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THE EFFECTIVENESS OF BLOGGING AS A TOOL TO IMPROVE DIETARY INTAKE IN
COLLEGE STUDENTS

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ABSTRACT

For the purposes of this study, a blogging intervention was designed around the principles of the Dietary Guidelines for Americans 2010 and was administered to college age individuals enrolled in an introductory nutrition course. The blogging group (n=91) completed a series of blogs over the course of ten weeks and set goals for dietary behavior change. The control group (n=62) submitted an alternative reflective assignment. Both groups completed a 3-day diet record and entered it into a diet analysis software program.

At the completion of the study, the blogging group increased their intake of fruit ($P<.05$), vegetables ($P<.05$), calcium ($P<.05$), and potassium ($P<.05$) and decreased intake of saturated fat ($P<.05$). The control group showed no significant changes. When comparing the changes in dietary intake between the two groups a tendency toward significance in fruit intake was seen ($P=.059$).

When surveyed about their perceptions of the blog, 90% of participants said they responded honestly to the prompts for each blog. Seventy percent of participants indicated that they created habits for at least 3 goals. The most common goals achieved were increased fruit intake, increased vegetable intake, and increased physical activity.

The use of blogging and goal setting as a tool to improve dietary intake in college students has been shown to be promising, however, it does require further exploration.

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Chapter 1

Introduction

Literature Review

The Dietary Guidelines for Americans 2010 (DGA 2010) are a comprehensive set of recommendations provided by the U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (HHS) to reduce the risk of chronic disease and to promote the general health of Americans ages two and older. They encourage consuming recommended nutrients through food rather than supplementation. Most recommendations are based on Dietary Reference Intakes (DRIs) set forth by the Institute of Medicine. The Guidelines take into account a variety of dietary patterns, such as vegetarianism, Mediterranean diets, and DASH (Dietary Approach to Stop Hypertension) diets, as well as cultural practices. They promote five basic food groups (grains, dairy, protein, fruits, and vegetables) and several nutrients of concern for the prevention of chronic disease (calcium, iron, potassium, saturated fat, and sodium).¹

Rates of obesity are on the rise in the United States. The most recent NHANES data suggests that 140.2 million people, 64.2% of the population of the United States, should be advised to lose weight. The American diet has been labeled “obesogenic,” and contributes greatly to the steady rise in obesity and chronic disease seen across the country.² It does not come as a surprise that poor dietary patterns are closely linked to these increased rates of obesity, and diet quality has tremendous health related consequences.³

College campuses are no exception to the “obesogenic” environment of the American population. Unintentional weight gain commonly occurs between the ages of 18 and 34 years.⁴ In a national survey of 27,774 college and university students, 34% were categorized as being overweight or obese.⁵ Furthermore, many college students experience weight gain while in college. One study indicated that 70% of students surveyed experienced weight gain in the first two years of college.⁶

The lifestyles of university students are constantly changing. Access to healthy foods can vary greatly between institutions, and the ability for students to make healthy choices based on their current knowledge and what is available to them will vary greatly between students. High caloric diets and frequent snacking have become the norm.⁷

Young adults tend to be less health conscious than their older counterparts.⁸ They are less conscious of the larger implications this may have on their health. Limited research has been done on college-age students, and the available research does not account for the often hectic lifestyle of a college student.⁹ There has also been limited emphasis on the psychosocial factors that impact diet, a factor that may be particularly important when observing young adults.¹⁰ Research indicates, however, that nutrition education may play an important role in improving knowledge and health behaviors of college students.⁴

Dietary Intake of College-Age Students Compared to the Dietary Guidelines

Fruits and Vegetables

The DGA 2010 list both fruits and vegetables as foods to increase in the American diet. On average, American adults are only consuming 59% of the goal. The consumption of fruits

and vegetables has been linked to the prevention of chronic diseases such as heart attack, stroke, and certain cancers.¹

College students are consuming well below the recommendation for fruits and vegetables.⁹ The DGA 2010 recommend consuming at least 2 ½ cups of fruits and vegetables per day.¹ One study of 80 college students ages 18-24 years reported 72% of college age students surveyed were consuming less than 1 cup of vegetables per day and 90% reported consuming less than 1 cup of fruit per day.⁹ A national survey including 27,774 students indicated that 66.4% of all college students are consuming less than the recommendation.⁵

Because of their relatively good health college age individuals are less health conscious, and many consume less than the recommended amount of fruits and vegetables needed to prevent chronic disease.⁸ Several research studies have shown a relationship between consuming adequate amounts of fruits and vegetables and their relation to disease prevention.^{1,3,9,10}

Increasing fruits and vegetables is a cost effective way to avoid disease. The young adult years are an important age group because for most students, they are away from the dietary influences of their families and are making their own decisions about their diet. Furthermore, after college, many students may begin families and can impart healthy eating habits onto future generations.⁸

Several variables can affect the amount of fruits and vegetables consumed by college students. Gender is the strongest determinant. Women are more likely than men to be meeting the recommendations for fruit and vegetable intake. Women are also more likely to have had prior success in the past in increasing fruit and vegetable intake. It has been shown that men tend to report higher intakes of all food groups with the exception of total fruits. Where the students live also has an effect on the number of fruit servings they consume. Living in on

campus residence halls is positively associated with a higher intake of fruit and fruit juice. For both genders, eating breakfast was shown to improve fruit intake.¹⁰

Potassium

Potassium is listed as a nutrient of concern by DGA 2010. Potassium is an important nutrient as it has been linked to lower blood pressure values, decreased incidence of kidney stones, and prevention of bone loss. Healthy adults are advised to consume 4700mg of potassium per day to meet the Adequate Intake (AI) receive health benefits. Sources of potassium include fruits, vegetables, and milk products. On average, Americans are only consuming 56% of the recommended AI level.¹ Little research has been done on the intake of potassium in college-aged populations, however based on the NHANES data for 20-30 year olds, less than 1% are consuming the recommendation for potassium intake.¹¹

Dairy

Dairy products, or other calcium fortified products, are also included as a food to increase by the Dietary Guidelines for Americans 2010. The average intake for American adults is well below the recommendation. The Guidelines recommend that adults consume 3 cups of fat-free or low-fat milk and milk products per day. On average American adults only consume 52% of the goal.¹

Dairy products have been linked to several positive health outcomes. Milk and milk products have been shown to improve bone health. Adequate consumption of dairy can

also reduce the risk of type 2 diabetes and cardiovascular disease. Milk consumption may also help to lower blood pressure.¹

The college atmosphere is not always conducive to healthy eating behaviors, and a substantial decline in dairy consumption in this population has been observed. Adequate consumption of low fat dairy is associated with positive health status.¹² Those who are meeting the dietary recommendations for dairy are more likely to be consuming the recommendation for calcium which is linked to weight status. Consumption of low-fat dairy products is associated with lower weight status and body fat percentage in college-age individuals.¹³

Calcium

Calcium is a nutrient of concern for Americans. The DGA 2010 indicate calcium on their list of nutrients to increase. The greatest source of calcium for most Americans is milk and milk products or calcium fortified foods such as ready to eat cereals and orange juice. As a whole, Americans are only consuming 75% of the recommended goal set by the USDA. Calcium is an important nutrient in the body as it contributes to nerve transmission, muscle contraction, and dilation and constriction of the blood vessels. Calcium also lays a role in bone health. Poor bone health may lead to osteoporosis and bone fractures.¹

Adult women, including those in college, are a population of particular concern.¹ The increase in weight that is seen among college students may be the result of poor calcium intake as their dairy consumption decreases.¹³

Protein

Protein foods include meat, poultry, seafood, eggs, nuts and seeds, and soy products. These foods provide valuable B vitamins, vitamin E, iron, zinc, and magnesium as well as protein to the diet.¹ Americans generally overconsume protein by 1.5 to 2 times the amount recommended by the World Health Organization.¹⁴

Iron

Iron is identified by the DGA 2010 as an additional nutrient of concern, particularly for women of childbearing age.¹ Women between the ages of 19 and 30 are advised to consume 18mg of iron per day. Iron is important in the blood for assisting in the transport of oxygen to the various tissues of the body. It also plays an integral role in several enzymes necessary for digestion and muscle activity. Poor iron consumption may lead to iron deficiency anemia. Iron deficiency can result in general fatigue and poor memory.¹⁵ To improve iron status, it is recommended to increase intake of heme iron, such as lean meat, poultry, and seafood.¹ Consuming iron with vitamin C rich foods such as fruits and vegetables can help to improve absorption.^{1,15} College-aged women have been shown to have particularly low intakes of iron. On average, college women are only consuming about 50% of the RDA.¹⁶ This indicates a need for further research and intervention strategies.

Saturated Fat

Saturated fat is a particular nutrient of concern because of its relation to cardiovascular disease. Saturated fat has been shown to increase both total cholesterol and LDL cholesterol in the body. Because the body is capable of producing the saturated fat that it needs for normal function, there is no dietary requirement. Saturated fat should account for less than 10% of total calories.¹ Based on NHANES data, Americans are generally consuming between 11.5-12.9% of the calories from saturated fat.¹⁷ On average Americans are consuming 110% of the recommendation. The primary contributors of saturated fat in the American diet are full-fat cheese (8.5%), pizza (5.9%), grain-based desserts (5.8%), and dairy-based desserts (5.6%).¹

Frying food in oil can greatly increase the amount of saturated fat in the food.¹ College men are more likely to consume fried foods like potatoes.¹⁰ Fifty percent of all college students, however, report eating high fat or fried fast food at least three times in one week.⁶

Sodium

Nearly all Americans overconsume sodium. The maximum value set by the Dietary Guidelines for American 2010 is 2300 mg per day, and 90.7% of Americans are consuming greater than this each day.¹¹ Americans are consuming 149% of the recommended goal. Men consistently have a higher average rate of consumption when compared to women. The most common sources of sodium in the American diet include yeast bread (7.3%), chicken and chicken mixed dishes (6.8%), pizza (6.3%), and pasta and pasta dishes (5.1%). High intakes of sodium have been linked to high blood pressure which is associated with cardiovascular disease.¹

College students are no exception. Both men and women have been shown to exceed the recommendation for sodium, and men consume more sodium when compared to their female counterparts.¹⁸

Social Cognitive Theory and Goal Setting

The Social Cognitive Theory has been well established as a useful approach to promote health related behavior changes. The SCT rests on the primary notion that behavior, environment, and personal factors are all interconnected. To elicit behavior change, a multifaceted approach must be adopted. Success in behavior change is determined by self-efficacy, outcome expectations, and goal setting. Individual goals can also be affected by self-efficacy and outcome expectations as well as sociostructural factors such as facilitator or impediments.¹⁹ Incorporating SCT and the practice of goal setting has been shown to be effective in establishing dietary change.²⁰ It is believed that when one sets a specific goal for improvement, he or she is more likely to make progress than if the goal had not been set.¹⁹

When setting goals, it is useful to apply the acronym SMART. SMART goals refer to those that are specific (S), measurable (M), achievable (A), relevant (R), and time-bound (T). A specific goal is one that uses an exact quantity for reference. For example, a non-specific goal would be wishing to lose weight, whereas a specific goal would be wishing to lose 10 pounds. A measurable goal is one that can be tracked. This is easy to do when the goal is specific. For example, a goal of losing 10 pounds is measurable in that there is a specific value that can be referenced and tracked for progress. An achievable goal is one that is realistic for the person or population involved. For example, wishing to increase grade point average from 3.0 to 4.0 in a

single academic semester is not realistic. However, setting a goal to improve by 5 points on the next exam is much more achievable. Setting an achievable goal prevents feelings of failure and discouragement. A relevant goal is one that is meaningful and pertinent to the goal setter. The goal setter must believe the goal is worth pursuing. For example, setting a goal to increase fruit and vegetable intake will not be successful unless the person believes that it is important to do so. A time-bound goal is one that sets a deadline for the goal to be reached. This gives the goal setter more motivation to complete the goal than if given an indefinite period of time. An example of a time-bound goal would be a student completing an extra credit assignment by the end of the current week. When used in conjunction, the SMART guidelines help to create a more effective goal.²¹ A completed SMART goal could include the following: a goal to increase dairy consumption by one cup per day in 75% of the population in 6 months.

Current research implies that setting goals can greatly improve health outcomes.²¹⁻²⁶ One research study including 1442 adults indicated a nearly 30% difference in intake between the number of participants who set specific goals to increase their physical activity and those who did not set goals.²³ There is a need for assessing the effectiveness of goal setting in improving dietary intake.²² Goal setting can be a useful tool in improving the quality of dietary intake in adults.²⁴ Guided goal setting, in which the practitioner suggests particular goals are sets the goal for the participants can be especially effective in improving dietary intake.²⁵

O'Donnell et al (2014) determined that in a web-based nutrition intervention, goal setting was effective in increasing the consumption of fruits and vegetables. This study was completed over the course of 10 weeks and examined the relationship between intake, goal, and percentage of the goal achieved over time. The study involved 8 different universities across the United States and targeted college students between the ages of 18 and 24 years. Participants set weekly

goals about fruit and vegetable intake as well as physical activity. Participants self-reported their intake of fruits and vegetables and amount of time spent exercising by choosing an option from a drop down menu. The target goal of the study was for students to greater than or equal to 5 servings of fruits and vegetables per day. At the beginning of the study 3.1% of participants were reaching this goal, and at the completion of the study (week 10), 8.4% of the participants had reached this goal. At week 2 of the study 28.9% of participants were reaching their personal goals and at week 10 58.0% of participants had achieved their goals. One weakness cited was the use of the drop down menu to determine fruit and vegetable intake. The researchers suggested that using diet records may be a more reliable way of obtaining dietary intake information. Because there is such limited research on the relationship between goal setting and fruit and vegetable consumption in young adults, this study indicates the need for further exploration. In particular, a need for more consistent methods of reporting intake.²⁶

Blogging as a Tool

When attempting to make behavior change, reflective journaling can be a useful tool.²⁷ Research suggests that journaling, when completed with regularity, results in more thoughtful and integrated practices.²⁸ In clinical practice, journaling is often used to assist patients trying to improve their diet quality.²¹ Incorporating active thought and self-assessment outside of the classroom helps to elevate the level of work completed by students inside the classroom.²⁸ Journaling is an opportunity for students to demonstrate written communication and analytical thinking skills.²⁷

When determining how to design an intervention, it is important to consider the current culture of the population. The use of technology has become widespread in recent years and has nearly disbanded the use of pen and paper, especially with young adult populations.²⁹ Blogging in particular has been a popular tool for many health related behavior change interventions.^{9,29-31} Taking advantage of the current knowledge base and comfort of the population in using this tool may improve outcomes.²⁹

With the wide spread use of technology, particularly in young adult populations, it comes as no surprise that technology has worked its way into the classroom.²⁹ Blogging in particular has been shown to create an open and interactive environment in which student and their educators can share ideas with ease.³⁰ The blog is considered the next step in the evolution of journaling practices.³²

The term “blog” is a combination of the words “web” and “log.” They allow the author to incorporate written text with video, pictures, hyperlinks, audio, and a whole host of additional resources that are only available in a digital media. Many provide the option for readers to respond to the posts. They are highly accessible to the public, which has allowed them to be used for everything from journalism to self-help to education. Blogging allows students to take an active part in the education process instead of passively receiving information.²⁹

Having a course blog can be helpful as it allows a professor to post additional, course related information to aid the students’ learning. This is also an excellent venue to allow student to post their thought and reactions and to have them read and critiqued by other students. Blogging is an easy way to incorporate technology as it requires little skill on the part of the poster or reader.³⁰ It may be more beneficial to assess students on the completeness of their work and their active use of the blog resource than on a set number of assignments graded for

completion. Evaluation of the blog should be open ended and focus more on the objectives of orientation, assessment, and/or evaluation. Strictly grading the blog could hinder its usefulness.²⁹

Bringing technology into a classroom, however, does not automatically mean that the students' experience will be enriched. While integrating in class activities with new technologies can enhance the academic achievement of the student, the most important factor in any classroom will continue to be an environment conducive to learning. Multimedia in the classroom allows students to develop real world skills that are becoming increasingly important in today's technology driven world. With the accessibility and ease of use that technology can offer, it certainly shows promises as an educational tool of the future.³⁰

One study in particular evaluated the use of blogging as a tool to improve the quality of a college level health education class. The course focused on personal health and wellness. Twenty-one students set a goal at the beginning of the semester and each week submitted a blog post containing a photo of themselves working toward the goal. Students were allowed to choose any goal they deemed useful as long as it was related to health and wellness. The blog allowed the student to discuss goals and their implementation which could then be assessed by the instructor. The blog also allowed students to track their own progress as they move through various stages of change. Strengths of the study included the opportunity for the instructor to interact with students and encourage them in ways that are not possible through conventional assignments. It also cultivated community among students and taught diversity appreciation.³¹ Another strength was the use of goal setting. A potential area for improvement would be to create a clear connection between the course content and the blog content. Although the freedom of expression offered by the blog proved to be beneficial, it is unclear whether or not it truly improved the students' understanding of the course content.

Hypothesis

The importance of a healthy diet has been well documented. The Dietary Guidelines for Americans 2010 have identified that American intake of fruits and vegetables, dairy, protein, calcium iron, potassium, saturated fat, and sodium needs to be improved. The purpose of this study is to evaluate whether incorporating a blogging assignment designed to have the student set goals and reflect on their goals to improve their intake of key foods and nutrients will improve the diet quality of college students over the course of the semester. We hypothesize that at the completion of the study, intake of vegetables, fruits, dairy, calcium, iron, and potassium will increase and intake of protein, saturated fat, and sodium will decrease. A secondary intent of this study is to evaluate the effectiveness of blogging as a tool to promote dietary behavior change and to use in a college level introductory nutrition course. In addition, we intend to fill in the gaps in current research concerning the importance of goal setting in improving nutrition related behaviors.

The study design and data collection was completed by Dr. Mary Dean Coleman-Kelly of Nutritional Sciences Department at the Pennsylvania State University. My role in the study included data entry and all statistical analyses. I completed a review of the current literature and completed the final thesis manuscript.

Chapter 2

Methods

The study was conducted during the spring semester at a large, 4-year, public university in Pennsylvania. Two introductory nutrition classes for non-majors were used for this study. The students enrolled in the class were from a variety of academic majors, and the class was comprised of first-, second-, third-, and fourth-year college students. Participation in the study was voluntary, and all students were eligible to participate in the study and were included as long as they completed each part of the study requirements. Participants who signed the informed consent form, and completed at minimum the pre-and post-three day diet records, at least two blog posts (experimental group only), and the end of the study survey were offered extra credit. To avoid coercion, an alternative extra credit opportunity was offered to those who chose not to participate in the study. Students were allowed to leave the study at any time. This study was approved by The Pennsylvania State University Institutional Review Board (IRB# 38728).

MyDietAnalysis Project

Participants in both classes were asked to record their dietary intake for three consecutive days (two weekdays and one weekend day) at the beginning of the semester and 14 weeks later at the end of the semester. To ensure accuracy, the instructors of each section gave specific instructions with examples that demonstrated how to complete an accurate dietary record. After recording their diets for three days, students in each class entered their 3-day dietary intake data in a dietary analysis software program provided with the required text book.

The software used was MyDietAnalysis (2012, Pearson Education North America, New York, NY). The program is designed specifically for Pearson Education publishing company's "MyNutrition Lab." The food database is generated by ESHA Research, Inc. (2012, Salem, OR) and consists of nearly 20,000 different foods. Students purchased a one-year subscription as a part of the required materials for the course. The software was accessible online. Participants were provided with a courseID by their instructor. This feature allowed the instructor and teaching assistants to evaluate the students' 3-day food records and the foods entered into the software program. The teaching assistants reviewed all data to check for any errors in reporting. The participants were asked to resubmit the data if it was inaccurate.

Course Overview

One section of the introductory nutrition class was assigned to complete a semester long blogging project (blogging group) and the other (control group) completed the traditional dietary analysis project assigned to students enrolled in the introductory nutrition course

Blogging Group

For the blogging project, students were asked to submit blog posts at two week intervals examining their diet in comparison to the dietary recommendations of the 2010 Dietary Guidelines for Americans. Students used the public, university pass space "www.blogs.psu.edu" to create their blogs. They were given an in class tutorial on how to set up an account and profile. Photos demonstrating each step were shared on the course management website for reference and were accessible by all participants. The students were informed that the blog posts would be

made available for the public to see unless they designated it a private blog. They were given the option to make their blog private so that only the instructor and the TA assigned to grade their blog could read the blog. Instructions for making the blog private were provided to the class.

They also were asked set goals to improve their diets. Participants were given instruction within the course on how to create SMART goals. For the first blog post, teaching assistants for the course reviewed each participant's goals, and participants were allowed to resubmit them if they did not meet the course criteria. Students created an action plan for achieving those goals and then evaluated their progress. Throughout the course of the semester, as the course content was covered, students were asked to evaluate their diet related to the nutrients covered in class and then determine whether they were meeting the dietary recommendations. The blogs contributed to the participants' final grade in the course. Each blog was graded on thoughtfulness of answers not whether or the goal was met.

Figures 1 and 2 depict a summary of the progression of the blogging assignment.

Figure 1: Progression of Blogs Part 1

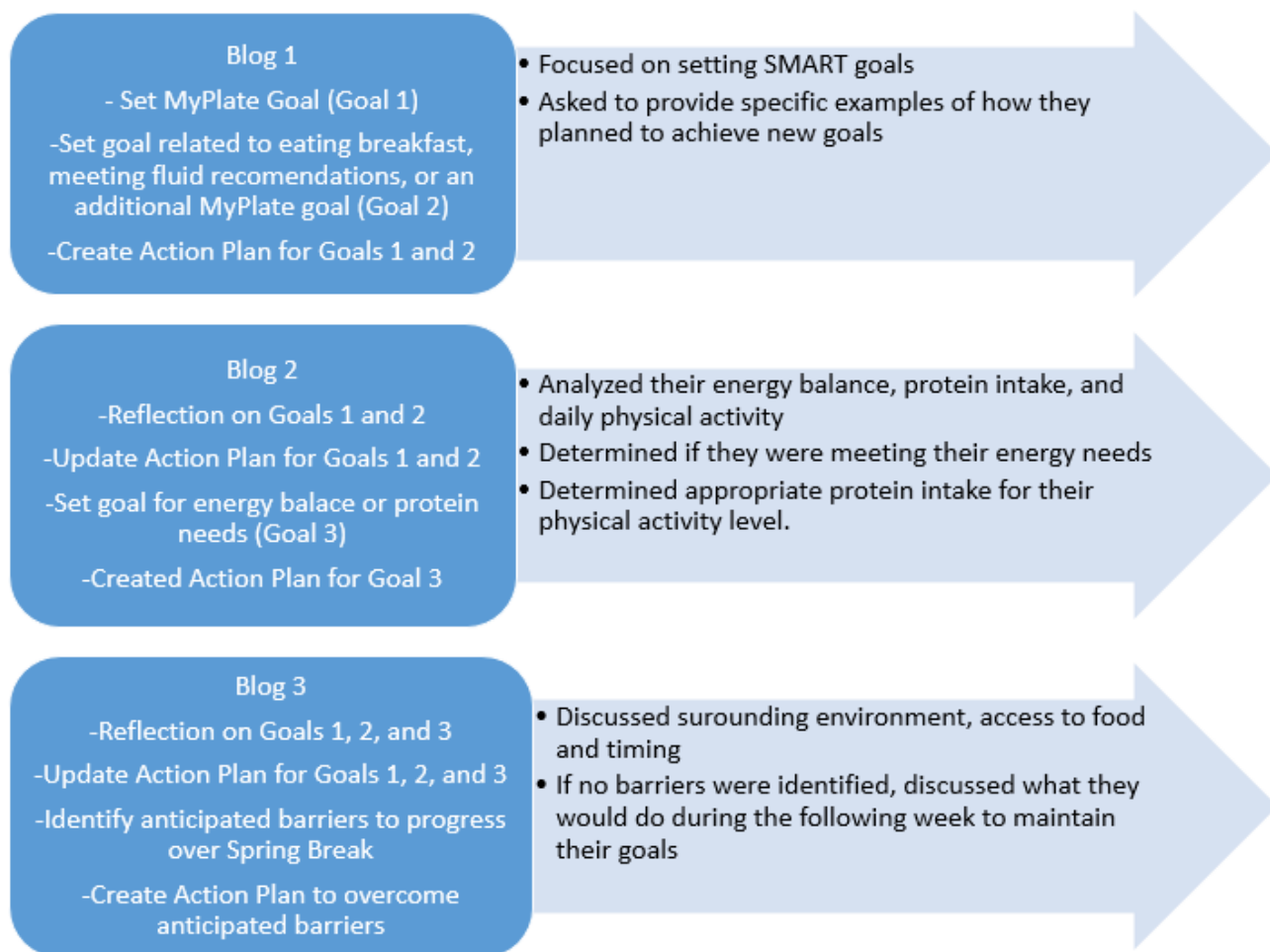
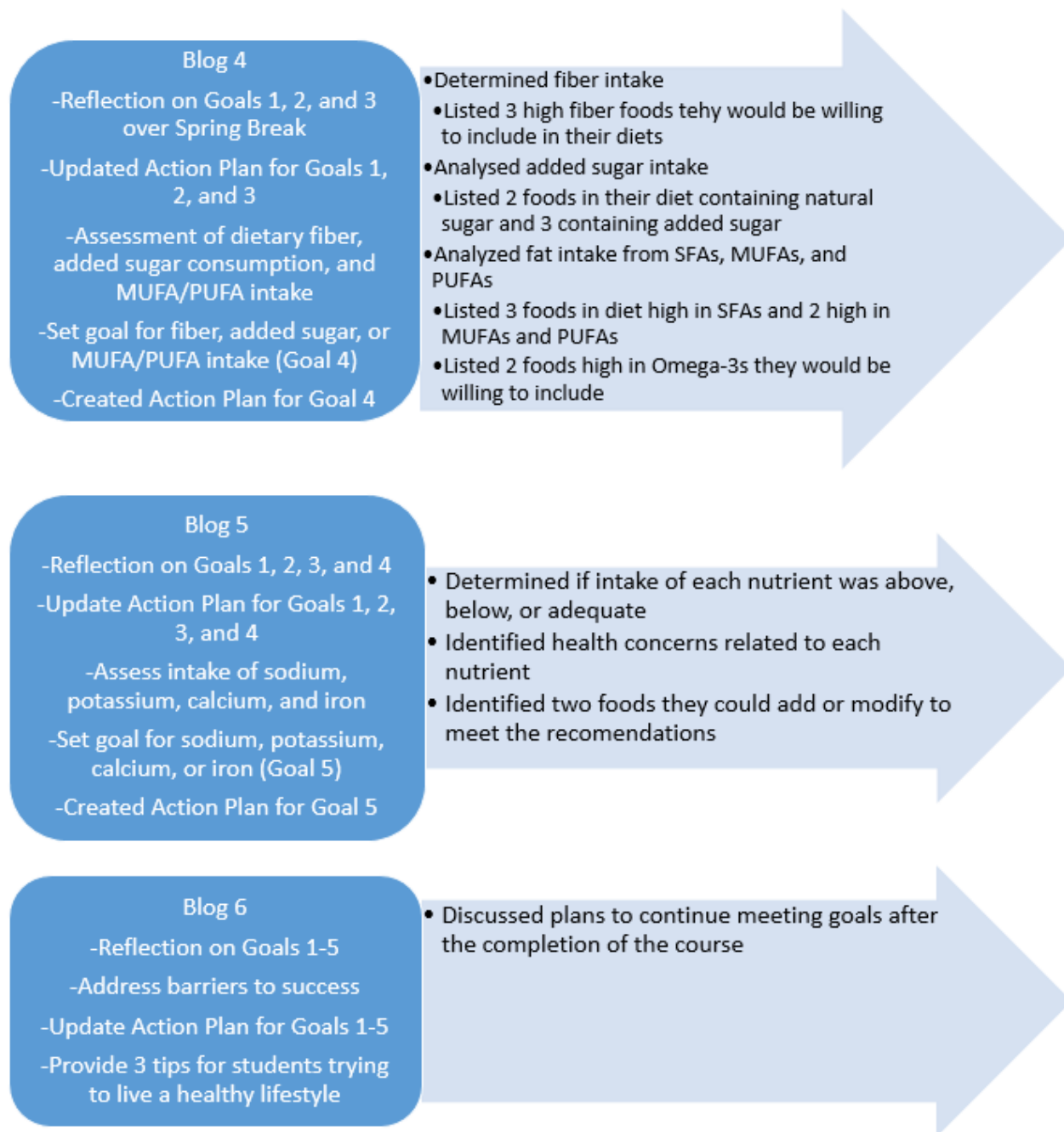


Figure 2: Progression of Blogs Part 2



Following the completion of the blogging assignment, students were asked to record their dietary intake for three days (two weekdays and one weekend day) and enter this information into the MyDietAnalysis software. Students using the blogging tool were asked to fill out and submit a 10-15 minute online survey assessing their experience. An example of the survey is located in Appendix A.

Control Group

Participants in the control group completed the traditional diet analysis project assigned in the introductory nutrition course for non-majors. Similar to the blogging group, participants were asked to keep a 3-day food record for three consecutive days, including a weekend day. Food records were submitted at week 4 and again at week 14 of the semester. They used an identical diet analysis software program as the blogging group, MyDietAnalysis, to enter their dietary intake and obtain reports to analyze their intake.

The course included a series of assessments and reflections related to the reports they received from MyDietAnalysis. For the first assignment they were asked to assess their physical activity level and calculate their energy needs. In the second project, participants assessed their carbohydrate and added sugar consumption. The third project focused on fat in the diet including monounsaturated, polyunsaturated, saturated, and trans-fat, and their relation to cardiovascular disease. The final project asked participants to examine the micronutrients vitamin D, calcium, iron, sodium and potassium in their diet and their relation to disease.

Analysis

Each participant self-reported the following demographic information: gender, age, height, and weight, BMI was automatically calculated by the dietary software using the height and weight entered by the participant.

Participants in each section were asked to generate reports using MyDietAnalysis software to analyze their 3-day dietary records. The reports included the MyPlate report and a comparison of their actual versus recommended intake bar graph that compared their intake to the Dietary Reference Intakes for their age, gender, and estimated kcalorie needs. All five food groups (dairy, grains, protein, fruits, and vegetables) were measured as well as several nutrients of interest (calcium, iron, potassium, saturated fat, and sodium).

A paired t-test was used to compare the dietary intake data of the major food groups of the MyPlate and the individual nutrients (sodium, potassium, saturated fat, calcium, and iron) of each group at the beginning and end of the study. The difference between pre- and post-course values were determined for each measure. Unpaired t-tests were used to assess whether differences existed in the intake of the major food groups of the MyPlate and the individual nutrients (sodium, potassium, saturated fat, calcium, and iron) between the two groups. Statistical significance was set at $P < .05$. The software used was Minitab v17 1.0[®] (2013, LEAD Technologies Inc., Charlotte, NC)

Chapter 3

Results

The final data set was representative of three major categories of interest. These included dietary intake, demographics, and survey response feedback.

Demographics

At the completion of the study, 153 participants completed the study. In the blogging group (n=91), 34% were male (n=31) and 66% were female (n=60). All members of the blogging group fell between the ages of 18-22 years, with one exception who reported an age of 30 years. The mean age was 20.5 ± 1.0 years. Based on the CDC BMI classifications, 2% were underweight (n=2), 68% were normal (n=62), 21% were overweight (n=19), and 9% were obese (n=8). The mean weight was 69.1 ± 14.7 kilograms.

Completion of each blog was monitored. From the blogging group, 31 did not complete the first blog, 23 did not complete the second, 29 the third, 48 the fourth, 31 the fifth, and 47 the final reflection.

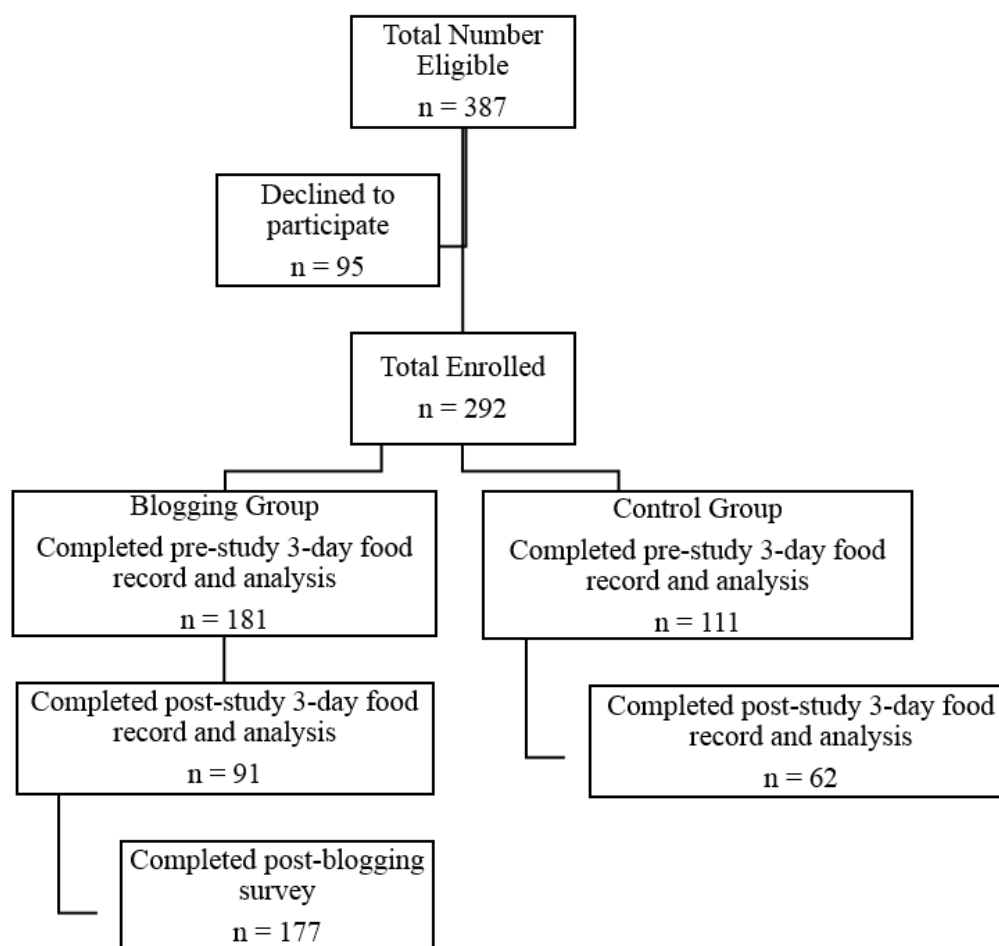
Of the control group (n=62), 24% were male (n=15) and 76% were female (n=47). All members of the control group fell between the ages of 18-23 years. The mean age was 20.5 ± 1.3 years. The CDC BMI classifications indicated that 8% were underweight (n=5), 69% were normal (n=43), 18% were overweight (n=11), and 5% were obese (n=3). The mean weight was

64.8 ± 14.2 kilograms. All demographic information is listed in Table 1 below. A table for attrition can be found in Figure 3 below.

Table 1: Demographic Information

Demographic	Blogging (n=91)	Control (n=62)
Gender		
Male	34%	24%
Female	66%	76%
Weight Status		
Underweight	2%	8%
Normal	68%	69%
Overweight	21%	18%
Obese	9%	5%
Mean Weight (kg)	69.1 ± 14.7	64.8 ± 14.2
Mean Age (years)	20.5 ± 1.0	20.5 ± 1.3

Figure 3: Diagram of the enrollment and participation rates for the blogging research study



Dietary Intake

To assess the effectiveness of blogging as a tool to improve dietary intake, the relationship between pre- and post-blogging data within each group was assessed. Using the foods and nutrients of concern identified by the Dietary Guidelines for Americans 2010 as the basis for the food groups and nutrients we targeted, we compared differences in the intake of the food groups outlined by MyPlate: grains, fruits, vegetables, dairy, and protein as well as individual nutrients (calcium, iron, potassium, saturated fat, and sodium) over time. These values were then

compared to one another within and between groups to determine if there was a significant difference.

Pre- vs. Post-blogging Data

For the blogging group (n=91), the MyPlate categories found to be statistically significant were fruit (P<.05) and vegetables (P<.05). Fruit increased by about a half a cup and vegetables increased by about a quarter of a cup. The trends found to be significant were an increase in calcium (P<.05) by nearly 100mg, an increase in potassium (P<.05) by nearly 200 mg, and a decrease in saturated fat (P<.05) by 2.5 g. There were no differences in dietary intake of dairy, grains, and protein as well as iron and sodium over the 14-week period for the blogging group. The changes in dietary intake for the blogging group are shown in Table 2.

For the control group (n=62), there were no significant changes in dietary intake over time for the major food groups in MyPlate (grains, dairy, protein, fruits, and vegetables), or the individual nutrients (sodium, calcium, potassium, and iron). The changes in dietary intake for the control group are shown in Table 3.

Table 2: Changes in dietary intake over a ten week period for the blogging group (n=91)

Nutrient	Pre-	Post-	P-value ^{a,b}
Dairy (cups)	1.5 ± 0.1	2.0 ± 0.5	.094
Fruit (cups)	1.0 ± 0.1	1.4 ± 0.1	.002 ^b
Vegetable (cups)	1.4 ± 0.1	1.6 ± 0.1	.012 ^b
Grains (oz.)	5.4 ± 0.3	5.2 ± 0.2	.772
Protein (oz.)	4.8 ± 0.3	5.3 ± 0.4	.933

Calcium (mg)	757.2 ± 37.2	823.6 ± 36.4	.034 ^b
Iron (mg)	13.5 ± 0.8	13.3 ± 0.7	.592
Potassium (mg)	1653.0 ± 99.3	1865.0 ± 96.3	.006 ^b
Saturated Fat (g)	20.5 ± 1.1	18.0 ± 0.8	.004 ^b
Sodium (mg)	3153.0 ± 125.0	3011.0 ± 116.0	.158

^aPaired t-tests were used to evaluate changes in dietary intake of food groups and select nutrients over a 10 week period

^bindicates statistical significance, P<.05

Table 3: Changes in dietary intake over a ten week period for the control group (n=62)

Nutrient	Pre-	Post-	P-value ^{a,b}
Dairy (cups)	1.3 ± 0.1	1.4 ± 0.1	.126
Fruit (cups)	0.8 ± 0.1	0.8 ± 0.1	.319
Vegetable (cups)	1.3 ± 0.2	1.5 ± 0.1	.259
Grains (oz.)	4.2 ± 0.3	4.3 ± 0.3	.410
Protein (oz.)	3.8 ± 0.4	3.8 ± 0.3	.391
Calcium (mg)	701.8 ± 49.5	763.4 ± 53.1	.328
Iron (mg)	13.7 ± 1.1	14.1 ± 0.9	.468
Potassium (mg)	1385.0 ± 108.0	1502.0 ± 90.0	.113
Saturated Fat (g)	19.7 ± 1.5	18.1 ± 1.4	.482
Sodium (mg)	2967.0 ± 177.0	2960 ± 181.0	.251

^aPaired t-tests were used to evaluate changes in dietary intake of food groups and select nutrients over a 10-week period.

^bStatistical significance was set at P<.05

Blogging vs. Control Group

The effectiveness of blogging as a tool to improve dietary intake was examined by comparing the change in dietary intake of the major food groups and individual nutrients to the change in dietary intake reported by the control group.

With the exception of grain intake ($P=.006$), no significant differences were shown between the baseline intake and demographic data of the blogging and control groups. The difference between the two groups showed a tendency toward significance for fruits ($P=0.059$). There were no differences between the two groups for the remaining food groups: grains, vegetables, and protein. There were not significant differences in the intake of individual nutrients: saturated fat, sodium, potassium, calcium, and iron. The comparison of the differences in dietary intake are shown in Table 4.

Table 4: Comparison of the differences in dietary intake between the blogging and control groups over a 10-week period

Nutrient	Blogging (n=91)	Control (n=62)	P-value ^{a,b}
Dairy (cups)	0.55 ± 0.4	0.10 ± 0.2	.313
Fruit (cups)	0.37 ± 0.1	0.03 ± 0.1	.057
Vegetable (cups)	0.27 ± 0.1	0.11 ± 0.2	.435
Grains (oz.)	-0.20 ± 0.3	0.09 ± 0.3	.487
Protein (oz.)	-0.48 ± 0.3	0.03 ± 0.4	.320
Calcium (mg)	66.44 ± 36.0	61.64 ± 53.0	.476

Iron (mg)	-0.20 ± 0.9	0.38 ± 0.8	.631
Potassium (mg)	212.02 ± 82.0	117.35 ± 84.0	.423
Saturated Fat (g)	2.42 ± 0.9	1.59 ± 1.3	.599
Sodium (mg)	141.81 ± 141.0	7.36 ± 163.0	.533

^aUnpaired t-tests were used to evaluate changes in dietary intake of food groups and select nutrients over a 10-week period.

^bindicates statistical significance, $P < .05$

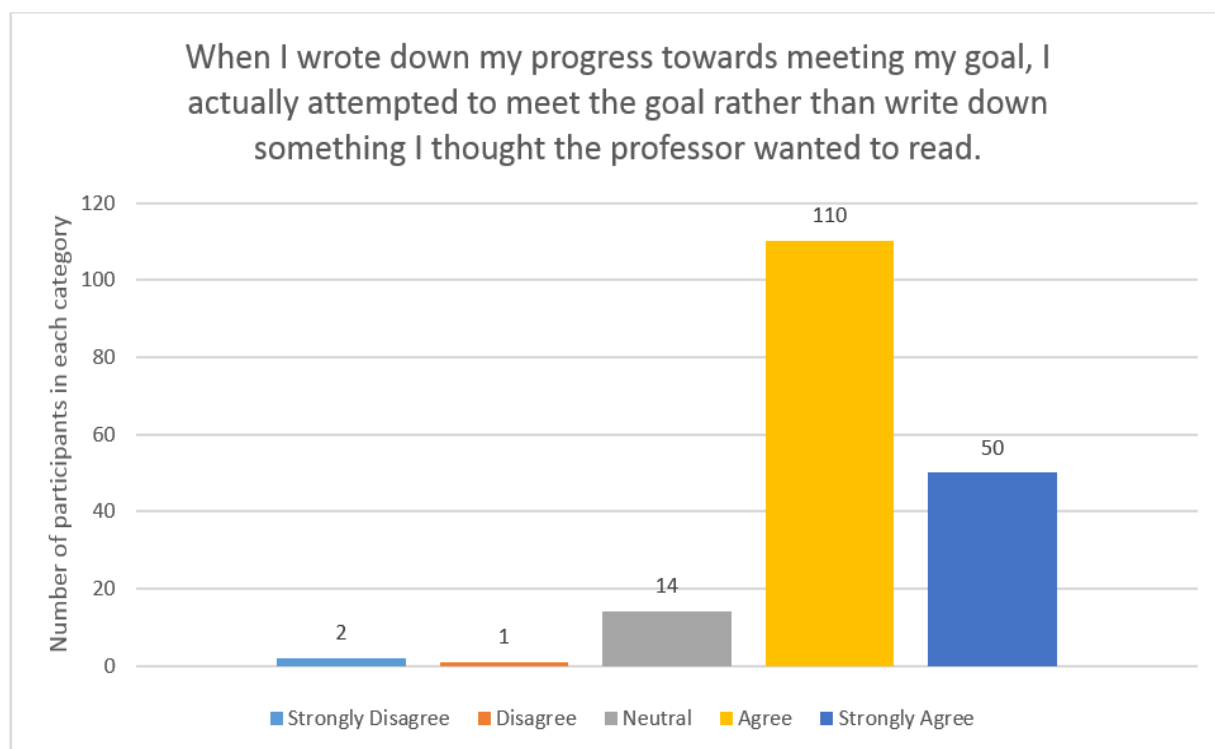
Survey Responses

A survey was provided to the blogging group to obtain their feedback regarding their thoughts on the assignment and using blogging as a tool to help them develop healthful dietary habits.

Effectiveness of Blogging to Improve Dietary Habits

In order to determine whether the students were providing honest feedback about their success and failure with meeting their dietary goals, the participants were asked to rate on a scale of 1 (strongly disagree) to 5 (strongly agree) their feelings toward the following statement: “When I wrote down my progress towards meeting my goal, I actually attempted to meet the goal rather than write down something I thought the professor wanted to read.” The results showed that 90% of responders agreed with the statement. The results of the survey are depicted in Figure 4.

Figure 4: Histogram of descriptive data showing the level of agreement participants had regarding the honesty of their answers when posting their blog reflections (n=177)



To assess how successful the participants were in achieving their goals, they were asked to complete the statement: “After completing this project, I have established a habit for _____ of my goals,” and given a choice of numbers 1-5. The results showed that 70% indicated they established a habit for at least three goals that were set during the blogging process. The results of the survey question are depicted in Figure 5. The top five nutritional goals established were increased fruit intake, increased vegetable intake, increased physical activity, increased dairy intake, and decreased added sugar intake. The results of the survey question are depicted in Figure 6.

Figure 5: Pie graph depicting the participant's perception of the number of goals that they established habits for by the end of the 10-week study (n=177)

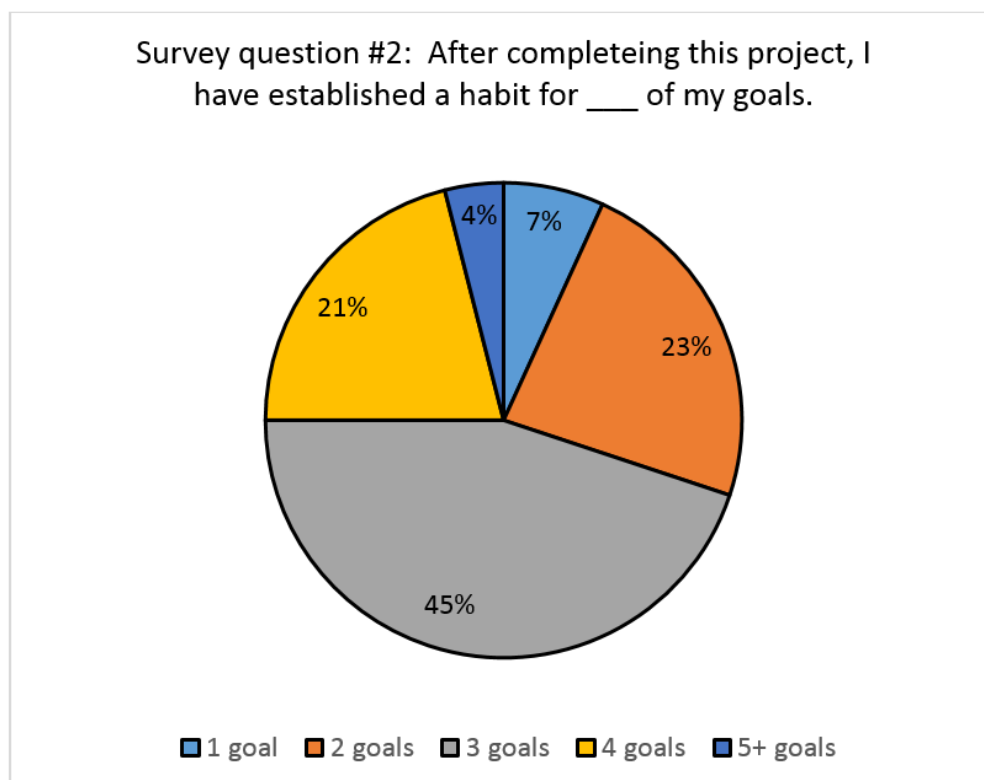
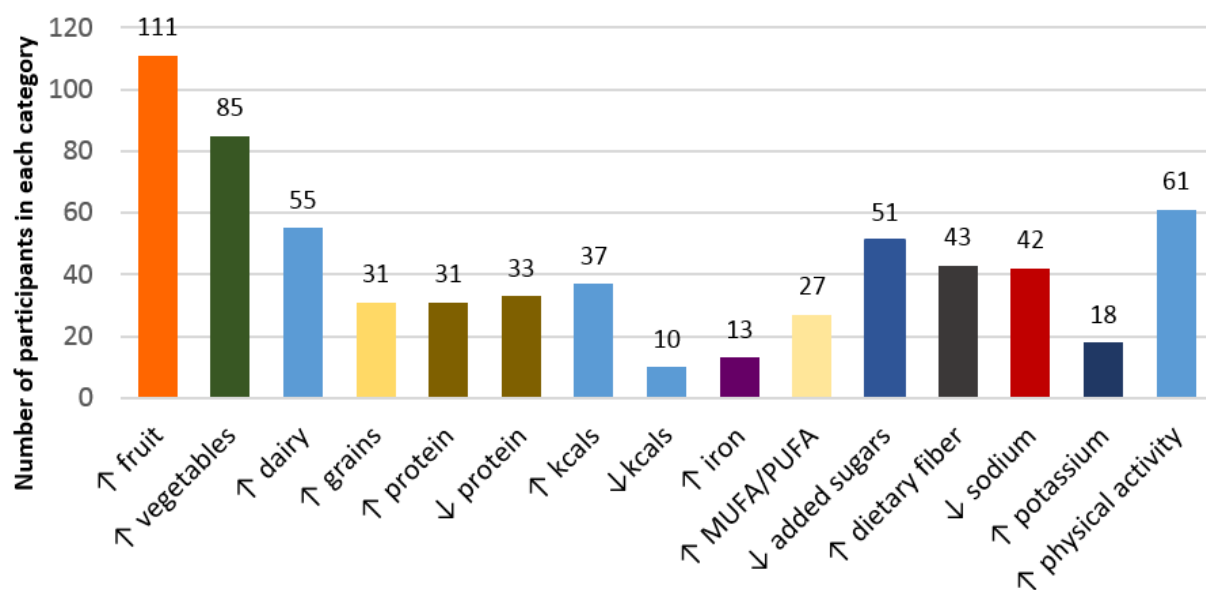


Figure 6: Histogram showing the number of students who reported that they made habits out of specific goals set during the blogging study



Students' Perspective of Using Blogging as a Tool to Improve their Dietary Habits

In order to assess the participants' general feelings about the blogging assignment, they were asked, "What did you like about blogging?" Responses included freedom of expression, they found it encouraging, the blogging software was easy to use, blogging made it easier to follow through with goals, and the project called for closer evaluation of dietary habits than they had previously given. A few excerpts from student responses can be found below:

1. Expression:

"I liked writing down my feelings about things because it later made these feelings more clear to me."

"It is helpful to express your thoughts/feelings on health and nutrition. A lot of people, like myself, don't talk about how they eat. Blogging enhanced the meaning and my ability to complete nutritional goals."

2. Encouragement:

"By blogging my goals and seeing my progress it helped encourage me to continue to move forward. I would see the progress I made from previous weeks and I felt good about myself. It also helped me keep my goals organized and remind me what I wanted my end result to be."

"I liked that it was at regular intervals and kept my goals in my mind so that I could always stay on track. It wasn't just busy work; it helped us grow nutritionally."

3. Close Evaluation:

"It gave me the opportunity to really break down my diet and think about the individual nutrients that I was eating or not eating. I never broke down my diet like this before, and it allowed me to make healthy changes."

"It gave me a chance to reflect on my diet. Even while not blogging, I would swirl ideas around in my head for things I had been doing differently that I could include in my next post."

Conversely, students were also asked, "What did you dislike about blogging?" Responses included the amount of time required, it became repetitive, difficulty remembering to complete the assignments, and the invasion of privacy. A few excerpts from student responses can be found below:

1. Time:

“It was sometimes time consuming and I had to schedule my time wisely.”

“It took more effort than I would have liked for a 1.5 credit course.”

2. Repetitive:

“I felt as though I continued to write the same thing each week. I kept having to explain my progress on each goal and what I did to achieve it, when really it just felt repetitive. It was also a little more time consuming than I expected.”

“Sometimes I felt like it got repetitive continually reporting back about the same goals especially the ones that I had already met.”

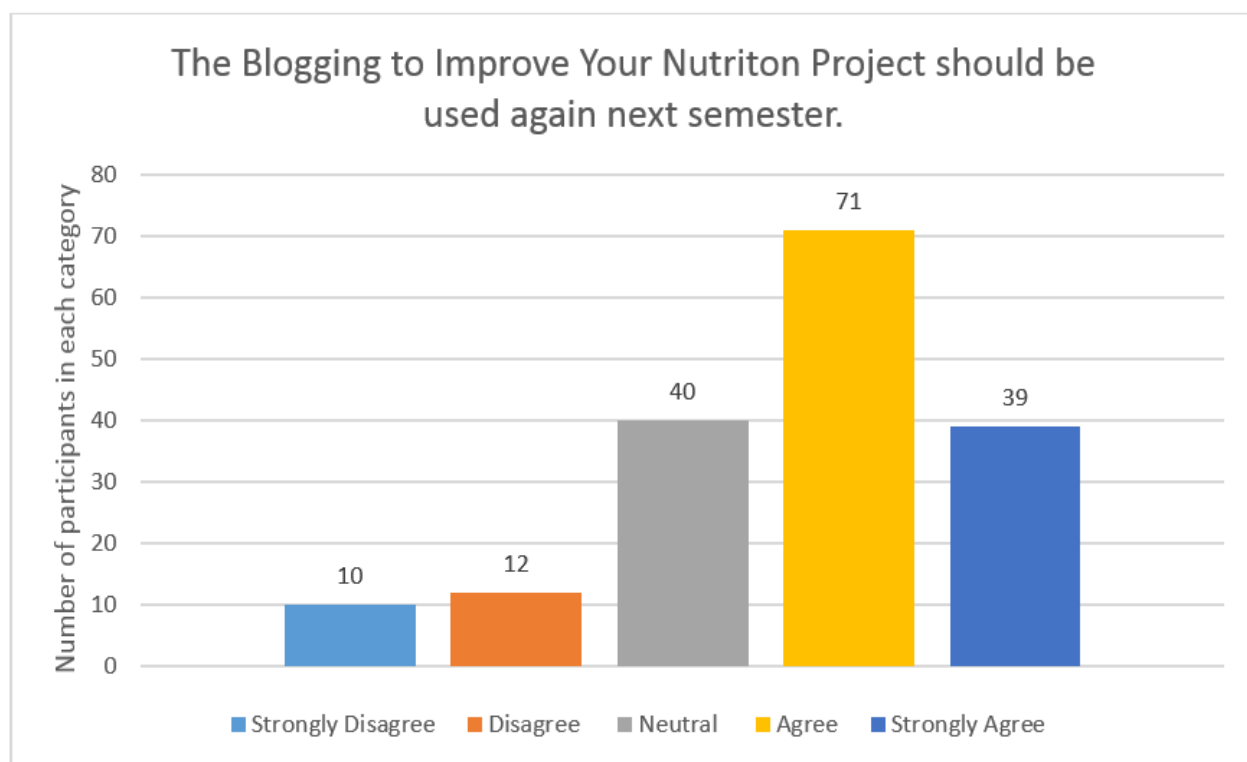
3. Invasion of Privacy:

“I didn't like that we had to make them public and that everyone can read them. There were certain things I didn't write about because I didn't want others to see them.”

“The fact that it's out there for everyone to read. I'd rather write a "nutrition journal" that was for my eyes only.”

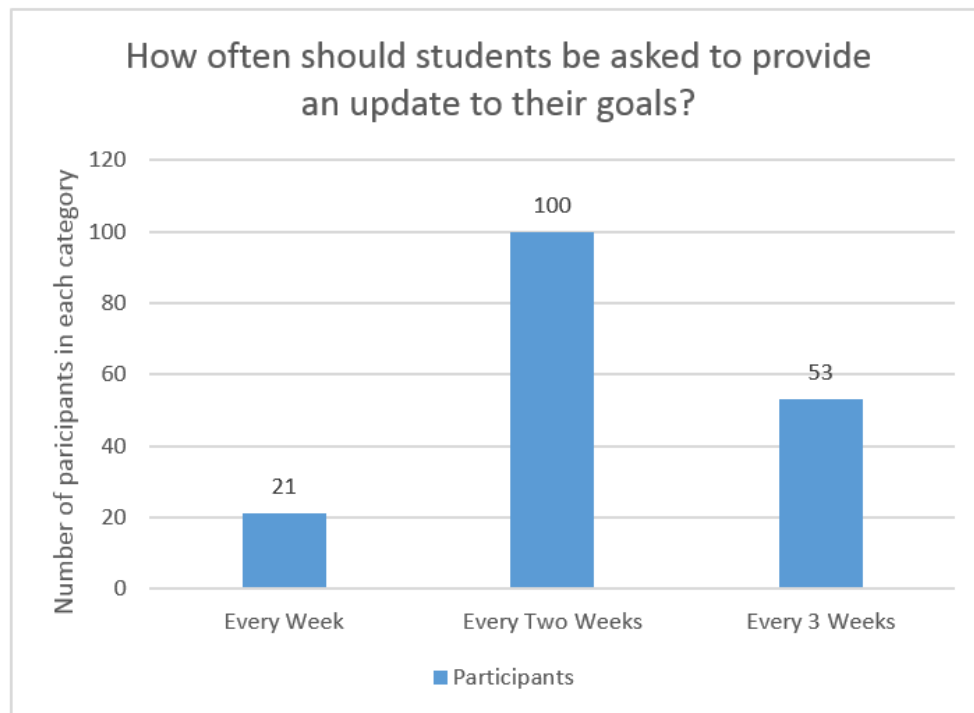
To assess the students' perception of the usefulness of the blog they were asked to rate the following statement on a scale of 1 (strongly disagree) to 5 (strongly agree): “The Blogging to Improve Your Nutrition Project should be used again next semester.” The results indicated that 62% agreed with the statement. The results of the survey question can be found in Figure 7.

Figure 7: Histogram of descriptive data showing the level of agreement participants had regarding their thoughts on whether blogging should be used in future semesters for the diet analysis project (n=177)



In order to determine if the frequency of the blogs was beneficial in helping the students achieve their goals they were asked, "If the Blogging to Improve your Nutrition Project is used again next semester, how often should the students be asked to provide an update to their goals?" Answer choices included: Every week after the goal has been set, every two weeks after the goal has been set (the current frequency with which the blogs were due), or every three weeks after the goal has been set. 57% of responders chose to keep the same timeline. Results from the survey question can be found in Figure 8.

Figure 8: Histogram of descriptive data showing participants' perception of the effectiveness of the frequency of the blog posts on helping them reach their dietary goals (n=177)



Additional comments and suggestions for improvement included in class clarification of the blogging criteria, more freedom in the content of the blog posts, increased incentives for reading other blogs, and including the opportunity for work in small groups.

Chapter 4

Discussion and Implications

Summary of findings

The findings of this study show that blogging is an effective tool at eliciting positive dietary changes for several food groups and nutrients, but not all, over a 10-week period. Fruit intake in the blogging group compared to the control showed a tendency toward significance. We believe that had a larger sample size been used, a clear significant difference would have been observed in fruit intake. When compared individually, the blogging group increased their intake of fruits and vegetables, calcium, and potassium and decreased their saturated fat consumption over the course of ten weeks. There were no differences in dietary intake of any food group or individual nutrients in the control group using the traditional course model at the end of ten weeks. Although both classes were enrolled in a nutrition education course and the traditional model also included an assignment for dietary intake reflection, significant changes were only seen within the blogging group.

Based on the data collected, we determined that blogging can be a beneficial tool in effecting dietary behavior change. Although we were unable to find a significant difference in dietary intake between the blogging and control group, a recent unpublished study from our lab suggested otherwise. The previous study involved 111 college students, ages 18-22 years, in a nutrition based discussion forum. Participants were assigned the either the blog, face to face small group discussions, or the control. At the end of the 12 –week study, the blogging group had increased their fruit and vegetable intake by nearly 2.5 cups on average while the other two groups showed decreases in fruit and vegetable intake. This aligns with the current findings of

this study and further supports the effectiveness of blogging in facilitating dietary behavior change during the semester the course is taken.

Student Perceptions Compared to Actual Findings

Of particular interest is the participants' perception of the blogging assignment. The majority of survey responders indicated that the blog held them accountable for their choices. This suggests that having a public blogging site is useful in keeping students accountable for their goals. Participants also indicated that the blog allowed them to see their own progress over time, which in turn served as a form of motivation. These perceptions indicate that blogging is a useful tool for encouraging prolonged behavior change over time. Others revealed that they appreciated the close evaluation that was required by the blogging assignment. The blogging process involved a more detailed analysis of dietary intake than is typical of the traditional introductory nutrition course, and participants indicated that this was a useful instrument in helping them reach their goals.

Conversely, the participants indicated that they disliked the time required to complete each blog. This may indicate that the current blogging assignment was not sensitive enough to the busy schedules of college students. It may also imply that the current assignment may be better suited for a 3.0 credit class as opposed to the 1.5 credit course for which it was designed.

In addition, a large portion of participants indicated that the assignment was repetitive and became tedious. It is worthwhile to note, however, that the repetition may have been a primary contributor to the success of the MyPlate goals. The first blog post asked participants to set a goal for one of the MyPlate food groups (grains, protein, dairy, fruits, or vegetables) and

they reflected on the progress of this goal in every subsequent blog post for the remainder of the study. Based on the survey feedback, participants were the most successful in reaching their goals of increasing their intake of fruits and vegetables, two of the MyPlate food groups. Goals that were set later in the semester (potassium and iron) were among the least successful. This indicates that although the blogs may have been perceived as tedious, the repetition played an important role in their success in reaching their goals.

Strengths

Blogging assignments must be an integral part of the coursework to be the most effective. The more tightly they are tied to in class material, the more benefit they will have.²⁹ One strength of our study is we included a group of students enrolled in different sections of the same introductory nutrition course to serve as experimental group and the control group. Previous research has shown that taking a nutrition education class can cause positive changes in dietary behavior. Matvienko et al²⁶ found that twenty-one college freshman taking a nutrition course that had topics related to energy balance and weight loss resulted in weight loss, reduced intake of calories, total carbohydrate and total fat compared to a control group not enrolled in a nutrition class. The nutrition class was not designed to be a weight loss program and the students in this course did not complete assignments that asked them to collect dietary intake data or reflect on the quality of their diets or behavior change techniques.⁴ Because both the blogging and control groups were enrolled in the introductory nutrition class, we were able to control for the confounding factor of being enrolled in a nutrition class and thereby contribute the positive dietary changes reported in our results to the success of the blog.

Students who enrolled in each introductory nutrition course chose to enroll in the respective sections voluntarily; therefore the population we used was randomized based on the nature of how the students were enrolled in the class. Because of this, we had a highly diverse population in both the blogging and control groups.

Having the participants submit 3-day food logs into the MyDietAnalysis software allowed for highly detailed analysis. The analysis software utilizes a large, reliable database allowing for a more accurate and complete assessment of the participants' diets. We were able to examine the intake of micronutrients and address their importance. Similar studies grouped fruit and vegetable intake together in one category.²⁶ Our study assessed each MyPlate food group separately to better understand the dietary patterns of college students. The study also asked participants to submit a 3-day record at the beginning of the study and then again at the completion. This allowed us to detect changes made in their diets over time. The 3-day diet record allowed us to have a more accurate estimation of typical dietary patterns as opposed to a 24-hour recall.²¹ By using the 3-day diet record, we included more food choices overtime. This helps to reduce inaccuracies in reporting.²¹

Participants reported that, once an account was set up, the blogging software was easy to use. This indicates that the technology was accessible and appropriate for this population. By having the blog posts due at two week intervals, the participants were able to reflect on their goals with regularity. This encouraged them to be actively thinking about their goals and their progress consistently throughout the course of the study. We believe that this ultimately lead to greater behavior change in the blogging group.

The feedback provided by the Teaching Assistants (TAs) was especially useful in encouraging the participants in their process. TAs provided suggestions for overcoming barriers

and offered congratulations when goals were met. Having active engagement between the facilitators and the bloggers results in a higher success rate.³¹

When asked if they responded honestly in the blogs, 90% of participants indicated that they were honest in their responses. This suggests that we were able to minimize any bias from students wishing to impress the professor or teaching assistants by inflating their success.

Limitations

Although special care was taken to ensure continuity between groups, there were a few opportunities for error. The primary source of error may have come from the self-reported data.³³ Although the submissions were monitored for errors, there was no way to ensure that participants were being completely truthful in their 3-day diet records. Smaller errors in portion size or food preparation may have gone undetected.

We were unable to account for the differences in instructors for each course. The head researcher of this study instructed the blogging group section. It is possible that participants in the blogging group may have felt a stronger sense of loyalty to the professor and thus improved their diets for the sake of the study. In addition, the teaching styles of the individual professors may have had an effect on the motivation of the participants to improve their diets.

We were able to track dietary change over the course of the 10-week study, but we were unable to determine if the habits established were continued after the completion of the study.³³ To receive the long-term benefits of the dietary goals established during the course of the study, they need to be continued for much longer than one semester.

Implications for Research and Practice

This study implicated several avenues for future exploration. The use of SMART goals in affecting dietary change requires further discussion. In this study, setting SMART goals was an important part of the blogging design. The effectiveness of SMART goals in the classroom setting is a point of interest and is worth greater examination.

It may also be beneficial to explore the effect of readiness to change on the success of blogging to improve dietary intake. This study did not take into account whether or not the participants were interested in making a dietary change before including them in the study. Perhaps by surveying participants at the onset to determine their readiness to change, the effectiveness of blogging as a tool to improve dietary intake at all stages of change could be determined.

With the increasing popularity of mobile applications for cellphones, tablets, and computers, it may be useful to consider how to modify the blogging software so that it is more easily accessible on a variety of devices. The format of the original blog may need to be modified to be more compatible with a mobile device. It may be useful to combine the data analysis software and the blogging software into one application to make them easier to use in conjunction “on-the-go.”

Students also indicated a desire for small group discussions throughout the course of the study to provide additional support in reaching their goals. Future research may wish to examine the benefit of adding regular group meetings of participants with similar goals.

Appendix A

Feedback Survey

1. When I wrote down my progress towards meeting my goal, I actually attempted to meet the goal rather than write down something I thought the professor wanted to read. (scale)
2. After completing this project, I have established a habit for _____ of my goals.
3. Click on the nutritional goal or goals that you have established a habit for over the course of the semester. (Note: you can answer more than one item.)
 - a. Increase fruit intake
 - b. Increase vegetable intake
 - c. Increase dairy intake
 - d. Increase grain intake
 - e. Increase protein intake
 - f. Decrease protein intake
 - g. Increase kcal intake
 - h. Decrease kcal intake
 - i. Increase physical activity
 - j. Increase MUFA and PUFA intake
 - k. Decrease added sugar intake
 - l. Increase Dietary fiber intake
 - m. Decrease sodium intake
 - n. Increase potassium intake
 - o. Increase iron intake
4. Did you read your fellow classmate's blogs? If you read their blogs, discuss how often you read them (e.g., one time, for each submission, etc) and why you read them. If you didn't read your fellow classmates blogs, explain why.
5. The Blogging to Improve Your Nutrition Project should be used again next semester. (scale)
6. What did you like about blogging?
7. What did you dislike about blogging?
8. If the Blogging to Improve your Nutrition Project is used again next semester, how often should the students be asked to provide an update to their goals? (Please consider the usefulness of using this to help keep you accountable for meeting your goals.)
 - a. Every week after the goal has been set
 - b. Every two weeks after the goal has been set
 - c. Every three weeks after the goal has been set
9. Do you have any other comments about this project or suggestions I could use to improve this project?

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Cornell Cooperative Extension of Broome County, Binghamton NY

Nutrition Educator

May 2014-July 2014

- Obtained 300 hours of field work experience, educated low-income individuals and families through interactive presentations in order to improve dietary habits using NY State SNAP-Ed and EFNEP curriculum, hosted food preparation demonstrations and tastings at local farmers' markets

The Pennsylvania State University, University Park PA

Research Assistant to Mary Dean Coleman-Kelly, PhD, RD

January 2012-present

- Conduction research on the effectiveness of blogging as a tool for improving dietary intake in college students, completing Senior Thesis in May 2015

Teaching Assistant

Fall Semester 2012

- Led review sessions and graded assignments for an introductory nutrition class, developed skills in communication, conflict mediation, and teaching styles

HealthWorks, University Health Services, University Park PA

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August 2013-present

- Led group education sessions with Penn State students on health related issues such as nutrition, body image, and eating disorders in order to improve knowledge and self-efficacy

HIV Prevention Counselor

September 2014-present

- Provided psychological counseling and education to students before and after being tested for HIV, developed skills in interpersonal relations

Association of Home-Schooled Children, State College PA

Educator

August-October 2013

- Created song and dance routines to encourage healthy eating and physical activity, developed a healthy lunch menu for the event, designed a sensory MyPlate activity in which students used all 5 sense to assess their food

Rock on Café, Broome/Tioga BOCES Food Services, Endicott NY

Intern

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- Created a farm-to-table activity that brought students out into the garden to harvest food to create a healthy lunch, learned the technical side of foodservice, developed skills in menu development, marketing, and data collection

United Health Services Hospitals, Binghamton NY

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- Shadowed hospital dietitian in Intensive Care Unit

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Pennsylvania State University, University Park PA

Schreyer Honors College Distinguished Honors Faculty Program

January 2014- present

- Faculty assistant, provided catering arrangements and reservations for college lecture series, developed skills in written and verbal communication, organization, and personal responsibility

ACADEMIC AWARDS, HONORS, AND ACTIVITIES

- Schreyer Honors College
- Dean's List 2011-present
- Parmi Nous Honor and Tradition Society, 2014-present
- Schreyer Honors College Student Council, Recruitment Chair, 2013-14
- Penn State Lion Scouts, Homecoming Chair 2012-13, Alumni Relations Chair 2013-14
- Study Abroad, Dublin, Ireland, Dance Department, May- June 2013
- Member of the Academy of Nutrition and Dietetics
- SevSafe Certified