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The Effect of a Fruit and Vegetable Program on Diet Quality and Produce Consumption

Jeanne Arbuckle
Illinois State University, jarbuck@ilstu.edu

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Fruits and vegetables are an important part of our diet, yet few individuals consume the recommended amounts. Incorporating produce in our diet provides many necessary nutrients and may aid in decreasing the risk of chronic disease, controlling obesity and improving mental functioning. In an attempt to increase intake, a program was created to provide fresh fruits and vegetables on a weekly basis to a Midwestern university population for eight weeks. Participants chose from three sizes of produce bags and were supplied with seven different types of fruits and vegetables each week. Dietetic interns performed the planning, ordering, organizing and preparing of the produce for participants to pick up as well as managing volunteers to help with the process. The purpose of this quantitative study was to test whether the program would increase the consumption of fruits and vegetables for its participants or otherwise change the behavior of the participants regarding fruits and vegetables. While individuals who were involved in the fruit and vegetable program had an increase in both fruit and vegetable consumption, those increases were not significant. The study also found insignificant increases in intake of vitamin-rich vegetables (defined as broccoli, Brussels sprouts,

carrots, collards, kale, red pepper, spinach, sweet potatoes and winter squash) and leafy green vegetables (defined as collards, kale, mustard greens, romaine lettuce, spinach, or Swiss chard). After the study, participants were significantly more likely to consume a lunch or dinner meal containing grains, vegetables or beans but little or no meat, poultry, fish, eggs or cheese. An improvement in the healthy quality of participant's diets (based on the total points available in the survey) was observed after the program, but it was not significant. Data from Likert-style healthy eating behavior questions were also analyzed using principal component analysis with varimax rotation. Participants perceived that they increased fruit and vegetable consumption and improved their healthy eating behaviors while involved in the program.

THE EFFECT OF A FRUIT AND VEGETABLE PROGRAM ON DIET QUALITY AND PRODUCE CONSUMPTION

JEANNE ARBUCKLE

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JEANNE ARBUCKLE

COMMITTEE MEMBERS:

Julie R. Schumacher, Chair

Robert W. Cullen

Hae J. Gam

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JOURNAL ARTICLE

Introduction

Fruit and vegetable consumption offers many acknowledged benefits, such as the diverse assortment of necessary nutrients including vitamins, minerals, fiber and phytochemicals as well as assistance in the prevention of a variety of chronic diseases (Liu, 2013). In addition, it has been shown that higher intakes of fruit and vegetables could lower calories consumed, increase satiety and help manage weight (Boeing et al., 2012). Despite all these reasons to consume a wide variety of fruits and vegetables, consumption is far below what is considered optimal in the United States (Krebs-Smith, Guenther, Subar, Kirkpatrick, & Dodd, 2010).

The State Indicator Report on Fruits and Vegetables revealed that among US adults, 32.8% consumed at least two servings of fruit per day and 27.4% of adults consumed at least three servings of vegetables per day. This research also determined that 32.2% of adolescents had an intake of at least two servings of fruit and 13.2% ate three or more servings of vegetables per day. Additionally, it was reported that only 14% of adults consumed both two or more servings of fruits and three or more servings of vegetables. The number of adolescents reaching those goals was lower at 9.5% (Centers for Disease Control and Prevention, 2009). In a more recent article, the Centers for Disease Control and Prevention confirmed a 67% increase in the amount of fresh, frozen

or canned fruit not including juice consumed by children (in child care, Head Start, preschool or pre-kindergarten) 2-18 years old, during 2003-2010. No improvement occurred in the amount of vegetables children ate from 2003 to 2010. Moreover, during 2007-2010, 90% of children did not consume the recommended amount of vegetables (Centers for Disease Control and Prevention, 2014). According to the Produce for Better Health Foundation, adult males averaged 1.37 cups of vegetables and 0.71 cups of fruit per day in 2009. The same report found that adult females consumed 1.11 cups of vegetables and 0.65 cups of fruit on the average day. Further, the report found that children's intake averaged 0.80 servings of vegetables and 0.69 servings of fruit per day (Produce for Better Health Foundation, 2010).

Many factors contribute to the low intake of fruits and vegetables, including the expense and limited availability of high quality fresh produce. Farmers markets have been established to supply fresh fruits and vegetables directly from the farmer, increasing the freshness and appeal. Some farmers also provide produce in a format called community supported agriculture (CSA). These programs offer a share of the farm outputs, usually in the form of weekly produce distribution, for a specified number of weeks in return for an up-front payment. Landis, Smith, Lairson, Mckay, Nelson, & O'Briant, (2010) found that a CSA membership was associated with consumption of a larger number and wider variety of fruits and vegetables compared to that of individuals with similar sociodemographic characteristics who did not belong to a CSA.

In order to increase the quantity of fruits and vegetables in the diets of students, faculty, staff and retirees of a large Midwestern university, a program named Fresh FAVs (for fruit and vegetable) was created to supply weekly produce to participants. This

program provided fresh fruits and vegetables direct from a wholesale distributor. Because the path from producer to consumer was shortened, the produce was fresher than that found in some grocery stores. In addition, the program used volunteers to supply the labor, lowering the cost. Affordability of the produce was also increased by the quantity discount afforded by the university's volume purchased.

Some characteristics of Fresh FAVs were similar to CSA programs. In both cases, participants chose the quantity they wished to receive each week and paid prior to the start of the program. Another common characteristic was the division of the available produce proportionately based on the size of the "bag" purchased. Produce was distributed weekly from a central location, as is common with CSA's. Unlike a CSA, however, produce was obtained from a vendor who purchased from many different farms, few if any of whom were local. CSA members usually join due to environmental concerns, desire for organic or local produce, support for the local economy, to gain knowledge of where food comes from and how it was grown, or as a source for fresh produce. The fruit and vegetable program studied in this study was a source for fresh produce but did not resolve any of the other concerns mentioned.

The purpose of this quantitative study was to test whether a fresh fruit and vegetable program would increase the consumption of fruits and vegetables for its participants. This study focused on the following hypotheses:

1. Participants in the program would consume more fruits and more vegetables while they were participants in the program than consumed prior to the program.
2. Participants in the program would consume more vitamin-rich vegetables including broccoli, Brussels sprouts, carrots, collards, kale, red pepper, spinach, sweet potatoes, and

winter squash during the program as compared to their consumption level before beginning the program.

3. Participants would consume more leafy green vegetables including collards, kale, mustard greens, romaine lettuce, spinach, and Swiss chard for the duration of the program compared to their intake before the program.
4. The fruit and vegetable program would inspire people to consume a healthier diet, including adequate amounts and variety of fruits, vegetables, whole grains, lean meats, and low-fat dairy; and limited amounts of fried foods, sugar, sodium and unhealthy fats.

Methods

Participants

A purposive sample of the fresh fruit and vegetable program participants (N=179) was recruited to participate in an online survey before the initial week of the program and after the last week of the program. The survey required the participant to complete an electronic informed consent document before answering the survey questions. The initial survey was conducted in February, 2014 before the beginning of the fruit and vegetable program, and the follow-up study was conducted in April 2014 at the conclusion of the program. All procedures were reviewed and approved by the University's Institutional Review Board (IRB).

Program Description

Fresh FAVs was developed and administered by students in the dietetic internship program under the supervision of the program director. Participants were recruited from students, faculty, staff, and retirees of a Midwestern public university. Prior to the program's start, each participant purchased a small (intended to feed one to two people),

medium (for three to four people), or large (for five to six people) produce package. The money from the participants was used to create a weekly budget for purchasing produce over the eight weeks of the program. Produce was provided on a weekly basis eight times during the last half of the spring semester. Each week, four varieties of fresh vegetables and three varieties of fresh fruits were purchased from the company that supplied food to the dining centers of the university in quantities sufficient to fill the packages proportionally, but still stay within the budget. Factors considered in determining the type of produce to purchase included color, size, budget, availability, and amount of work necessary to separate the produce into appropriate individually packaged portions. One expensive item, one unusual item, and one to two items requiring packaging were chosen each week. . Once the items were determined for the week's package, two recipes using the some of the produce to be provided were emailed to the participants.

Once the produce arrived on Fridays, volunteers assisted the dietetic interns in counting, dividing and setting up the produce for pick up by the participants. There were two designated pickup times of one and one-half hours each on the designated day each week, from 12-1:30 P.M. and 3:30-5 P.M. Volunteers also assisted interns during pick up times. Excess produce was donated to a local residential treatment center for children or the local mission that served the homeless and hungry.

Rate Your Diet

The survey instrument chosen for this study was used to measure the healthiness of a participant's overall diet. It was created by the Center for Science in the Public Interest (CSPI). Permission was granted by CSPI in writing for use of the instrument. The original survey was titled Rate Your Diet. It assigned a point value to each answer.

Possible scores for each of the 39 questions had varying ranges from -4 to +3, with lower scores indicating healthier choices. Total points for the survey ranged from -119 to +113.

The Rate Your Diet Survey is similar to a food frequency questionnaire in that it measures the types and quantities of food the survey-taker typically consumes. Questions in the survey were divided by category. The fruits, vegetables, grains, and beans category included questions about the number of servings of fruit juice, fruits, vegetables, grains and beans typically consumed. Types of vegetables, breads, and cereals commonly eaten were queried. Questions in the meat, poultry, and seafood category measured the frequency of high-fat and lean red meat consumption, the size of red meat servings, and whether fat was trimmed from red meat. In addition, information was requested about the types of ground meat, chicken parts, and varieties of seafood normally consumed; and whether skin was removed from poultry before it was eaten. Questions about mixed foods determined the survey-taker's most typical breakfast, types of sandwich fillings, toppings for pizza and pasta, salad dressings, and salad toppings. The mixed food category also asked about the quantity of egg yolks as well as the number of servings of cheese and low-fat calcium-rich foods consumed. The fats and oils category included questions to determine the type of condiments used on breakfast breads, sandwiches, and salads made with pasta and meat. This section also asked about the use of butter, margarine, and oils for cooking. The questions in the beverages section were intended to identify the most common beverages consumed and the types of fruit beverages and milk the respondent drinks. The last section included questions about snacks including salty snacks, cookies, cakes, pastries, and frozen desserts. Each answer had a point value assigned to it. The

intention of the original survey was to sum the points from each question to calculate a score which determined the healthiness of a person's dietary habits.

In the researchers' survey, the respondent was given the question and possible answers, but the point values were assigned by the software without showing the points assigned to the answers on the screen. The intention of the researchers was that the survey-taker remain unaware of the points being assigned and calculated in the background in order to prevent bias. Some of the questions from the original survey directed the respondent to add or subtract from the question's original points if foods were consumed in a certain way. For example, the original question may ask about servings of pizza, and direct the survey-taker to add points for extra cheese. To alleviate the respondents from calculating these points, additional questions were added to the survey to identify these behaviors and assign the appropriate point values. Total points were calculated to determine the healthy quality of participants' diets. The same questionnaire was administered to the fruit and vegetable program participants before the program and at the conclusion of the program.

Additional Information Captured

In addition to the questions from the Rate Your Diet survey, demographic information including gender, age group, campus relationship (faculty, staff, student or retiree), and departmental affiliation was captured. Six Likert-type items developed to measure the improvement of healthy eating behaviors after program participation were also included in the follow-up survey. These items were reviewed by a committee of nutrition professors and statisticians for content and face validity. Further, they were used in factor analysis to assess the value of the program.

Data Analysis

Descriptive statistics were used to compute the frequencies, means, and standard deviations of the servings consumed before and after the intervention. To identify the difference between fruit and vegetable consumption before and after the program, paired samples *t*-tests were conducted. In order to determine construct validity of measurement with multiple items, principal component analysis with varimax rotation was conducted. Constructs with factor loadings of items above .55 and not higher than .30 on the other factors were considered valid. Internal reliability of each measurement was also evaluated through Cronbach's standardized *alpha* values; when the *alpha* values were above .70, the items were retained for further analysis. All statistical analyses were conducted using IBM SPSS Statistics software (version 20, 2011, IBM Corporation, Somers, NY).

Results

A total of 140 (78.2%) pretests and 130 (72.6%) posttests were collected from the 179 Fresh FAVs participants. Eighteen pretests and twelve posttests were excluded from analysis due to incomplete responses. Of the 122 pretest respondents, 78.7% were female (*n*=96), 18.0% were male (*n*=22), and 3.3% (*n*=4) of the participants did not respond to the gender question (see Figure 1). More females (81.4%; *n*=96) than males (18.6%; *n*=22) also responded in the posttest. The participants were divided into six age groups as described in Figure 2.

The study also captured the type of association the participants had with the university (Figure 3). In the pretest, there were 23 (18.9%) faculty, 75 (61.5%) staff, 10 (8.2%) undergraduate students, 7 (5.7%) graduate students, 3 (2.5%) retirees and 4

(3.3%) participants who left the field blank. In the posttest, there were 23 (19.4%) faculty, 79 (66.9%) staff, 6 (5.1%) undergraduate students, 5 (4.2%) graduate students, and 5 (4.2%) retirees. The follow-up survey incorporated additional questions which addressed participants' perceptions of the effect of the program on their food-related behaviors.

Figure 1. Gender of Participants in the Fruit and Vegetable Program

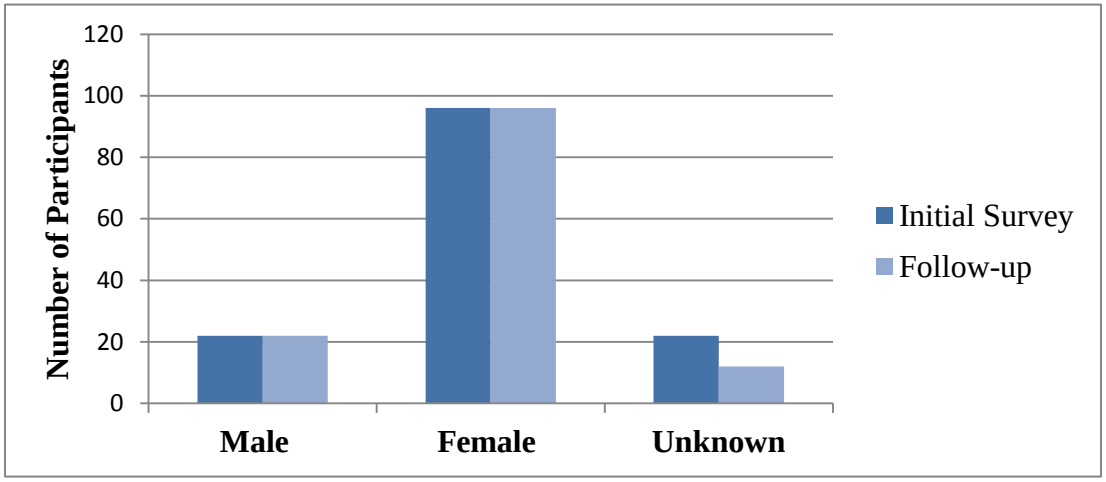


Figure 2. Age Group of Participants in the Fruit and Vegetable Program

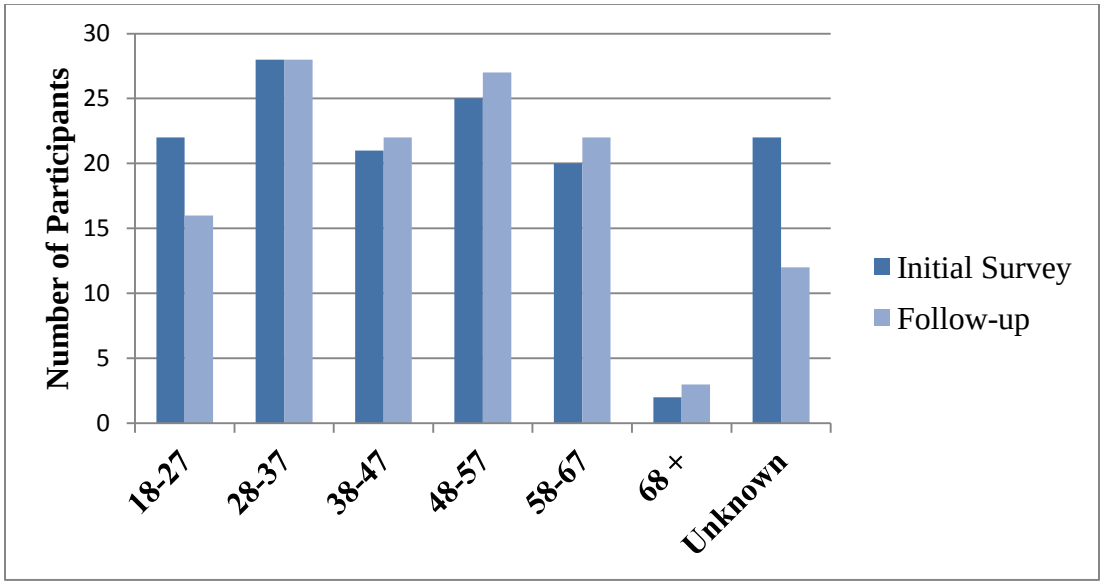
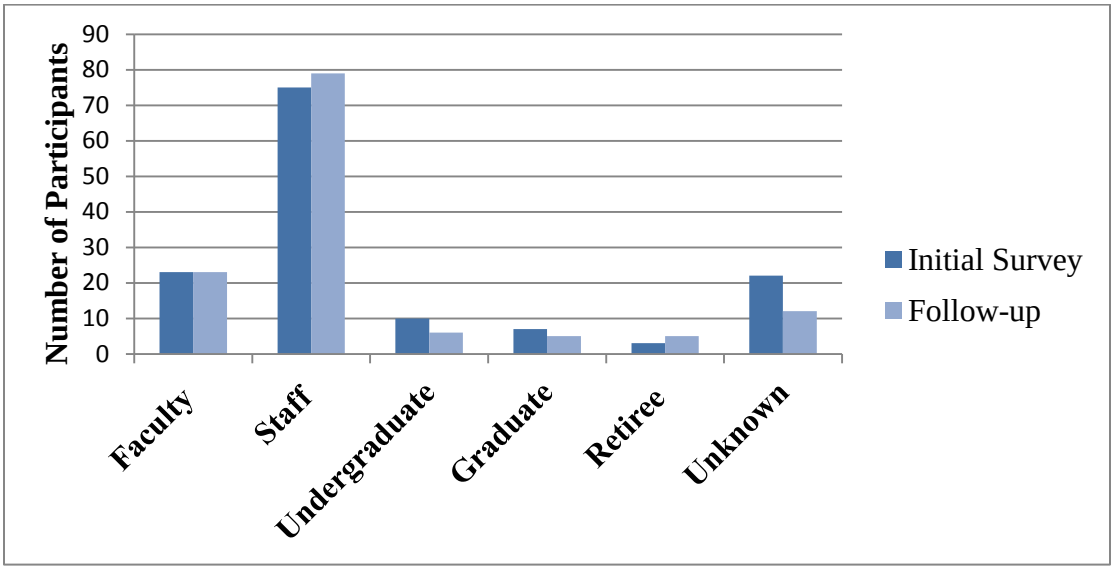


Figure 3. University Status of Participants in the Fruit and Vegetable Program



Prior to the program, participants estimated their usual fruit intake at less than two servings per day (*M* = 0.84, *SD* = 1.226, see Table 1) and vegetable intake at approximately two servings per day (*M* = 1.07, *SD* = 1.159, see Table 1). After the study was complete, people who participated in the program estimated their average consumption at just over two servings of fruit (*M* = 1.14 points, *SD* = 1.226 points) and slightly more than two servings of vegetables (*M* = 1.18 points, *SD* = 1.159) per day. Intake of both fruits and vegetables increased from participants' original estimates; however, the changes were not significant (*t*=1.81, *p*=.72; *t*=.658. *p*=.511).

Table 1. Points for Fruit and Vegetable Servings

Servings	Points
0	-3
less than 1	-2
1	0
2	1
3	2
4 or more	3

Program participants averaged four to six vitamin-rich vegetable servings (*M* = 1.63 points, *SD* = 1.061 points, see Table 2) per week at the end of the program. This was an average increase of 0.28 points, but not a significant difference. The vitamin-rich vegetables included broccoli, Brussels sprouts, carrots, collards, kale, red pepper, spinach, sweet potatoes, or winter squash. Participants also stated that they averaged one to two servings of leafy greens (*M* = 1.16 points, *SD* = 1.674 points, see Table 3) per week, including collards, kale, mustard greens, romaine lettuce, spinach, or Swiss chard.

Table 2. Points for Vitamin-Rich Vegetable Servings

Servings	Points
0	-3
1 to 3	1
4 to 6	2
7 or more	3

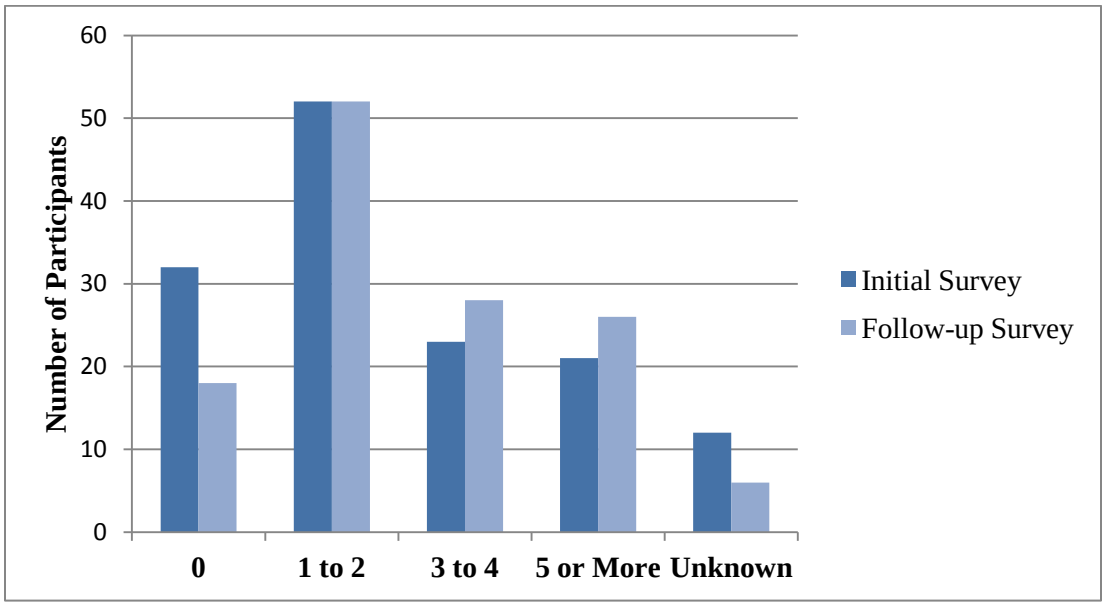
Table 3. Points for Leafy Green Vegetable Servings

Servings	Points
0	-3
less than 1	-2
1 to 2	1
3 to 4	2
5 or more	3

After the study, participants were significantly more likely (t= 2.12, p = .035) to consume a lunch or dinner meal containing grains, vegetables or beans but little or no meat, poultry, fish, eggs or cheese. This is the only produce-related question from the Rate Your Diet portion of the survey to show significant results for the entire population. The other questions measuring fruit and vegetable intake showed insignificant increases, as previously explained. An improvement in the healthy quality of participants' diets

(based on total points) was observed after the program, but it was not significant (t=.1.938, p=.054).

Figure 4. Participants Reported Number of Times Per Week Their Lunch or Dinner Contained Grains, Vegetables, or Beans, but Little or No Meat, Poultry, Fish, Eggs, or Cheese



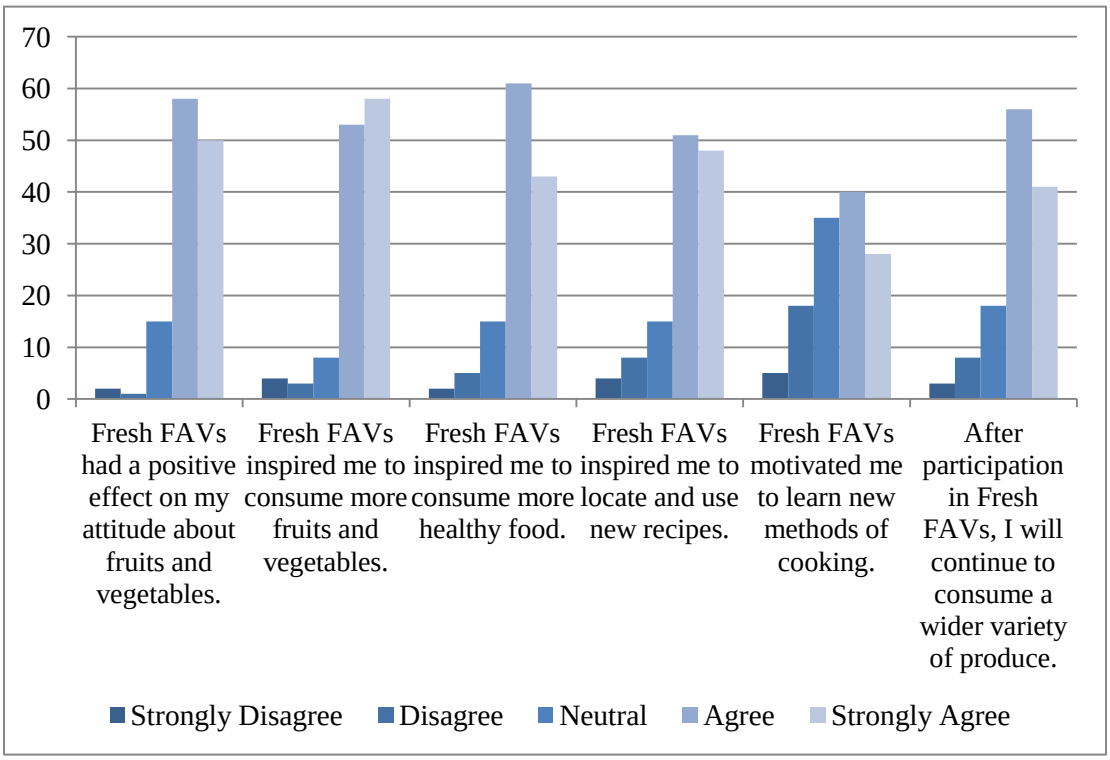
After separating data by gender, a paired samples t-test compared data from the survey taken before the program to data from the survey taken at the conclusion of the program. This assessment found no difference between males and females with regard to the likelihood of consuming a meal containing grains, vegetables or beans but little or no meat, poultry, fish, eggs or cheese (F=.645, p=.587) (Figure 4). An independent samples t-test compared the difference between males and females for all of the "Rate Your Diet" questions in the survey. It was found that women consumed significantly more vitamin-rich vegetables (M=1.58; SD=1.063) than men (M=1.07; SD=1.634) (t=2.533, p=.011). While females averaged a higher consumption of fruit, vegetables and leafy green vegetables, these numbers were not significant (t=1.258, p=.209; t=1.928, p=.055).

Point scores for the five questions that were most closely related to fruit and vegetable consumption were totaled. The means of the total fruit and vegetable consumption score were compared by gender using an independent samples *t*-test. No significant difference was found between males and females.

Linear regression was used to determine whether participants' fruit and vegetable consumption affected the healthy eating behaviors. Results showed that these variables were positively related ($F(1,124) = .014$, $p > .05$), but were not statistically significant. Overall, participants felt an improvement in the healthiness of their diet due to their participation in the program; however, there were no gender differences related to this improvement.

Data from the healthy eating behavior questions (Figure 5) were also analyzed using principal component analysis with varimax rotation. Participants perceived that they increased fruit and vegetable consumption and improved their healthy eating behaviors while involved in the program. Eighty-six percent of participants agreed or strongly agreed that the program had a positive effect on their attitude about fruits and vegetables, while only 14% disagreed (0.8%), strongly disagreed (1.6%), or were neutral (12%). Similarly, 88% of participants agreed or strongly agreed that Fresh FAVs inspired them to consume more fruits and vegetables. Likewise, 82.5% of participants agreed or strongly agreed with the statement "Fresh FAVs inspired me to consume more healthy food." Slightly fewer (78.5%) agreed or strongly agreed that the program inspired them to locate and use new recipes. Conversely, only 54% agreed or strongly agreed that Fresh FAVs inspired them to learn new methods of cooking.

Figure 5. Healthy Eating Behaviors of Fresh FAVs Participants



Discussion

The purpose of this study was to test whether participants would increase their consumption of fruit, vegetables, vitamin-rich vegetables and leafy greens after participation in the Fresh FAVs program. There was an increase, but not significant, for each produce group, demonstrating the effectiveness of the program. In addition, this research also measured whether the program could inspire people to improve the healthy quality of their diet, defined as including adequate amounts and variety of fruits, vegetables, whole grains, lean meats, and low-fat dairy; and limiting fried foods, sugar, sodium and unhealthy fats. Results of the study showed that participants significantly increased the number of meals including mostly plant-based foods with minimal animal-based foods. In order to use all the produce provided by Fresh FAVs, participants may

have purchased amounts of other foods smaller than their normal purchase amount, resulting in the higher quantity of plant-based foods in participants' diets. The study also found a non-significant improvement in the overall healthy quality (based on total points) of participants' diets.

The majority of Fresh FAV's participants who responded to the survey were female, including 79% in the pretest and 81% in the posttest. Results from the study showed that women consumed more fruits, vegetables, and leafy greens than men, but these numbers were not significant. Moreover, women consumed significantly more vitamin-rich vegetables than men. Bellavia, Larsson, Bottai, Wolk, & Orsini (2013) also found that women consumed more servings of fruit and vegetables than men. Similarly, in a study by Lazzeri et al., (2013), adolescent females reported higher consumption levels of both fruit and vegetables than adolescent males. This may indicate that women are more likely to incorporate produce in their diet than men. However, there was no gender difference related to participants' perception of improvement in the healthiness of their diet. This may indicate that men are less concerned about including fruits and vegetables in their diet.

Most participants agreed that the program improved their attitude about and their intake of fruits and vegetables, as well as increasing their intake of healthy food in general. More than 75% felt the program inspired them to locate and use new recipes, and slightly over half believed the program inspired them to learn new methods of cooking. This strong evidence shows that the program improved skills for planning and preparation of healthy meals as well as inspiring positive behavior change in most of the

people involved during the program. However, the study did not determine whether this behavior change continued after the conclusion of the program.

This study may be valuable to others hoping to create a successful program to increase fruit and vegetable consumption, whether in a University setting or in other venues. A review of current literature found no reports of similar programs in University settings, although a model for a University CSA exists (Wharton & Harmon, 2009). The information from this research may also be useful in improving the program in the future.

There were many advantages to the program. First, it was located on the campus where most of the participants either took classes or worked, allowing easy and convenient access to the pick-up location. Likewise, two different pick-up times were offered for a total of three hours, maximizing the times pick-up was available. In addition, produce was limited to seven items to avoid overwhelming the participants with excess produce or expense. The fruit and vegetable bags were offered in three sizes in order to tailor the bag to family size or offer the opportunity for sharing a bag. Furthermore, recipe ideas were offered by email, and a Facebook page was created to allow participants to share ideas for using the produce. Because the vendor had a contract with the University, the produce was offered at a price competitive with or better than local grocery stores. Additionally, participants were exposed to fruits and vegetables that many were unfamiliar with, such as fennel, kale and eggplant, and might not have purchased on their own, providing the opportunity to gain familiarity with new types of produce. Unwanted and excess produce was donated to disadvantaged groups who have limited opportunities to consume a wide variety of fresh produce. The program was an

excellent leadership experience for the dietetic interns who administered the program, as well as a volunteer opportunity for many students.

However, there were a few disadvantages noted by participants and one frequently expressed by individuals who did not enroll in the program prior to the deadline. Participants frequently requested a list of produce to be supplied for the week to assist in their grocery planning, but the program was unable to provide this information until the shipment was verified by the vendor a day or two before delivery. Furthermore, the requirement for the money to be paid for the entire eight week program prior to its inception was a disadvantage for those on a limited budget. In addition, people were unable to join the program once it had begun for the semester as the budget for each week had already been determined.

The Fresh FAV's population had some similarities with CSA populations, but demographic data captured about participants was limited. Past studies have identified CSA populations as likely to be mostly Caucasian, highly educated, and have a higher than average income (Cohen, Gearhart, and Garland, 2012; Landis, et al., 2010; Russell and Zepeda, 2008; Uribe, Winham, and Wharton, 2012). The survey used for this study did not capture race, education level or income level of the survey population, making it difficult to compare the study's population in these categories; however, as all of the population had some affiliation with a University, it is likely that they also were more highly educated than the general population. Program participants in two CSAs were more than 80% female (Cohen, et al., 2012; Uribe, et al., 2012); 78% of Fresh FAV's participants surveyed were also female. Furthermore, other studies had an average age of 35.9 (+/– 10.0) (Cohen, et al., 2012), 42 (Uribe, et al., 2012), 43.7 (Landis, et al., 2010),

and 47 (Russell and Zepeda, 2008). The average age of a Fresh FAV's participant was not calculated; however the participants were fairly evenly distributed over the age groups 28-37 (24%), 38-47 (19%), 48-57 (23%) and 58-67 (19%), showing that participants of the fruit and vegetable program most likely had a slightly higher average age.

This study has several limitations that should be taken into consideration when interpreting the results. Due to the convenience sample which was limited to participants who were willing to spend money and effort to participate in the program, the results of the study may not be generalizable to the entire population. In addition, participants in the program are likely people who already have some familiarity with including fruits and vegetables in their diet. The results might be different if the population included people with limited expertise with produce. In addition, the data captured for this study occurred at one point in time, at the conclusion of the eight week program. It is unknown whether behaviors changed during the program would continue to occur after the conclusion of the program. Therefore, the long-term effectiveness of the program is unknown. Furthermore, the study was limited by the demographic information captured. Additionally, the study did not capture the variety of fruits and vegetables consumed. Data was not available to thoroughly describe the participants and be able to compare them with other studies. The survey used in the study was another weakness. Responses to some of the questions measured servings in ranges, such as one to three servings or four or more servings, which made it impossible to identify the exact number of servings consumed, and consequently complicated statistical analysis. Responses with a direct

correlation between the number of servings consumed and the number of points assigned would have improved the ability to generate meaningful statistics.

Future directions may include exploring ways to address the long-term effectiveness of the program. The current study did not measure whether behavior change continued beyond the conclusion of the program. It may also be valuable to determine whether there is an increase in the variety of produce consumed after participation in the Fresh FAV's program. Investigating barriers to consumption associated with the program is another possibility for additional research. Wharton and Harmon (2009) mentioned that campus-based CSAs might have an impact on health by changing attitudes, as well as improving food skills and eating behaviors of participants, especially students. This could also apply to the fruit and vegetable program, and it might be of interest to measure the student impact of a similar program with a larger student population.

In conclusion, participants increased their consumption of fruits, vegetables, vitamin-rich vegetables and leafy greens after the program, but not at a significant level. The healthy quality of participants' diets also improved, but insignificantly. Results showed that women improved their diets in all these categories at a greater level than men. Moreover, there was a significant increase for all participants in the meals consumed containing mostly plant-based foods with limited animal-based foods. Improved attitudes and healthy behaviors related to fruits, vegetables, and healthy eating were also reported for all participants at the conclusion of the program.

Advantages of the program included a convenient method of increasing the fruits and vegetables in participants' diets, provision of recipe and preparation suggestions, reasonable cost, the opportunity to try new foods, the chance to donate to underprivileged

groups, and the opportunity for student leadership and volunteer experiences. The inability to inform participants of the produce they would receive early in the week was one disadvantage for many enrolled in the program. Paying for all eight weeks before the program started and the inability to allow new participants after the program began were also problematic for some. However, the participants reported that the program was very valuable overall in improving their fruit and vegetable consumption.

CHAPTER II

REVIEW OF RELATED LITERATURE

Extended Literature Review

Introduction

Fruits and vegetables are an important part of one's daily diet, yet few people consume them in the recommended amounts. Lutfiyya, Chang, and Lipsky (2012) found that 78.8% of rural US adults and 75.6% of non-rural US adults consumed less than five servings of fruits and vegetables per day. MyPlate recommends three to five cups of fruit and vegetables per day (USDA, n.d.). Servings of most fruits and vegetables are generally counted in one-half cup increments, so three to five cups would be six to ten servings (American Heart Association, 2015).

There are many benefits acquired from meeting the recommended amount of fruits and vegetables per day. Among these benefits are decreased calorie intake, increased satiety, provision of important nutrients, prevention of certain chronic diseases, and decreased risk of overweight/obesity. In addition, fruits and vegetables provide a wide array of colors on the plate, making food more visually appealing.

Benefits of Fruit and Vegetable Intake

Energy density and caloric intake. The Centers for Disease Control and Prevention (CDC) define energy density as the calories contained in a specific weight of food (CDC, n.d.a). Energy density may affect the balance of energy intake with energy

expenditure and consequently, the ability to maintain current body weight. Foods that are low in energy density, such as fruits and vegetables, may help people decrease their energy intake and promote a healthy weight (Hackett, 2012). Foods with high energy density may cause consumption of excess calories, therefore promoting weight gain and leading to obesity (Prentice and Jebb, 2003). Increasing the fruits and vegetables in a meal may lower the energy density and permit consumption of larger, more satisfying portions while maintaining or decreasing the energy level, thus improving weight management (Rolls, Ello-Martin, and Tohill, 2004).

Including fruits and vegetables in meals can help lower the energy density of meals. Considerable weight loss has been associated with diets having lower energy density due to the addition of water-rich foods such as fruits and vegetables (Rolls, 2009). These lower energy-density diets are thought to assist in weight loss as people tend to decrease their energy intake despite the lack of limits on consumption (Rolls, et al., 2004). Since people usually consume food with a similar weight, reducing the energy density may also reduce caloric intake (Rolls, 2009). Studies have also shown that the addition of pureed vegetables reduced energy density of foods and decreased energy intake (Spill, Birch, Roe, and Rolls, 2011; Vale, Schumacher, Cullen, and Gam, 2014).

According to Rolls (2009), water decreases the caloric value of foods because it adds weight to the food without adding energy. Nearly all fruits and vegetables contain large quantities of water. Rolls, et al. (2004) attribute the lower energy density in fruits and vegetables mostly to the high quantity of water and low amount of fat present, although the fiber contained in produce also lowers the caloric value.

Satiety. Satiety is the body's physiological response to adequate consumption of food (McGuire and Beerman, 2011). Increased satiety is another benefit attributed to the intake of fruits and vegetables. Rolls, et al. (2004) believe increased satiety is due to the reduced energy density, increased fiber content and glycemic index of fruits and vegetables. Rolls (2009) determined that reduced energy density in foods such as fruits and vegetables may increase satiety by delaying gastric emptying.

Some studies have identified that larger quantities of fiber increase satiety and reduce consumption of calories (Rolls et al., 2004). A meta-analysis by Clark and Slavin (2013) determined that some fibers may have a stronger impact on satiety than others. Savastano, Hodge, Nunex, Walker, and Kapikian (2014) investigated the impact of fiber on energy intake and satiety and found that the groups consuming the extra fiber had decreased energy intake and increased satiety when compared to the control group. Harrold et al., 2013, also observed that fiber consumed 15 minutes before meals significantly decreased caloric intake during the meal.

Glycemic index has been defined by the American Diabetes Association (2014) as a number used to compare how foods with carbohydrates affect blood sugar. Many studies researching the effects of glycemic index on satiety have conflicting results (Bornet, Jardy-Gennetier, Jacquet, and Stowell, 2007; Burton-Freeman and Keim, 2008; Wolever, Leung, Vuksan, and Jenkins, 2009; Papadaki, et al., 2010). In a review of recent research, Jones determined that the impact of the glycemic index on satiety may vary based on the participant's personal characteristics. Furthermore, Jones (2013) suggests that the varied ways of measuring satiety may be responsible for the conflicting results among studies. The variation in glycemic index among vegetables may also have an

impact on the differing outcomes. However, glycemic index is another possible mechanism that assists fruits and vegetables in impacting satiety.

Disease risk. Consumption of fruits and vegetables may protect against a number of chronic diseases. Elevated levels of fruit and vegetable intake have been associated with a decreased frequency of chronic disease related to obesity, such as type two diabetes and cardiovascular disease. In addition, Bellavia, et al. (2013), found a relationship between intake of less than five servings of fruits and vegetables per day and higher overall mortality rates. Possible evidence was found to indicate that higher intakes of fruits and vegetables reduce the risk of dementia and preclude increased weight. Another benefit indicated by this research is a lower risk of some eye diseases, rheumatoid arthritis, osteoporosis, asthma and COPD with an increase in consumption of fruits and vegetables (Boeing, et al., 2012).

A current research study investigating ideal consumption levels for the general population in England determined that the lowest mortality rate occurs with individuals who consume at least seven servings of fruits and vegetables. For this study, servings were defined as 80 grams (slightly more than one-half cup), as determined by NHS England (Oyebode, Gordon-Dseagu, Walker, & Mindell, 2014). Another recent study concluded that each additional portion of fruit decreased risk of death by 6% and each additional portion of vegetables decreased the risk of death by 5% up to five servings per day (Wang, Ouyang, Liu, Zhu, Zhao, Bao, & Hu, 2014).

Type 2 diabetes. Lambrinoudaki et al. (2012) stressed the importance of eating patterns high in fruits and vegetables as part of a healthy diet helpful in the prevention of type 2 diabetes (T2D) and other chronic diseases. Moreover, two meta-analyses found an

association between an increased intake of leafy green vegetables and a significant decrease in the risk of T2D (Carter, Gray, Troughton, Khunti and Davies, 2010; Li, Fan, Zhang, Hou, & Tang, 2014). The study by Li, et al. (2014) determined that consuming more fruit may also lower the risk of T2D. A study investigating fruit and vegetable intake in patients with T2D also found that increased consumption produced higher levels of carotenoid and the enzymes associated with the antioxidant function of HDL, suggesting that an increase in fruits and vegetables consumed may help lower the risk of T2D and related cardiovascular disease (Daniels, et al., 2014).

Heart disease and stroke. Studies show that fruits and vegetables decrease the risk of cardiovascular disease. In a review of several studies, Boeing, et al. (2012), found convincing evidence that consumption of fruits and vegetables may assist in the prevention of hypertension, heart disease and stroke. Similarly, Bhupathiraju et al. (2013) determined that an inverse relationship existed between consumption of more of fruits and vegetables and risk of heart disease. In an Italian cohort study, Bendinelli et al. (2011) substantiated a lower risk of coronary heart disease for individuals consuming larger quantities of leafy green vegetables. Finally, He, Nowson, Lucas and MacGregor (2007) determined that participants in a number of cohort studies who consumed more than five servings of fruits and vegetables had a 17% lower risk of coronary heart disease when compared to those who consumed less than three servings per day.

Oxidative stress. Oxidative stress occurs when there are more free radicals and reactive species than antioxidants can defend against, and may increase the risk of chronic diseases such as coronary artery disease and T2D (Cocate et al., 2014). Antioxidants are found in a wide variety of fruits and vegetables (Wood, et al., 2012). In

a recent cross-sectional study, Cocate et al., observed that a higher consumption of fruits and vegetables was associated with reduced oxidative stress markers. Cocate et al. (2014) also found that fiber, vitamin C, and magnesium from fruits and vegetables played an important part in lowering oxidative stress markers. Other recent studies reported similar results (Meyer, 2013; Hermsdorff, et al., 2012).

Cancer. There is extensive conflicting information about cancer and its relationship to fruit and vegetable intake. Some cancers appear to be less prevalent in populations who consume high amounts of fruits and vegetables while others are not affected. The many different forms and locations of cancer may play a part in the apparent lack of consistent results. Boffeta, et al. (2010) found a small relationship between a decreased risk of overall cancer and consumption of high amounts of fruits and vegetables. However, this was considered to be very weak evidence. Conversely, Boeing, et al. (2012) reported probable evidence that cancer risk decreases as intake of fruits and vegetables increases. The seemingly conflicting evidence may be due to the difference in how various forms of cancer react to individual nutrients and the difficulty in summarizing all those differences into one statement.

Many studies tie abundant fruit and vegetable intake to a lower risk of a variety of cancers, sometimes with other factors included. For example, Hardin, Cheng and Witte (2011) found that diets high in fruits and vegetables and low in foods with a high glycemic index decreased the risk of acquiring more aggressive prostate tumors. Conversely, in a prospective cohort study Takachi, et al. established that prostate cancer may not be related to fruit and vegetable intake. In their review of previous related research, Takachi, et al. determined that few studies found an inverse association between

prostate cancer and an increased consumption of fruits and vegetables, and their research supported this position. However, the possibility of detection bias could not be ruled out in this research (Takachi, et al., 2010).

Limited research was available to explain the association of fruit and vegetable consumption with pancreatic cancer. One study by Lin, et al. (2006) observed a 50% reduction in the relationship of high fruit consumption with the probability of pancreatic cancer. In addition, pancreatic cancer risk was found to be lowered by most nutrients acquired through consumption of fruits and vegetables (Jansen, et al., 2013). Likewise, the possibility of pancreatic cancer was determined to be less likely in individuals who consumed large quantities of fruits and vegetables (Jansen, et al., 2011).

Moreover, Lahmann, Ibiebele, Webb, Nagle and Whiteman (2014) concluded that there is a decreased risk of esophageal cancer with higher fiber consumption. Conversely, Adair, Hoy, Dettrick and Lopez (2011) found a weak relationship between fruit and vegetable consumption and esophageal cancer. The same study discovered a much stronger association with pharyngeal cancer.

Ovarian cancer is another form whose association with fruit and vegetable consumption has produced inconsistent results in research studies. Tang, Lee, Su, and Binns (2014) observed a decrease in the incidence of ovarian cancer in southern Chinese women when fruit and vegetable intake increased. Additionally, intake of cruciferous vegetables was determined to lower the risk of ovarian cancer (Han, Li, and Yu, 2014). However, a prospective cohort study by Xie, et al. (2014) found little connection between fruit and vegetable intake and the risk of ovarian cancer.

Lung cancer studies also provide a variety of results. One study in Iran determined that fruits were protective against lung cancer (Hosseini, et al., 2014). Another study found the same relationship between fruit consumption and lung cancer only in smokers (Bradbury, Appleby, and Key, 2014). Tang, et al. (2010) also found that a high intake of cruciferous vegetables was associated with a decreased risk of lung cancer in smokers. Furthermore, consumption of green leafy vegetables, vegetables high in beta-carotene, and watermelon were found to lower the risk of lung cancer (Takata et al., 2013).

A meta-analysis determined that a diet high in fruits and vegetables may help decrease the likelihood of gastric cancer (Massarrat and Stolte, 2014). A pooled analysis of four large Japanese cohort studies also found a decrease in the risk of gastric cancer related to vegetable intake but not fruit intake (Shimazu et al., 2014). Conversely, Wang, et al. (2014) determined that fruit intake but not vegetable intake was associated with a decreased the risk of gastric cancer in a meta-analysis of 24 cohort studies.

Vieira, et al. analyzed 15 research studies, resulting in a determination that there is no relationship between the risk of bladder cancer and consumption of total fruit, total vegetables and total fruit and vegetables. After adjusting for smoking status, one study demonstrated an inverse association. However, certain individual fruits and vegetables were inversely associated with a decreased risk. Citrus fruits were significantly associated with a reduced risk of bladder cancer until one study was removed. Cruciferous vegetables were also inversely associated with a decreased risk in a small number of observations (Vieira, et al., 2014). Similarly, a meta-analysis of case-control and cohort studies observed a relationship between consumption of citrus fruit and a smaller risk of

bladder cancer (Liang, Lv, Chen, Jiang, and Wang, 2014). Thus, it seems clear that fruits and vegetables may be beneficial for some types of cancer.

Cognitive impairment. There have been several studies investigating the relationship of fruit and vegetable intake with various types of cognitive impairment. Lamport, Saunders, Butler, and Spencer (2014) reported that frequent intake of fruits, vegetables and juices over a lifetime had a positive impact on comprehension in healthy older adults and may be protective against cognitive aging and dementia. In a study by Kesse-Guyot, Andreeva, Lassale, Hercberg, & Galan (2014), limited intake of fruits and vegetables were one of the unhealthy behaviors associated with reduced verbal memory. Park, You and Chang (2010), found that nutrients such as vitamin A, beta carotene, vitamin C, fiber and folate could be lacking in people with depression. Additional studies found that diets high in fruits and vegetables were protective against depression (Akbaraly et al, 2009; Samieri et al., 2008). In a meta-analysis by Sanhueza, Ryan, & Foxcroft (2013), a lower risk of depression was indicated by a diet incorporating folate, omega-3 fatty acids, olive oil, fish, fruits, vegetables and nuts. Boeing et al. also found that older adults with depression were more likely to exhibit lower consumption of fruits and vegetables. They identified that antioxidants from food sources were inversely related to depression, but other forms of antioxidants were not (Boeing et al., 2012). Finally, in a study by Florence, Asbridge, and Veugelers (2008), fruit and vegetable intake was found to positively impact academic performance in children.

Lung diseases. Lung diseases may also be positively impacted by a diet high in fruits and vegetables. Chatzi et al. (2007) observed an improvement in allergic symptoms such as wheezing and rhinitis related to a diet high in fruits and vegetables. In addition,

Mendes, et al., (2011) found an inverse association between the regular consumption of fruits during the most recent 30 days and the risk of having more severe asthma in children. In a meta-analysis, it was reported that diets high in fruits especially, but also in raw vegetables, were significantly associated with a lower risk of wheezing. The results of this study also showed that consumption of vegetables in higher quantities decreased the risk of asthma (Seyedrezazaeh, et al., 2014). Another study also reviewed previous research about the intake of fruits and vegetables and the effect on lung diseases. Their study found possible evidence of a negative association between fruit and vegetable consumption and a decreased risk of asthma and COPD (Boeing et al., 2012).

Bone health. Research has investigated the impact of fruit and vegetable consumption on bone health in a variety of ways. Studies may use osteoporosis, osteoporotic fracture, bone mineral content, bone mineral density, or other bone metabolism parameters as a measure of bone strength and stability. Boeing, et al. (2012) found possible evidence that a high intake of fruits and vegetables may improve bone health. Research investigating osteoporosis, osteoporotic fracture, bone density and bone metabolism parameters produced inconsistent results causing the "possible evidence" designation. Other studies reviewed for this research examined the impact of fruit and vegetable intake during childhood as well as the influence of maternal intake during pregnancy. These factors highlight the complexity of assessing the relationship between diet and bone health.

A more recent study investigating adolescents, young, and postmenopausal women found increased bone mineral density and bone mineral content in all three groups significantly associated with higher fruit consumption. The effects were strongest

in boys and postmenopausal women (Li, et al., 2013). Conversely, Neville, et al. (2014) investigated older adults and determined no significant difference in bone markers between the group that significantly increased their fruit and vegetable intake and the group that continued to consume two or fewer servings of produce per day. Similar to the research by Boeing, et al. (2012), the results of these studies show that there is not clear agreement about the relationship of fruits and vegetables on bone health.

Eye diseases and conditions. There are a variety of eye diseases and conditions that may be influenced by the intake of fruits and vegetables, such as age-related macular degeneration (AMD), glaucoma, cataracts, and diabetic retinopathy. Amirul Islam, et al. evaluated how food frequency data related to AMD. Based on this data, it was determined that a diet including high amounts of fruits, vegetables, chicken, and nuts paired with limited red meat decreased the risk of advanced AMD (Amirul Islam, et al., 2014). Less severe AMD was not associated with any particular pattern of consumption (Amirul Islam, et al., 2014). Another study found a significant relationship between diet and AMD based on Oriental (more fruits, vegetables, legumes, whole grains, tomatoes and seafood) and Western (more red meat, processed meat, high-fat dairy, French fries, refined grains, and eggs) dietary patterns. Participants in the study who consumed a diet close to the Western diet had a greatly increased risk of AMD, whereas the odds of AMD continued to decrease as the diet pattern moved closer to an Oriental diet (Chiu, et al., 2014). Both of these studies associate improved conditions with dietary patterns including fruits and vegetables as opposed to an association with fruits and vegetables themselves. In contrast, Jonas, Nangia, Kulkarni, Gupta, and Khare (2012) discovered a mildly significant relationship between AMD and a limited consumption of fruit.

All individuals with diabetes are at risk for diabetic retinopathy, and 40-45% of diabetic Americans have been diagnosed with it. Mahoney and Loprenzi (2014) determined that diabetic adults with a high intake of fruits and vegetables containing flavonoids had a decreased risk of diabetic retinopathy. A higher fruit consumption within a normal range of fruit intake and as a part of a low-fat, low-calorie diet was also related to a lower incidence of diabetic retinopathy (Tanaka et al., 2013).

Furthermore, a smaller risk of glaucoma was found for older African-American women when they consumed more fruits and vegetables with high concentrations of vitamin A, vitamin C and carotenoids (Giaconi, et al., 2012). Additionally, Pastor-Valero (2013) discovered an inverse association between fruit, vegetable, vitamin C and vitamin E consumption on a regular basis and the risk of cataracts. The meta-analysis compiled by Boeing, et al. found possible evidence that a higher intake of fruits and vegetables may decrease the risk of macular degeneration and cataracts. Conversely, the evidence was insufficient to show any effect of increased fruit and vegetable intake on the risk of glaucoma or diabetic retinopathy (Boeing, et al., 2012).

Rheumatoid arthritis. A general review of factors impacting rheumatoid arthritis (RA) concluded that characteristics of a healthy diet including fruits and vegetables may be beneficial to patients with RA (O'Connor, 2013). Furthermore, a study of RA patients with healthy arteries investigated how the intake of vegetables and fruits related to arterial function (Crilly & McNeill, 2012). The results showed a relationship between patients with better arterial function and the consumption of vegetables, but not fruits, on a daily basis. Boeing, et al. (2012) also found possible evidence relating a high

consumption of produce with a lower risk of rheumatoid arthritis; this was only considered possible evidence due to the limited number of studies available.

Overweight and obesity. A number of factors play a part in overweight and obesity, including an imbalance between energy intake and energy expenditure. Intake of fruits and vegetables are one factor, and their impact may be due to several different causes. First of all, fruits and vegetables are lower in calories, and therefore, when consumed in place of higher calorie foods, energy balance is improved. Based on the studies reviewed by Rolls, et al. (2004), the authors suspect fruits and vegetables may also impact weight management by decreasing hunger and increasing satiety.

Furthermore, fruits and vegetables are high in fiber compared to most other foods, and epidemiologic studies have shown that people with higher fiber intakes are more likely to have a lower body weight (Clark and Slavin, 2013). Davis, Hodges and Gilham (2006) determined that study participants consuming a diet high in fiber, complex carbohydrate, and fruit were more likely to have a normal amount of body fat and a healthy weight based on their height. A systematic review determined that the majority of studies reviewed found an inverse relationship between overweight/obese adults and fruit and vegetable intake. However, the study did not identify whether that relationship was due to the fruits and vegetables, decreased energy intake or increased activity levels (Ledoux, Hingle & Baranowski, 2010).

Optimal Intake

Recommendations for optimal intake of fruits and vegetables differ slightly among experts. The DGA make general recommendations, such as increasing the consumption of fruits and vegetables and the variety of vegetables. The Guidelines also

suggest intake of foods that contain the nutrients most lacking in U.S. diets. Fruits and vegetables are a significant contributor to these nutrients that are lacking (USDA, 2010).

Advice from other groups is more specific. On the ChooseMyPlate website, the USDA recommends one and one-half to two cups of fruit per day and two to three cups of vegetables per day for adults and one to two cups of fruit per day and one to three cups of vegetables per day for children. The exact amount is determined by age and gender. The USDA further specifies one and one-half to two cups of leafy green vegetables, four to six cups of red and orange vegetables, one to two cups of beans and peas, four to six cups of starchy vegetables, and three and one-half to five cups of other vegetables per week for adults, thus identifying the need for a variety of fruits and vegetables to provide diverse nutrients. For children, one-half to two cups of leafy green vegetables, two and one-half to six cups of red and orange vegetables, one-half to two cups of beans and peas, two to six cups of starchy vegetables and one and one-half to five cups of other vegetables. The simplified version advises individuals to fill half of their nine-inch plate with fruits and vegetables (USDA, n.d.).

Similarly, the Harvard School of Public Health (2015) suggests people on a 2000-calorie per day diet aim for two cups of fruit and two and one-half cups of vegetables (nine servings one-half cup servings). Furthermore, Health Canada's Food Guide, last updated in 2007, recommends seven to ten one-half cup (one cup for leafy greens) or one piece servings of fruits and vegetables for adults, and four to eight servings for children. Canadian recommendations are also determined based on age and gender (Health Canada, 2007). Additionally, the World Health Organization (2004) suggests a minimum of five servings (slightly over one-half cup) per day. The Australian government also

encourages five to seven and one-half servings of vegetables (one cup for leafy greens and one-half cup for other vegetables) and two cup servings of fruit (one cup, one medium piece, or two small pieces) (Australian Government Department of Health, n.d.). Furthermore, recommendations in Japan include five to six servings of vegetables and two servings of fruit per day (The Japan Dietetic Association, n.d.).

Current Intake

Results from the Behavioral Risk Factor Surveillance System in 2011 showed that the national median for fruit intake was 1.1 times per day and 1.6 times per day for vegetable intake. Moreover, 37.9% of people surveyed consumed fruit less than once per day and 22.5% consumed vegetables less than once per day. Illinois responses were similar, with the same medians for fruits and vegetables, but 36% of people surveyed consumed fruit less than once daily, and 25% consumed vegetables less than once daily (CDC, n.d.b). From 2011 to 2013, rather than improving, results actually declined slightly. Both the national median and state median for fruits and vegetables remained the same, as did the percent in Illinois who ate fruit less than once a day. However, 37.7% of the national population reported consuming fruit less than once per day, and 22.6% reported consuming vegetables less than once per day. In Illinois the percentage for vegetables rose to 25.2% (CDC, 2013). This data indicates that current consumption is moving toward smaller numbers of fruits and vegetables both nationally and locally.

Similarly, data from the USDA Economic Research Service shows a downward trend in vegetable consumption. This data is not a direct measure of food consumption, but is commonly used as an alternate method of comparing intake over time. Estimated consumption of fresh-market vegetables (excluding potatoes, sweet potatoes, dry pulses

and mushrooms) has changed little since 2006. However, estimated fresh vegetable intake in 2013 was 138.9 pounds, down from an average of more than 146 pound between 2000 and 2009. Additionally, processed vegetables (excluding potatoes and mushrooms) in 2013 decreased three percent compared to the average from 2010 to 2012. Moreover, per capita use of a group of commercially produced, fresh vegetables, processed vegetables, and dry pulses were 385.7 pounds in 2013, decreased from 424.6 pounds in 2000 (Economic Research Service, 2014).

Comparison Between Optimal and Current Intake

Clearly, there is a discrepancy between the recommended intake of fruits and vegetables and the amount Americans are currently consuming, and that difference is increasing (Economic Research Service, 2014). A large portion of the population is consuming fruits and vegetables less than once per day, and the median for both types of produce is less than two times per day (CDC, n.d.b). While it is possible that each time fruit or vegetables are consumed, multiple servings are included, it is unlikely that many people meet the recommended amounts (according to USDA, (n.d.), of as much as two cups of fruit or three cups of vegetables) in one meal. Therefore, it seems probable that a large number of Americans are not meeting their fruit and vegetable needs.

Possible Causes of Discrepancy Between Optimal and Current Intake

Several factors impacting fruit and vegetable intake by children and adolescents were identified by Krolner, Rasmussen, Brug, Knut-Inge, Wind, and Due. First of all, taste and preferences were determined to be an important factor, and the larger number of fruits and vegetables children enjoyed (which appeared to be related to socio-economic position and age), the higher their total consumption of fruits and vegetables was likely to

be. Sensory and physical attributes of produce, such as taste, texture, appearance, and smell was another factor impacting children's desire to eat fruit and vegetables. Additionally, satiety may be a factor for some students. Krolner, et al. reported different satiety responses to fruits and vegetables in different studies. Other factors determined to have an impact included children's expectations of fruits and vegetables impact on satiety, health, appearance; children's perceptions of appropriate time or setting for fruit and vegetable intake; nutrition knowledge; difficulty, convenience and capability of preparation; cost; availability of fruits and vegetables at home, at school, and locally; and the influence of parents, peers and media Krolner, et al. (2011). Moreover, Ganann, Fitzpatrick-Lewis, Ciliska, and Peirson, (2012) included lack of access to fruits and vegetables, socioeconomic status of consumers, cost of produce, understanding of nutrition, preferences and self-efficacy in their discussion of determinants of fruit and vegetable consumption by children and adolescents.

In a study investigating 320 professional women aged 45 to 55, Gacek (2013) identified a relationship between self-efficacy, optimism, life-satisfaction and a higher level of fruit and vegetable intake, suggesting that the lack of strong self-efficacy, optimism and satisfaction with life may be a barrier to appropriate levels of fruit and vegetable consumption. Furthermore, Pitts, et al. (2013) discovered that there was no association between college students who shopped at a farmer's market and the probability of consuming at least five servings of fruit and vegetables, but other individuals shopping at a farmer's market were much more likely to eat five or more servings of fruits and vegetables daily. This signifies that limited access to fruits and vegetables or limited access to a higher quality of fruits and vegetables may also reduce

the quantity individuals consume. Thornton, Crawford and Ball (2010) also determined that those consuming fruit on a more frequent basis had access to venues selling fruits and vegetables that operated for longer hours.

Older adults may have their own unique situations that present additional barriers for fruit and vegetable consumption. Disease may affect taste preferences, mechanical digestion and/or absorption, and shopping or preparation ability. A fixed income may prevent purchase of more expensive forms of produce, thus limiting available options. Nicklett and Kadell (2013) discussed a large number of factors negatively impacting fruit and vegetable consumption, including changes in taste, smell and hunger awareness that affect appetite; chewing, swallowing and digestive difficulties; mental and emotional changes that may affect desire to eat or pleasure gained from food; and physical limitations that make acquiring or preparing food difficult, frequently removing choice from the individual when they need to rely on others for food provision.

Barriers may vary somewhat with age and stage of life, but some can be present across the entire life-span. Socioeconomic status and access to fruits and vegetables are factors that can impact any age group. Darmon and Drenewski (2008) determined that a higher socioeconomic status increases the likelihood of fresh vegetable and fruit consumption. Furthermore, Aggarwal, et al. (2014) found that individuals who shopped at low-cost supermarkets had a significantly lower intake of fruits and vegetables than those who shopped at supermarkets with higher prices, even after adjusting for socioeconomic status. Thus, it may be that the availability of tempting fruit and vegetable options in any form is more constrained at a low-cost supermarket, decreasing the

likelihood of purchasing and consuming a quantity of fruit and vegetables sufficient to meet nutritional needs.

Community Supported Agriculture

Community supported agriculture (CSA) is a method of agricultural distribution that brings together the farmer growing crops with customers who prefer to purchase food directly from the farmer. The farmer generally offers shares of his farm outputs, including produce, meat, poultry or eggs. In return, the farmer typically receives cash to cover inputs such as the seed and labor required to grow and nurture the products. Most CSAs offer a bag or box usually averaging between 8.5 and 27 pounds of produce (Cohen, et al., 2012) available for pickup at a specified location and time on a weekly or bi-weekly basis. Fruits and vegetables harvested are divided proportionately among the shareholders, thus allowing any risks or rewards to be shared with the CSA members.

The CSA distribution model first appeared in the United States in the middle 1980's (Janssen, 2010), and has become very popular during the last 20 years (Cohen, et al., 2012). In some locations, the demand for a CSA share exceeds available membership opportunities. Consequently, many CSAs have a waiting list of potential customers. No governmental agency maintains data on CSAs, but LocalHarvest (2015) has a database listing more than 4,000 CSA programs in the US.

Studies show that individuals who join a CSA share similar characteristics. Uribe, et al. (2012) determined that participants of the CSA were older, had completed more years of education, and had an income above the national average. Other research indicates that women, as the primary shoppers of food (Zepeda & Li, 2007), are more likely to participate in a CSA (Perez, Allex & Brown, 2003; Russell & Zepeda, 2008;

Uribe, et al., 2012; Curtis, Ward, Allen & Slocum, 2013). Curtis, et al. (2013) also found that members were highly educated, but with average income levels and qualms about health and food safety. Finally, Brehm and Eisenhauer (2008) found members of CSAs to be supporters of environmental protection and sustainability.

Consumers choose to purchase a CSA membership for a variety of reasons. One study found that participants join a CSA to support local agriculture, obtain healthier food, and understand where their food is coming from and how it is produced (Landis, et al., 2010). In addition, Cooley and Lass (1998) determined that, as well as a desire to support local farms, individuals participated in a CSA for higher quality produce, safer produce and a desire to promote environmental sustainability. Uribe, et al. (2012) found in summarizing previous research studies that members perceived produce from a CSA to be consistently safe, nutritious and superior in quality. Moreover, a study by Brehm and Eisenhauer (2008) concluded that support for the community beyond agriculture was a motivating factor for joining a CSA.

Research demonstrates that consumers who purchase a share of a CSA eat a wider variety of fruits and vegetables (Cohen et al., 2012; Quandt, Dupuis, Fish & D'Agostino, Jr., 2013).Furthermore, Uribe, et al. (2012) determined that most CSA shareholders and their family members increased their consumption of fruits and vegetables due to their participation in the CSA. Previous research reported similar results (Perez, et al., 2003; Landis, et al., 2010). Some studies have also established that members of a CSA program eat at home more frequently after joining the program (Perez, et al., 2003; Russell & Zepeda, 2008; Curtis, et al., 2013).Additionally, many CSAs have an educational aspect, allowing members the opportunity to learn about seasonality of produce, in addition to

cooking methods and preservation techniques (Curtis, et al., 2013), thus improving their food preparation skills and increasing the likelihood of consuming adequate daily servings of fruit and vegetables.

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APPENDIX A

RECRUITMENT EMAIL

Hi Everyone!

Fresh FAVs will be back in action this semester! I hope everyone is as excited as I am. I wanted to personally email all of you to give you all of the information for signing up for this semester.

Things are slightly different this time. We are now doing a small, medium, and large bag. The pick-up times have also changed. Pick-up will continue to be on Fridays but the times will be from noon-1:30 and 3:30-5pm.

For more information and the the registration form just follow this link:

http://wellness.illinoisstate.edu/healthy-living/nutrition/FreshFAVs.shtml

Try not to wait to the last minute to sign up. As of now there is not a cap on the number of participants. However, if we get too many we may have to cap it and I would hate for you to miss your chance to participate!

Please feel free to forward this information on to anyone at ISU that may want to participate. Many of you have told me that other people in your office are wanting to participate this time so make sure to share the news!

If you have any questions please do not hesitate to ask!

Erin Moses

APPENDIX B

CONSENT FORM

Consent Form

The Department of Family and Consumer Sciences' Fresh FAVs Planning Committee at Illinois State University is conducting a research study for the purpose of assessing the dietary intake of participants.

Procedure: We are requesting your participation, which will involve completing an online survey. Your time commitment will be approximately 10 minutes. At the conclusion of the eight-week Fresh FAVs program, we will contact you to complete another survey. The aggregate data will be analyzed for possible correlations.

Withdrawal: Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, you may do so without penalty.

Confidentiality: The results of the research study may be published, but your name will not be used. All Information collected for the purpose of this study will remain anonymous.

Risks: The minimal risks associated with this study are no greater than those experienced in everyday life.

Benefits: Benefits of this study include helping the Fresh FAVs planning committee understand the impact of the program.

If you have any questions concerning the research study, please call Dr. Julie Schumacher at (309) 438-7031.

Sincerely,

Julie Schumacher, EdD, RD, LDN & Jeanne Arbuckle, Dietetic Intern

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Research Ethics & Compliance Office at Illinois State University at (309) 438-2529.

1. Do you agree to participate in this study?*

   - ○ Yes, I agree to participate in this study and am 18 years old or older
   - ○ No, I do not agree to participate in this study or I am <18 years old

APPENDIX C

PRE-SURVEY

1. How many servings of fruit or 100% fruit juice do you eat per day? (OMIT fruit snacks like Fruit Roll-Ups and fruit-on-the-bottom yogurt. One serving=one piece or 1/2 cup of fruit or 6 oz. of fruit juice.)

(a) 0	-3
(b) less than 1	-2
(c) 1	0
(d) 2	+1
(e) 3	+2
(f) 4 or more	+3

2. How many servings of non-fried vegetables do you eat per day? (One serving = 1/2 cup. INCLUDE potatoes.)

(a) 0	-3
(b) less than 1	-2
(c) 1	0
(d) 2	+1
(e) 3	+2
(f) 4 or more	+3

3. How many servings of vitamin-rich vegetables do you eat per week? (One serving=1/2 cup. ONLY count broccoli, Brussels sprouts, carrots, collards, kale, red pepper, spinach, sweet potatoes, or winter squash.)

(a) 0	-3
(b) 1 to 3	+1
(c) 4 to 6	+2
(d) 7 or more	+3

4. How many servings or leafy green vegetables do you eat per week? (One serving = 1/2 cup cooked or 1 cup raw. ONLY count collards, kale, mustard greens, romaine lettuce, spinach, or Swiss chard.)

(a) 0	-3
(b) less than 1	-2
(c) 1 to 2	+1
(d) 3 to 4	+2
(e) 5 or more	+3

5. How many times per week does your lunch or dinner contain grains, vegetables, or beans, but little or no meat, poultry, fish, eggs, or cheese?

(a) 0	-1
(b) 1 to 2	+1
(c) 3 to 4	+2
(d) 5 or more	+3

6. How many times per week do you eat beans, split peas, or lentils? (OMIT green beans.)

(a) 0	-3
(b) less than 1	-1
(c) 1	0
(d) 2	+1
(e) 3	+2
(f) 4 or more	+3

7. How many servings of grains do you eat per day? (One serving= 1 slice of bread, 1 oz. of crackers, 1 large pancake, I cup pasta or cold cereal, or 1/2 cup granola, cooked cereal, rice, or bulgur. OMIT heavily sweetened cold cereals.)

(a) 0	-3
(b) 1 to 2	0
(c) 3 to 4	+1
(d) 5 to 7	+2
(e) 8 or more	+3

8. What type of bread, rolls, etc., do you eat?

(a) 100% whole wheat as the only flour	+3
(b) whole wheat flour as the 1st or 2nd flour	+2
(c) rye, pumpernickel, or oatmeal	+1
(d) white, French, or Italian	0

9. What kind of breakfast cereal do you eat?

(a) whole-grain (like oatmeal or Wheaties)	+3
(b) low-fiber (like Cream of Wheat or Corn Flakes)	0
(c) sugary low-fiber (like Frosted Flakes) or low-fat granola	-1
(d) regular granola	-2

MEAT, POULTRY & SEAFOOD

10. How many times per week do you eat high-fat red meats (hamburgers, pork chops, ribs, hot dogs, pot roast, sausage, bologna, steaks other than round steak, etc.)?

(a) 0	+3
(b) less than 1	+2
(c) 1	-1
(d) 2	-2
(e) 3	-3
(f) 4 or more	-4

11. How many times per week do you eat lean red meats (hot dogs or luncheon meats with no more than 2 grams of fat per serving, round steak, or pork tenderloin)?

(a) 0	+3
(b) less than 1	+1
(c) 1	0
(d) 2-3	-1
(e) 4-5	-2
(f) 6 or more	-3

12. After cooking, how large is the serving of red meat you eat? (To convert from raw to cooked, reduce by 25 percent. For example, 4 oz. of raw meat shrinks to 3 oz. after cooking. There are 16 oz. in a pound.)

(a) 6 oz. or more	-3
(b) 4 to 5 oz	-2
(c) 3 oz. or less	0
(d) don’t eat red meat	+3

13. If you eat red meat, do you trim the visible fat when you cook or eat it?

(a) yes	+1
(b) no	-3

14. What kind of ground meat or poultry do you eat?

(a) regular ground beef	-4
(b) ground beef that’s 11% to 25% fat	-3
(c) ground chicken or 10% fat ground beef	-2
(d) ground turkey	-1
(e) ground turkey breast	+3
(f) don’t eat ground meat or poultry	+3

15. What chicken parts do you eat?

(a) breast	+3
(b) drumstick	+1
(c) thigh	-1
(d) wing	-2
(e) don’t eat poultry	+3

16. If you eat poultry, do you remove the skin before eating?
(a) yes +2
(b) no -3

17. if you eat seafood, how many times per week? (OMIT deep-fried foods, tuna packed in oil, and mayonnaise-laden tuna salad—low-fat mayo is okay.)
(a) less than 1 0
(b) 1 +1
(c) 2 +2
(d) 3 or more +3

MIXED FOODS

18. What is your most typical breakfast?
(a) biscuit sandwich or croissant sandwich -4
(b) croissant, Danish, or doughnut -3
(c) eggs -3
(d) pancakes, French toast, or waffles -1
(e) cereal, toast, or bagel (no cream cheese) +3
(f) low-fat yogurt or low-fat cottage cheese +3
(g) don't eat breakfast 0

19. Does your typical breakfast also include sausage?
(a) yes -3
(b) no 0
(c) don't eat breakfast 0

20. What sandwich fillings do you eat?
(a) regular luncheon meat, cheese, or egg salad -3
(b) tuna or chicken salad or ham -2
(c) peanut butter 0
(d) roast beef +1
(e) low-fat luncheon meat +1
(f) tuna or chicken salad made with fat-free mayo +3
(g) turkey breast or hummus +3

21. What do you order on your pizza?
(a) no cheese with at least one vegetable topping +3
(b) cheese with at least one vegetable topping -1
(c) cheese -2
(d) cheese with one meat topping -3
(e) don't eat pizza +3

22. Do you order extra cheese?
(a) yes -1
(b) no 0
(c) don't eat breakfast 0

23. Do you order a cheese-filled crust?
(a) yes -1
(b) no 0
(c) don't eat breakfast 0

24. Do you order more than one meat topping?
(a) yes -1
(b) no 0
(c) don't eat breakfast 0

25. What do you put on your pasta?
(a) tomato sauce or red clam sauce +3
(b) meat sauce or meat balls -1
(c) pesto or another oily sauce -3
(d) Alfredo or another creamy sauce -4

26. Do you add sautéed vegetables to your pasta?
(a) yes +1
(b) no 0
(c) don't eat pasta 0

27. How many times per week do you eat deep-fried foods (fish, chicken, 61auté61 fries, potato chips, etc.)?
(a) 0 +3
(b) 1 0
(c) 2 -1
(d) 3 -2
(e) 4 or more -3

28. At a salad bar, what do you choose?
(a) nothing, lemon, or vinegar +3
(b) fat-free dressing +2
(c) low- or reduced-calorie dressing +1
(d) oil and vinegar -1
(e) regular dressing -2
(f) cole slaw, pasta salad, or potato salad -2
(g) cheese or eggs -3

29. How many times per week do you eat canned or dried soups or frozen dinners? (OMIT lower-sodium, low-fat ones.)

(a) 0	+3
(b) 1	0
(c) 2	-1
(d) 3 to 4	-2
(e) 5 or more	-3

30. How many servings of low-fat calcium-rich foods do you eat per day? (One serving=2/3 cup low-fat or non-fat milk or yogurt, 1 oz. low-fat cheese, 1 1/2 oz. sardines, 3 1/2 oz. canned salmon with bones, 1 oz. tofu made with calcium sul-fate, 1 cup collards or kale, or 200 mg of a calcium supplement.)

(a) 0	-3
(b) less than 1	-1
(c) 1	+1
(d) 2	+2
(e) 3 or more	+3

31. How many times per week do you eat cheese? (INCLUDE pizza, cheeseburgers, lasagna, tacos or nachos with cheese, etc. OMIT foods made with low-fat cheese.)

(a) 0	+3
(b) 1	+1
(c) 2	-1
(d) 3	-2
(e) 4 or more	-3

32. How many egg yolks do you eat per week? (ADD 1 yolk for every slice of quiche you eat.)

(a) 0	+3
(b) 1	+1
(c) 2	0
(d) 3	-1
(e) 4	-2
(f) 5 or more	-3

FATS & OILS

33. What do you put on your bread, toast, bagel, or English muffin?

(a) stick butter or cream cheese	-4
(b) stick margarine or whipped butter	-3
(c) regular tub margarine	-2
(d) light tub margarine or whipped light butter	-1
(e) jam, fat-free margarine, or fat-free cream cheese	0
(f) nothing	+3

34. What do you spread on your sandwiches?

(a) mayonnaise	-2
(b) light mayonnaise	-1
(c) catsup, mustard, or fat-free mayonnaise	+1
(d) nothing	+2

35. With what do you make tuna salad, pasta salad, chicken salad, etc?

(a) mayonnaise	-2
(b) light mayonnaise	-1
(c) fat-tree mayonnaise	0
(d) low-fat yogurt	+2

36. What do you use to sauté vegetables or other foods? (Vegetable oil includes safflower, corn, sunflower, and soybean.)

(a) butter or lard	-3
(b) margarine	-2
(c) vegetable oil or light margarine	-1
(d) olive or canola oil	+1
(e) broth	+2
(f) cooking spray	+3

BEVERAGES

37. What do you drink on a typical day?

(a) water or club soda	+3
(b) caffeine-free coffee or tea	0
(c) diet soda	-1
(d) coffee or tea (up to 4 a day)	-1
(e) regular soda (up to 2 a day)	-2
(f) regular soda (3 or more a day)	-3
(g) coffee or tea (5 or more a day)	-3

38. What kind of "fruit" beverage do you drink?

(a) orange, grapefruit, prune, or pineapple juice	+3
(b) apple, grape, or pear juice	+1
(c) cranberry juice blend or cocktail	0
(d) fruit "drink," "ade," or "punch"	-3

39. What kind of milk do you drink?

(a) whole	-3
(b) 2% fat	-1
(c) 1% low-fat	+2
(d) skim	+3

DESSERTS & SNACKS

40. What do you eat as a snack?
(a) fruits or vegetables +3
(b) low-fat yogurt +2
(c) low-fat crackers +1
(d) cookies or fried chips -2
(e) nuts or granola bar -2
(f) candy bar or pastry -3

41. Which of the following "salty" snacks do you eat?
(a) potato chips, corn chips, or popcorn -3
(b) tortilla chips -2
(c) salted pretzels or light microwave popcorn -1
(d) unsalted pretzels +2
(e) baked tortilla or potato chips or homemade air-popped popcorn +3
(f) don't eat salty snacks +3

42. What kind of cookies do you eat?
(a) fat-free cookies +2
(b) graham crackers or reduced-fat cookies +1
(c) oatmeal cookies -1
(d) sandwich cookies (like Oreos) -2
(e) chocolate coated, chocolate chip, or peanut butter -3
(f) don't eat cookies +3

43. What kind of cake or pastry do you eat?
(a) cheesecake -4
(b) pie or doughnuts -3
(c) cake with frosting -2
(d) cake without frosting -1
(e) muffins 0
(f) angelfood, fat-free cake, or fat-free pastry +1
(g) don't eat cakes or pastries +3

44. What kind of frozen dessert do you eat?
(a) gourmet ice cream -4
(b) regular ice cream -3
(c) frozen yogurt or light ice cream -1
(d) sorbet, sherbet, or ices -1
(e) non-fat frozen yogurt or fat-free ice cream +1
(f) don't eat frozen desserts +3

45. Do you add hot fudge topping to your frozen dessert?
(a) yes -1
(b) no 0

46. Do you add nuts to your frozen dessert?
(a) yes -1
(b) no 0

47. Do you add chocolate candy bars or pieces to your frozen dessert?
(a) yes -1
(b) no 0

48. What is your connection to ISU?
(a) undergraduate student
(b) graduate student
(c) faculty
(d) staff
(e) retiree

49. What is your home department or unit on campus?:

50. What is your gender?
(a) female
(b) male

51. In what range does your age fall?
(a) 18-27
(b) 28-37
(c) 38-47
(d) 48-57
(e) 58-67
(f) 68 or older

52. Please pick a 4 digit code that you will remember when you complete this survey again at the end of the Fresh FAVs Spring 2014 session.

APPENDIX D

ADDITIONAL POST-SURVEY QUESTIONS

On a scale of 1-5 with 1=Strongly Disagree and 5=Strongly Agree, please rate the following statements:

1. Fresh FAVs had a positive effect on my attitude about produce.
2. Fresh FAVs inspired me to consume more fruits and vegetables.
3. Fresh FAVs inspired me to consume more healthy foods.
4. Fresh FAVs inspired me to locate and use new recipes.
5. Fresh FAVs inspired me to learn new methods of cooking.
6. After participation in Fresh FAVs, I will continue to consume a wider variety of produce than before participating in the program.

What did you like best about the Fresh FAVs Program?

What suggestions for improvement do you have for the Fresh FAVs Program?