PATTERNS OF USE BEFORE AND AFTER A LABELING INTERVENTION AMONG COLLEGIATE DIVISION I ATHLETES AT A FUELING STATION

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Nutrition, Dietetics, and Food Sciences

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2018

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ABSTRACT

The Patterns of Use Before and After a Labeling Intervention Among Collegiate Division I Athletes at a Fueling Station

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Utah State University, 2018

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Division I athletes are always looking to gain an edge over their competitors, and optimally timed nutrition strategies can help an athlete fuel for workouts and recovery effectively. However, many athletes have insufficient nutrition knowledge. The objective of the research was to examine patterns in food selection, timing of eating, and self-reported purpose of eating in a university-sponsored fueling station before and after the implementation of a labeling system aimed at educating athletes about appropriately timed food choices. The labeling system was named "Gain Your Edge" food labels. The Fueling Station was selected because it reaches a large population of all athletes each week, all athletes are able to use it, and it provides education.

The timing of eating, timing of workout, and food selections were collected from the athletes in the form of an online Qualtrics survey that was taken after each visit to the Fueling Station. The results show that after four weeks, the food labels did not result in any change in the athlete's appropriateness of food choices, however 95% were aware of the food labels, and 76% said that the food labels impacted their choices. More research is needed on effectively educating athletes on the importance of timing when eating.

(82 pages)

PUBLIC ABSTRACT

The Patterns of Use Before and After a Labeling Intervention Among Collegiate Division I Athletes at a Fueling Station

Julie Buzzard

The Fueling Station at Utah State University was created to provide pre-workout fueling and post-workout recovery foods to the Utah State University athletes. The athletes use an online survey to mark what foods they selected after each visit to the Fueling Station.

There is a large amount of research on the lack of sports nutrition knowledge in collegiate athletes, but there is little information on the dietary intake of athletes, the education of athletes, and the education of macronutrient timing in athletes.

A food labeling system named “Gain Your Edge” food labels that targeted the education of timing was created in the Utah State University Fueling Station. It lets athletes know which food choices might be the most appropriate choices for certain periods of timing (i.e. pre-workout versus post-workout). The Fueling Station was selected as an outlet for education because it reaches a large percentage of all Utah State athletes each week.

The survey responses by the athletes were used to determine if the fueling station visits were appropriate or not appropriate based on the reported timing of eating, purpose of eating, and food selections. After four weeks of implementation, it was determined that the food labels did result in significant changes in percentage of appropriate fueling station visits for the athletes. However, almost all the athletes noticed the food labels, and more than 75% of the athletes said that the food labels influenced their food selection. This research project contributes important information about the patterns of use in a University-sponsored fueling station to the limited knowledge base of collegiate sports nutrition research.

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CHAPTER I

THE IMPORTANCE OF PROPER NUTRITION IN COLLEGE ATHLETES AND THE BARRIERS AND INFLUENCES ON THESE ATHLETES

ABSTRACT

Nutrition plays an important role in athletic performance, and it is important for an athlete to fuel his or her body in a way that maximizes performance and minimizes recovery time. There are many barriers that prevent collegiate athletes from meeting this goal including lack of nutrition knowledge, time, and resources. Additionally, coaches, strength and conditioning specialists, athletic trainers, peers, and family may influence the dietary habits of these individuals. Sports dietitians are nutrition professionals that can help educate athletes on research-based nutritional strategies to maximize performance. Because of the importance of timing in macronutrient consumption, collegiate athletes not only need to be educated on basic nutritional principals, but on maximizing performance and recovery through properly timed eating.

THE PROBLEM

LACK OF NUTRITIONAL KNOWLEDGE IN COLLEGIATE ATHLETES

Athletes are always aiming to improve their performance in order to gain an edge over their competitors. The main goal of many athletes is to optimize performance and maintain a healthy body composition for their given sport. It is established that well-chosen nutrition strategies can improve athletic performance and recovery.[1] Dietary choices influence energy balance, nutrient intake, and even hydration status.[2] Additionally, timing and macronutrient composition impact upcoming training sessions

and recovery time.[2] Despite the established relationship between nutrition and performance, athletes often overlook the sports nutrition component, or they simply are not educated on incorporating proper nutritional strategies into their diet.[3]

Collegiate athletes must balance heavy schoolwork with demanding practice schedules. It is extremely important that this population of athletes is fueling his or her body to maximize performance, however there is currently no mandatory comprehensive nutrition education program by the National Collegiate Athletic Association (NCAA).[3] This is in contrast to the required academic support and life skills programs.[3]

Several researchers have identified the lack of basic nutrition knowledge in NCAA collegiate athletes of various sports through nutritional surveys. For example, many athletes believe that vitamins and mineral supplements contribute to energy.[4] The role of protein is also commonly misunderstood. In one survey of 237 collegiate Division I participants, nearly 50% of athletes believed that protein is the main source of energy for the muscle.[4] Jacobson et al. revealed other misconceptions about the role of protein.[5] In a survey of 330 collegiate athletes, 21% thought protein was an immediate energy source and 13% thought protein would increase muscle size.[5] Many studies demonstrate that athletes recognize the function of carbohydrates as an immediate energy source, but few know how many carbohydrates or other macronutrients are recommended.[2] Torres-McGeghee et al. found that out of 185 student-athletes surveyed through a random sample of Division I, II, and II schools, only 9% had adequate sports nutrition knowledge, which was defined by answering at least 15 of 20 (75%) questions correctly.[6] It is clear that nutrition knowledge deficits are present in this population, and findings show that this has caused many dietary inadequacies in athletes' actual intake.[4]

Collegiate athletes often appear generally healthy according to weight for height and body fat standards, but research shows inadequate nutrient intakes.[7] Webber et al. found that diets were adequate in calcium, iron, and vitamin C, but inadequate in fiber, fruits and vegetables.[7] It appears the common collegiate athlete's diet lacks fruits, vegetables, and whole grains, but is high in fat and processed foods.[8] With inadequate nutrient intakes, athletes are susceptible to decreases in performance and recovery.[1]

Many studies focus on the nutritional knowledge of collegiate athletes and dietary patterns, but to the authors' knowledge, no studies focus on dietary intake, timing, and the education of timing in this population. The position statement by the Academy of Nutrition and Dietetics has recently drawn additional evidence to the importance of timing in fueling athletes. In fact, it currently recommends that ~10 grams of essential amino acids, or 20-30 grams of total protein, are consumed during the recovery period, which is 0-2 hours after exercise.[1] Studies show that this leads to increased whole body and muscle protein synthesis as well as improved nitrogen balance.[1] Due to the importance of timing in macronutrient consumption, collegiate athletes not only need to be educated on basic nutritional principals, but on maximizing performance and recovery through properly timed eating patterns.

BACKGROUND

The Utah State University Fueling Station opened January of 2016. The purpose of the Fueling Station is to provide pre-workout and post-workout nutrition for the athletes. Since opening, the Fueling Station has been collecting data from its patrons in the form of an online survey that they complete after each visit to the fueling station. The survey contains questions about the individual's student ID number, sports team, gender,

last workout, purpose of eating, and which food items were selected. This survey is available on three iPads that are on the eating tables in the fueling station. Athletes typically fill out the survey on an iPad as they eat, and this has been the system since the Fueling Station opened. The athletes are allowed to make any food selections that they want with each use of the Fueling Station, but they are asked to fill out the mandatory survey as a way to "check-out" after each individual visit. The current director of sports nutrition has used this survey for internal information about food inventory and program evaluation. Because this information is valuable to capture the eating habits of Division I collegiate athletes, this survey will now be used for research purposes.

BARRIERS TO PROPER NUTRITION IN COLLEGIATE ATHLETES

Collegiate athletes have an incredibly busy schedule, and therefore optimal nutrition is sometimes hindered. Athletes are often traveling to competitions, and this disrupts normal eating patterns and behaviors.[9] “Eating-on-the-road” is different for each team and each collegiate program, but the meal options often are not optimal for games or competitions.[8] With school and sports, it can be hard to find time to prepare healthy food. Financial resources can also impact whether a collegiate athlete will grocery shop.[9] Many NCAA athletic programs will provide fueling stations and meals for their athletes, but it varies depending on sport, school, and division of athletics.[2]

Even with proper resources and readily available food provided by the university, many college athletes still lack basic knowledge about proper nutrition practices. As mentioned earlier, lack of nutrition knowledge is a huge barrier in the eating behaviors of this population. A recent survey completed by Andrews et al. of male and female Division I student athletes from baseball, softball, men’s soccer, track and field, and

tennis resulted in consistent findings with previous nutrition knowledge surveys. Out of the 123 athletes, only 12 were found to have adequate sports nutrition knowledge, answering at least 75% of questions correctly. The average score of the survey was 56.9%, which did not differ by gender, age, team, or completion of previous nutritional coursework.[3] Even older athletes that were adjusted to the rigor of a collegiate athletic environment were unable to score higher on the sports nutrition knowledge survey. Individuals that had previously taken nutrition coursework did not seem to retain the information they had learned due to a possible lack of motivation and understanding of its impact on performance measures. However, another study conducted by Nascimento et al. found that nutrition coursework was effective in improving athletes' knowledge when it was combined with individual consultations.[3] The lack of nutrition knowledge is a barrier that impacts proper nutrition in male and female collegiate athletes of many different sports and experience levels. In addition to the barriers with time, money, and knowledge, many collegiate athletes are influenced by outside sources that affect their dietary choices.

FACTORS THAT INFLUENCE WHAT COLLEGIATE ATHLETES EAT

Collegiate athletes' dietary choices are influenced by many factors. There is nutrition information all over the Internet, and it is easy for athletes to stumble upon a "quick fix" and believe it is scientifically sound. Often times, this information is inaccurate and from questionable sources[3]. In 1992, Jacobson and Aldana completed a nutrition knowledge survey and reported that most participants received their nutrition knowledge from magazines, athletic trainers, friends, and coursework.[10] Jacobson et al. completed a follow-up study in 2001 and found a difference in the influences in dietary

choices of male and female athletes. Female student-athletes were more likely to report receiving nutritional information from nutrition professionals, whereas male student-athletes indicated that strength and conditioning specialists and athletic trainers were the primary source. However, both male and females still confirmed relying on friends, family, and magazines as well.[5] Additionally, collegiate athletes may also practice some nutritional behaviors for cultural or religious reasons.[3]

Collegiate athletes are around many trainers, strength and conditioning specialists, and team coaches. If a school does employ a sports dietitian, it may only be one individual for as many as 400 collegiate athletes. Trainers, strength and conditioning specialists, and team coaches spend a lot of time with the athletes, and they can be easily accessible for quick advice or tips.

Despite many of these professionals not being qualified to give nutrition advice, many athletes are influenced by them.[3] This is a concern because the athletes might receive incorrect information or theories that are not backed by research.[6] The nutrition knowledge of collegiate coaches, athletic trainers, and strength and conditioning specialists have been previously examined, however the results are not consistent. A study by Smith-Rockwell et al. found that 66% of athletic trainers had adequate nutrition knowledge.[11] A similar study completed by Shifflett et al. found that the nutrition knowledge of athletic trainers was actually higher, at 74%.[12] Both of these studies are over a decade old, and the National Athletic Trainers' Association (NATA) has since updated its required nutrition curriculum.[13] Due to the updated standards, the basic nutrition knowledge should be greater for the newly certified athletic trainers. However,

already certified athletic trainers may not have received this information, and they may still be providing inaccurate nutritional advice to athletes.[6]

Strength and conditioning specialists are typically responsible for a collegiate athlete's physical development and fitness, but athletes are also influenced by the nutritional advice these specialists sometimes provide.[6] Torres-McGehee et al. surveyed the nutrition knowledge of 579 student-athletes, coaches, athletic trainers, and strength and conditioning specialists. Adequate sports nutrition knowledge was defined by scoring at least 75% in each domain. The four domains were: micronutrients and macronutrients, supplements and performance, weight management and eating disorders, and hydration.[6] 77.8% of athletic trainers, and 81.6% of strength and conditioning specialists were found to have adequate sports nutrition knowledge.[6] Coaches scored the lowest, with only 35.9% found to be adequately educated on this topic.[6] Athletes have many opportunities for contact with athletic trainers, strength and conditioning specialists, and coaches, so it is critical that these professionals are not providing nutritional advice that will hinder an athlete's performance. These individuals have a large influence on collegiate athletes, and sometimes they are the only source of knowledge for an athlete. There are many collegiate sports dietitians, but a large portion of NCAA schools still do not have one, so the largest influence are the other coaches that interact with the student-athlete. As of 2016, there were 88 full-time sports dietitians working in 61 schools in big athletic conferences.[16] Even in schools with sports dietitians, athletes still may follow practices recommended from these other professionals. In a sports nutrition knowledge survey conducted at Utah State University, 46% of the 96 athletes surveyed said that coaches or trainers were their primary source of nutrition information.[17] Athletic trainers and

strength and conditioning specialists may exhibit some sports nutrition knowledge, but it is imperative to the health of the collegiate athlete that they only provide advice within the scope of their practice, and athletes are referred to sports dietitians.

SPORTS DIETITIANS AND COLLEGIATE ATHLETES

While not every collegiate athletic department employs a full-time Registered Dietitian, this is quickly changing. In fact, this number has nearly quadrupled since 2010, the year the Collegiate and Professional Sports Dietitians Association (CPSDA) was chartered.[14] The availability of a sports dietitian allows the collegiate athletes to receive evidence-based nutrition education, as opposed to a non-research backed theory they may receive elsewhere.[15]

A study showed that educational sessions with a dietitian improved both nutritional knowledge and dietary intake in NCAA women's volleyball athletes.[16] The effectiveness of a dietitian was measured by examining the dietary patterns of this team over two off seasons, with the first off-season being baseline measurements with no intervention. The athletes completed 3-day food diaries four different times during each season. The intervention was meeting with a registered dietitian for an individual counseling session four times to discuss effective nutritional strategies and improvements. Results showed significant improvements in sports nutrition knowledge, and even significant improvements in dietary intake, however many still did not reach the current recommendations for athletes.[16]

A recent study examined the dietary habits and behaviors of collegiate athletes who had access to a sports dietitian and compared their responses to athletes who did not receive their nutrition information from a sports dietitian. The study surveyed 383 NCAA

Division I athletes from two different universities, and included 62 questions containing information on sport participation, general eating habits, breakfast, hydration, nutrition during team trips, nutrient periodization, and demographic information.[18] While both of these schools employed a full-time sports dietitian, only 60% responded that this was the main source of nutrition knowledge. When a sports dietitian was the primary nutrition information source, athletes had a greater understanding of nutrient periodization (47.12%) versus those without a sports dietitian (32.85%). Additionally, those receiving primary nutrition information from a sports dietitian were less likely to consume fast food.[18]

The same authors later published an article discussing the availability of a sports dietitian and its specific impact on baseball. Its aim was to examine the differences in dietary intake between using a sports dietitian or a strength and conditioning specialist as the main source of nutrition information. The baseball players with access to a sports dietitian were found to be more likely to eat before activity, and they consumed less fast food, caffeinated beverages, and soda.[19] The players with access to a sports dietitian were also more likely to prepare their own meals and take daily multi-vitamins. The baseball players that received primary nutritional information from strength and conditioning specialists were more likely to eat fast-food meals before competitions and felt that they had sport coaches who were less aware of healthy food options.[19]

The published studies show that sports dietitians positively influence the collegiate-athletes' dietary intake and nutritional knowledge. They are educated professionals that are a valuable asset to a collegiate athletic program. The evidence-based eating strategies and dietary plans provided by sports dietitians may lead to

improved performance and recovery in collegiate athletes. While sports dietitians can make a significant improvement in nutrition knowledge and behavior in collegiate athletes, there are still barriers in delivering the information. In the previously discussed study conducted by Hull et al., sports dietitians were available at both Division I universities, but nearly 40% of the athletes still reported receiving their primary nutrition knowledge from other sources.[18] The study of NCAA female volleyball players showed the effectiveness of individual counseling sessions with a dietitian on dietary knowledge and intake,[16] but there are other ways that a sports dietitian can improve the nutrition curriculum for all student-athletes. Athletes can benefit from general outreach efforts such as educational boards, knowledge and education through social media and blogs, and interactions with the sports nutrition staff.[18] An effective sports nutrition program can help ensure the work of a sports dietitian is actually a benefit to collegiate athletes' nutrition knowledge and improving their dietary intake.

Researchers from the University of Wisconsin published guidelines for developing an effective performance nutrition curriculum, and its lasting positive impact on collegiate athletes.[14] Educating athletes on basic nutrition concepts and food skills, how to properly fuel before, during, and after practices and competitions, and ways to enhance performance are all components of a successful program. Athletes come to college with all different levels of nutritional knowledge, and an effective sports nutrition program could help maximize knowledge and performance for all individuals. There are currently many sports nutrition programs nationwide, but there is little research on the effectiveness of these overall programs. Many studies have been published examining nutritional knowledge through surveys, but few studies demonstrate the value of a full-

time sports dietitian on changes in dietary intake outside the scope of an individual team.[14]

Collegiate sports nutrition programs have grown at a huge rate, and the recent growth can be partially attributed to changes in NCAA feeding rules. A feeding restriction was implemented in 1991, which aimed to keep a competitive balance among schools by limiting food expenses.[20] However, in April 2014, these previously imposed restrictions were lifted on what schools could provide athletes. Since this restriction was lifted, many schools have hired sports dietitians, or allowed their already existing sports nutrition program to grow.[20] Many universities provide fueling stations that provide pre-workout and recovery nutrition for its athletes. Despite the growing number of fueling stations, there is no published research examining their efficacy in properly fueling athletes.

CURRENT NUTRITION RECOMMENDATIONS FOR ATHLETES

The Academy of Nutrition and Dietetics position paper on nutrition for athletic performance includes current recommendations for properly fueling the body. Carbohydrates are extremely important for athletes because they provide fuel for the brain and central nervous system.[1] They support exercise over a large range of intensities due to carbohydrates' anaerobic and oxidative pathways. Carbohydrates are advantageous over fat as energy because it provides a greater yield of ATP per volume of oxygen used, which improves exercise efficiency overall.[21] Carbohydrates also enhance performance of prolonged sustained or intermittent high-intensity exercises. Consequences of carbohydrate depletion are fatigue in the form of reduced work rates, impaired skill and concentration, and increased perception of effort.[1] Because of carbohydrates role, it is

important that the collegiate athlete eat enough of this macronutrient in their overall diet, before exercise, and during exercises that last longer than one hour.[1] Carbohydrate needs can be as high as 12 g/kg/day in athletes that are completing 4-5 hours of moderate to high-intensity exercise each day. For an athlete that is completing a moderate exercise program, 5-7 g/kg/day would be enough.[1]

Dietary protein is important because it provides a trigger and a substrate for the synthesis of contractile and metabolic proteins.[22] The current recommendations for absolute quantities of protein in athletes are generally between 1.2-2.0 g/kg/day. This amount should be able to support metabolic adaption, repair, remodeling, and protein turnover.[1] Fat is necessary in a healthy diet, and its consumption in athletes should be in accordance with public health guidelines. Athletes should not consume less than 20% of their energy intake from fat in order to reduce nutritional deficiencies.[1]

NUTRITION AND TIMING

As noted earlier, the timing of nutrition is extremely important in performance factors. Foods higher in carbohydrates should be consumed before exercise and during prolonged exercise as an energy source. Carbohydrate supplementation is not needed in exercise lasting less than 45 minutes; however, 30-60 g/hour are recommended in exercises lasting 1-2.5 hours.[23] This carbohydrate intake provides fuel for the muscles when the glycogen stores become depleted.[1]

Upon completion of exercise, about 10 grams of essential amino acids, or 20-30 grams of protein are recommended in the early recovery phase, or 0-2 hours after exercise.[24] Research shows that muscle protein synthesis is optimized in response to this

consumption.[1] The International Society of Sports Nutrition (ISSN) provides similar recommendations for protein consumption after exercise at 20-40 grams.[25]

Purpose and Objectives:

The purpose of this research is to examine patterns in food selection, timing of eating, and self-reported purpose for eating among collegiate Division I athletes participating in a University-sponsored fueling station before and after the implementation of a labeling system.

Specific Aims

1. Modify the current fueling station survey that athletes currently complete after every visit to the Fueling Station to address timing of eating, and self-reported purpose for eating, in addition to food selection among collegiate Division I athletes participating in a university-sponsored fueling station.
    a. Pilot the use of the modified survey over a period of 1 week to test its feasibility of use by athletes in the Utah State University (USU) Fueling Station.
    b. Examine patterns of intake and purpose for eating by sport, gender, and workout timing
2. Assist in the development and implementation of a food labeling system at the USU Fueling Station.
    a. Determine the nutrient compositions of food offering through ESHA software.

   b. Categorize food into weight balance, hydration, muscle recovery, quick energy, and sustained energy and use symbols to mark these foods on the labels in the fueling station.
   c. Note good and great sources of vitamins and minerals on the label as well.

3. Use the survey developed in aim 1 to examine changes in food selection, timing of eating, and self-reported purpose for eating among collegiate Division I athletes participating in the USU Fueling Station after a 30-day implementation of the food labeling system developed in aim 2.

Our hypothesis is that labeling foods at the Fueling Station with information about what nutrition goals are met by consumption of specific foods will help athletes make food choices that better match their purpose for eating and may contribute to their improved health and performance.

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CHAPTER II

THE PATTERNS OF USE OF COLLEGE ATHLETES AT A FUELING STATION DURING A HIGH-TRAFFIC WEEK

ABSTRACT

Proper nutrition practices are important in collegiate athletes to improve athletic performance and recovery. Fueling stations are set up in collegiate athletic departments for athletes to conveniently get healthy foods. There is currently no published research on the efficacy of fueling stations. The objective of this research was to determine the patterns of use of collegiate athletes in a Division I fueling station. Athletes completed an online Qualtrics questionnaire after each visit to the Fueling Station, answering questions about their most recent workout or training, what their purpose of eating was, and what food selections they made. The results show that the Utah State Fueling Station reached 81.4% of all athletes, and 81.44% of those that used the Fueling Station were for the purpose of either pre-workout or post-workout fueling needs. Fueling stations are an effective way to provide nutrition to a large number of athletes, and it is possible that incorporating nutrition education strategies into fueling stations can help sports dietitians provide research-backed information to a large number of individuals very quickly.

INTRODUCTION

Collegiate athletes lead a busy life balancing team practice, schoolwork, and often an intense travel schedule for competitions. It is very important for these athletes to fuel their body properly, despite the hectic schedule. Proper nutrition practices can improve athletic performance and recovery.[1] Dietary choices influence an athlete's energy balance, nutrient intake, and even hydration status.[2] The timing of when athletes eat their food can

also impact their performance and recovery time. Well-chosen nutrition strategies can help an athlete maximize performance and minimize recovery time.[2] For example, foods higher in carbohydrates should be consumed before exercise and during prolonged exercise as an energy source.[3] Carbohydrates can provide fuel for the muscles when the glycogen stores become depleted.[1] In addition, in the early phases of recovery, 10 grams of essential amino acids, or 20-30 grams of protein, are recommended to optimize muscle protein synthesis.[1]

Many large collegiate athletic programs have sports nutrition departments to help provide athletes with healthy and convenient nutrition choices. The number of collegiate sports nutrition programs has grown at a large rate. Previously, the NCAA regulated the amount of money a university could spend on food. This rule was implemented in 1991, and it aimed to keep a competitive balance between schools. In April 2014, all feeding restrictions were lifted. Schools were able to provide more nutrition to their athletes, and the lifting of this restriction allowed many sports nutrition programs to grow.[4] One way that many schools provide nutrition for their athletes is by running fueling stations. Fueling stations are a way for athletes to quickly get pre-workout fueling or post-workout recovery within the timeframe necessary to really impact performance. Despite the growing number of fueling stations at many major NCAA athletic programs, there is no published research examining the typical patterns of use of these stations by Division I athletes.

Utah State University first opened a Fueling Station for its athletes in January of 2016. The goal of the fueling station was to provide pre-workout and post-workout nutrition to all varsity athletes. All Division I athletes are welcome to utilize the Fueling

Station during open hours. The athletes can make any food selection they want, but they must "check-out" by taking a Qualtrics survey on an iPad. The Qualtrics survey asks basic questions about sport, gender, and which foods were selected. The Fueling Station has been collecting data in this form from the patrons since opening. Until now, the data had only been used for program evaluation and inventory purposes. The objective of this research was to examine the timing of eating, self-reported purpose of eating, and food selection among collegiate Division I athletes participating in a university-sponsored fueling station.

METHODS

The Utah State University fueling station's original survey contained questions about the student's individual ID number, sports team, and which food items were selected. The modification of the survey included adding additional questions asking gender, workout, and what the purpose of eating is (i.e. hunger, pre-workout fueling, post-workout recovery). In order to make the structure of the food-items more logical and be easy to understand for users, they were categorized by food group according to the MyPlate food groups. The updated survey has seven different categories for food, including every item that the Utah State Fueling Station offers. These were fruits, vegetables, protein, dairy, and grains which are the five MyPlate food groups. The additional two categories were daily specials and condiments. Daily specials are special foods that are only offered on specific days of the week. Since daily specials often fall into more than one food group category, they were given their own individual grouping. The daily specials include smoothies, lunch meat and spinach wraps, oat and flax energy bites, and fruit and yogurt parfaits. Dips and toppings were also given their own category

because they are served in small 1.5 oz containers, so often the amount eaten is minimal. The table below includes the updated survey questions, and the different choices for each question. The questions about gender, sport, last workout, what the workout was, and the purpose of eating are structured so that individuals may only make one selection. The other questions allow the user to make as many selections as they want, as often more than one item per category is taken.

Table 2-1. Updated Qualtrics Survey for Utah State Fueling Station

Question on Qualtrics Survey	Choices
Enter the last 4 digits of your A number	
Mark Gender	Male, Female
What is your sport?	Basketball, Cross Country, Football, Golf, Gymnastics, Track, Field Events, Soccer, Softball, Volleyball
My last workout...	Was 0-2 hours ago, Is in 0-2 hours, Other
My workout is/was...	Weights, Conditioning, Practice/Competition, Other
My reason for eating is...	Pre workout/fueling, Post workout/recovery, Hunger, Convenience
Mark which fruits you took from the fueling station	Apple, Apple crisp chips, Applesauce, Avocado, Banana, Dried fruit, Grapes, Kiwi, Oranges, Pear, Peach/Nectarine, Pineapple, Plum, Squeeze fruit
Mark which vegetables you took from the fueling station	Bell peppers, Broccoli, Carrots, Cauliflower, Celery, Cucumber, Sugar snap peas
Mark which protein you took from the fueling station	Beef Jerky, Black beans, Chicken, Cottage cheese, Eggs, Hummus, Nuts, Seeds, Trail mix, Peanut butter, Protein bar, Tuna, Other
Mark which dairy items you took from the fueling station	Almond milk (dairy free), Cream cheese, Chocolate milk, Flavored milk, Greek yogurt, Milk, String cheese/cheddar cheese slice
Mark which grains you took from the fueling station	Bagel, Bread, Cereal, Chex mix, Goldfish, Granola, Kind bars, Oatmeal, Pita chips, Popcorn, Pretzels, Tortilla chips, Other
Mark which daily special you took from the fueling station	Energy bites, Yogurt parfait, Smoothie, Wraps
Mark which condiments you took from the fueling station	Guacamole, Honey, Hot sauce, Jelly, Mayonnaise, Mustard, Ranch, Salsa, Other

The new thirteen question survey was implemented in the Fueling Station on October 2, 2017. Survey responses from a high traffic week were captured to analyze the general Fueling Station patterns of use. The week selected was Monday, October 9, 2017 to Friday, October 13, 2017. During this week, the Fueling Station was running on its normal schedule. This means that it was open each morning from 6-9 am, and each afternoon from 1-4 pm, with the exception of Wednesday. On Wednesday, October 11, the Fueling Station was open from 1-6 pm. Monday, Tuesday, and Thursday, the athletes have access to a catered dinner. Because this is unavailable on Wednesday evenings, the Fueling Station is open until 6 pm to allow those with later practices to have access to the Fueling Station for recovery nutrition.

DATA ANALYSIS

The survey results from this high traffic week were analyzed to determine patterns of use based on gender, sport, and self-reported purpose of eating. A variable was created using the students' ID number to determine how many visits to the Fueling Station they made for the week. It is common for an athlete to visit the Fueling Station many times in a week, and often more than once a day. This variable captured the percentage of all Utah State University athletes that visit the Fueling Station in a typical week.

Variables were created to look at the number of food selections in a given food group per visit. The quantity of food taken was not captured in the Qualtrics survey, but the number of different food choices was. Fruit choices were summed across each recorded survey response for the total number of fruit choices in that specific Fueling Station visit. The same was done to create a variable for vegetable, protein, dairy, and grain choices.

The dataset was analyzed using SPSS software. Cross tabs and frequencies were used to determine the typical patterns of the athletes at the Fueling Station by gender and sport. To determine the percentage of total athletes that visit the Fueling Station in a typical week out of all Utah State University athletes, only the first visit of the data collection was used. For the descriptive data examining food choice, all survey responses were used. One-way ANOVA tests were used to see if there were any significant differences among gender or sport in average number of food selections per Fueling Station visit.

RESULTS

The Qualtrics survey responses were analyzed for data collected from October 9 to October 13, 2017. Table 2 shows how many individuals visited the Fueling Station at least once during this week of data collection, which team they were from, and the total percentage of that team that was captured in this data. A total of 275 different athletes visited the Fueling Station at least once. The Utah State team rosters were used to determine the total number of individuals on each team, and what percentage of each team was captured in this week. On the survey, there are different options for cross country, track, and field events. Because there is a lot of overlap on these teams, these were put into one group. No individual was double counted when determining the number of athletes on each team or how many were captured in the Fueling Station survey. There are 338 athletes rostered as Division I USU athletes in October of 2017, responses were captured for 275 athletes (81.4%).

Table 2-2. Population of Athletes Who Visited Fueling Station (n=275)

Team	Gender	Visited Fueling Station	Percentage Captured
Basketball	Men	3	21.4%
	Women	11	91.67%
Cross Country & Track	Men	50	100%[1]
	Women	48	84.2%
Football	Men	82	82.3%
Golf	Men	7	87.5%
Gymnastics	Women	14	77.8%
Tennis	Men	6	75%
	Women	5	55.6%
Soccer	Women	24	77.4%
Softball	Women	15	75%
Volleyball	Women	10	66.7%
Total Athletes		**275**	**81.4%**

[1]There were 3 more individuals captured from the survey than on the team roster, so there might have been user-error in typing ID numbers into the Qualtrics survey

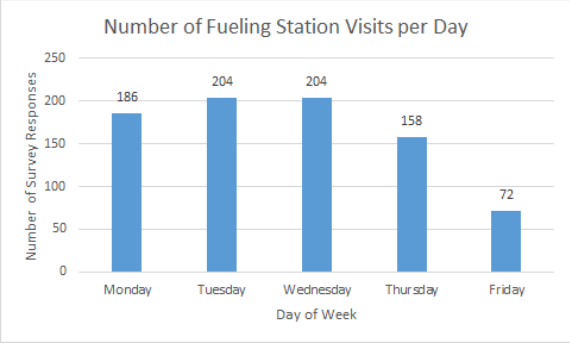
The Fueling Station is often visited by the same individual multiple times in a week, and sometimes multiple times in a day. Table 3 shows the breakdown of athlete visit numbers to the Fueling Station in the selected week. In the given week, there were 824 total Fueling Station visits during the 10 open shifts. Of these 824 visits, 275, or 33.4%, were athletes visiting the Fueling Station for the first time that week. Of those 275 individuals, 87 (31.6%) only visited the Fueling Station that one time. The other 188 athletes visited the Fueling Station at least once more in addition to his or her first visit. 549 of the survey responses were completed by athletes visiting the Fueling Station for their second through ninth time in the week.

Table 2-3. Breakdown of Athlete Visits (n=824)

Visit of Week	Frequency	Percent
1	275	33.4%
2	188	22.8%
3	140	17.0%
4	100	12.1%
5	55	6.7%
6	34	4.1%
7	20	2.4%
8	8	1.0%
9	4	0.5%
Total	**824**	**100%**

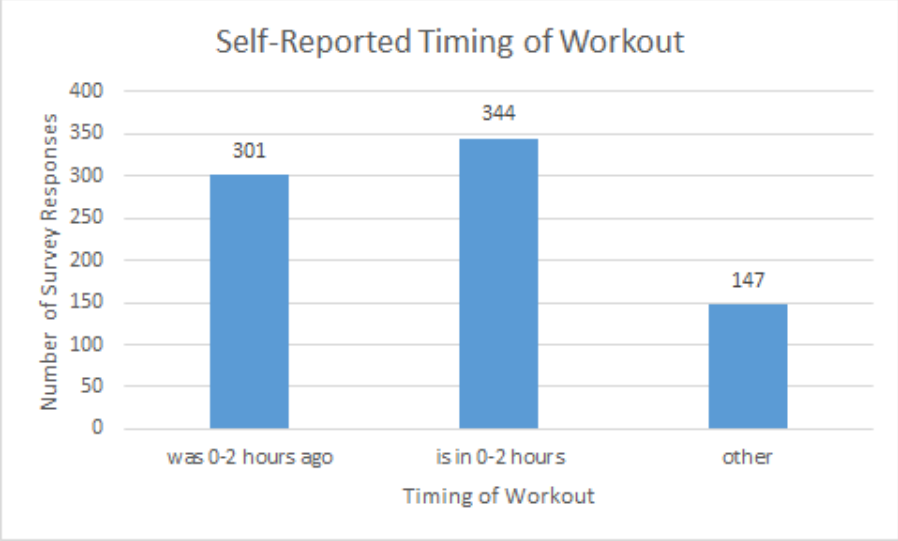
Figure 1 shows the number of Fueling Station visits per day of week. Tuesday and Wednesday are the highest traffic days with 49.6%, or 408 out of 824, of the entire week's visits coming from these two days. A possible explanation for this is that many teams are in season in the fall and are traveling for competition. It is common that traveling occurs over the weekend, and teams begin to leave on Thursday. Additionally, the Fueling Station was open for two hours longer on Wednesday than on any other day. Friday received the lowest number of visits to the Fueling Station with only 72, or 8.7% of visits.

Figure 2-1. Number of Fueling Station Visits per Day



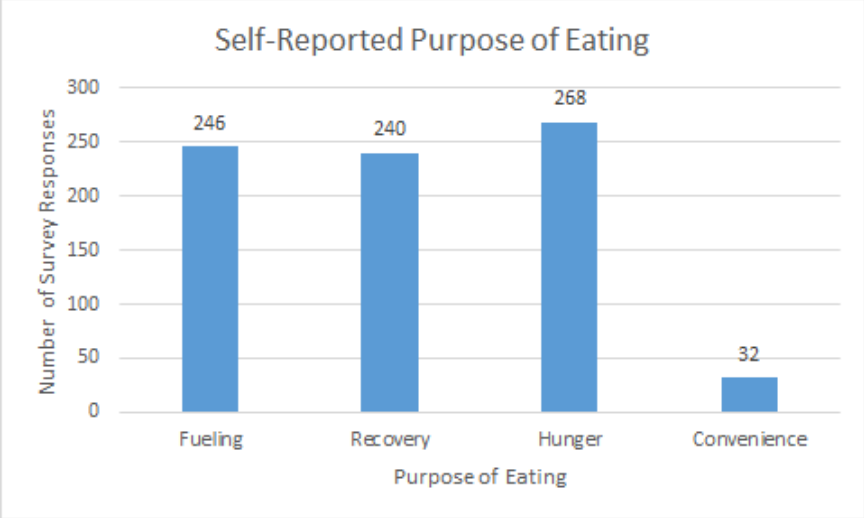
The purpose of the Fueling Station is to provide pre-workout fueling or post-workout recovery for the athletes. The results for the self-reported timing of eating are shown in figure 2. The data show that 81.44% of the athletes that answered this question reported that they were either pre-workout or post-workout for that specific visit to the Fueling Station. 147, or 18.56% of athletes that responded to this question were not within a pre-workout or post-workout window. Figure 3 shows the results for the athletes' self-reported purpose of eating. The data show that 61.83% of the athletes that answered this question reported that they were eating for either pre-workout fueling or post-workout recovery. 34.10% marked that they were eating because they were hungry, and 4.07% marked that they were eating because it was convenient. The results of these two questions show that 18.56% of the athletes are utilizing the Fueling Station during a period of time that would not support pre- or post-workout fueling and 38.17% marked that they were eating foods provided by the Fueling Station for a purpose other than pre- or post-workout fueling. Table 4 shows the relationship between self-reported timing of workout and self-reported timing of eating. A chi-squared analysis ($p<0.01$) shows that there is a strong relationship between the two, and athletes are making the connection between timing of workout and purpose of eating. For example, 215 athletes selected that they were eating for recovery when their last workout had been 0-2 hours ago.

Figure 2-2. Self-Reported Timing of Workout[1] (n=792)



[1]32 missing responses

Figure 2-3: Self-Reported Purpose of Eating[1] (n=786)



[1]38 missing responses

Table 2-4. Self-Reported Purpose of Eating and Self-Reported Timing of Workout (n=779)

		Purpose of Eating			
		Fueling/Pre-workout	Recovery/Post-workout	Hunger	Convenience
Last workout	Was 0-2 hours ago	11 (1.4%)	215 (27.6%)	68 (8.7%)	5 (0.6%)
	Is in 0-2 hours	213 (27.3%)	22 (2.8%)	90 (11.6%)	11 (1.4%)
	Other	22 (2.8%)	1 (0.1%)	105 (13.5%)	16 (2.1%)

Chi-Squared test $p<0.01$

The average number of food selections in each category was looked at using the variables created for each category (fruits, vegetables, protein, grain, and dairy). Figure 4 shows the average fruit and vegetable intake between males and females. It shows that on average, males selected 0.93 fruit choices and females selected 0.95. There is no significant difference between males and females in fruit selection. On average, males selected 0.15 vegetable choices and females selected 0.21 choices. These numbers represent the average number of choices made from this category in each visit to the Fueling Station. There is no significant difference between number of vegetable selections in males and females. All athletes consumed significantly more fruit choices than vegetable choices ($p<0.01$) in each visit to the Fueling Station. It is important to note that there are more fruit choices than vegetable choices available at the Fueling Station, however, there are always two different types of fresh vegetable options to select from. There are many more fruit options, including canned, fresh, and dried fruit choices.

Figure 5 shows the results of the average number of grain, protein, and dairy selections. Females had a significantly higher average number of grain selection than males ($p<0.01$). Males had a significantly larger number of protein selections than

females (p=0.022). There was no significant difference between males and females in dairy intake. These numbers only account for the average number of food selections in each category. Because the Qualtrics survey did not specify amount of each food item taken or consumed, it only can account for the average number of different food choices selected in the specific category.

Figure 2-4. Male vs. Female Fruit & Vegetable Selections

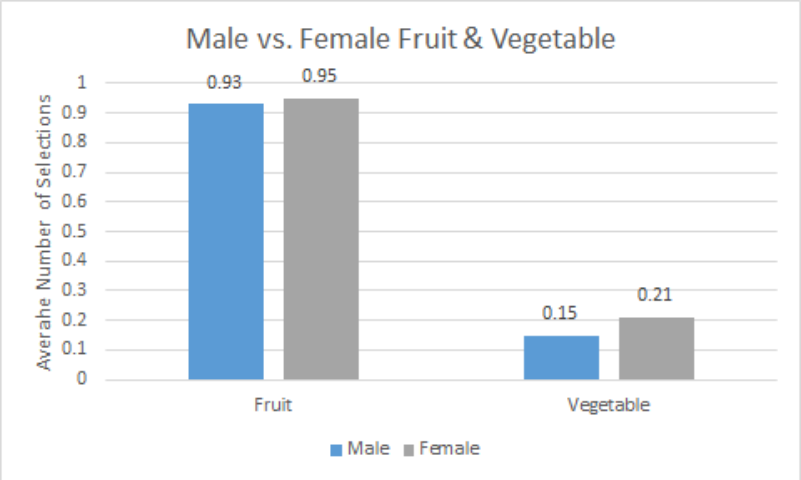
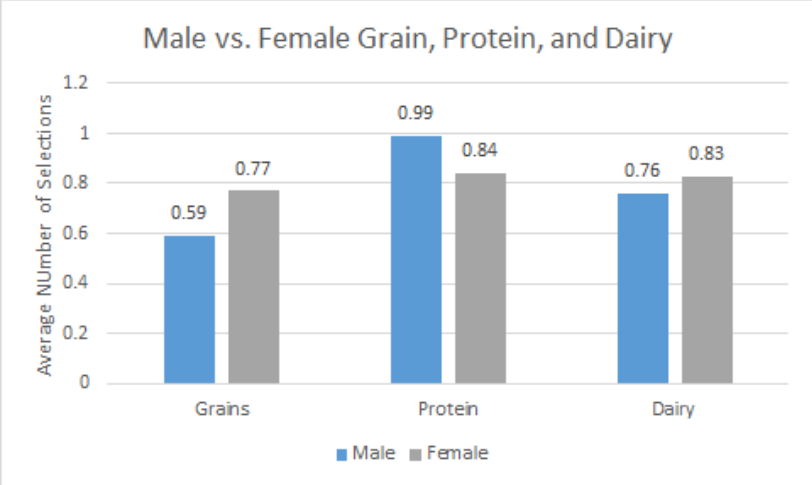


Figure 2-5. Male vs. Female Grain, Protein, and Dairy Selections



The results of the survey show that cross country, soccer, and softball athletes were the only sports that averaged a larger grain selection than protein. All other sports teams selected more protein choices than grain, with the exception of women's volleyball, which had an equal number of protein and grain choices per Fueling Station visit. The average number of food selections in grain, protein, and dairy among sport are shown in table 5. Cross country athletes on average selected significantly more grain ($p<0.01$) and dairy choices ($p<0.01$) than football athletes. Between these two teams, there was no significant difference in average number of protein, fruit, or vegetable selections. Cross country athletes selected an average of 1.07 grain choices and 1.08 dairy choices. In contrast, football players selected 0.33 grain choices and 0.51 dairy choices.

Table 2-5. Average Number of Food Selections per Category among Sport

	Grains	Protein	Dairy
Basketball	.5455	.9394	.4848
Cross Country	1.0807	.9068	1.0807
Football	.3319	.9580	.5084
Golf	.7273	1.0909	1.0909
Gymnastics	.5313	.7188	1.0625
Tennis	.5556	1.222	.5926
Track	.7319	.9913	.7739
Field Events	.7805	1.0854	.8780
Soccer	.7969	.5938	.8125
Softball	.6154	.5897	1.1282
Volleyball	1.00	1.00	.8750

Table 2-6. Average number of Food Selections per Category in Cross Country vs. Football

	Cross Country	Football	Statistical Significance (P)
Grains	1.0683	.3319	<.01
Protein	.9068	.9580	.564
Dairy	1.0807	.5084	<0.01

DISCUSSION

The results show the patterns of use for a typical week in a university-sponsored Division I fueling station. While there are many fueling stations in NCAA collegiate athletic departments, there is no published research evaluating the efficacy of fueling stations. The data provide much-needed information in this area. The results show that 81.44% of Utah State athletes are using the Fueling Station while either pre-workout or post-workout. However, only 61.83% reported that they were eating for fueling or recovery. 38.17% of athletes marked that they were eating at the Fueling Station because of hunger or convenience.

During the selected week of survey data collection, there were 824 different visits to the fueling station from 275 different athletes. These data show that the Fueling Station is effective in reaching a large number of different individuals and providing them with healthy and convenient food choices. The number of survey responses shows that fueling stations are effective in providing nutrition to athletes despite their busy schedules.

Many collegiate athletic departments employ full-time sports dietitians to manage the fueling station and provide education to the athletes. This is a rapidly growing field, and the number of sports dietitians has nearly quadrupled since 2010, the year the Collegiate and Professional Sports Dietitians Association (CPSDA) was chartered.[5] The benefit to sports dietitians is that they provide evidence-based nutrition education, as opposed to non-research backed information that they may receive elsewhere.[6] There are published research studies that show sports dietitians positively influence the collegiate athletes dietary intake and nutritional knowledge.[7,8,9] A study of NCAA female volleyball players showed that individual counseling sessions were effective in improving

nutritional knowledge and intake,[7] but there are other ways to provide nutrition education to help collegiate athletes. Athletes can benefit from general outreach efforts like educational boards, knowledge and education through social media and blogs, and interactions with the sports nutrition staff.[8]

Many collegiate athletic programs only employ one or two sports dietitians, if any, and so it can be hard to reach every individual athlete. Athletes may seek nutrition information elsewhere due to convenience or contact with an athlete. This could be from a coach, athletic trainer, or strength and conditioning specialist. Despite many of these professionals not being qualified to give nutrition advice, many athletes are influenced by them.[10] The results of this study show that fueling stations are effective in reaching a large portion of athletes from a Division I athletic program. Fueling stations might serve as a possible outlet for sports dietitians to provide research-backed nutritional education to collegiate athletes that will actually benefit them.

The patterns of food selection among college athletes provide additional data on dietary intake in collegiate athletes. In a study of female college athletes, a 3-day food record, 24-hour recall, and nutrition questionnaire were used to determine if nutrition needs were being met. The results showed that energy and carbohydrate intakes were below the recommended amount that is required to support training.[2] Another study, conducted on Division III football players showed that less than 50% of them consumed fruits and vegetables daily, and linemen specifically consumed high amounts of total fat, saturated fat, dietary cholesterol, and sodium.[11] A study of collegiate track athletes showed an adequate intake of carbohydrates, but poor intake of vitamin E, vitamin C, and

protein.[12] The limited literature on dietary intake suggests that collegiate athletes are not meeting their nutritional needs.

The Qualtrics survey data do not capture overall dietary intake, just patterns of food intake from visits to the Fueling Station. The results show that there was no significant difference between gender in fruit, vegetable, or dairy intake. On average, individuals selected significantly more fruits than vegetables per visit to the Fueling Station. It is important to note that there are many more fruit options available at the Fueling Station. Females had more grain selections than males, and males had more protein selections than females. When comparing cross country runners to football players, there were significant differences in average number of grain and dairy choices. The average number of grain selections for football players was only .3319 per visit to the Fueling Station. It is possible that these individuals are not getting enough carbohydrates for their activity level. More research needs to be conducted to look at the relationship of dietary intake in different food groups among sports. In the future, quantity of food should be collected in order to get a clearer picture of actual consumption.

There are a number of limitations to this survey data. First, the Qualtrics survey only captures the food selections, not the amount of food that was taken or consumed. For example, if an athlete took multiple portions of the same item, it would count the same on the survey as if an athlete selected only one portion of that item. The survey is filled out by an athlete and it is all self-reported. There could be bias in what the athlete chooses to report. The analysis of the survey data showed that sometimes athletes skipped answering certain questions, like purpose of eating or timing of eating.

Fueling stations are effective in providing nutrition to a large number of athletes. Because fueling stations reach so many individuals, it is possible that nutrition education strategies can be incorporated into fueling stations by sports dietitians to provide research-backed information. General outreach efforts in the Fueling Stations might add to collegiate athletes' nutrition knowledge to help them better understand proper dietary intake strategies to maximize performance and minimize recovery time.

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CHAPTER III

THE CREATION OF A FOOD LABELING SYSTEM TO EDUCATE COLLEGIATE DIVISION I ATHLETES ON THE IMPORTANCE OF TIMING OF EATING AND PERFORMANCE

ABSTRACT

The "Gain Your Edge" food labels were created to provide point of access cues to the Utah State University athletes in an accessible format to help them understand which food choices might be appropriate for their purpose of eating. Nutrition plays a role in athletic performance, and despite this established relationship, athletes often do not eat the correct foods at the correct times to maximize performance and minimize recovery time. The "Gain Your Edge" labels use six different categories to help athletes understand what the purpose of that specific food is, and when it might be most appropriate to eat. The six categories are long-lasting energy, hydration, muscle recovery, weight management, lean muscle, and quick energy. Other food labeling systems have been effective in changing users to make more healthful choices, so it is possible that the implementation of the "Gain Your Edge" food labels will be an effective way to deliver a targeted nutrition intervention to the Utah State University athletes.

INTRODUCTION

Athletes are always aiming to improve their performance in order to gain an edge over their competitors. The main goal of many athletes is to optimize performance and maintain a healthy body composition for their given sport. It is established that well-chosen nutrition strategies can improve athletic performance and recovery.[1] Dietary choices influence energy balance, nutrient intake, and even hydration status.[2]

Additionally, the timing of when food is eaten and the macronutrient composition of the food may impact the athlete's performance during future training sessions as well as the time needed to recover after training.[2] Despite the established relationship between nutrition and performance, athletes often do not eat the correct foods at the correct times to maximize performance and minimize recovery time.[3]

Collegiate athletes are required to balance heavy schoolwork with demanding practice and competition schedules. It is extremely important that an athlete fuels his or her body in a way that maximizes performance and minimizes recovery time. However, many barriers prevent athletes from obtaining this goal. Barriers to fueling optimally include lack of nutrition knowledge, time, skill, and resources. There is currently no mandatory comprehensive nutrition education program endorsed by the National Collegiate Athletic Association (NCAA).[3] This is in contrast to the required academic support and life skills programs.[3]

Several researchers have identified the lack of basic nutrition knowledge in NCAA collegiate athletes of various sports through nutritional surveys. For instance, many athletes believe that vitamins and mineral supplements contribute to energy.[4] The role of protein is also commonly misunderstood. In one survey of 237 collegiate Division I participants, nearly 50% of athletes believed that protein is the main source of energy for the muscle.[4] Jacobson et al. revealed other misconceptions about the role of protein.[5] In a survey of 330 collegiate athletes, 21% thought protein was an immediate energy source and 13% thought protein would increase muscle size.[5] Many studies demonstrate that athletes recognize the function of carbohydrates as an immediate energy source, but few know how much of carbohydrate or other macronutrients are recommended.[2] Torres-

McGeghee et al. found that out of 185 student-athletes surveyed through a random sample of Division I, II, and II schools, only 9% had adequate sports nutrition knowledge, which was defined by answering at least 15 of 20 questions correctly, or 75%.[6] It is clear that nutrition knowledge deficits are present in this population, and findings provide evidence that this lack of nutrition knowledge may contribute to many dietary inadequacies in athletes' dietary intake.

Collegiate athletes often appear generally healthy according to weight for height and body fat standards, but research shows inadequate nutrient intakes.[7] Webber et al. Found from a volunteer sample of Division I college athletes that diets were adequate in calcium, iron, and vitamin C, but inadequate in fiber, fruits and vegetables.[7] It appears the common collegiate athlete's diet lacks fruits, vegetables, and whole grains, but is high in fat and processed foods.[8] With inadequate nutrient intakes, athletes are susceptible to decreases in performance and recovery.[1]

Many studies focus on the nutritional knowledge of collegiate athletes and dietary patterns, but to the knowledge of the authors, no studies focus on dietary intake, timing, and the education of timing in this population. The position statement by the Academy of Nutrition and Dietetics has recently drawn additional evidence to the importance of timing in fueling athletes. For pre-event fueling, it suggests that 1-4 grams/kg of bodyweight of carbohydrates be consumed 1-4 hours before exercise. The actual amount and type of carbohydrate should be based on individual preferences and tolerance.[1] During longer bouts of exercise, specifically longer than 60 minutes, additional carbohydrates may be needed to provide fuel for the muscles to supplement the endogenous stores. While carbohydrates are the main focus for pre-event fueling, protein

is important in post-event nutrition. It is currently recommended that ~10 grams of essential amino acids, or 20-30 grams of total protein, are consumed during the recovery period, which is 0-2 hours after exercise.[1] Studies show that this leads to increased whole body and muscle protein synthesis as well as improved nitrogen balance.[1] Due to the importance of timing in macronutrient consumption, collegiate athletes not only need to be educated on basic nutritional principals, but on maximizing performance and recovery through properly timed eating patterns.

Due to the lack of nutritional knowledge in Division I athletes, there was a strong need for an easy-to-delivery nutrition education tool to help the Utah State University athletes better understand appropriate fueling choices for their bodies. All Utah State University athletes have access to a fueling station. The purpose of the Fueling Station is to provide pre-workout and post-workout nutrition to the athletes. The Fueling Station is open Monday thru Friday from 6-9 am, and again from 1-4 pm. On Wednesdays, the Fueling Station is open until 6 pm. During the open hours, the athletes can come into the Fueling Station and select food from a variety of different options to assist with fueling or recovery. Because all athletes have access to this service and athletes make their own individual food choices, the Fueling Station was chosen to deliver an education intervention. The objective was to design a food labeling system in the Utah State University Fueling Station to provide a quick way for athletes to understand which food choices might best fit their purpose of eating.

DESCRIPTION OF INTERVENTION

The food labeling system, titled "Gain Your Edge," was modeled after a similar labeling system that has recently been implemented into the University of Utah's fueling

stations, developed by Craig Moore and the University of Utah Sports Nutrition Staff (unpublished or copyrighted). The premise of the "Gain Your Edge" (GYE) labels was to create a food label to be placed in front of each food offered in the Fueling Station that would let athletes know what that specific food provided to the body, and when it might be an appropriate situation to select that food. The goal of the labels was to provide point of access cues to the Utah State University athletes as they make food selections.

In order to begin the labeling system process, six different categories were defined, all corresponding to a different nutrient need. The six categories include long-lasting energy, hydration, muscle recovery, weight management, lean muscle, and quick energy. A symbol was selected to represent each of the six categories. Each food available to athletes in the Fueling Station has a label, displaying corresponding nutrition symbols that are based on the macronutrient distribution, the micronutrient content, and when it is an appropriate food choice. The table below shows each of the categories, its symbol, the definition of what this category means, and when it would be most appropriate to select this food option. Because many food items offered in the Utah State Fueling Station fall into more than one of the six categories, many food labels have more than one symbol. Figure 1 shows an example of a food that falls into many categories.

Figure 3-1. "Gain Your Edge" Food Label

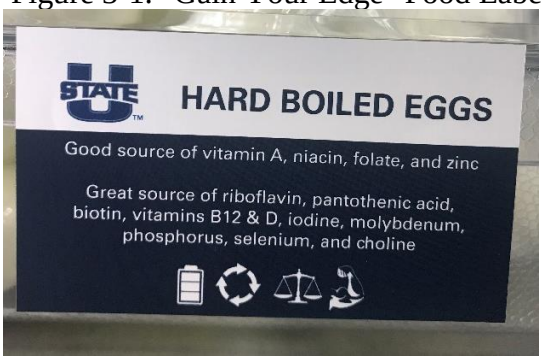
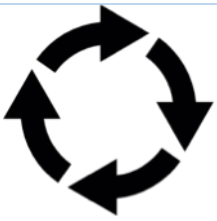
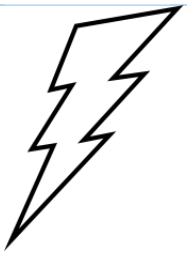


Table 3-1. "Gain Your Edge" Food Categories, Symbols, and Definitions

Long-Lasting Energy		High carbohydrate, protein, and/or fat for sustained energy. Examples include whole grains, healthy fats, high protein, or fiber. This is best eaten with meals and between workouts.
Hydration		High water content and/or electrolytes to help with reabsorption and absorption of nutrients. Examples include salty carbohydrates and fruit. This is best eaten pre/post workout/competition.
Muscle Recovery		Nutrient dense foods to kick-start recovery. Examples include fruits, vegetables, and foods containing protein. This is best eaten post-workout/competition.
Weight Management		Lower calorie and/or higher protein options. Examples include fruits, vegetables, meats. This is best eaten with meals or between workouts.

Lean Muscle		Lean protein to build and repair muscles. Examples include meats, some cheeses, Greek yogurt. This is best eaten post-workout/competition.
Quick Energy		Fast acting carbohydrates. Examples include some fruits, fruit squeezes, crackers, and chips. This is best eaten pre-workout, or during a workout or competition.

In addition to the symbols, the food labels note the good and great sources of vitamins and minerals. For the purpose of the food labels, a good source was defined as 10-19.9% of the Recommended Dietary Allowance (RDA). A great source was defined as 20% or more of the RDA. The food label also noted fiber as a good source if the serving size offered had 3 grams or more.

ESHA Nutrition Analysis Software was used to provide the nutrient composition of the food items and this information was used to identify what nutrition labels were appropriate for each food. The Fueling Station offers many food items that are made by employees or student volunteers. Examples include fruit and vegetable cups, chicken, tuna salad, wraps, and many different dipping sauces. In order to control for variability in size of these items, weights of the food were taken. Ten samples of each food item were weighed with a food scale. The average weight out of the ten samples was used. This is the size that was entered into ESHA software to get a detailed record of the food item's nutrient composition that is specific to the portion size offered in the Fueling Station.

The Fueling Station also offers a topping bar which allows the athletes to top items like oatmeal, cereal, yogurt, and toast. The topping bar is filled with nuts, seeds,

and dried fruit. The athletes are able to portion out these toppings on their own from a container with a spoon. For the purpose of measuring nutrient composition, two spoonful's of each item were used for size when inputting the food into ESHA. The nutrient analysis from ESHA was used to determine each food item's vitamin and mineral content to note the good and great sources on the food label.

The nutrient analysis was also used, along with the category definitions, to assign symbols to each of the Fueling Station food items. There are 80 different food items that are offered at the Fueling Station. Of the 80 food items, 49 fall into the long-lasting energy category, 52 fall into the hydration category, 57 are muscle recovery foods, 34 are weight management foods, 17 are lean muscle foods, and 29 are quick energy foods. The categorization of each food item offered is included in a table in the index. In addition to each food item receiving an individual label, a large poster was created that included a key. This poster is similar to the table above, and included the definition of the category, what the symbol looks like on the label, example foods that fall into that category, and when that food item would be an appropriate choice for an athlete. The final product was that each food item has its own individual label with good and great sources of vitamins and minerals, and the appropriate symbols according to its category.

DISCUSSION

The Utah State University Fueling Station labeling system was created in order to deliver quick nutrition education to Division I athletes in real time. The Fueling Station addresses many of the barriers to optimal nutrition that athletes face including making healthy food more accessible and convenient, however, many athletes continue to struggle with knowing what foods are most appropriate for their purpose of eating. It is

well established that many collegiate athletes lack basic nutrition knowledge,[4,5,6] and the GYE labels may be a way to help improve sports nutrition knowledge in a large number of athletes in a short amount of time. Food labeling systems have been used in many other contexts, but to the knowledge of the authors, there is currently no published research on the effectiveness of food labeling systems improving nutritional knowledge or dietary behavior in collegiate athletes. However, other forms of food labeling systems have been successful in their goal in other settings (i.e. promoting healthier behavior in consumers, decreasing caloric intake). Since there is success in other environments with food labeling systems, a food labeling system might work in a collegiate athletic environment to help educate athletes and better dietary intake.

A traffic light color-coded labeling system has been studied in different contexts for its effectiveness in promoting more healthful food choices. In a system like this, red, like a stop light, is used to label unhealthier choices, whereas green, like a greenlight, is used to note better choices. Two different studies, conducted by the same researchers, observed the effects of a traffic light color-coded system on the front of food packages.[9] These studies were conducted in order to observe actual consumer behavior and buying patterns when this system is in use. The results of these two studies show that actual food purchase behavior is affected by the front-of-package traffic light color nutrition labels. However, the effect of this depends on an individual's self-control. Consumers with low self-control, but not those that tested at high self-control, made more healthful food decisions when the color-coded labeling system was in place. This study was not used with an athletic population, and it does not address timing of eating certain macronutrients.

Another study compared a traffic light front-of-package label to a "Facts up Front" label.[10] The "Facts up Front" label displays grams/milligrams and percentage of daily value for a few key nutrients. The results showed that consumers actually had a better understanding of nutrition knowledge and label perceptions when both the traffic light color-coding and the "Facts up Front" label were used.[10] Current research suggests that the traffic light color-coding system may be an effective way to get consumers to make more healthful food choices, however more research needs to be conducted in a food purchase setting. Often times the research of this labeling system is conducted online, and there is a discrepancy in what people say they will do, and what they will actually do.[9]

A common food label seen by many is calorie content. This is often noted on restaurant menus, in the drive thru of a fast food chain, and in a variety of other commercial food settings. Research notes that energy labeling might help university students make more healthful choices in a college dining hall. One study conducted exit surveys in a university cafeteria before and after a calorie labeling system was implemented.[11] The food labeling system showed significant increases in noticing nutrition information and using the nutrition information to guide purchases, while it showed significant decreases in calorie content of foods purchased and the estimated amount of calories consumed.[11] Another similar study noted that after calorie content was added to prepackaged foods in all university dining facilities, there was a 7% reduction of mean total kcals purchased per week, and sales from "low-calorie" and "low-fat" foods increased, while sales from "high-calorie" and "high-fat" foods decreased.[12] A third study looked at the impact of an energy-labeling system alone versus an energy-labeling system

along with marketing materials. Only 30% of students recognized the labels, but once they were made aware of them, 75% were accepting of them.[13] Respondents that viewed the marketing material and then the energy labels on the food items selected meals with a lower mean energy content.[13] These studies offer evidence that point-of-purchase labels might be an effective method to encourage more healthful choices. These studies are conducted in university dining halls, and they observe the impact of the labels on students' choices. While the same age group is targeted in the Utah State University GYE labels, it is a competitive athlete population. To the knowledge of the researchers, no food labeling system to date has addressed the critical need for athletes to make appropriately timed food selections based on macronutrient and micronutrient content. It is possible that the Utah State athletes will respond positively to the GYE labels, and they will begin to make more appropriate choices for their specific workout or nutrient need.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The GYE food labels provide an outlet for easy-to-deliver education content. The symbols on each individual food label teach athletes about specific nutrient needs that that food provides. The definitions of each symbol on the key provide a resource of why a certain food falls into a specific category and can teach the appropriate timing of eating specific foods. If an athlete is running to practice and needs a quick burst of energy, they can easily locate the "lightning bolt" symbol in front of a variety of food choices and select something that will provide the necessary quick energy. If this intervention is successful, labeling systems can be an effective way for large scale athletic programs to deliver much needed target nutrition education to a large number of athletes.

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CHAPTER IV

THE CHANGE IN APPROPRIATENESS OF FOOD SELECTION IN COLLEGIATE ATHLETES AFTER THE IMPLEMENTATION OF A FOOD LABELING SYSTEM

ABSTRACT

Optimal nutritional strategies can help athletes maximize their performance and minimize recovery time. It is established that well-timed carbohydrate and protein intakes can improve physical performance. A food labeling system was implemented in a university-sponsored fueling station to educate the Division I athletes on the impact of timing of macronutrient consumption on performance. The purpose of this research was to examine the changes in the appropriateness of the athlete's visit to the Fueling Station based on food selection, self-reported timing of eating, and self-reported purpose of eating after the "Gain Your Edge" food labels were implemented at the Fueling Station. Data were collected using an online Qualtrics survey completed by the athletes after each visit to the Fueling Station. There was no significant change in the percentage of athletes making appropriate food selections at the Fueling Station, however, 95.52% of athletes noticed the food labels and 76.56% of athletes said that the food labels impacted their food selection. More research is needed to see if educating athletes on the importance of timing in sports nutrition through food labels can be effective in a large setting, like fueling stations.

INTRODUCTION

Division I athletes are always looking to gain an edge over their competitors. Optimal nutritional strategies can help athletes maximize their performance and minimize recovery time.[1] Dietary choices influence an athlete's energy balance, nutrient intake, and

hydration status.[2] The timing of when the food is consumed and the macronutrient composition of that food may impact an athlete's performance during training and competition, as well as recovery time.[2]

Carbohydrates are important in the body because they provide fuel for the brain and central nervous system. Additionally, they are also important to athletes because they are a substrate for muscular work and can support exercise over a large range of intensities.[1] Foods higher in carbohydrates should be consumed before exercise and during prolonged exercise as an immediate energy source. Carbohydrate supplementation is not needed in exercise lasting less than 45 minutes; however, 30-60 g/hour are recommended in exercises lasting 1-2.5 hours.[3] This carbohydrate intake during exercise provides fuel for the muscles when the glycogen stores become depleted.[1] This is the current recommendation by the Academy of Nutrition and Dietetics in performance position paper.[1]

Protein is important for athletes because of its repair and maintenance properties. Dietary protein along with exercise provide a trigger and substrate for the synthesis of contractile and metabolic proteins.[1] Upon completion of exercise, about 10 grams of essential amino acids, or 20-30 grams of protein are recommended in the early recovery phase, or 0-2 hours after exercise.[4] This is the current recommendation from the Academy of Nutrition and Dietetics position paper.[1] Research shows that muscle protein synthesis (MPS) is optimized in response to this consumption, and higher consumption is not associated with greater MPS.[1] The International Society of Sports Nutrition (ISSN) provides similar recommendations for protein consumption after exercise at 20-40 grams.[5]

Despite the established relationship between carbohydrate and protein intake and physical performance, athletes often neglect their nutrition, or they are not educated on incorporating proper nutritional strategies into their diet.[6] Several researchers have identified the lack of basic nutrition knowledge in NCAA collegiate athletes of various sports through nutritional surveys. For example, many athletes believe that vitamins and minerals contribute to energy,[7] don't understand the role of protein,[8] and do not know how much of each macronutrient they should be eating.[2] It is clear that nutrition knowledge deficits are present in this population, and this lack of nutritional knowledge can lead to many dietary inadequacies in college athletes' actual intake. Many studies focus on the lack of nutritional knowledge in collegiate athletes, but no studies, to the knowledge of the authors, focus on the purpose and timing of food choices among athletes.

Studies have shown that sports dietitians have a positive effect on improving nutrition knowledge and dietary intake in collegiate athletes.[9] However, if a college athletic department employs a sports dietitian, it might be only one or two dietitians to a few hundred athletes which can lead to barriers in delivering the information. In a study conducted by Hull et al., sports dietitians were available at two different Division I universities, but nearly 40% of athletes at the schools reported they received their nutrition knowledge from another source.[10] The evidence-based eating strategies and dietary plans provided by sports dietitians may lead to improved performance and recovery in collegiate athletes, but it can be difficult to disseminate this information to all athletes.

Many universities have fueling stations in their athletic department that provide pre-workout and recovery nutrition for their athletes. Fueling stations are funded by the athletic department and provide easily accessible food at no additional cost to the athletes. Because fueling stations serve a large number of athletes, it may be an effective outlet in delivering nutrition information to a large number of individuals very quickly. A food labeling system, known as "Gain Your Edge" food labels, was developed in the Utah State University Fueling Station to provide athletes with point-of-access cues on which food might be an appropriate selection for their purpose of eating.

Collegiate athletes need to not only be educated on basic nutritional principles, but on maximizing performance and recovery by choosing an appropriate food at the appropriate time. The purpose of this research was to examine the changes in the appropriateness of the athlete's food selection and the proximity of the eating occasion to the time and type of training before and after the "Gain Your Edge" labels were implemented at the Fueling Station.

METHODS

The Utah State University Division I athletes have access to a university-sponsored fueling station. The goal of the Fueling Station is to provide pre-workout and recovery food for all the athletes. The Fueling Station is open Monday thru Friday from 6-9 am, and 1-4 pm, with the exception of Wednesday afternoon. Wednesday afternoon the Fueling Station is open until 6 pm. During the open time, athletes can come in and make any food selection they choose. Foods offered in the Fueling Station include fruits, vegetables, yogurt, chicken, eggs, trail mix, breads, bagels, a variety of chips, different daily specials, and a topping bar with dried fruit, nuts, and seeds. In order to help the

athletes make better choices for their purpose of eating (i.e. pre-workout fueling, post-workout recovery), a food labeling system was created.

The food labeling system, "Gain Your Edge" labels, was designed to give cues to athletes on what food choices might be the most appropriate at the time of food selection. Food labels were placed in front of each individual food offered, noting good and great sources of vitamins and minerals and categorizing the foods based on nutrient need. The six categories that were used included long-lasting energy, hydration, muscle recovery, weight management, lean muscle, and quick energy. A symbol was selected to represent each of the six categories. The corresponding symbol was placed on the individual food label, and two large posters of the symbols and their definitions were placed in locations visible to the entire fueling station. Because many foods offered in the Utah State Fueling Station fall into more than one of the six categories, many food labels have more than one symbol on the label. The methods to create the labeling system have been previously described.

The labels were placed in the Fueling Station before the morning shift on Monday March 26, 2018. In addition to the food labels and the two large posters describing the definitions of the symbols, a whiteboard was placed at the entry way of the fueling station. The white board explained that there was a new food labeling system, and let the athletes know to ask the Fueling Station employees if they had any questions. Additionally, the board noted that the topping bar labels were based off of two spoonfuls of a topping.

Since the Fueling Station opened in January 2015, athletes have been required to "check-out" after each visit by taking a Qualtrics survey on one of three iPads placed on

the tables where athletes sit to eat their food. Because the athletes were already accustomed to checking out with a survey, which was previously used for program evaluation and inventory, it was easy to modify the survey for the purpose of this research.

The modification of the survey included adding additional questions asking gender, what the last workout was or what it will be (weights, conditioning, practice/competition, or other), when the last workout was or when it will be (was 0-2 hours ago, in 0-2 hours, or other), and what the purpose of eating is (pre-workout fueling, post-workout recovery, hunger, or convenience). Foods available to athletes at the Fueling Station were categorized into food groups. The updated survey has seven different categories for food and includes every item that the Utah State Fueling Station offers. The seven food groups were fruits, vegetables, protein, dairy, grains, daily specials, and condiments or toppings. Daily specials are special foods that are only offered on specific days of the week. Daily specials include smoothies, meat and spinach wraps, oat and flax energy bites, and yogurt and fruit parfaits. Because daily specials often fall into more than one food group category, they were given their own individual grouping.

The Qualtrics survey responses were used to examine changes in food selection, self-reported purpose of eating, and timing of eating after the implementation of the "Gain Your Edge" labels. To evaluate the baseline patterns of eating, data were collected from January 29, 2018 to February 2, 2018. The ending data were collected from April 16, 2018 to April 20, 2018. This was the fourth week the "Gain Your Edge" labels were in place. It is commonplace for athletes to visit the Fueling Station multiple times in one

week. Two yes or no questions were added to the survey and they are outlined in table 1. The questions asked if the athletes had noticed the "Gain Your Edge" labels, and if the "Gain Your Edge" labels impacted their food choices. The reason the final data were not collected April 23, 2018 to April 27, 2018 was because this week was the week before finals week, also known as "dead week," in the academic calendar. This week was a low traffic week for athletes in the Fueling Station. Only the first visit to the Fueling Station for each week of data collection is represented in the data analysis. There were no differences among visits to the Fueling Station and appropriateness for that individual.

Table 4-1. Additional Survey Questions for End Data

Question	Choices
Have you noticed the "Gain Your Edge" food labels in the fueling station?	Yes, No
Did the "Gain Your Edge" food labels impacted your food choices in the fueling station?	Yes, No

DATA CODING

A variable indicating the appropriateness of each participant's food selection was coded based on the information provided by the participant for the following variables: the athletes self-reported purpose of eating (pre-workout/fueling, post-workout/recovery, hunger, or convenience), their self-reported most recent workout (in 0-2 hours, 0-2 hours previously, or other), and the ratio of lean muscle to quick energy foods that they selected during their visit. The "quick energy" and "lean muscle" foods were used to determine the appropriateness of food selection because "quick energy" foods were labeled as being more appropriate as a pre-workout fueling snack, and "lean muscle" foods were labeled as being more appropriate as a post-workout recovery snack. These groups were also

mutually exclusive and no food provided both lean protein and quick energy. The number of quick energy and lean muscle food selections were summed across each Fueling Station visit for each participant. Because quantity of each food is not asked in the Qualtrics survey, only number of different food selections in each category was totaled.

The type of foods selected (as the ratio of quick energy to lean muscle) were used in addition to the self-reported timing of workout and purpose of eating to determine appropriateness. Table 2 and table 3 show the Qualtrics survey questions for self-reported purpose and timing of eating and the available quick energy and lean muscle foods in the Fueling Station.

Table 4-2. Self-Reported Timing and Purpose of Eating Survey Questions

My reason for eating is...	Pre-workout/fueling Post-workout/recovery Hunger Convenience
My last workout...	Was 0-2 hours ago Is in 0-2 hours Other

Table 4-3. Quick Energy and Lean Muscle Food Choices in Fueling Station

Quick Energy Food Choices	Pineapple, carrots, mandarin oranges, peaches, plums, pretzels, goldfish crackers, kiwi, apples, nectarines, grapes, bananas, oranges, Chex mix, chocolate chips, dried fruit, jam, fruit squeezes, applesauce, cinnamon Chex, special K red berries, honey nut cheerios, and apple crisp chips
Lean Muscle Food Choices	Cottage cheese, black beans, peanut butter, 1% milk, chocolate milk, eggs, chicken, Greek yogurt cream cheese, string cheese, cheddar cheese, Greek yogurt, tuna salad, Greek yogurt parfaits, energy bites, and beef jerky, wraps, and protein bars

The appropriateness variable was coded "1" for appropriate, "0" for not appropriate, "3" if the purpose of eating wasn't for either pre-workout or post-workout,

and there was no recent workout. A response was given an appropriate score of 1 if the timing of eating matched with the purpose of eating, and the food selection was appropriate.

A food selection was considered appropriate based on the ratio of food selections between quick energy and lean protein. If an individual made more food selections in the desired category versus the undesired category, it was considered an appropriate choice. If an individual made an even number of food selections, making the ratio 1:1, the food selection was still considered appropriate. If the individual did not make any food selection in either of the two categories, it was not considered appropriate.

If the timing and food choice was appropriate for the designated purpose of the eating occasion, the appropriateness variable was coded "1." For example, if the individual marked that they had a workout in 0-2 hours, their purpose of eating was for pre-workout fueling, and they made 3 quick energy selections, they would get an appropriateness score of 1. If either the food choice or timing was not appropriate for the designated purpose of the eating occasion, the food selection was not appropriate and received a score of "0." If the purpose of eating and timing of eating matched, and there were equal amounts of food choices in both quick energy and lean protein, an appropriateness score of "1" was given. If the response was missing data on either the timing of eating or purpose of eating question, no appropriateness score was given. Table 4, 5, and 6 show all possible instances of achieving an appropriateness score of 1, a not appropriate score of 0, and an appropriateness score of 3.

Table 4-4. Possible Scenarios for Appropriateness Score 1

Timing of eating	Purpose of Eating	Food Selection
Workout is in 0-2 hours	Pre-workout/fueling	Larger number of quick energy choices than lean protein choices
Workout is in 0-2 hours	Pre-workout/fueling	Even number of quick energy and lean protein choices
Workout was 0-2 hours ago	Post-workout/recovery	Larger number of lean protein choices than quick energy choices
Workout was 0-2 hours ago	Post-workout/recovery	Even number of lean protein and quick energy choices

Table 4-5. Possible Scenarios for Not Appropriate Score 0

Timing of Eating	Purpose of Eating	Food Selection
Workout is in 0-2 hours	Pre-workout/fueling	No food choices in either category
Workout is in 0-2 hours	Pre-workout/fueling	More lean protein choices than quick energy choices
Workout is in 0-2 hours	Post-workout/recovery	Any food selection; timing and purpose don't match so it is automatically not appropriate
Workout is in 0-2 hours	Hunger, convenience	Any food selection; timing and purpose don't match so it is automatically not appropriate
Workout was 0-2 hours ago	Post-workout/recovery	No food choices in either category
Workout was 0-2 hours ago	Post-workout/recovery	More quick energy choices than lean protein choices
Workout was 0-2 hours ago	Pre-workout/fueling	Any food selection; timing and purpose don't match so it is automatically not appropriate
Workout was 0-2 hours ago	Hunger, convenience	Any food selection; timing and purpose don't match so it is automatically not appropriate

Table 4-6. Possible Scenario for Appropriateness Score 3

Timing of Eating	Purpose of Eating	Food Selection
Other	Hunger, convenience	Any food selection; food choice does not matter because individual was neither pre-workout or post-workout

The athletes must "check-out" with the Qualtrics survey after each visit to the Fueling Station. However, many athletes visit the fueling station more than once a day, and multiple times a week. For the purpose of this statistical analysis, a new variable was created noting the visit number of the week of data collection. The Qualtrics survey collects the last 4 digits of an individual's student ID number. This number was used to calculate this new variable. The statistics were run only using the first visit of the data collection in order to make sure that there were no confounding variables from the same individual visiting multiple times. The data from the second data collection were coded the same as the baseline data. Individuals were matched based on ID number.

STATISTICAL ANALYSIS

The frequency of the distribution of timing of eating, purpose of eating, lean protein, quick energy, and appropriateness score were examined by gender and sport. The appropriateness variable was coded as described and the proportion of the participants by gender who made appropriate versus non-appropriate food choices was examined using the Pearson Chi-squared test statistic. The change in the proportion of the participants who made appropriate and non-appropriate food choices before and after the labeling intervention was examined using the McNemar's test using the Chi Squared distribution. All of the data were analyzed using SPSS software version 25.

RESULTS

Baseline data were collected from Monday, January 29, 2018 to Friday, February 2, 2018 and coded as described in the data coding section. Table 7 shows the characteristics of the Fueling Station users at baseline. At least one individual from each sports team visited the Fueling Station during baseline data collection. Cross country,

track, and field events have separate options in the Qualtrics survey. They have been combined to look at the population because there is a lot of overlap of athletes in these sports. Many individuals that run cross country are also members of the track team. There were 236 different athletes that visited the Fueling Station during the period of time that baseline data were collected. This represents 69.8% of Utah State athletes.

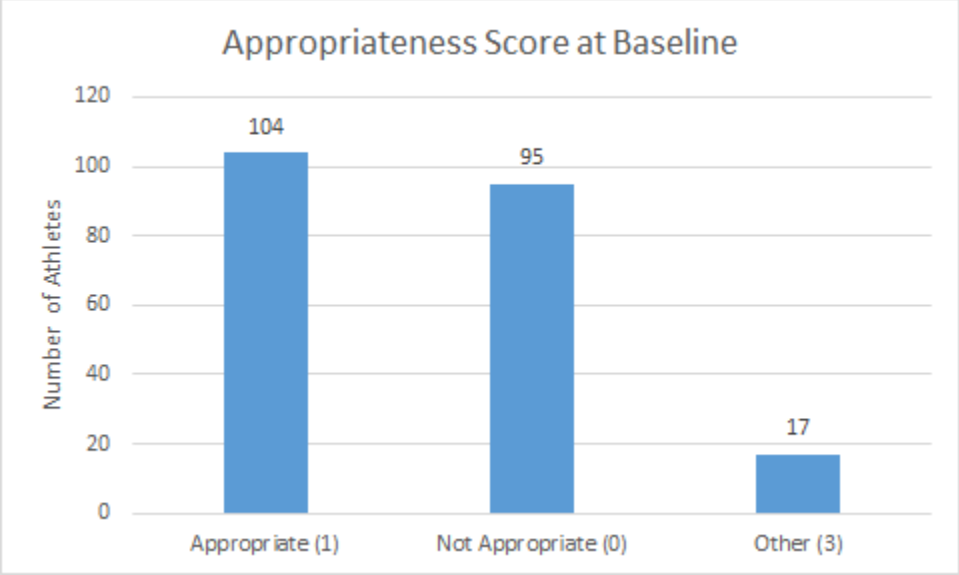
Table 4-7. Fueling Station Users at Baseline

Team	**Gender**	**Visited Fueling Station**	**Percent Captured**
Basketball	Men	1	7.1%
	Women	4	33.3%
Cross Country & Track	Men	40	85.1%
	Women	46	80.1%
Football	Men	71	71.7%
Golf	Men	7	87.5%
Gymnastics	Women	11	61.1%
Tennis	Men	2	25%
	Women	6	66.7%
Soccer	Women	24	77.4%
Softball	Women	12	60%
Volleyball	Women	12	80%
Total Athletes		**236**	**69.8%**

Of the 236 individual athletes that visited the Fueling Station at least once in the week of baseline data collection, an appropriateness score was determined for 216 athletes. There were 20 athletes who had missing data in survey responses and were unable to be assigned an appropriateness score. Figure 1 shows the breakdown of the appropriateness scores at baseline. 104 athletes (48.15%) made food selections that were appropriate for their purpose of timing of fueling and recovery. 95 athletes (43.98%) made food selections that were not appropriate. 71 athletes (32.87%, 68.23% of

appropriate) received a score of 1 for an appropriate visit to the Fueling Station when post-workout and eating for recovery was selected as the purpose of the eating occasion. In contrast, only 33 athletes (15.28%, 31.73% of appropriate) received a score of 1 for an appropriate visit when pre-workout was selected as the purpose of the eating occasion. At baseline when the athlete reported they had no recent workout, 2 received not appropriate scores and 17 received an appropriateness score of 3 indicating they were not using the Fueling Station for its purpose. Athletes had significantly more appropriate scores when eating for the purpose of post-workout recovery than when eating for the purpose of pre-workout fueling (p=0.008); those that had a score of 3 were excluded from this analysis. There were no significant differences between men and women and their appropriateness score at baseline.

Figure 4-1. Baseline Appropriateness Score[1] (n=216)

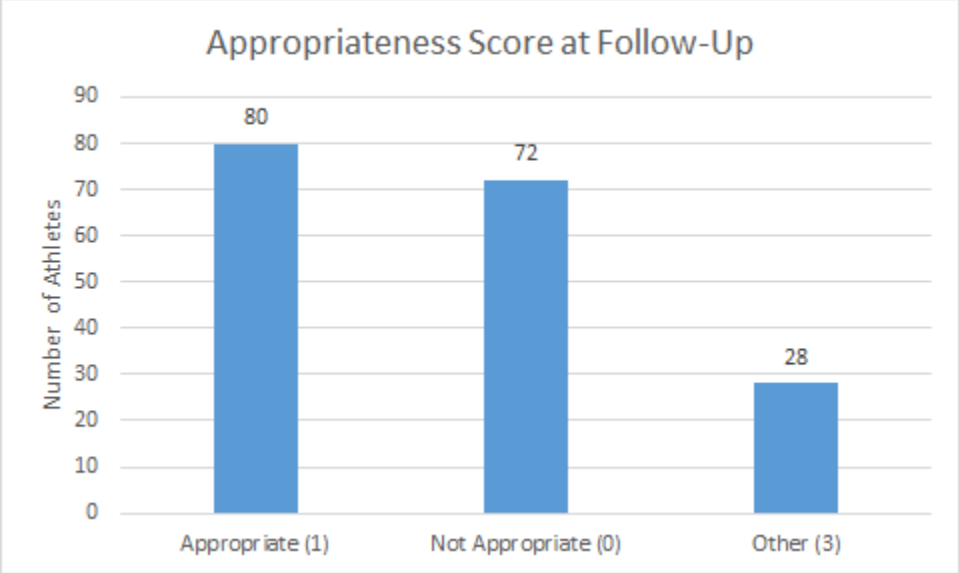


[1]Appropriateness score could not be calculated if missing data

The follow-up data were coded as described. There were 192 different athletes that visited the Fueling Station at least one time during the follow-up data collection

week. Appropriateness scores at follow-up were assigned to 180 of them. Figure 2 shows the overall appropriateness scores at follow-up. 80 athletes (44.44%) had an appropriateness score of 1, 72 athletes (40%) were not appropriate, and 28 athletes (15.56%) received a score of 3. There was no significant difference between men and women and their appropriateness score at follow-up.

Figure 4-2. Follow-Up Appropriateness Score (n=180)



The two data sets were matched based on ID number for the first visits of each data collections. There were 140 valid cases, where that athlete visited the Fueling Station at least once during the baseline data collection week and at least once during the follow-up data collection week. There were nine possible changes that could have occurred from baseline to follow-up data for each individual athlete. They could have had no change in appropriateness score (0 to 0, 1 to 1, or 3 to 3), change from not appropriate to appropriate or other (0 to 1, 0 to 3), change from appropriate to not appropriate or other (1 to 0, 1 to 3), or change from other to appropriate or not appropriate (3 to 1, 3 to

0). These are outlined in table 8 with the actual number of athletes per category. While 21 athletes were positively changed from not appropriate to appropriate, 23 athletes negatively changed from appropriate to not appropriate after the "Gain Your Edge" labels. The McNemar-Bowker test was run to examine if there were any significant changes in appropriateness from baseline to end-point data collection. The test results showed that there were no significant changes (p=0.188) among the 140 athletes because of the "Gain Your Edge" food labels in appropriateness score from baseline to end-point data. Figure 3 and figure 4 show the survey responses to the yes or no questions added to the Qualtrics survey for follow-up. Only the responses completed by athletes that had visited the Fueling Station at both baseline and follow-up were included. 67 athletes answered the question regarding noticing the "Gain Your Edge" food labels. 64 athletes (95.52%) said they noticed the food labels, whereas 3 athletes (4.48%) said they did not notice them. A total of 64 athletes responded to the second question regarding the impact the "Gain Your Edge" food labels had on their food choices. 49 athletes (76.56%) said that the food labels impacted their choices and 15 (23.44%) said that the food labels did not impact their food choices.

Table 4-8: Change in Appropriateness Score from Baseline to Follow-Up (n=180)

		Appropriateness Score at Baseline		
		0	1	3
Appropriateness Score at End	0	31 (22.1%)	23 (16.4%)	2 (1.4%)
	1	21 (15.0%)	39 (27.9%)	4 (2.9%)
	3	7 (5.0%)	9 (6.4%)	4 (2.9%)

McNemar-Bowker test p= 0.188

Figure 4-3: Athlete's Self-Report of Noticing "GYE" Labels (n=67)

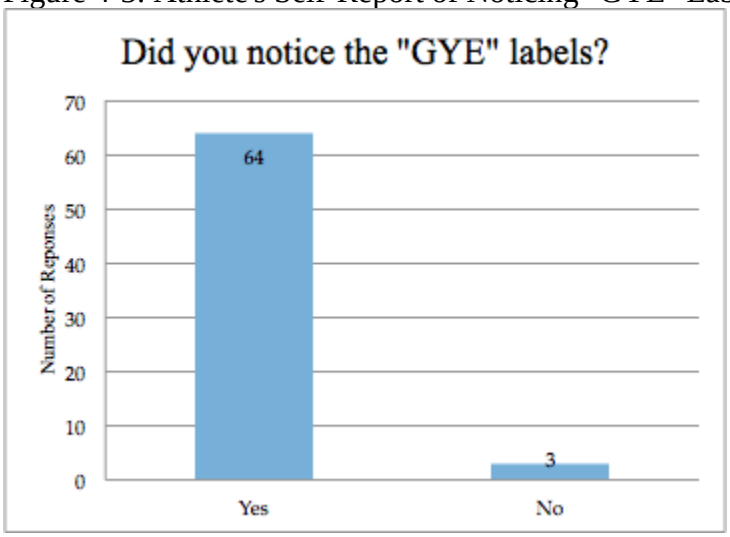
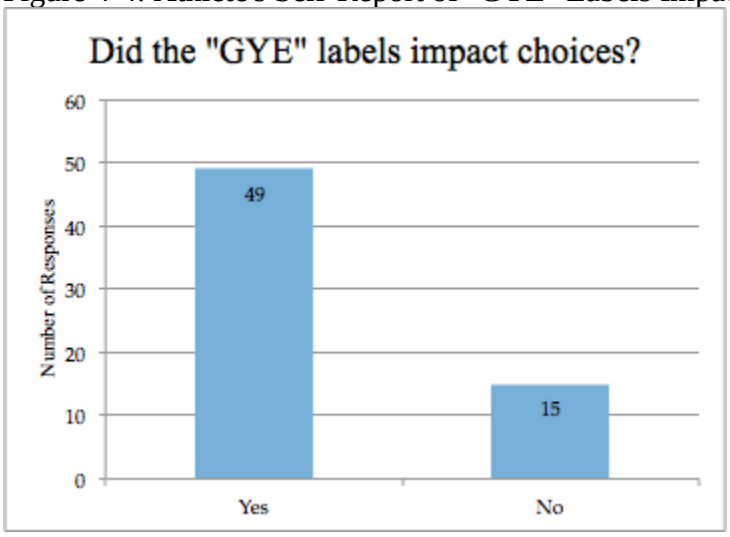


Figure 4-4: Athlete's Self-Report of "GYE" Labels Impact (n=64)



DISCUSSION

Of the athletes that visited the fueling station at least once during baseline data collection, once during follow-up data collection, and answered the additional Qualtrics survey questions, 95.52% said that they noticed the "Gain Your Edge" food labels and

76.56% said that the food labels impacted their food selection. The data on the individual food selections do not suggest that the implementation of the “GYE” labels changed athletes food selections according to the appropriate food choices of fueling.

The results show that the "Gain Your Edge" food labels did not improve the percent of appropriate visits to the Fueling Station that athletes were making when appropriateness was defined as an appropriate ratio of food selection to match the specific purpose and timing of eating that was self-reported by the athlete. While the Qualtrics survey responses were self-reported which leaves room for what the athletes chose to report, they were filled out by the athletes immediately after making the food selections. The athletes even had the food choices right in front of them at their table while filling out the survey. The way appropriateness was defined and the Qualtrics survey was modified, it enabled a third category "3" or "other" to be created. In these instances, the visits to the Fueling Station were not coded as "1" because they were not using the Fueling Station for the purpose of pre-workout fueling or post-workout recovery. However, they could not be considered an appropriateness score of "0" because the specific ratio selected of quick energy to lean muscle foods did not matter because the athlete did not have a recent workout.

There are many limitations to this study. First, quantity of food selected in the Fueling Station was not collected in the Qualtrics survey. The Qualtrics survey only captures number of different food selections. If an athlete selected multiple portions of the same food, it would not be shown in the data. For example, if an athlete selected more than one Greek yogurt, they would only mark that they took yogurt, and not the amount taken. The sample size is small compared to the entire population of athletes. A large

number of athletes were lost in the data analysis due to missing data. Athletes could have been in a hurry and accidentally missed a question in the iPad survey. This study was conducted in the spring, and the follow-up data were collected close to the end of semester. This could have been a potential reason that there were less athletes visiting the fueling station at follow-up.

The timing of how long the food labels were in place could have also impacted the results. It is possible that if the labels were in place for longer, that they would have made a significant improvement in number of appropriate visits to the Fueling Station. However, a study using food labels to elicit more healthful choices in food selection in a vending machine saw significant results after a two-week intervention.[11] Foods in a vending machine were labeled either red, yellow, or green based on least healthy to most healthy choices. After the labels were displayed in the vending machines across a college campus for two weeks, data showed that purchases of red and yellow labeled foods had decreased in most machines, and purchases of green labeled foods had increased in all vending machines.[11] In this study, if an athlete visited the Fueling Station at least once a week, they would have seen the "Gain Your Edge" food labels four times before the follow-up data were collected. However, since athletes often visit the fueling station multiple times per week, it is likely that they would have seen the food labels even more

The "Gain Your Edge" food labels did change some athletes' visits at the Fueling Station from not appropriate at baseline to appropriate at follow-up, but there were also athletes that changed from appropriate to not appropriate. The food labels did not make any significant changes in the athletes' intake behaviors in the Fueling Station. More

research is needed to see if educating athletes on the importance of timing in sports nutrition through food labels can be effective in a large setting, like fueling stations.

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CHAPTER V

GENERAL DISCUSSION AND IMPLICATIONS

There are many publications in the literature discussing the inadequacies of basic sports nutrition knowledge in college varsity athletes from any NCAA division. While there is a lot of research on the lack of knowledge, there is little out there on the education of basic nutrition of this population. There is no published research on the education of optimal timing practices in this population. This research was conducted to add to this limited knowledge base on educating college varsity athletes on proper nutrition practices, focusing mainly on making appropriately timed food selection choices.

This project is unique because it looks at the patterns of use of a university-sponsored fueling station, something that has never been done before. Many large collegiate athletic programs run fueling stations for their athletes to fuel for workouts and to recover after them. Despite the large quantity of fueling stations, there is no research on the effectiveness of fueling stations and evaluating if they are being used for their designated purpose. This project was conducted in the Fueling Station because it reaches a large number of athletes in a very short amount of time.

The food labeling intervention, “Gain Your Edge” food labels was created based off of a similar intervention that was implemented at the University of Utah. It was put into place in the Fueling Station because the previous patterns of use showed that it would be an effective outlet for delivering education to a large percentage of Utah State athletes. The food labels provide point-of-process cues so that the athletes can see what foods might be most appropriate for their specific purpose of eating as they are making

food selections. The literature shows that food labels have been effective in different populations to make more healthful choices.

The Utah State athletes "check-out" after each Fueling Station use on a survey marking their food selections, purpose of eating, and timing of eating. The survey responses were analyzed to determine appropriateness at baseline and after the food labels had been in the fueling station for four weeks. The results showed that the percentage of athletes making appropriate visits to the Fueling Station did not grow, but the athletes reported that they noticed the labels and over 75% of them said that the labels impacted their food selection.

Despite there being no statistically significant improvements in appropriate visits to the Fueling Station, this research adds important information on the use of fueling stations in collegiate Division I athletic programs. More research needs to be conducted on effective strategies to educate college athletes on the importance of nutrition and timing in an efficient and effective way. A more comprehensive survey to "check-out" at the fueling station could provide a better understanding of the quantities of specific foods that were consumed, which could help define "appropriate Fueling Station visit" differently. The lack of food quantity selected was a very large issue for the data analysis, however, the athletes that use the Fueling Station are often in a big hurry, and it did not seem feasible to lengthen the survey any more. Other options in the future could be to structure the survey in a way so that athletes would self-disclose how many items in each food group they selected. This would be a way to quickly capture quantity. For example, the survey could ask, "how many different fruits did you select?" An issue with this method would be that the survey responses would no longer relate back to the "Gain

Your Edge" food labels. Another option to capture food quantity selected by athletes could be to conduct observations of athletes' actual patterns of food selection.

Appropriate food choices are vital in regards to timing or workouts in athletes. College athletes have hectic schedules, and it is important that they are able to fuel before workouts and recover properly afterwards. Making appropriate food choices based on when the last workout was or when the next one will be can help athletes perform and feel their best.

APPENDICES

Food	How listed On Survey	Sustained Energy	Hydration	Muscle Recovery	Weight Management	Lean Muscle	Quick Energy	Good Source	Great Source
Cottage Cheese	Cottage cheese		X	X	X	X		Vitamin A, thiamin, pantothenic acid, calcium	riboflavin, vitamin B12, phosphorus, selenium, sodium
Pineapple	Pineapple		X	X	X		X	Thiamin, vitamin B6	Vitamin C, manganese
Carrots	Carrots	X	X	X	X		X	Vitamin C, fiber	Vitamin A
Broccoli	Broccoli	X	X	X	X			Vitamin A, folate	Vitamin C
Mandarin Oranges	Oranges		X	X	X		X		Vitamin C
Peaches	Peach/Nectarine		X	X	X		X	Niacin, vitamin C	
Roasted RP Hummus	Hummus	X	X	X				Sodium	
Black Beans	Black beans	X			X	X		Fiber	
Pico	Salsa		X		X			Sodium	
Salsa	Salsa		X		X			Sodium	
Guacamole	Guacamole	X	X					Sodium	Vitamin C
Peanut Butter	Peanut butter	X		X		X		Vitamin E, sodium	Niacin
Plum	Plum		X	X	X		X	Vitamin C	
Pita Chips	Pita chips	X	X					Sodium	
Pretzels	Pretzels		X				X	Riboflavin, niacin, iron	Thiamin, sodium

Popcorn	Popcorn	X	X						Sodium
Sweet Potato Chips	Tortilla chips	X	X					Vitamin A	
Kind bar	Kind bar	X		X				Niacin, iron, magnesium, manganese, phosphorus, fiber	
1% Milk	Milk	X	X	X	X	X		Vitamin A, niacin, pantothenic acid, selenium, zinc	Riboflavin, vitamins B12 & D, phosphorus, calcium
1% Choclate Milk	Chocolate milk, flavored milk	X	X	X		X		Vitamin A, niacin, bitoin, molybdenum, sodium, zinc	Riboflavin, vitamin B12, panthothenic acid, vitamin D, phosphorus, iodine, calcium
Goldfish Crackers	Goldfish		X				X	thiamin, sodium	
Kiwi	Kiwi		X	X	X		X		vitamin C, vitamin K
Apple	Apple	X	X	X	X		X	Vitamin C, biotin, fiber	
Nectarine	Peach/Nectarine		X	X	X		X	Niacin	
Pear	Pear	X	X	X	X			Vitamins C & K, fiber	
Grapes	Grapes		X	X	X		X	Vitamin C	

Cucumbers	Cucumber		X		X			Vitamin K	
Banana	Banana	X	X	X	X		X	Biotin, vitamin C, magnesium, manganese, potassium, and fiber	vitamin B6
Almond milk	Almond milk		X	X				Sodium, zinc	Riboflavin, vitamins B12, D, & E, calcium
Orange	Orange	X	X	X	X		X	Thiamin, folate, fiber	Vitamin C
Avocado	Avocado	X	X	X				Thiamin, magnesium, manganese, phosphorus, zinc, omega 3 fatty acids, fiber	Riboflavin, niacin, pantothenic acid, vitamin B6, biotin, vitamins C, E, & K, potassium, omega 6 fatty acids
Eggs	Eggs	X		X	X	X		Vitamin A, niacin, folate, zinc	Riboflavin, pantothenic acid, biotin, vitamins B12 & D, iodine, molybdenum, phosphorus, selenium, choline
Chex mix	Chex mix		X				X	Thiamin, riboflavin, niacin, folate, iron,	manganese, sodium

								phosphorus, omega-3 & omega-6 fatty acids, fiber	
Choc chips							X		
Chicken	Chicken	X		X	X	X			
Coconut		X						Fiber	
Chia seeds	Nuts, seeds, trail mix	X						Fiber	
Flax seed	Nuts, seeds, trail mix	X						Fiber	
Cashwers	Nuts, seeds, trail mix	X	X	X				Wide variety of vitamins and minerals	
Dried apples	Dried fruit	X		X				Fiber	
Banana Chips	Dried fruit	X		X			X	Manganese	
Craisins	Dried fruit			X			X		
Sunflower seeds	Nuts, seeds, trail mix	X	X	X				Magnesium, phosphorus	Vitamin E
Raisins	Dried fruit			X			X		
Dried blueberries	Dried fruit		X				X		
Almonds	Nuts, seeds, trail mix	X	X	X				Wide variety of vitamins and minerals	
Dried mango	Dried fruit						X	Vitamin C	Manganese

Dried tart cherries	Dried fruit			X			X	Vitamin A	
Veg cream cheese	Cream cheese	X						Sodium	
Greek yogurt cream cheese	Cream cheese					X		Calcium	
Jam	Jelly						X		
String cheese	String cheese/cheddar cheese	X	X	X		X		calcium, sodium	
Cheddar cheese	String cheese/cheddar cheese	X	X	X		X		Vitamin A, calcium, sodium	
Fruit squeeze	Squeeze fruit						X		Vitamin C
Applesauce	Applesauce		X				X	Vitamin C	
Oatmeal	Oatmeal	X		X	X			Magnesium, sodium, zinc, fiber	Vitamin A , thiamin, riboflavin, niacin, vitmain B6, folate iron, manganese, phosphorus
Greek yogurt	Greek yogurt	X		X	X	X		Riboflavin, vitamin B12, phosphorus	Calcium
Granola	Granola	X	X	X				Iron, magnesium, phosphorus,	Vitamin A, thiamin, riboflavin, niacin,

								selenium, sodium, fiber	vitamins B6, B12, D & E, folate, zinc
Frosted mini spooners	Cereal	X		X	X			Magnesium, fiber	Thiamin, riboflacin, niacin, vitamins B6, B12, folate, iron, phosphorus, and zinc
Cinnamon chex	Cereal		X	X			X	Calcium, sodium	Thiamin riboflavin, niacin, vitamins B6, B12, & D, folate, iron, and zinc
Special K red berries	Cereal		X	X			X	Vitamin A, sodium, fiber	Thiamin, riboflavin, niacin, vitamins B6, B12, C, D, & E, folate, iron
Honey nut cheerios	Cereal		X	X			X	Calcium, phosphorus, sodium	Thiamin, riboflavin, niacin, vitamins B6, B12, & D, folate, iron, zinc
Breads	Bread	X	X	X	X			Iron, magnesium, fiber	Thiamin, riboflavin, niacin, vitamins B6, B12, folate, iron, sodium
Bagels	Bagel	X	X						Thiamin, riboflavin, niacin, vitamins B6, B12,

									folate, iron
Tortillas	Bread	X	X		X			sodium, fiber	
Apple crisps	Apple crisps chips			X	X		X	vitamin , fiber	
Mixed nuts	Nuts, seeds, trail mix	X	X	X				Wide variety of vitamins and minerals	
Trail mix	Nuts, seeds, trail mix	X	X	X				Wide variety of vitamins and minerals, fiber	
Black bean hummus	Hummus	X	X	X					
Ranch	Ranch		X	X				Vitamin B12	
Tuna Salad	Tuna	X	X	X	X	X		Vitamin A, riboflavin, vitamins B12 & C	Sodium
Parfaits	Parfait	X		X	X	X		Riboflavin, vitamin B12, phosphorus	Calcium
Sugar snap peas	Sugar snap peas	X	X	X	X			Vitamin A, pantothenic acid, vitamin K, iron	Vitamin C
Cauliflower	Cauliflower	X	X	X	X			Vitamin B6, folate, vitamin K	Vitamin C
Bell peppers	Bell peppers	X	X	X	X				Vitamin C
Dried	Dried fruit			X			X		Vitamin C

strawberries									
Energy bites	Energy bites	X		X		X		Wide variety of vitamins and minerals, fiber	
Beef jerky	Beef jerky	X	X	X	X	X		Vitamin B12, iron, phosphorus	Sodium, zinc
Wraps	Wraps	X		X	X	X		Wide variety of vitamins and minerals	
Protein Bars	Protein Bars	X		X		X		Wide variety of vitamins and minerals	