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Assessing the Effectiveness of a Health-Belief Model-Based Intervention on the Nutrition Knowledge, Health Beliefs, and Behaviors of Adult Participants of the YMCA

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Abstract

Background: Nutrition is foundational for athletes to achieve optimal athletic performance and to promote proper recovery while reducing the risk of injury. Many lack nutrition-related knowledge, health beliefs, and behaviors pertaining to general and sports nutrition to do so.

Objectives: To assess the effectiveness of a health belief model-based intervention for improving nutrition-related knowledge, health beliefs, and behaviors.

Methods: A quasi-experimental design study and pre/post-intervention assessments were used to measure the effectiveness of an online health belief model-based intervention program in improving nutrition-related knowledge, health beliefs, and behaviors of adult participants (n = 4) of the YMCA. Mann-Whitney U tests were used to assess for changes in significance in nutrition related knowledge, health beliefs, and behaviors.

Results: The intervention did not produce improvements in nutrition-related knowledge, health beliefs, and behaviors of statistical significance related to general and sports nutrition.

Conclusions: The discrepancies in the findings of the current study and prior studies relating to the effectiveness of the intervention's theoretical framework in producing improvements in general and sports nutrition related knowledge, health beliefs, and behaviors may suggest that the current studies' unequal, small sample size resulted in the inability to determine statistical significance.

Introduction

Athletes expend high levels of physical activity to achieve peak physical condition.¹ To support these needs and to optimize athletic performance, nutrition must be considered for consumption of a well-balanced, high-quality diet with adequate intake. This also allows athletes to reduce their risk of injury and recovery properly.^{1,2} Athletes have nutritional requirements which can differ from their non-athletic counterparts. While similar at baseline, needs may differ depending on the type and level of intensity. Variations occur in macronutrient needs, caloric requirements, and electrolyte or micronutrient repletion.³ While athletes are concerned about their nutritional intake, many lack nutrition education. To understand these nutritional requirements, athletes must have the nutrition-related knowledge to form healthy habits and obtain nutritional adequacy.⁴

Foundational knowledge regarding general nutrition is necessary to understand sports nutrition. Common issues such as inadequate consumption, macronutrient imbalances, and poor-quality food choices are associated with lack of nutrition education. Athletes with poor nutrition knowledge increase the risk of negatively impacting health status and performance. They may experience injuries, gastrointestinal issues, menstrual dysfunction, and other physical effects⁵ such as decreases in bone-mineral density, compromised immune function, and reduction of skeletal muscle mass¹ due to poor food choices such as low energy and carbohydrate intake. Providing nutrition education results in higher levels of nutritional awareness through food selection and preparation, food quality and quantity, as well as supplement safety.⁵

A needs assessment was conducted on adult participants of the Greene County, NY YMCA to assess the nutrition-related knowledge, health beliefs, and behaviors.⁶ The findings of the assessment indicated a deficit of general and sports nutrition-related knowledge among adult athletes; increasing the risk of making poor dietary choices, impacting performance¹ and health status.²

To address inadequate sports nutrition knowledge in athletes, sports nutrition guidelines⁷ have been developed to support their lifestyles. Yet, many athletes have poor adherence to guidelines and lack the knowledge needed. Therefore, education-based interventions are not sufficient in solving this issue. The use of behavioral science and strategies⁸ acknowledges the factors which impact success of interventions.⁹ These may include social influence, culture, individual preferences, and psychological factors.⁵ Addressing such factors, regardless of significance, results in positive changes. Although, there are a limited number of systematic reviews and studies which pertain to behavioral strategies for sports nutrition interventions.⁹ The health belief model theory has been used to successfully increase nutrition-related knowledge¹⁰ health beliefs,¹¹ and behaviors¹² in adults. This behavior change theory focuses on individuals for addressing social contexts for behaviors, and is used to increase health knowledge, perception of risks, encourage action for risk elimination, and build self-efficacy for making changes.¹³ While previous research has demonstrated such results regarding a health-belief model theory-based intervention for nutrition-related knowledge,¹⁰ health beliefs,¹¹ and behaviors,¹² few exist regarding the adult athlete population and with the combination of these elements. This indicates a gap in the literature regarding this intervention type.

The purpose of the current quasi-experimental design study was to determine the effect of a nutrition education and health belief model theory-based intervention to measure changes in general and sports nutrition-related knowledge, health beliefs, and behaviors and to address the gap in existing literature of the adult athlete population.

Methods

Study Design

A quasi-experimental design with a pre and post intervention assessment was used to measure the effectiveness of an online health belief model theory-based intervention to improve nutrition-related knowledge, health beliefs, and behaviors in adult participants at the Greene

County YMCA in Coxsackie, NY. The project was approved by the State University of New York at Oneonta Institutional Review Board. All study participants provided informed consent.

Intervention

A brief nutrition education program was developed for the intervention at the Greene County YMCA, located in Coxsackie, NY. Two separate educational videos, lasting 10-15 minutes each, were developed and were made available to adult participants through an email provided by the primary investigator, with links to each. Participants were given two weeks to watch both videos, from the time the email links were provided. Only participants who signed up to participate in the intervention and provided informed consent received an email with links to the videos.

The intervention was built upon the theoretical framework of the health belief model theory. The health belief model theory was applied to encourage optimal behavior change in participants by targeting barriers, benefits, self-efficacy, and threat for nutrition related beliefs and behaviors, while improving nutrition knowledge. Perceived benefits, susceptibility, severity, barriers, cues to action, and behaviors were measured for potential nutrition-related health risks associated with adults to target behavior change through adequate nutrition practices.

Both intervention videos contained general and sports nutrition education and food preparation demonstrations. The aim of the videos was to demonstrate and improve skills for the preparation of healthful foods to support nutritional needs while providing nutrition education. The first video demonstrated the preparation of a smoothie bowl along with a discussion regarding the food groups, metabolism, electrolyte needs, and daily upper limit for caffeine. The second video showed the preparation of a protein ball recipe and included a discussion about protein intakes and recommendations. A live Q and A session was held via teams following the completion of the intervention to answer questions.

Out of the 1,350 adults who attend the Greene County YMCA, 18 participants signed up and 11 participants completed the informed consent forms through Qualtrics. This equates to a 0.8% participation rate. The response rate of the study was 61.1%, as most participants provided informed consent and completed the pre-intervention assessment. However, 4 participants completed the intervention and post-intervention assessment, producing a 36.4% completion rate.

The participants consisted of adults 18 years and older who attend the Greene County YMCA in Coxsackie, NY. The participants attend the facility for physical-fitness related activities including instructed group exercise classes, individual workouts, personal training, and more. A flyer was developed and distributed in the facility to recruit participants at the facility during the hours of operation. Informed consent was obtained 1 week prior to the intervention via Qualtrics, provided by the principle investigator.

Measures/Tools

Participants were asked to fill out a tool measuring knowledge, health beliefs, and behaviors (see Appendix A) regarding general and sports nutrition to determine the intervention's effectiveness. The tool was provided to participants pre-intervention and post-intervention via

email through Qualtrics by the principle investigator. The assessment tool was developed by the principle investigator for the participants aged 18 and older and assessed general and sports nutrition-related knowledge, health beliefs, and behaviors. The assessment included 3 sections, knowledge, health beliefs, and behaviors and 20 questions, 10 of which were multiple choice, (questions 1-5 in the knowledge section and 1-5 in the behaviors section), and 10 required participants to rate their opinions using the Likert scale (questions 1-10 in the health beliefs section). It took participants approximately 10 minutes to complete the assessment.

Data Analysis

Quantitative data was gathered from the pre and post intervention assessment and was analyzed using SPSS version 28, to assess nutrition-related knowledge, health belief, and behavior changes among the participants. Since the population standard deviation was unknown and submissions were randomized, a Mann-Whitney U test was used to determine whether significant changes were present in the nutrition-related knowledge, health beliefs, and behaviors of participants from the pre and post intervention assessments. Statistical significance was determined using a P-value of $P < 0.05$. Median group standard deviations and group scores were used to summarize data from the pre and post intervention assessments.

Results

Sports and General Nutrition Knowledge

(See **Appendix A** for *YMCA Intervention tool* and questionnaire items)

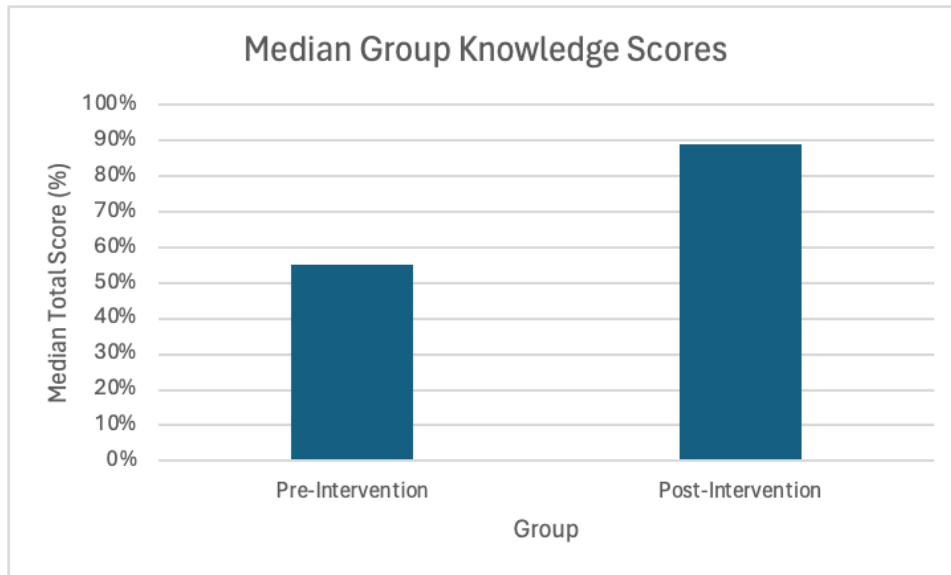
The pre- and post- intervention sample sizes and median group scores from the knowledge section of the YMCA Intervention Tool measuring knowledge, health beliefs, and behaviors are presented in **Table 1**. A Mann Whitney U test was conducted to compare median nutrition knowledge, health beliefs, and behavior scores associated with general and sports nutrition on pre- and post-intervention assessments. A Mann-Whitney U test revealed no significant differences in the nutrition-related knowledge scores (see **Figure 1**) of the pre-intervention group (Md = 5, n = 11) and post-intervention group (Md = 8, n = 4), $U = 33.500$, $z = 1.522$, $p = 0.14$, $r = 0.39$.

Table 1. Pre- and Post-Intervention median group knowledge scores from the *YMCA Intervention Tool*

	Sample Size (n)	Median (M) Group Percentage Score (%)
Pre-Intervention	11	55%
Post-Intervention	4	89%

The median group score is based on average points earned out of 9 possible points for each participant. Each correctly selected answer or response receives 1 point. Survey item #1 contained 5 components and was worth 5 points (each correct response was worth 1 point) and survey items #2-5 were worth 1 point.

Figure 1. Changes in median Knowledge scores from the pre-and post-intervention YMCA Intervention Tool



The figure displays medians. Median group percentage scores are based on the average points earned by participants in the pre-intervention group (n = 11) and post-intervention group (n = 4) out of the total possible points for the Knowledge section (9). The changes in median group scores from the pre- and post-intervention assessment were not statistically significant (p = 0.14).

Sports and General Nutrition Health Beliefs

The pre- and post- intervention sample sizes and median group scores from the health beliefs section of the YMCA Intervention tool measuring knowledge, health beliefs, and behaviors are presented in **Table 2**. A Mann Whitney U test was conducted to compare median nutrition knowledge, health beliefs, and behavior scores associated with general and sports nutrition on pre- and post-intervention assessments. A Mann-Whitney U test revealed no significant differences in the nutrition-related health belief scores (see **Figure 2**) of the pre-intervention group (Md = 28 , n = 11) and post-intervention group (Md = 31, n = 4), U = 30.500, z = 1.117, p = 0.28, r = 0.29.

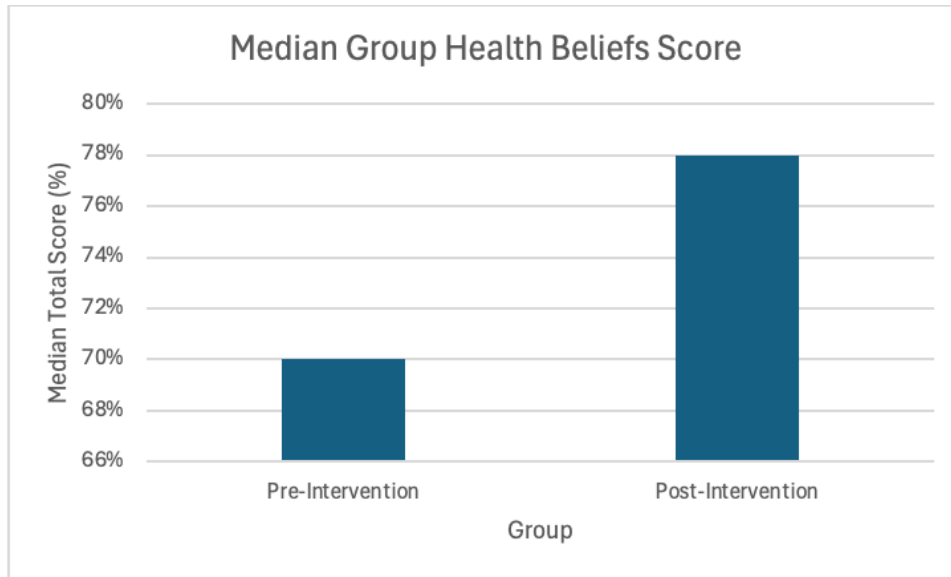
Table 2. Pre- and Post-Intervention median group health belief scores from the YMCA Intervention Tool

	Sample Size (n)	Median (M) Group Percentage Score (%)
Pre-Intervention	11	70%
Post-Intervention	4	78%

The median group score is based on average points earned out of 40 possible points for each participant. The Likert scale was used for all survey items, each optimally selected response

received 4 points, each second optimally selected response received 3 points, each third optimally selected response received 2 points, and each least optimally selected response received 1 point. Survey items #1-10 contained 4 components and were worth 4 points.

Figure 2. Changes in median Health Belief scores from the pre-and post-intervention *YMCA Intervention Tool*



The figure displays medians. Median group percentage scores are based on the average points earned by participants in the pre-intervention group (n = 11) and post-intervention group (n = 4) out of the total possible points for the Health Belief section (40). The changes in median group scores from the pre- and post-intervention assessment were not statistically significant (p = 0.28).

Sports and General Nutrition Behaviors

The pre- and post- intervention sample sizes and median group scores from the behaviors section of the *YMCA Intervention tool* measuring knowledge, health beliefs, and behaviors are presented in **Table 3**. A Mann Whitney U test was conducted to compare mean nutrition knowledge, health beliefs, and behavior scores associated with general and sports nutrition on pre- and post-intervention assessments. A Mann-Whitney U test revealed no significant differences in the nutrition-related behavior scores (see **Figure 3**) of the pre-intervention group (Md = 15, n=11) and post-intervention group (Md = 16, n=4), U = 26.000, z = 0.526, p = 0.66, r = 0.14.

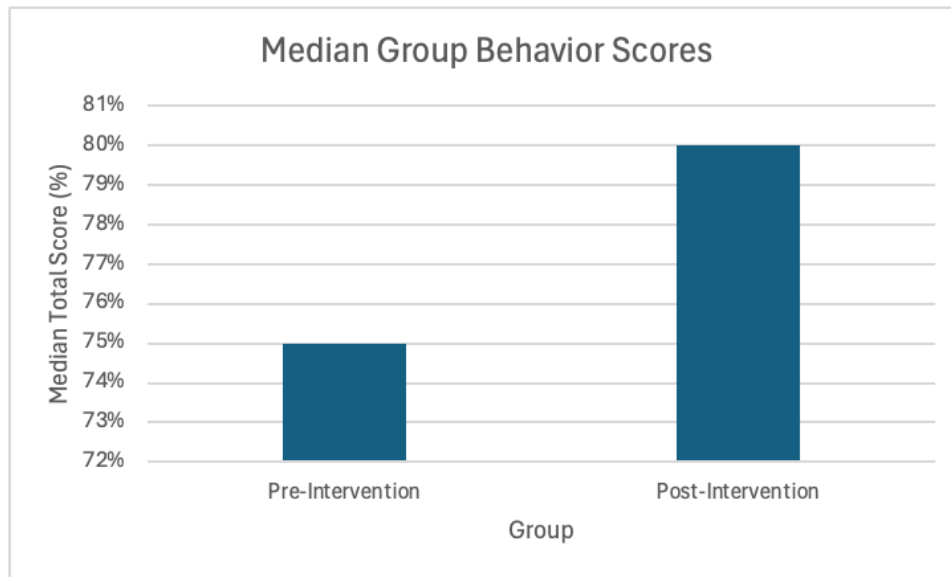
Table 3. Pre- and Post-Intervention median group behavior scores from the *YMCA Intervention Tool*

	Sample Size (n)	Median (M) Group Percentage Score (%)

Pre-Intervention	11	75%
Post-Intervention	4	80%

The median group score is based on average points earned out of 20 possible points for each participant. Survey items #1-5 contained 5 components and were worth 4 points. Optimally selected answers were worth 4 points, second optimally selected answers were worth 3 points, third optimally selected answers were worth 2 points, fourth optimally selected answers were worth 1 point, and the least optimally selected answer was worth 0 points.

Figure 3. Changes in median Behavior scores from the pre-and post-intervention *YMCA Intervention Tool*



The figure displays medians. Median group percentage scores are based on the average points earned by participants in the pre-intervention group (n = 11) and post-intervention group (n = 4) out of the total possible points for the Behavior section (20). The changes in median group scores from the pre- and post-intervention assessment were not statistically significant (p = 0.66).

Discussion

The current study showed that a health-belief-based intervention did not yield statistically significant improvements in nutrition related knowledge, health beliefs, or behaviors in adult participants at the Greene County YMCA.

The lack of the statistical significance in the study's findings could be attributed to the unequal and small sample sizes. Unequal and inadequate sample sizes can compromise the validity of the study by decreasing the empirical power of tests, lowering the possibility of producing a significant result, due to type II errors and false premises.^{14,15} Future research should assess the effectiveness of a health belief model theory-based intervention in improving general and sports nutrition-related knowledge, health beliefs, and behaviors using an equal and larger sample size of adult participants of the YMCA. Studying the effectiveness of a similar

intervention based on the health belief model for changes in nutrition-related knowledge, health beliefs, and behaviors with an equal and larger sample size would help determine if the validity of the current study's findings were compromised by the unequal and small sample size.

Prior research assessing the effectiveness of a health-belief model-based intervention on nutrition-related outcomes in adult populations concluded that such interventions are effective in increasing nutrition-related knowledge¹⁰ and behaviors,¹² unlike the current study. However, these studies also indicated that while foundational nutrition knowledge is important for making nutrition-related decisions and impact nutrition-related behaviors, it is insufficient for the basis of health beliefs and behaviors, indicating the need for a behavior-change model such as the health belief model.¹⁰

An additional study measured the impact of the health belief model on nutritional attitudes in athletic and sedentary university students with a population of 234 students.¹¹ The athletic students had an active gym membership, like the participants of the current study. Like the current study, they also found that a health belief model theory-based intervention was not significantly correlated with changes in nutrition-related health beliefs.¹¹ The intervention was similar in that it measured changes in nutrition-related health beliefs in athletes, although statistical analysis of the study used paired samples with no dropouts, resulting in equal intervention groups. Their results did produce a statistically significant outcome regarding self-efficacy, which may be impacted by these factors. However, this outcome was not measured in the current study. The small and unequal sample size of the current study may explain the insignificant results in pre- and post-intervention nutrition health beliefs, in adult athletes. This finding indicates a need for further research using an equal and larger sample size.

The current study found that the intervention, which incorporated the health belief model, resulted in a 34%, insignificant increase in nutrition-related knowledge, 8%, insignificant increase in nutrition-related health beliefs, 5%, insignificant increase in nutrition-related behaviors. Prior studies have found that interventions utilizing the health belief model for nutrition related outcomes are successful for increasing health behaviors¹⁶ with dietary patterns and nutrition-related knowledge.¹⁷

Strengths and Limitations

The limitations of the study includes the online method of delivery. While online interventions may be easily accessible, it resulted in an unequal and unpaired, small sample size (pre-intervention n = 11, post-intervention n = 4). Unequal, small sample sizes can compromise the reliability of the study's findings due to limited empirical power and larger margins of error. Both can result in a type II error, which increases the probability of producing a false-negative, occurring when a researcher rejects a null hypothesis which is correct for the population. Furthermore, all participants who enrolled in the study did not participate in the intervention and were not included in the data analysis. Additionally, not all participants who participated in the pre-intervention group participated in all intervention sessions and the post-intervention group, producing unequal/unpaired sample sizes. This is due to the large number of withdrawals (n = 8), in which the pre-intervention group (n=11) and the post-intervention group (n = 4) differed in sample size. One member of the pre-intervention group did not complete all sections of the pre-intervention assessment, causing unequal distributions in the sections of the questionnaire, knowledge (n = 11), health beliefs (n = 11) behaviors (n = 10). In addition, the intervention

videos produced for the participants had a higher number views (n = 14) than those in the pre-intervention (n = 11) and post-intervention (n = 4) groups. Lastly, the intervention included general nutrition more so than sports nutrition due to the general nutrition knowledge deficit. However, a strength of the current study includes evidence that the intervention utilizing the health belief model for improving nutrition-related knowledge, health beliefs, and behaviors did result in an increase in all sections, although insignificant.

Conclusion & Recommendations for Further Research

The current study demonstrates that a health-belief model-based intervention was not effective in producing significant improvements in general and sports nutrition related knowledge, health beliefs, and behaviors in adult YMCA participants. The discrepancies in the findings of the current study and prior studies relating to the effectiveness of the intervention's theoretical framework in generating improvements in general and sports nutrition related knowledge, health beliefs, and behaviors, may suggest that the current studies' unequal and unpaired small sample size resulted in the inability to determine statistical significance. Additional research is needed to study the effectiveness of a health-belief model-based intervention for improving the general and sports nutrition related knowledge, health beliefs, and behaviors in adult YMCA participants to reduce the risk of unequal and unpaired sample sizes and type II errors occurring.

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Appendix A

This intervention tool will be used to measure knowledge, health beliefs, and behaviors regarding general and sports nutrition. It will measure the effectiveness of a health belief model theory-based intervention program for general and sports nutrition. The intervention will provide insight for perceived benefits, susceptibility, severity, barriers, cues to action, and behaviors for nutrition-related beliefs and behaviors while improving nutrition knowledge. In previous studies, the health belief model has been used to encourage optimal behavior change by targeting barriers, benefits, self-efficacy, and threat. The education offered during the cooking classes can provide awareness for potential health risks based on the topics covered in my questionnaire. This can trigger perceived severity of this issue, which will help to reflect using self-efficacy. By using the education provided in the classes, athletes will have perceived benefits. They will likely be aware of their own susceptibility based on health status and behaviors, including barriers. The intervention can pose as a cue to action by creating awareness.

Knowledge

1. List all MyPlate food groups below.
2. What is the daily upper limit for caffeine?
 - a. 400 milligrams ~4 8 ounce cups
 - b. 300 milligrams ~3 8 ounce cups
 - c. 200 milligrams ~2 8 ounce cups
3. T/F athletes should try to eat 1 gram of protein per pound of body weight to gain muscle mass
4. T/F eating certain foods can speed up metabolism
5. T/F all types of exercise require electrolyte consumption

Health beliefs (susceptibility, severity, barriers, benefits, self-efficacy)

Perceived susceptibility

Nutrition is important for my overall health.

Choose one: strongly disagree, disagree, agree, strongly agree

Nutrition is important for my athletic performance and recovery.

Choose one: strongly disagree, disagree, agree, strongly agree

Perceived severity

I am concerned about my overall health, performance, and/or recovery.

Choose one: strongly disagree, disagree, agree, strongly agree

Perceived benefits

I am confident that I can use nutrition to perform and/or recover better.

Choose one: strongly disagree, disagree, agree, strongly agree

I have the knowledge to make dietary choices for optimal health, performance, and recovery.

Choose one: strongly disagree, disagree, agree, strongly agree

Perceived barriers

I have the self-efficacy to make dietary changes to optimize health, performance, and recovery.

Choose one: strongly disagree, disagree, agree, strongly agree

I do not have enough time to make dietary changes to optimize health, performance, and recovery.

Choose one: strongly disagree, disagree, agree, strongly agree

Cues to action

My friends and family members value nutrition and health.

Choose one: strongly disagree, disagree, agree, strongly agree

I use social media or online platforms as a source of knowledge for how to optimize my nutrition and/or health.

Choose one: strongly disagree, disagree, agree, strongly agree

I use printed flyers or papers as a source of knowledge for how to optimize my nutrition and/or health.

Choose one: strongly disagree, disagree, agree, strongly agree

Behaviors

1. I ate vegetables this week.
 - a. 0 days
 - b. 1-2 days
 - c. 3-4 days
 - d. 5-6 days
 - e. 7 days
2. I ate fruits this week.
 - a. 0 days
 - b. 1-2 days
 - c. 3-4 days
 - d. 5-6 days
 - e. 7 days
3. I ate carbohydrates this week (breads, pastas, wheat products, grains, corn, potatoes, peas, fruit, dairy, etc.)
 - a. 0 days
 - b. 1-2 days

- c. 3-4 days
 - d. 5-6 days
 - e. 7 days
4. I ate protein sources this week (meats, cheeses, nuts, seeds, beans, legumes, tofu, etc.)
- a. 0 days
 - b. 1-2 days
 - c. 3-4 days
 - d. 5-6 days
 - e. 7 days
5. I ate dairy foods this week (milk, yogurt, cheese, lactose-free milk, fortified soy milk and yogurt.)
- a. 0 days
 - b. 1-2 days
 - c. 3-4 days
 - d. 5-6 days
 - e. 7 days