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**Intervention to Influence Healthy Eating Habits Among Dominican University
Students: An Examination of Eating Habits**

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Abstract

Background: Food insecurity among college students has become an issue among many universities nationwide. Campus food pantries emerged to combat this problem by providing students with a diverse selection of fresh foods such as fruits, vegetables, grains, and protein. Most universities are in the pilot process of their food pantries and not many studies have been done to examine the use of healthy ingredients among students. This study aims to evaluate the effectiveness of the intervention in improving awareness and knowledge of healthier eating habits and options at the campus food pantry at Dominican University of California.

Methods: The study included 23 eligible participants who filled out both pre-intervention and post-intervention surveys as well as visited the pantry at least once during the intervention stage to view the recipe posters. The intervention was recipe posters placed at the pantry for students to view. Recipes were based on ingredients given at the pantry and chosen based on the number of food pantry items included, difficulty, total preparation and cooking time. Recipes came from national organizations, such as Choose My Plate, Harvest of the Month, and CalFresh Champions for Change.

Results: A McNemar's test was used to determine significant differences between the pre-test and post-test. The test determined that there was no significant difference in the proportions of confidence in pre- and post-intervention for ability to create healthy meals ($p=1.000$), knowledge of key nutrients ($p=0.754$), and meeting USDA Daily Recommendations ($p=1.000$). A manual evaluation was done to assess changes in confidence. Of the 23 participants, 39.1% of participants increased in confidence in terms of ability to create healthy meals and knowledge of key nutrients and 13.0% of participants increased in confidence regarding meeting USDA Daily Recommendations.

Discussion: The intervention was not impactful enough to show any significant differences in confidence and knowledge of the participants to improve eating habits. However, some participants found improvements in their confidence in their abilities to adopt healthier eating habits. More research is needed to evaluate these findings with adjustments to the study design and population.

Introduction

Food insecurity is the inability to have reliable stability to an adequate amount of nutritious food. In 2018, 11.1% of U.S. households were food insecure, with 7.1% of households with children were food insecure (“Food Security in the U.S.”, 2019). Factors that affect food security status include income, race/ethnicity, disability, and employment, as well as households with children and single-headed households (Clay et al., 2018; “The Impact of Poverty, Food Insecurity, and Poor Nutrition on Health and Well-Being”, 2017; “Who Are the World’s Food Insecure? Identifying Risk Factors of Food Insecurity Around the World”, 2019). Households that exceed the national average for food insecurity include low-income households (29.1%), single mom households (27.8%), Black and non-Hispanic households (21.2%), and men living alone (12.5%) (“Food insecurity in the U.S.”, 2019). Households that are higher than the national average for food insecurity have more limited ability to purchase an adequate amount of nutritious foods, and must find ways to cope with this by settling for cheaper, less nutritious and higher calorie foods (“Health Implications of Food Insecurity”, 2018). Eating unhealthy foods can lead to chronic diseases, such as obesity, diabetes, hypertension, stroke, coronary heart disease, and chronic obstructive pulmonary disease (“Health Implications of Food Insecurity”, 2018; “The Impact of Poverty, Food Insecurity, and Poor Nutrition on Health and Well-Being”, 2017). People from food insecure households were more likely to self-report poor/fair health and score low on the physical and mental health scale (Stuff et al., 2004).

College is a crucial transition period in an individual’s life. Students are faced with new responsibilities and stress that affect their overall health, such as handling their own food and meals. In 2019, 19% of first-year students from eight U.S. universities were found to be food insecure by the end of their first year of college, with 7.1% of them reporting severe food insecurity and 25.3% feeling anxious about food shortage (Zein et al., 2019). Experiencing food insecurity leads to higher perceived stress, eating disorders, and poorer sleep quality among food insecure students compared to their food secure peers (Zein et al., 2019). Establishing good eating habits can be a struggle for students, resulting in inadequate nutrition intake. Students typically choose what food they eat based on taste and convenience in accordance with their busy schedules and stress (Deliens et al., 2014), leading to consumption of fast food and frozen meals (Abraham et al., 2018). In dining halls, students are not able to control what is being served, leaving students with limited options and availability to meet their nutritional needs (Li et al., 2012). With the obstacles that they face, college students develop poor eating habits and neglect meeting nutritional standards (Deshpande et al., 2009).

National and local food banks have started to partner with universities to implement food pantries on campus. The purpose of food pantries is to provide students with adequate nutritious foods and hunger relief (Price et al., 2019). However, a survey done at the University of Florida found that only 7.7% of students used the food pantry (Zein et al., 2019). Barriers to utilizing the food pantry include negative stigma surrounding the program, inconvenient hours, and feelings

of personal failure (Zein et al., 2019). Previous studies on food pantries found that although they relieve hunger, they may not provide the most nutritious foods. Most foods given at these pantries include canned foods, processed meats, and foods with long shelf lives (Zein et al., 2019). A systematic review analyzing diet quality among food pantry users found that they have low intake of nutrition such as vitamins, iron, magnesium, and zinc (Simmet et al., 2017). Food pantry users also did not reach adequate consumption of fruits, vegetables, dairy products, and calcium (Simmet et al., 2017). Offering resources in addition to the food pantry encourages users to have better diet quality. Creating an environment where users are interactively learning can increase the likelihood of improving their perceptions and behaviors of diet quality. (Caspi et al., 2017). Providing recipes and nutrition education materials can motivate food pantry users to consume more varied fruits and vegetables and decrease sodium intake (Long et al., 2019). Studies that use these programs and resources found some association or effect in these interventions on improving participants' diet choices and quality (Caspi et al., 2017; Long et al., 2019).

There have been many studies done that examine college students' eating behaviors and the role of food pantries to tackle insecurities. However, there is uncertainty of whether students utilize all of their food pantry offerings in order to create healthy meals. Studies conducted at different U.S. universities have looked into food pantry utilization among their students but have not examined how students use the food pantry items to cook healthy, nutritious meals (Zein et al., 2019; Price et al., 2019). Most universities implementing a food pantry on campus are still in the pilot process, making utilization of food pantry studies essentially nonexistent. At Dominican University of California, food pantry products include fresh fruits and vegetables, proteins such as eggs, and other foods donated by the SF Marin Food Bank. Although the food pantry helps in alleviating food insecurity for students, it is unclear whether students' eating habits and diets are improving with the introduction of these healthy food options. In this study, a pretest posttest design will be utilized to evaluate the effectiveness of the intervention in improving awareness and knowledge of healthier eating habits and options at the campus food pantry at Dominican University of California.

Methods

Participants

The study was conducted at Dominican University of California, located in San Rafael, CA. Participants were recruited through face-to-face conversation, flyer advertisements, and by word of mouth. Eligibility criteria included current university students, visited the campus food pantry at least once between November 2019 and March 2020, and must have completed both the pre-intervention and post-intervention survey. Of the 23 eligible participants, 82.6% were female, 69.6% were undergraduate students, 52.5% were employed, and 95.7% lived off campus. More information about demographics are in Table 1.

Procedure

The study design included three stages: pre-intervention, intervention, and post-intervention. During the pre-intervention phase, participants were asked to fill out a pre-intervention survey, which included an online consent form. The pre-intervention phase took place in November 2019 for three weeks. The intervention phase took place for six weeks starting in January 2020. After six weeks, the participants were sent an email to fill out a post-intervention survey. Participants had a two-week time-frame to fill out the survey at the end of February 2020. Consent was given electronically at the beginning of the pre-intervention survey. This study was approved by the Dominican University of California Institutional Review Board for the Protection of Human Participants (#10800).

Measures/Materials

The pre-intervention survey consisted of questions that asked about their current utilization of food pantry items and ability and confidence to create healthy meals. The intervention was a “Recipe of the Week” poster, which included easy-to-follow recipes based on the ingredients given at the pantry. Recipes were constructed based on the number of food pantry items, difficulty, and total preparation and cooking time. The recipe posters were displayed on an A-frame board and placed next to the check-in table to be easily accessible for students to view on their way into the food pantry. Recipes came from national organizations, such as Choose My Plate, Harvest of the Month, and CalFresh Champions for Change which provide healthy recipes to meet nutritional standards for the whole population. The post-intervention survey asked about their utilization of food pantry items and ability and confidence to create healthy meals after using the recipe posters. In this survey, participants were able to write any feedback, suggestions or questions they had. Demographic characteristics were also collected during this stage. All surveys were created using Qualtrics survey management software and the recipe posters were hand-made posters.

Statistical Analysis

Statistical analysis was done using IBM SPSS Statistics Data Editor Version 26. Missing data included answers left blank or participants who did not fill out both surveys. Missing data was ignored and not counted in this data analysis, which included 7 participants. For analysis, the alpha level was set to 0.05. The frequency of visits variable was dichotomized to “Once a week” and “Less than once a week”. The confidence in meals variable was dichotomized to “Confident” and “Not confident”. The confidence in nutrients variable was dichotomized to “Confident” and “Not confident”. The USDA Daily variable was dichotomized to “Yes” and “No”. Year in school variables were dichotomized to “Undergraduate” and “Graduate and above”. Employment was dichotomized to “Employed” and “Not employed”. A univariate analysis was performed to establish population characteristics in terms of demographic factors, use of food pantry, and confidence in meals and nutrients. To determine the appropriate significance test, an assumption test was done. This study passes the assumptions of having one nominal variable with two categories and the groups in the dependent variable were mutually exclusive. The study did not pass the assumption of having a random sample. A McNemar’s test was used to determine statistical significance in the difference between confidence in creating healthy meals, knowledge of key nutrients, and meeting USDA daily recommendations in pre-intervention and post-intervention. A univariate analysis was performed to identify changes in confidence levels among confidence in creating healthy meals, knowledge of key nutrients, and meeting USDA daily recommendations. A qualitative analysis was done to evaluate reasons why participants do not use all of the food pantry items as well as feedback and suggestions for the campus pantry.

Results

Table 1 is a univariate analysis for demographic factors, pre-intervention test variables, and post-intervention test variables. In the sample, 19(82.6%) of participants were female, 16(69.6%) were undergraduate students, 12(52.2%) were employed, and 22(95.7%) lived off-campus. In the pre-intervention test, 18(78.3) participants used the Penguin Pantry every week and 16(69.9%) used all of the food taken at the pantry. Out of 23 participants, 15(65.2%) were confident in their ability to create healthy meals using pantry items, 12(52.2%) were confident in their knowledge of key nutrients from pantry items, and 7(30.4%) think they meet the USDA Daily Recommendations. In the post-intervention test, 21(91.3%) visited the pantry at least once between the end of January 2020 and the beginning of March 2020. Out of the 23 participants, 16(69.6%) were confident in their ability to create meals using pantry items, 14(60.9%) were confident in their knowledge of key nutrients from pantry items, and 8(34.8%) think they meet the USDA Daily Recommendations. Eight of the participants (34.8%) attempted the recipe poster while 11(47.8%) found the poster simple and easy and 20(90.9%) found the poster easy to understand and follow. Out of the 23 participants, 16(72.7%) found that the recipe helped them utilize food pantry items to create healthier meals and 13(59.1%) said the recipe influenced their decision in choosing to eat healthier. Twenty-one of the participants (91.3%) think that weekly recipe posters would help the Dominican community build healthier eating habits and providing additional resources would encourage students to improve their eating habits.

Table 1. Univariate Analysis for Demographics, Pre-intervention Test, and Post-Intervention Test	
	n(%)
Demographics	
Female	19(82.6)
Undergraduate	16(69.6)
Employed	12(52.2)
Off-campus	22(95.7)
Pre-intervention Test	
Uses pantry every week	18(78.3)
Uses all of the food taken at pantry	16(69.6)
Confident in ability to create meals using pantry items	15(65.2)
Confident in knowledge of key nutrients from pantry items	12(52.2)

Thinks they meet nutritional standards set by USDA Daily Recommendations	7(30.4)
Post-intervention Test	
Visited the pantry in the past 6 weeks	21(91.3)
Confident in ability to create meals using pantry items	16(69.6)
Confident in knowledge of key nutrients from pantry items	14(60.9)
Thinks they meet nutritional standards set by USDA Daily Recommendations	8(34.8)
Attempted recipe poster	8(34.8)
Found recipe simple and easy	11(47.8)
Found poster to easy to understand and follow	20(90.9)
Found recipe helped them utilize food pantry items to create healthier meals	16(72.7)
Recipe influenced their decision in choosing to eat healthier	13(59.1)
Think that weekly recipe posters would help the Dominican community build healthier eating habits	21(91.3)
Thinks that providing additional resources would encourage students to improve their eating habits	21(91.3)

Table 2 was a McNemar test used to determine statistical significance between the participants' confidence in creating a healthy meal in the pre-intervention survey and post-intervention survey. Ten participants who answered "Confident" in the pre-test answered "Confident" in the post-test. Five participants who answered "Confident" in the pre-test answered "Not confident" in the post-test. Six participants who answered "Not confident" in the pre-test answered "Confident" in the post-test. Two participants who answered "Not confident in the pre-test answered "Not confident" in the post-test. An exact McNemar's test determined that there was no significant difference in the proportions of confidence in pre- and post-intervention, $p=1.000$.

Table 2. McNemar's Test for Confidence In Ability to Create Healthy Meals Using Pantry Items (Pre-Test vs. Post-Test)			
Pre-Test	Post-Test		P-value
	Confident	Not confident	
Confident	10	5	p=1.000
Not confident	6	2	

Table 3 was a McNemar test used to determine statistical significance between participants' confidence in their knowledge of key nutrients in the pre-intervention survey and post-intervention survey. Eight participants who answered "Confident" in the pre-test answered "Confident" in the post-test. Four participants who answered "Confident" in the pre-test answered "Not confident" in the post-test. Six participants who answered "Not confident" answered "Confident" in the post-test. Five participants who answered "Not confident" in the pre-test answered "Not confident" in the post-test. An exact McNemar's test determined that there was no significant difference in the proportions of confidence in pre-and post-intervention, $p=0.754$.

Table 3. McNemar's Test for Confidence In Knowledge of Key Nutrients in Pantry Items (Pre-Test vs. Post-Test)			
Pre-Test	Post-Test		P-value
	Confident	Not confident	
Confident	8	4	p=0.754
Not confident	6	5	

Table 4 was a McNemar test used to determine statistical significance between if participant's think they meet USDA Daily Recommendations in the pre-intervention survey and post-intervention survey. Five participants who answered "Yes" in the pre-test answered "Yes" in the post-test. Two participants who answered "Yes" in the pre-test answered "No" in the post-test. Three participants who answered "No" in the pre-test answered "Yes" in the post-test. Thirteen participants who answered "No" in the pre-test answered "No" in the post-test. An exact McNemar's test was determined that there was no significant difference in the pre- and post-intervention, $p=1.000$.

Pre-Test	Post-Test, n		P-value
	Yes	No	
Yes	5	2	p=1.000
No	3	13	

Table 5 reports changes in participants' confidence in ability to create healthy meals, knowledge of key nutrients, and meeting USDA Daily Recommendations. For the ability to create healthy meals, 9(39.1%) participants increased in confidence, 9(39.1%) participants stayed the same in confidence, and 5(21.7%) decreased in confidence. For knowledge of key nutrients, 9(39.1%) participants increased in confidence, 7(30.4%) stayed the same in confidence, and 7(30.4%) decreased in confidence. For meeting USDA Daily Recommendations, 3(13.0%) increased in confidence, 18(78.3%) stayed the same in confidence, and 2(8.7%) decreased in confidence.

	Ability to Create Healthy Meals	Knowledge of Key Nutrients	Meet USDA Daily Recommendations
Increase in Confidence	9(39.1)	9(39.1)	3(13.0)
Same Confidence	9(39.1)	7(30.4)	18(78.3)
Decrease in Confidence	5(21.7)	7(30.4)	2(8.7)

A qualitative analysis was done to understand reasons why participants do not use all of the food they receive from the campus food pantry as well as feedback and suggestions to improve healthy eating among Dominican University of California students. Two themes were evident when participants were asked why they did not use all of the food pantry items that they did not take:

1. *Participants have not used the food items before or they did not like the food item*

One participant mentioned that they had never used the food pantry items before. One of the reasons why could be because of their comfort level of preparation or lack of experience with cooking. Participants also mentioned that they grabbed food that they did not like because the food was available and free for them. Some participants grabbed food they did not like, but gave them to a friend that likes it. One participant mentioned that they “grabbed things they don’t end up liking”. Having a lack of variety of appealing foods and a lack of consumer input could have contributed to this outcome. On the other hand, participants could feel pressured to grab the food available because it was free.

2. Participants forgot about the food they took or the food was expired

Participants expressed that they sometimes forgot about the food they grabbed, but it was not often that this occurred. A reason for this could be that they grabbed a lot of food from the pantry and were not able to use all of it in a timely manner before it expired. Participants expressed that some of the items that they had grabbed from the pantry were already expired “multiple years ago”. Often, food pantries receive foods that are either expired or nearing expiration. By the time these foods are processed and ready for distribution, many already pass the usable date. This issue stems from food pantries not receiving the freshest produce.

Participants provided feedback and suggestions on how to improve Penguin Pantry services to improve healthier eating among the student population. By “providing fresh whole foods” and “drawing attention to healthy eating”, students could be more motivated to adopt healthier lifestyles. One suggestion was to upload the recipe posters on a website for easy access. By creating a website with recipes can be easily accessible for students. Students would be able to bookmark the website and click on the link every week to view new recipes using the ingredients from that week. This could improve communication between the Penguin Pantry and the students.

Discussion

The intervention was not impactful enough to show any significant differences in confidence and knowledge of the participants to improve eating habits. The results from the study were not expected because the literature suggests that providing resources such as recipes would encourage pantry users to improve their diet (Caspi et al., 2017; Long et al., 2019). Caspi et al. (2017) used a six-session nutrition class with a 24 hour recall to create a healthy eating index (HEI) and analyzed participant cooking skills via a survey to evaluate the effectiveness of their intervention. Researchers found improvements in HEI scores as well as cooking skills, providing some evidence that improvements in diet and skills can be demonstrated with minimal intervention (Caspi et al., 2017). Long et al. (2019) conducted a year-long pretest posttest intervention which included increasing the donation, distribution, and education of nutritious foods such as fresh fruits and vegetables from donors as well as education materials and recipes to pantry users. Results from this study showed that pantry users had an increased intake of fresh fruits and vegetables, increased calories, and reduced sodium intake (Long et al., 2019).

The results in this study showed no difference when participants were given a recipe. A reason why the results were what they were could have been a lack of attention among participants when filling out the survey or the language of the survey was not specific enough for participants to understand. A lack of variety in pantry items could also be a factor because participants could have chosen unfamiliar foods they did not want to eat due to a lack of appealing food options. A lack of alternatives or substitutes for recipes that did not include every food pantry item that week could have resulted in participants' lack of confidence. Since participants filled out the pre-intervention survey prior to winter break, participants could have endured housing changes, nutritional source changes, or socioeconomic changes that may result in an increase or decrease in confidence upon returning from break. Caspi et al. (2017) found statistical significance due to their utilization of four food pantries rather than one with a larger sample population resulting in a more diverse population. Their healthy cooking score improvements were statistically significant, while their HEI scores were not.

This study emphasized the difficulty of maintaining a large sample size of a college student population and convincing participants to fill out both surveys. Based on the comments and feedback from participants, the recipes need to be simpler, more inclusive, easier to adapt with different ingredient substitutes or alternatives, and supported with another supplemental intervention or resource.

A strength of this study was that the recipes came from government agencies. These recipes were standardized recipes that were approved or produced by verified dietitians. Because there is very limited research in this area, the findings from this research set the framework and support future studies involving campus food pantries and eating habits among college students. Because the intervention took place in the fall and winter months, the foods that were offered were similar and there were minimal seasonal differences in the foods available to participants.

While seasonal changes in foods offered or foods being offered out of season could have led to unappealing foods for participants, this was not an issue for this study due to the similarities in food options offered and lack of seasonality.

There were a few limitations in this study. Having a small sample size affects the generalizability of results. A lack of participant attention when answering questions negatively affected the validity and accuracy of the results. The intervention stage was not very long and it is possible that confidence levels are not measurable in a six week time frame. Another limitation could be that the tools used to measure confidence were not the most accurate at quantitatively measuring this value.

Caspi et al. (2017) and Long et al. (2019) have demonstrated success in areas where this study requires improvements. For future studies, it is important to increase the sample size to be representative of the target population (Caspi et al., 2017). In addition to providing recipes, there should be another intervention such as taste tests or cooking demonstrations (Long et al., 2019). Modifying the questionnaire and measurement tool could provide researchers with more accurate data (Caspi et al., 2017; Long et al., 2019). This type of study should take place for at least a year long to adequately measure the fluctuations and effect of the intervention on confidence levels since confidence is developed over a longer period of time than the study allowed (Long et al., 2019).

Current programs and resources are not enough to promote nutrition and health among college students. Foods at food pantries are not always the most appealing to college students, and/or individuals do not know what to do with the food once they get it home. Based on the literature, providing resources do help improve attitudes on healthy eating, but more studies need to be done to explore the efficacy of various interventions in addition to providing recipes.

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