intervention group (Table 1). In those who were going to attend the tour, 43 (46%) were consuming two or more servings of fruit per day whereas 50 (54%) were consuming fewer servings daily. The distribution of students who did or did not consuming greater than two servings of fruit per day was almost evenly distributed between both the control and intervention groups.

Fruit Consumption Pre-Intervention		
Servings:	Intervention n (%)	Control n (%)
At least 2 servings/day	43 (46.2)	25 (49)
Fewer than 2 servings/day	50 (53.8)	26 (51)
TOTAL:	93 (100)	51 (100)

Table 1: Fruit consumption pre-intervention by group.
p=0.442

After the intervention, there was no statistically significant difference in consumption of at least two fruit servings/day by intervention group. Fruit consumption increased among participants in both the control and experimental group (Table 2). However, the experimental group demonstrated a greater increase in the percentage of participants increasing consumption to two or more servings per day compared to participants in the control group. At baseline, 46.2% of participants in the intervention group consumed two or more servings of fruit per day, whereas, after the intervention, 65.2% of participants consumed two or more servings. Although the results are not statistically significant, a 19% increase in participants who now consume at least two servings of fruit per day is clinically relevant. The percentages of students in the control

group who did or did not consume two or more servings fruit per day were evenly distributed and similar to the baseline results.

Fruit Consumption Post-Intervention		
Servings:	Intervention n (%)	Control n (%)
At least 2 servings/day	60 (65.2)	27 (52.9)
Fewer than 2 servings/day	32 (34.8)	24 (47.1)
TOTAL:	92 (100)	51 (100)

Table 2: Fruit consumption post-intervention by group.
p=0.104

Vegetable intake significantly differed in consumption of two or more servings of vegetables per day between the participants in the control versus intervention group (Table 3). The distribution among participants consuming two or more, compared to those consuming fewer than two, vegetable servings per day was relatively even among the intervention group, whereas the control group experienced a greater distribution.

Vegetable Consumption Pre-Intervention		
Servings:	Intervention n (%)	Control n (%)
At least 2 servings/day	52 (55.9)	19 (37.3)
Fewer than 2 servings/day	41 (44.1)	32 (62.7)
TOTAL:	93 (100)	51 (100)

Table 3: Vegetable consumption pre-intervention by group.
p=0.024*

The statistical significance observed pre-intervention was not maintained after the intervention (Table 4). The counts/percentages in the intervention group by intake status did not change. However, six students in the control group changed from consuming fewer than two servings of vegetables per day to consuming two or more servings per day. The percentages of students in the control and intervention groups who did or did not consume two or more servings fruit per day were evenly distributed.

Vegetable Consumption Post-Intervention		
Servings:	Intervention n (%)	Control n (%)
At least 2 servings/day	52 (55.9)	25 (49)
Fewer than 2 servings/day	41 (44.1)	26 (51)
TOTAL:	93 (100)	51 (100)

Table 4: Vegetable consumption post-intervention by group.
p=0.268

The number of forms of fruit consumed varied slightly before and after intervention among the control and experimental groups. The control group experienced a decrease in the percentage of participants consuming two forms of fruit, while also experiencing an increase in the percentage of participants consuming three and four forms. This change indicates participants consuming two forms of fruit before the intervention increased the number of forms consumed post intervention. The experimental group also experienced a decrease in the proportion of participants consuming two forms of fruit. The experimental group demonstrated an increase in the proportion of participants consuming one and four forms of fruits (Figure 1).

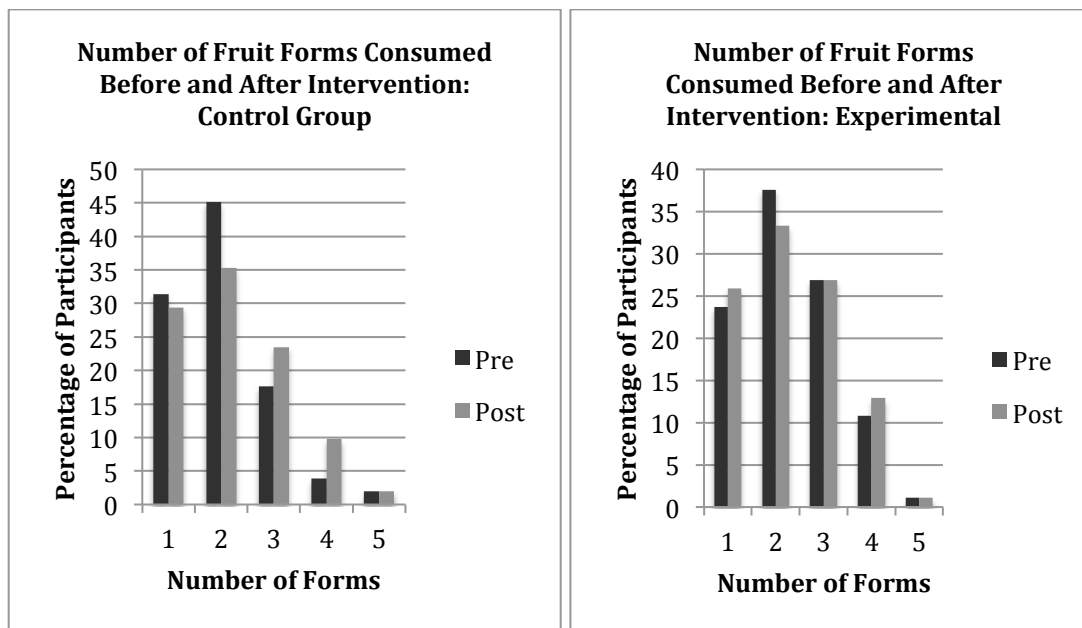


Figure 1: Number of forms of fruits consumed before and after the intervention. Forms include fresh, frozen, canned, dried, and juice

The frequency of fruit forms consumed before and after the intervention experienced minimal changes among the control and experimental groups. Fresh and juice were the most frequently consumed forms of fruit for both the control and experimental groups (Figure 2).

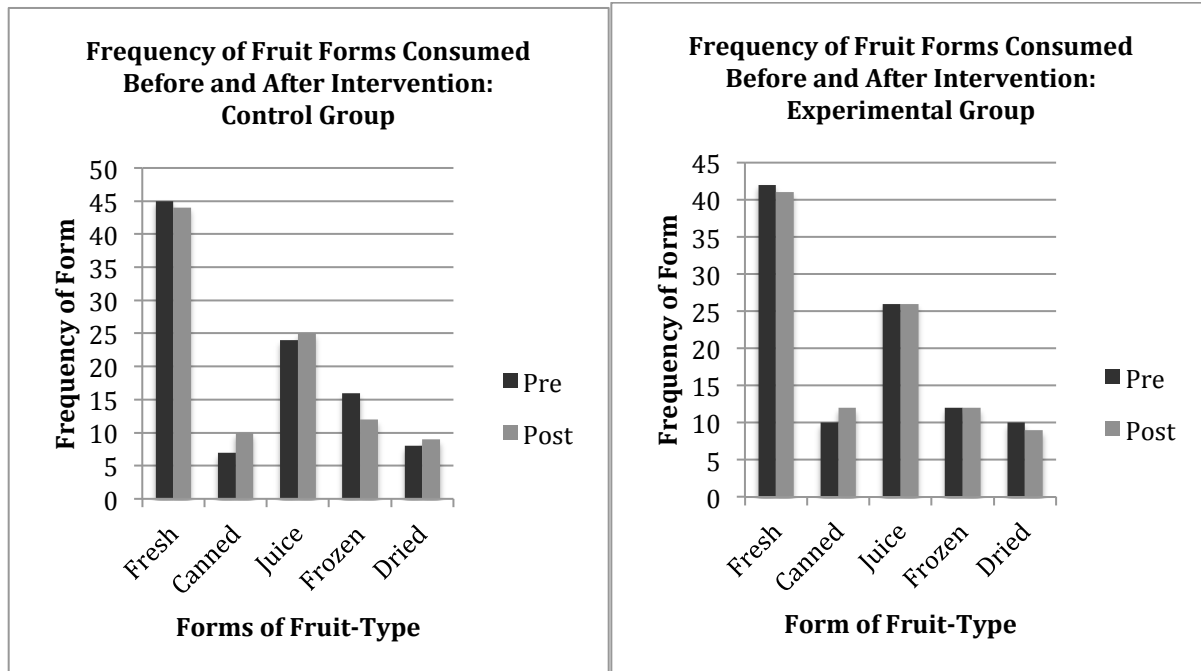


Figure 2: Frequency of fruit forms consumed before and after intervention. Forms include fresh, canned, juice, frozen and dried.

The number of forms of vegetables consumed varied slightly before and after the intervention among the control and experimental groups. Both the control and experimental groups experienced a decrease in the percentage of participants consuming two forms of vegetables and an increase in the percentage of participants consuming one form of vegetable. The control group experienced a greater proportion of participants consuming five forms of vegetables, while the experimental group experienced a higher percentage of participants consuming four forms of vegetables. The grocery tour intervention did not increase the number of forms of vegetables consumed among the control or experimental groups (Figure 3).

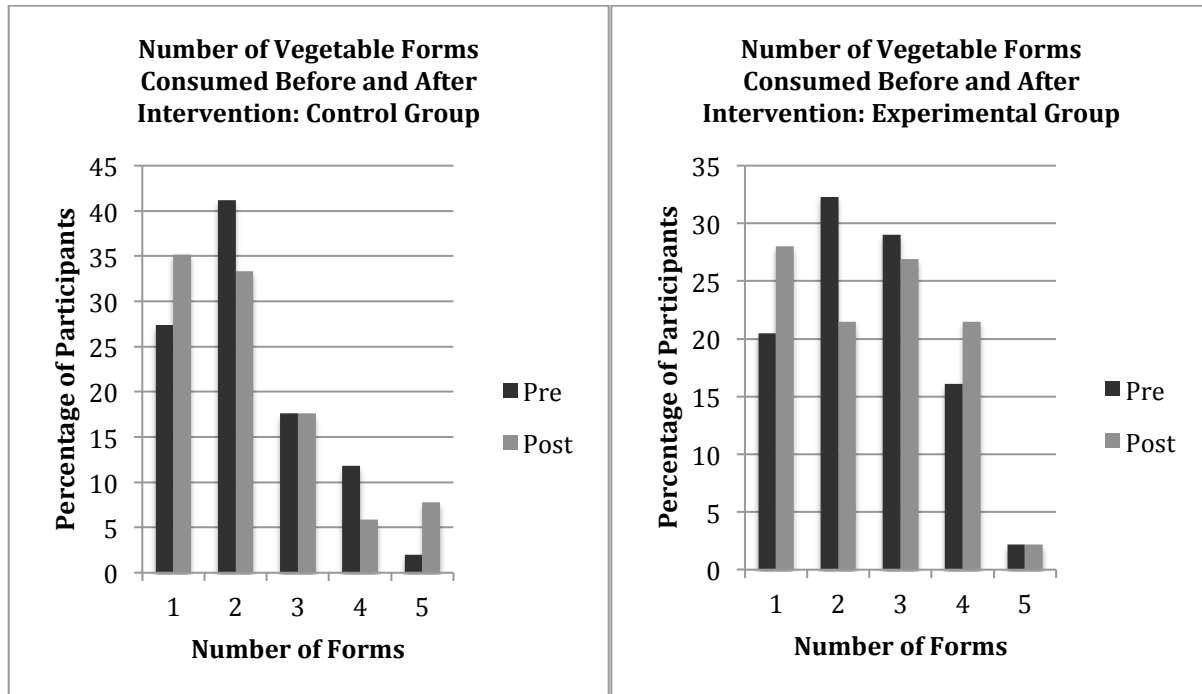


Figure 3: Number of forms of vegetables consumed before and after the intervention. Forms include fresh, frozen, canned, dried, and juice.

The frequency of vegetable forms consumed before and after the intervention experienced minimal changes among the control and experimental groups. Fresh and cooked were the most frequently consumed forms of vegetable for both the control and experimental groups. The control group experienced an increased frequency of fresh and frozen vegetables and a decreased frequency of cooked and canned after the intervention. The experimental group experienced a greater frequency of frozen and juice forms of vegetables while also experiencing a higher frequency of cooked vegetables after the intervention (Figure 4).

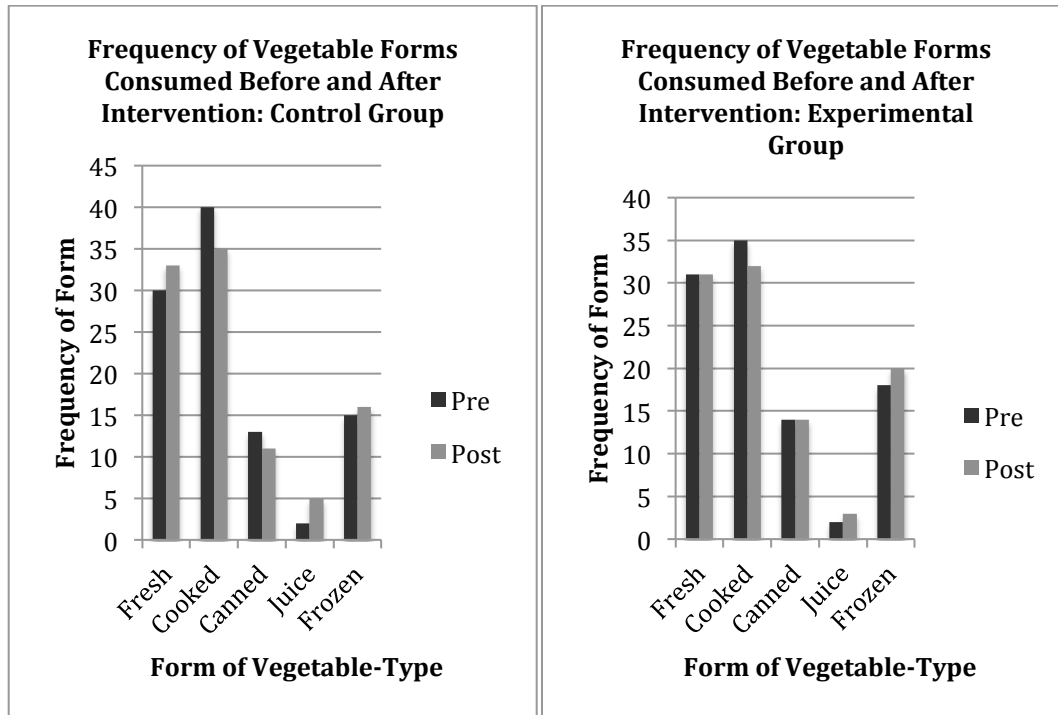


Figure 4: Frequency of vegetable forms consumed before and after intervention. Forms include fresh, cooked, canned, juice, and frozen.

The control group reported prevention of disease, while the experimental group reported good taste, as the most frequent reason to consume fruit both before and after the intervention.

The control and experimental group both reported “healthy for me” as the second most frequent reason to consume fruit (Table 5).

Reasons to Consume Fruit Before and After Intervention				
Reason	Control		Experimental	
	Pre n (%)	Post n (%)	Pre n (%)	Post n (%)
1	12 (23.5)	16 (31.4)	31 (33.3)	33 (35.5)
2	38 (74.5)	33 (64.7)	3 (3.2)	1 (1.1)
3	1 (2.0)	2 (3.9)	56 (60.2)	55 (59.1)
4	0 (0)	0 (0)	1 (1.1)	3 (3.2)
5	0 (0)	0 (0)	1 (1.1)	0 (0)
6	0 (0)	0 (0)	1 (1.1)	1 (1.1)

Table 5: Reasons to consume fruit before and after intervention. Reasons include:

1. “They are healthy for me”.
2. “They will prevent disease”.
3. “They taste good”.
4. “They are convenient”.
5. “They are inexpensive”.
6. “Other”.

Both the control and experimental groups reported health as the most frequent reason to consume vegetables both before and after the intervention. Good taste was the second most frequently chosen reason to consume vegetables for both the control and experimental groups before and after intervention (Table 6).

Reasons to Consume Vegetables Before and After Intervention				
Reason	Control		Experimental	
	Pre n (%)	Post n (%)	Pre n (%)	Post n (%)
1	38 (74.5)	39 (76.5)	66 (71.0)	69 (74.2)
2	4 (7.8)	5 (9.8)	2 (2.2)	1 (1.1)
3	8 (15.7)	6 (11.8)	18 (19.4)	17 (18.3)
4	0 (0)	0 (0)	1 (1.1)	2 (2.2)
5	0 (0)	0 (0)	2 (2.2)	1 (1.1)
6	1 (2.0)	1 (2.0)	4 (4.3)	2 (2.2)

Table 6: Reasons to consume vegetables before and after intervention. Reasons include:

1. "They are healthy for me".
2. "They will prevent disease".
3. "They taste good".
4. "They are convenient".
5. "They are inexpensive".
6. "Other".

The experimental group reported cost as the most frequent reason not to consume fruit before the intervention, but after the intervention, "other reasons" was the most frequently reported reason for not consuming fruits. The control group reported the lack of concern for eating fruits, expensive to purchase, and "other" most frequently as the main reasons not to consume fruit both before and after the intervention (Table 7).

Reasons Not to Consume Fruit Before and After Intervention				
Reason	Control		Experimental	
	Pre n (%)	Post n (%)	Pre n (%)	Post n (%)
1	11 (21.6)	14 (27.5)	18 (19.4)	10 (10.8)
2	11 (21.6)	16 (31.4)	35 (37.4)	44 (47.3)
3	4 (7.8)	5 (9.8)	5 (5.4)	9 (9.7)
4	3 (5.9)	1 (2.0)	2 (2.2)	2 (2.2)
5	22 (43.1)	14 (27.5)	31 (33.3)	28 (30.1)

Table 7: Reasons not to consume fruit before and after intervention. Reasons include:

1. "I am not concerned about eating fruits".
2. "They are expensive to purchase".
3. "It is time consuming to prepare".
4. "They don't taste good".
5. "Other".

The control and experimental group reported "other" as the most frequent reason not to consume vegetables before the intervention. After the intervention, no concern about consuming vegetables, time-consuming to prepare, and "other" were reported with equal frequency in the control group as reasons not to consume vegetables. The experimental group reported time-consuming to prepare as the most frequently chosen reason not to consume vegetables, with "other" and expensive to purchase as close contenders (Table 8).

Reasons Not to Consume Vegetables Before and After Intervention				
Reason	Control		Experimental	
	Pre n (%)	Post n (%)	Pre n (%)	Post n (%)
1	7 (13.7)	12 (23.5)	10 (10.8)	5 (5.4)
2	3 (5.9)	4 (7.8)	10 (10.8)	20 (21.5)
3	13 (25.5)	12 (23.5)	22 (23.7)	27 (29)
4	11 (21.6)	11 (21.6)	25 (26.9)	18 (19.4)
5	17 (33.3)	12 (23.5)	26 (28.0)	23 (24.7)

Table 8: Reasons to consume fruit before and after intervention. Reasons include:

1. "I am not concerned about eating vegetables".
2. "They are expensive to purchase".
3. "It is time consuming to prepare".
4. "They don't taste good".
5. "Other".

CHAPTER V: DISCUSSION AND CONCLUSION:

Discussion

Before and after attending a grocery store tour, the participants in the experimental group reported taste and good health as reasons to consume fruits. The rationale indicated is consistent with the percentage of participants consuming two or more servings per day, as the frequency in which both reasons to consume fruit increased. The proportion of participants in the experimental group reporting health as a reason to consume fruit increased from 33.3% to 35.5% after the intervention. Before and after the intervention, the participants in the control group reported prevention of disease and health as the most frequently chosen reasons to consume fruit. These results are consistent with the slight increase in the percentage of participants consuming two or more servings per day. The increase in fruit consumption among the control and experimental groups indicates the nutrition course may have had a greater influence on fruit consumption, rather than the grocery tours. Students choosing to enroll in NUTR 2100/3100 may have had previous nutrition and health related knowledge or beliefs, influencing the reasons and rationale to consume fruits. Before the intervention, the participants in the control group reported “other” as the most frequent reason not to consume fruit. Future studies need to include free text entry to grasp the opinions of participants, as there may be alternatives to the answer choices provided that uncover unsuspected barriers. After the intervention, these participants, as well as the participants in the experimental group, reported “expensive to purchase” as the most frequently chosen reason not to consume fruit. As there was an increase in the percentage among all

participants choosing health as the main reason to consume fruit after the intervention, enrollment in NUTR 2100/3100 may have had some influence on actual consumption of fruit as well as the participants' rationale and motivation to consume fruit. Due to the high frequency of the "expensive to purchase" reason across all participants, cost effective ways to incorporate fruit discussed during grocery store tours were not effective in addressing this barrier.

The absence of change in vegetable consumption among the experimental group after the intervention may be due to the perceptions regarding vegetables before the grocery tour experience. Before participating in a grocery tours, health was the most frequently chosen reason to consume vegetables in the experimental group. Before attending a grocery store tour, roughly 56% of the experimental group reported consuming 2 or more servings of vegetables per day. As more than half of the participants reported high intake of vegetable servings before attending the tour and the percentage of in the experimental group maintained this consumption after the tour, it is likely these participants chose to be enrolled in a nutrition course and attend a grocery tour due to a predisposed concern about health. The number of participants in the experimental group reporting health as the main reason to consume vegetables increased after the intervention from 71% to 74.2%. As with a shift to identifying health benefits as the main reason to consume vegetables, it would be expected to see an increased number of participants among this group consuming 2 or more servings per day. However, according to the results of this study, that was not the case. These results slightly conflict with the 44% of participants in the experimental group still consuming less than two servings of vegetables per day. The participants in the experimental group reported "time-consuming to prepare" most frequently, while "other" and "expensive to purchase" were also frequently reported as reasons for not consuming vegetables. After the intervention, the participants in the control group reported, "no concern" about

consuming vegetables, “time consuming to prepare” and “other” with equal frequency. Time and financial constraints were barriers preventing participants in the experimental group, as well as the control group, from increasing consumption of one or less serving to two or more servings per day. When asked to choose the best reason not to consume vegetables, 23.5% of participants in the control and 24.7% of participants in the experimental group chose “other” after the intervention.

To fully capture the opinions of participants, future studies should provide participants with a free response entry option when asked to provide reasons or rationale justifying specific behaviors. Future studies should correlate the results from the fruit and vegetable consumption surveys with the surveys provided at the grocery store tour survey, which allows more free response entry. These results indicate enrollment in a nutrition course can have some impact on fruit and vegetable consumption, but cannot entirely close the gap between all barriers present. Future grocery store tours can have a greater emphasis on consuming fruits and vegetables on a budget and varying the ways to prepare and incorporate these foods into the diet. The grocery store tour intervention was successful in increasing fruit consumption, maintaining vegetable consumption, and improving the rationale to consume fruits and vegetables among the experimental group. Although the participants in the control group did not participate in a grocery store tour, these individuals were motivated to consume more fruits and vegetables on a daily basis. Enrollment in a nutrition-related course had some influence on the consumption and perceptions among all students participating in the study.

The frequency of each form and number of forms of fruits and vegetables consumed by the participants in the control and experimental groups were very similar before and after the intervention. Both groups experienced an increased frequency of four forms of fruit consumed

after the intervention and a decreased frequency of two forms consumed. The participants in the control group reported a greater frequency of three forms consumed, while participants in the experimental group reported an increased frequency of one form consumed. The frequencies in which these forms increased were comparable between the two groups. These results are inconsistent with other findings of this study, regarding the rationale to consume and not to consume fruit. Varying the forms of fruit consumed, such as canned and dried forms, can be cost effective, as these two forms are shelf-stable, increasing the time available for consumption[6, 72, 73]. Participants in both the control and experimental groups reported consuming fresh and cooked forms of vegetables most frequently before and after the intervention. After the intervention, both groups experienced an increased frequency for frozen vegetables and a decreased frequency for cooked vegetables. These results may be due to confusion between cooked and frozen vegetables, as one does not usually consume vegetables frozen—but will cook them before eating. The control group participants reported an increased frequency in fresh vegetables and a decreased frequency for canned vegetables. The experimental group participants reported an increased frequency of juice forms of vegetables. These mixed results indicate neither grocery store tours nor enrollment in a nutrition course impacted types and number of forms of vegetables consumed by participants. The focus of the grocery store tours was to promote fruit and vegetable consumption across all forms available[29]. Increasing the types of vegetables consumed can add variety and nutrients to the diet[15, 23]. Future studies are needed to investigate barriers to consuming different forms of fruits and vegetables.

A limitation of this study is the lack of long-term follow-up, regarding fruit and vegetable consumption and the rationale behind consuming or not consuming these foods. The length of time between participants attending a grocery tour and when they completed the final

consumption survey could have caused a variation in the average number of servings per day reported. Participants completing the tour a few weeks before the survey may have reported a higher serving intake compared to a student completing a tour months before completing the final survey. The length of time between tour attendance and completion of the final survey could have impacted the rationale to consume or not to consume fruits and vegetables.

Participants learned the health benefits of fruits and vegetables throughout the semester due to enrollment in nutrition-related courses. Due to the flexibility in the completion of the initial and final survey, participants may not have been able to provide the best representation as the rationale. Participants with no prior nutrition or health-related knowledge or concern might have reported significantly different answers on the final survey compared to the initial survey. The goal of this study was to determine whether attending a grocery store tour affected fruit and vegetable consumption among college students. Future studies need to collect data from the study participants, regarding beliefs about consumer behaviors and nutrition knowledge, over an extended period. Collecting follow-up data would indicate if interventions were successful in creating long-term behavior changes.

Another limitation was the lack of socioeconomic data collected from study participants. Participants in this study, in the control and experimental group, reported “cost” with a high frequency as a barrier to consuming fruits and vegetables. Although the CP students were trained to discuss cost-effective strategies to incorporate fruit and vegetables into the diet, these strategies were not specifically catered to the needs of participants. For example, when participants toured the canned fruit and vegetable aisle, a discussion covering the unit price and benefit of purchasing in bulk was facilitated[29][29][29]. Understanding the population, especially the income level and methods of transportation, would allow development of future

studies that could incorporate successful strategies indicated in the literature, rather than broad recommendations and messages[43, 74]. An estimated average income level would be useful to create realistic and feasible strategies to increase fruit and vegetable purchases. Many university students rely on student loans or work several jobs to cover their expenses[58]. Due to these variables, and the negative barriers and perceptions regarding healthy foods choices, purchasing and consuming fruits and vegetables may not be a priority[27, 32]. When considering the total cost of obesity, type 2 diabetes, or cardiovascular disease on the healthcare system in the United States, purchasing fruits and vegetables is a cost-effective way to minimize risk for developing these diseases[11]. Study participants with low-income may benefit from education on the advantages of 100% fruit juice, canned fruits and vegetables, and dried fruits as these are all shelf-stable, nutritious, budget-conscious options worthy of being incorporated into the diet[6].

The lack of socio-demographic data prevents an analysis of fruit and vegetable consumption and rationale associated with intake among men and women of various age groups. To maintain a short, quick survey and promote maximum student participation, this type of data was excluded. An increased number of questions, on either the initial or final survey, could have decreased participation. Among the literature, there are mixed results regarding success outcomes of nutrition interventions comparing males versus females[4, 10, 11, 24, 31, 39, 48]. Other studies indicate females may face disproportionate weight-related discrimination compared with male counterparts, resulting in negative social consequences[56]. Therefore, women are more likely to be concerned about their health and body image[10]. Differentiating the increases of fruit and vegetable consumption among women versus men would have indicated if findings from this study are consistent with the current mix of literature. The age range of the participants would have been useful in the analysis of reasons to or not to consume

fruits and vegetables. The perception of health and diet is dynamic through transitional periods of life, such as attending a University. Social, environmental, and behavioral influences vary depending upon the stage of life[5, 27, 75]. These influences can have either positive or adverse impact on capacity for healthy lifestyle choices[27]. To truly grasp the perceptions regarding fruits and vegetables among men and women of different ages, a collection of frequently consumed foods would be necessary. As indicated by the mixed results of this study, university students will consume fruit and vegetable for a variety of reasons. They will also not consume fruits and vegetables for many reasons. Before developing individualized nutrition interventions regarding barriers such as cost and time consuming to prepare, it would be useful to know what is eaten in place of fruits and vegetables—regarding specific foods are eaten and where they originate. If frequently consuming high-calorie, energy-dense meals outside of the home, nutrition interventions suggesting preparing meals at home would be counterproductive. Future studies analyzing the rationale associated with fruit and vegetable consumption, and lack thereof, between women and men of various age groups, is needed.

A study conducted by the Harvard School of Public Health found hours spent watching television or the desire to excel academically were the primary influential factors about healthy lifestyle habits and perceptions[56]. Students spending more time watching television are more likely to be exposed to advertisements for energy-dense, low nutrient foods. Researchers suggest this exposure may have influenced these students to choose the less healthy options when given a chance. Females were more likely to pursue lifestyle choices promoting overall wellbeing, and therefore fewer incidences of obesity were reported. As described in other studies, women reported a greater concern about body weight and may expend more effort to maintain or lost weight through dietary control and exercise compared to male counterparts[24, 56].

Conclusion:

The purpose of this study was to identify if participation in a grocery store tour altered fruit and vegetable consumption among college students enrolled in an introductory nutrition course. The data collected in this study indicate grocery store tours increase fruit consumption among undergraduate students. Due to the increase in fruit consumption between both groups, enrollment in a nutrition course may play an influential role. Future studies are needed to investigate the influence of nutrition courses and to quantify other reasons to consume fruits and vegetables as well as not to consume fruits and vegetables.

CHAPTER VII: REFERENCES:

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CHAPTER VIII. APPENDIX

- 1. Fruit and Vegetable Consumption Survey**
- 2. Informed Consent**
- 3. Additional Information Provided in Syllabus**
- 4. Grocery Tour Cheat Sheet**
- 5. Tour Evaluation Checklist**
- 6. Sample Item Checklist**
- 7. “Fruit & Veggies Tour Survey” provided by PBH**