Fueling Station Utilization by Division I Athletes at the University of Pittsburgh

by

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Bachelor of Science in Athletic Training, Wheeling Jesuit University, 2018

Submitted to the Graduate Faculty of

The University of Pittsburgh School of Health and Rehabilitation Sciences

of the requirements for the degree of

Master of Science

The University of Pittsburgh

2020

THE UNIVERSITY OF PITTSBURGH

SCHOOL OF HEALTH AND REHABILITATION SCIENCES

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Sports nutrition is an important aspect of any athlete's training and performance. With the 2014 NCAA policy change in regards to providing student-athletes snacks and meals, many organizations have providing resources and services to meet this need. These facilities help provide the macronutrients and encourage proper nutrient timing to help student-athletes enhance their performance and fuel their recovery. However, there is little to no research done on the effectiveness or impact these programs have had on student-athletes and their training and performance.

The aim of this study was to determine the average amount of points being spent by student-athletes per week, to determine the most popular items purchased before and after exercise, and to determine if student-athletes were using the fueling station to replace traditional meals. Data on the amount of points spent by student-athletes over the course of 14 weeks was collected from the Fueling Stations data base. Subjects participated in a short survey that asked questions regarding student-athlete purchasing habits, the amount of points they spend per week, items they typically purchase, if they used the fueling station to replace traditional meals, and why they used the fueling station to replace traditional meals.

Data from the Fueling Station consisted of 256 student-athletes and 90 of 115 student-athletes that completed the survey were included in the analysis. 25 survey participants were excluded because they were injured or held redshirt status. Results found that on average student-athletes did not spend their total allotted 40 points per week. The most popular items purchased

before exercise were Uncrustables®, bananas, and Chewy Bars, while the most popular items purchased after practice were Uncrustables®, Greek yogurt, and chocolate milk. The data showed that over one half of the student-athletes surveyed used the Fueling Station to replace traditional meals, mainly breakfast and lunch.

These results suggest that student-athletes have an adequate amount of points to purchase whatever items they need before and after exercise. However, 30% of the student-athletes use all of their points. Student-athletes do use the Fueling Station to replace traditional meals and that the most popular items purchased before and after exercise fall in trend with ACSM recommendations. Further research is warranted to assess fueling practices in other Division I organizations.

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Preface

My idea for this research project started when I was doing my independent study in nutrition at the Fitzgerald Fueling Station at the University of Pittsburgh. My passion of athletics and sports nutrition led me to investigate the fueling habits of the student-athletes and if they were taking full advantage of the service it offered. Services like the Fueling Stations are relatively new and there is currently no literature on their impact on student-athletes and their performance. This project aims to fill that gap in literature and inspire others to investigate similar venues at other organizations.

I would like to thank my committee members for their patient guidance and support during the research process. You have all made this research project an enjoyable and fulfilling experience that I would like to continue in my future career. Secondly, I would like to thank my parents and friends for their unwavering love, support, and encouragement. I could have never have reached this level of success without them. Thank you all for your support and kind words.

Hail to Pitt!

1.0 Introduction

Sport nutrition has been well documented as being a prominent aspect in any athlete's training. An athlete's diet and overall nutrition play an important role in optimizing training sessions and providing crucial nutrients for performance and recovery.[1] Competitive athletes have two primary dietary goals: 1) eating to maximize performance and 2) obtaining optimal body composition.[2] Quality nutrition assists in the ability to train intensely, as well as promote muscle recovery and metabolic adaptations to endurance and resistance exercise.[3] Athletes should be able to obtain adequate energy from food macronutrients: carbohydrates, protein, and fats, without help from additional of dietary supplements.[1] The nutritional requirements of athletes also depend on multiple variables including training volume, sport, position, competition schedule and many others.[1] It is important for sport medicine providers to educate athletes on the different aspects of proper nutrition such as choosing foods and fluids for fueling and hydration, nutrient timing, and energy balance since this education is often lacking.[1] To assist in nutritional education the American College of Sport Medicine (ACSM) has published guidelines, based on sound scientific evidence, for quantity, structure, and timing of food intake.[3] These guidelines are vital to ensure athletes fuel and nourish themselves effectively, thereby reducing the risk for injury and illness while improving athletic performance.[3]

1.1 Energy Requirements

The energy intake from an athlete's diet is essential in supporting optimal body function, helps determine an athlete's intake requirements of macronutrients and micronutrients, and assists in manipulating body composition.[4] Most well-balanced diets should be able to provide an athlete with enough energy to maintain energy balance.[3] Dietary energy is expended during important physiological processes, including cellular maintenance, thermoregulation, growth, reproduction, immunity, and locomotion.[5] If these energy needs are not met, other sources of fuel will be used to provide energy: mainly body fat and lean muscle.[6] Low calorie intake can also result in a slower resting metabolic rate over time.[6] This can have negative effects on a number of body systems including the immune, endocrine, musculoskeletal systems and can result in innumerable problems both now and in the future.[6]

Athletes' nutritional and energy requirements widely vary, depending on their sport, position, timing of the season, training days, rest days, [1] and can vary from day to day during the year due of changes in training volume and intensity.[4] Factors such as exposure to heat or cold, fear, stress, high altitude, physical injuries, and specific drugs or medications may increase energy needs above normal.[4] Other than a reduction in training, energy requirements are lower due to aging, decreases in fat free mass (FFM), and recent evidence suggests, the follicular stage of the menstrual cycle.[4]

The American College of Sport Medicine recommends that "athletes need to consume adequate energy during periods of high intensity and/or long duration training to maintain body weight and health and to maximize training effects."[3] The ACSM recommends energy requirements are to be calculated using either dietary reference intakes, which are well researched and modeled after equations based on Basal or resting energy + activities for daily living + physical

activity energy expenditure. The gold-standard method to assess energy expenditure is doubly labelled water.[3]

1.2 Carbohydrates

Carbohydrates have received a great deal of attention in sports nutrition due to its various roles in performance and adaption to training.[4] Firstly, carbohydrates provide a primary source of fuel for the brain, the central nervous system[1], and muscular system that can support exercise over a long period of time through both the anerobic and aerobic pathways.[4] Especially when working at high intensities carbohydrates are the predominate fuel, fat contributes very little comparatively. Carbohydrates provides a greater yield of adenosine triphosphate (ATP) per volume of oxygen compare to fats, therefore improving exercise efficacy.[4] Second, the size of carbohydrate stores can be manipulated daily through dietary intake or even a single exercise session.[4] Thirdly, new evidence has found that muscle glycogen, which has a role as a muscle substrate, is crucial in direct and indirect roles of a muscle's adaptation to training.[4] Research supports that high intensity exercise or endurance exercise is enhanced by a high carbohydrate availability, where inadequate muscle glycogen stores are associated with decreased work rate, impaired skills and concentration, and increased perceived effort.[11] To replenish glycogen stores athletes should focus on consuming whole grains, fruits and vegetables, and legumes as they are highly nutritious and high in antioxidants, fiber, vitamins, and minerals and avoid overly processed carbohydrates whenever possible.[1]

The primary source of fuel used by the skeletal muscles during prolonged aerobic exercise of a strenuous nature is muscle glycogen.[12] The most important dietary factor affecting muscle

glycogen stores is the amount of carbohydrates consumed.[9] It has be shown that aerobic endurance is directly related to the initial muscle glycogen stores and strenuous exercise cannot be maintained when these stores are depleted and the perception of fatigue during prolonged intense exercise parallels the decline in muscle glycogen.[12] The restoration of muscle and liver glycogen is a fundamental goal of recovery between training sessions or events, especially in a condensed time period.[13]

1.2.1 Carbohydrate Guidelines

Recommendations for carbohydrate intake and timing of consumption must consider the athlete's training and competition schedule.[4] These guidelines can be provided using the athlete's body size as a proxy for the size of muscle glycogen stores.[4] The timing of carbohydrate intake in relation to exercise is crucial.[3] When exercise intensity or duration increases carbohydrates become the main energy substrate, which makes glycogen depletion an important limiting factor of performance.[14] The body contains limited glycogen stores that can only sustain approximately 90 minutes to 3 hours of moderate to high intensity activity.[3] As a result, sport nutrition recommendations have focused on strategies to enhance body carbohydrate availability.[9] The ACSM provides broad guidelines, recommending 6-10 g/kg BW/day. These requirements depend on several factors including the athlete's total daily energy expenditure, sport, gender, and environmental conditions.[4]

1.3 Protein

Protein is essential for many bodily processes.[1] It is the building blocks of muscle, tendons, and other soft tissues, and they are essential for building enzymes, hormones, and neurotransmitters for the body.[1] Protein is made of essential amino acids, which are not made in the body and obtained through a proper diet, and nonessential amino acids which are made in the body.[1] Muscle protein synthesis (MPS) is the driving force behind adaptive responses to exercise i.e. the process of building up muscle mass after exercise and it is essential for recovery and adaptation.[17] During strenuous exercise there is generally damage to the active muscle and this damage can continue after exercise due to acceleration in protein degradation or turnover.[12] For complete recovery it is important initiate MPS while limiting protein degradation.[12]

In healthy active individuals skeletal muscle protein display turnover rates of approximately 1.3% day.$^{-1}$.[17] This exists in equilibrium with muscle protein breakdown (MPB) and muscle protein synthesis in a fasted state.[17] After consuming food, primarily protein, the muscle protein synthesis exceeds muscle protein breakdown.[17] Increases in MPS after each exercise session drives adaptation to exercise training.[17] Intense endurance or resistance exercise can induce an increase in protein turnover, and until protein is consumed, a negative protein balance.[15] Net muscle protein balance which is the difference between MPS and MPB generally remains negative in the recovery period after resistance exercise in the absence of nutrient intake.[18] Protein intake post exercise enhances muscle protein synthesis and net protein balance.[15] It is only following the intake of protein that rates of MPS exceed those of MPB, resulting in a positive muscle protein balance and net protein accretion.[19]

Protein consumption prior to endurance and resistive training has been shown to enhance rates of muscle protein synthesis.[15] Several dose-response studies suggest approximately 20g of

high quality protein is enough to maximize MPS at rest following resistance and high intensity aerobic exercise.[15] Muscle protein synthesis rates have been found to triple 45-90 minutes after protein intake at rest, and then return to baseline levels.[15]

1.3.1 Optimal Protein Sources

There are multiple sources of protein athletes can choose from however, most animal sources of protein contain all the essential amino acids and are considered complete proteins.[20] Plants-based sources of protein in general, lack some of the essential amino acids and are classified as incomplete proteins.[20]

The body needs optimal protein sources after exercise to assist in maintenance, repair, and synthesis of skeletal protein.[4] Protein quality can be measured by the Protein Digestibility-Corrected Amino Acid Score (PDCAAS), where a score close to or equal to 1 indicates a protein of high quality.[3] Protein sources with a score close or equal to 1 include milk (casein and whey), eggs, and meat products.[3] Studies have found that milk-based protein consumption after resistance exercise increases muscle strength and had favorable effects on body composition compared to other protein sources.[4] Dairy protein seem to be superior to other sources of protein due to its high concentration of leucine and the digestion and absorption of branched-chain amino acids of fluid dairy products.[4] There have also been reports of increased muscle protein synthesis and protein acceleration with products such as whole milk, lean meat, and dietary supplements.[4]

Third party protein substitutes, such as protein shakes, with high quality ingredients can serve as a sufficient source of protein when whole foods are not available.[4] However, it is important to assess the athlete's diet and try to incorporate more whole food protein sources before opting for a protein supplement.[4]

1.3.2 Protein Guidelines

Guidelines now recognize the importance of a post exercise intake of high quality protein for recovery, noting the importance of protein synthesis in promoting muscle adaptation and repair.[7] Multiple studies have shown that athletes have higher protein requirements compared to non-athletes, which is 0.8 g per kilogram body weight per day.[1] This is because protein requirements are increased with speed, strength, and endurance training because more protein is needed to support of muscle synthesis, reduce muscle protein breakdown, and repair muscle.[3] The ACSM recommends 1.2 – 2.0 g per kilogram body weight per day for athletes through their diet.[1,3,4]

1.4 Fats

Fat is an important component in an athlete's diet[4] and the daily requirements are only slightly higher than those of non-athletes.[3] Adequate amounts of fats promote optimal health, provide energy for muscle metabolism and the body, are essential elements of cell membranes, facilitate the absorption of fat-soluble vitamins, regulate hormones, brain health and replenish intramuscular triacylglycerol stores.[3,4]

1.4.1 Fat Guidelines

The ACSM recommend that athletes do not consume less than 15% - 20% total daily calories due to fats' essential role in many bodily process.[1,4] Athletes should intake good sources

of fat, such as salmon, avocados, and nut butters, that are high in unsaturated fats and essential fatty acids.[1] Sources of foods containing trans-fat should be avoided and saturated fats consumed should be less than 10% of total daily calories.[1] The recommendations set by the ACSM should be sufficient for any athlete and high fat diets are not recommended due to lack of carbohydrates consumed and may have negative effects on training and performance.[3]

1.5 Nutrient Timing

1.5.1 Carbohydrates

1.5.1.1 Pre-exercise

For a pretraining or pre-event meals for activity that lasts longer than 60 minutes, the ACSM recommends 200-300g of food high in carbohydrates and moderate protein but low in fat and fiber 3-4 hours prior.[4] The amount of carbohydrates consumed prior to exercise will depend on what the athlete is comfortable with since high carbohydrate meals can often cause gastrointestinal discomfort.[1,3,4] A common strategy to improve glycogen stores is carbohydrate loading, which involves changes to training and an increase in carbohydrate intake that can maximize muscle glycogen stores.[3] This strategy has found to elevate muscle glycogen stores, increases endurance and performance, and helps maintain muscle tissue that may be affected by low glycogen stores.[3]

1.5.1.2 Post-exercise

Consuming carbohydrates immediately post-exercise to coincide with the initial rapid phase of glycogen synthesis has been used as a strategy to maximize rates of muscle glycogen synthesis.[15] Carbohydrate intake post exercise is responsible for replenishing and increasing glycogen stores.[3] Glycogen depletion is a limiting factor in performance and it is important to start exercise or competition with stores as full as possible.[14] Glycogen depletion is stimulates glycogen synthase which is responsible for synthesis and increases insulin sensitivity and cell membrane permeability.[14] The 2016 study by Burke et al., *"Postexercise muscle glycogen resynthesis in humans"* found that the ratio of glycogen re-synthesis was much higher if carbohydrates intake took place with 2 hours post-exercise compared to a later intake. This is especially important if an athlete has little time between events or multiple training sessions per day.[14] Quick refueling is important when there is less than eight hours of recovery time between training sessions or competition.[3] Enhancing the rate of glycogen synthesis with immediate carbohydrate consumption after exercise appears most relevant when the next exercise session is within 8 hours of the first.[15] The ACSM recommends that carbohydrate intake should range between 1.0-1.5 g/kg BW/day and should be ingested within 30 minutes to maximize glycogen synthesis[14] as well as glycogen levels and should be repeated again every two hours for 4-6 hours if they are training more than once a day or have multiple events.[3]

The Glycemic Index ranks carbohydrate containing foods according to the blood-glucose response caused by consumption when compared to glucose or white bread.[3] Carbohydrate sources with rapid-absorption rates, a high glycemic index (e.g. glucose), could facilitate glycogen re-synthesis more than carbohydrates with lower absorption rates or a low glycemic index(e.g. fructose).[14] Therefore, high glycemic index carbohydrates should be combined with protein, which

will increase the insulin response.[14] The combination of intaking glucose and fructose post-exercise has shown to be an effective strategy to lower gastrointestinal distress and accelerate liver glycogen re-synthesis, and may be preferable.[14]

1.5.2 Protein

1.5.2.1 Pre-exercise

The ACSM recommends a moderate amount of protein be added to a pre-exercise meal.[3] However, no specific guidelines have been outlined at this time.[3]

1.5.2.2 Post-exercise

During post-exercise, the ACSM states the primary goal of recovery is to replenish fluids, electrolytes, energy, and carbohydrates to replace muscle glycogen and facilitate recovery and adding protein will supply amino acids for the maintenance and repair of muscle.[3] This combination of carbohydrates and protein is essential in replenishing muscle glycogen, promoting protein synthesis, and improving performance.[3] This recovery can be achieved through dietary means alone, a common protein source being low fat milk, and additional supplementation is not warranted.[3] However, at this time the ASCM has not provided any specific guidelines for protein intake post-exercise.[3]

1.6 Fueling Stations at the University of Pittsburgh

In 2014 the National Collegiate Athletic Association (NCAA) approved a new rule that allowed organizations to provide unlimited meals and snacks for Division I student-athletes[21]. This new model, which is available to all scholarship and walk on student-athletes, moved away from the traditional three meals a day or food stipend rule for student-athletes[21]. This change was an attempt to meet the nutritional demands that student-athletes need to enhance performance and assist in recovery[21].

Since this change, many high-level athletic organizations, like the University of Pittsburgh, have implemented fueling stations or similar venues to provide food for their athletes outside of the traditional meal plan. The Fueling Stations' goal is to make accessible healthy pre and post food options, thus helping athletes meet the fueling requirements for performance and recovery. The University of Pittsburgh's fueling stations, which are located in multiple training facilities throughout campus, offer a variety of healthy food items and snacks such as wraps, sandwiches, high protein options such as protein bars and Greek yogurt and carbohydrate rich products such as fruits and granola bars. Athletes purchase these items via a point system: one-point equates to $1; and, all athletes, except for the Swimming and Diving team, are allotted 40 points per week. The student-athletes are allotted points so there is an accurate way to track the number of points student-athletes are spending and to make sure student-athletes cannot purchase all of the products at once.

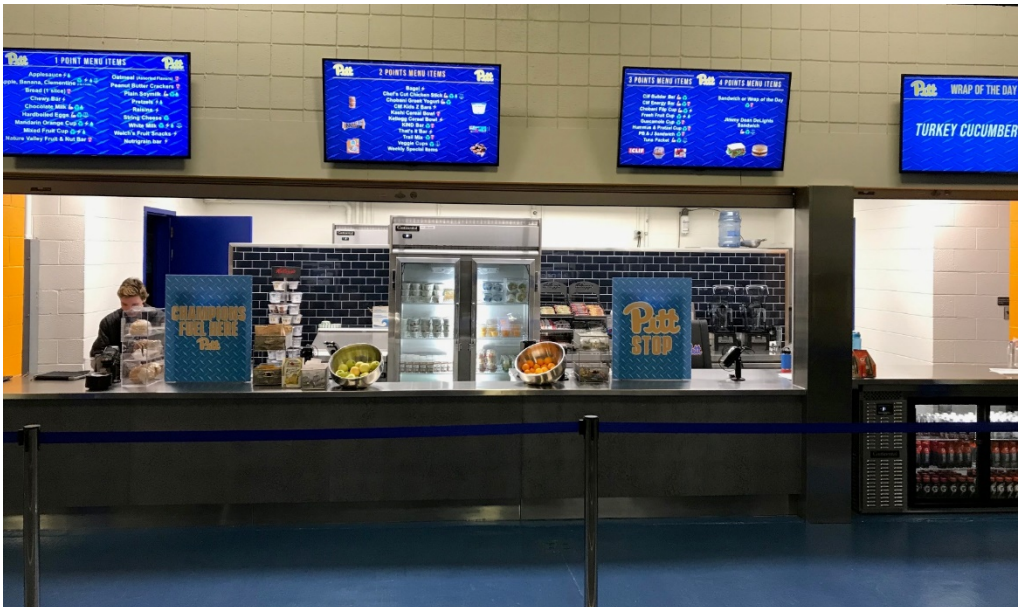

Figure 1 The Front of the Fueling Station at the Fitzgerald Field House

1.7 Study Problem, Purpose, Specific Aims, and Significance

1.7.1 Study Problem

While the NCAA's rule on allowing unlimited food was introduced several years ago, there is little to no data on how institutions are implementing these changes and how they are assisting their student-athletes. Similarly, the University of Pittsburgh's Fueling Stations are only about three years old and there have been no studies or analysis of their data to determine if the fueling station is being used to its full potential by the student-athletes. This study aims to determine what foods are being purchased before and after practice, to determine the average amount of points an athlete spends per week, and to determine if student-athletes are using the Fueling Station to

replace traditional meals. This information will help determine if the Fueling Stations are being utilized by the student-athletes, if the goods offered are meeting the student-athletes' needs, and if the student-athletes have enough points to meet their needs each week.

1.7.2 Study Purpose

The purpose of this study is to determine what foods are being purchased before and after practice, to determine the average amount of points being spent weekly by athletes, and to determine if student-athletes are using the Fueling Station to replace traditional meals.

1.7.3 Specific Aims

Specific Aims 1: To determine the average amount of points student- athletes spends per week.

Specific Aim 2: To identify food and drink items Division I student-athletes purchase before and after practice or exercise.

Specific Aim 3: To determine if student-athletes are using the Fueling Station to replace traditional meals.

1.7.4 Study Significance

The Academy of Nutrition and Dietitians of Canada, Dietitians of Canada, and the American College of Sports Medicine have established that athletic performance and recovery are optimized by a well-chosen nutrition program[3]. The amount of food, type and timing of consumption will enhance health and performance of an athlete during training and competitive sport. An increasing number of high-level athletic organizations, such as the University of

Pittsburgh Athletics, are providing healthy and nutritious food options for athletes outside of their meal plans. Research is warranted to investigate if athletes are utilizing fueling stations and additional nutritional resources provided to optimize fueling and recovery for their sport and performance via purchasing items before and after activity or exercise. Additionally, research is needed to investigate if there is a trend in eating style or pattern.

2.0 Methodology

2.1 Experimental Design

This is a descriptive study that will utilize a survey to gather information on athlete nutrition habits and utilization of the Fueling Stations at the University of Pittsburgh. A Fueling Station survey and monthly collected Fueling Station purchasing spreadsheets will provide the data to address each of these specific aims. This survey will have questions centered around the type and quantity of food items purchased, how frequently athletes purchase items on a daily basis, and questions on why athletes may be skipping traditional meals.

2.2 Subject Recruitment

Subjects were recruited from the Division I sport teams at the University of Pittsburgh. Subjects were recruited by asking student-athletes to complete a short survey at the Fitzgerald Field House Fueling Station either before or after their practice time. Participation in the survey was voluntary and the student-athlete could drop out of the study at any time. A sample set of 80 participants with a goal of 100 Division I athletes was determined appropriate for this study[2].

2.3 Subject Characterization

2.3.1 Inclusion Criteria

To be eligible for this study, individuals were required to be a member of one of the following University of Pittsburgh's sports teams: Men's Soccer, Women's Soccer, Men's Cross Country, Women's Cross Country, Men's Track and Field, Women's Track and Field, Women's Volleyball, Wrestling, Women's Gymnastics, Baseball, or Softball. Individuals must be at least 18 years of age.

2.3.2 Exclusion Criteria

Subjects were excluded if the they are under 18 years of age. Individuals were excluded if they were members of the Swimming and Diving team since they are allotted 30 points per week and have their own supply room of nutritious food items. Subjects were also excluded if they currently hold redshirt status or are injured. Redshirt status is defined as the delay or suspension of an athlete's participation to lengthen their period of edibility; these athletes still workout with the team but are excluded from competition.

2.4 Instrumentation

2.4.1 Fueling Station Data

The Fitzgerald Fueling Station uses the Moocho: Deals and Rewards App to record transactions and complies the data into organized spreadsheets for ease of access. These spreadsheets record the athlete's name, email address, date, time, team affiliation, location of purchase, and amount of points spent per transaction. To ensure anonymity, the data produced and received from the Fueling Stations omitted the name and email address of all student-athletes. The Fueling Station data was provided by the Director of Nutrition who has given permission to use this data. All data was from the Fall semester of the 2019 academic year.

2.4.2 Qualtrics Survey Data

The survey was developed in Qualtrics, a survey tool used by the University of Pittsburgh that assists in the creation of surveys and survey questions. In this study, the student-athletes were asked to complete a 14-question survey. Four questions pertained to the student-athlete's demographic information: age, gender, sport, and injury/redshirt status. The remaining 10 questions were completed using multiple choice and "select all that apply" for the selection of items for purchase. Examples of questions included: "How often do you purchase items from the Fueling Stations per week?" and "Do you use the Fueling Stations for meals instead of going to the dining halls or going out to get food for traditional meals?" All survey data was collected

anonymously. Data was collected during the 2019-2020 academic year and all data was kept on a private University of Pittsburgh server.

2.5 Procedures

2.5.1 Data Collection

The University of Pittsburgh's Institutional Review Board has granted approval to conduct this study. The data from the fueling station was collected from the university servers and provided by the Director of Nutrition. All survey data was collected in person at the Fitzgerald Fueling Station before and after practice times. The student-athletes were shown and read a form that explained the purpose of the study and the request for voluntary participation. The student-athletes were informed that they have the option to skip questions or exit the study without penalty at any time. The study survey was administered to the student-athletes and completed on paper with the primary investigator present to answer any questions or concerns. The survey consisted of 14 questions and took no more than 2 minutes to complete. After completion of the survey, the student-athlete returned the survey and their participation in this study was complete. All paper surveys were manually recorded on Qualtrics by the primary investigator, which sorted and recorded the data.

2.6 Data Reduction

14 weeks of Fueling Station data was entered into SPSS Version 26.0 (IBM Corporation, Armonk, NY, 2019). Any data listing the Swimming and Diving Team was removed and data was categorized by team along with recorded number of points spent by each team.

Data from the Fueling Station surveys was manually entered into the Qualtrics Online Survey Services. Twenty-five surveys were excluded because the respondents stated they either were injured or currently held redshirt status on the team, these were excluded from the results. The results from each question was generated and complied into bar graphs, by Qualtrics for ease of access and readability. All of the survey questions were multiple choice excluding a question that asked why athletes skipped traditional meals and used the fueling station, which contained a free text response option. Any free text response that did not fall into an existing option (dining halls being closed, Class, extracurricular activities, living off campus, or having no meal plan) were categorized either as “Convenience” or “Money”. The free text responses primarily were about the easy of convenience or about of student-athletes did not have the funds to spend money on food elsewhere. For example, one student-athlete list “convenient, saves time” and was sorted into the “Convenience” category. While another student-athlete stated they “save money” and this response was categorized as “Money”.

2.7 Data Analysis

All Fueling Station Data was entered into SPSS Version 26.0 (IBM Corporation, Armonk, NY, 2019). The team categories were analyzed to determine the number of athletes per team that

had purchased items at a Fueling Station. The average amount of points spent per week per team was calculated by taking the teams' total points and dividing them by 14 weeks. The average amount of points spent per athlete per week was calculated using the average points spent by team, per week, across the number of athletes on that team that purchased items and then and dividing by the number of athletes on the team.

All survey data was entered into the Qualtrics Core XM Online Survey Services software (Qualtrics, Provo, UT, 2019). Qualtrics automatically generates the recorded responses into numerical and percentile figures. The number of male and female respondents, team affiliation, items purchased, and traditional meals skipped will be represented in tables and figures.

3.0 Results

3.1.1 Fueling Station Data

The data of 256 student-athletes was collected from the Fueling Stations database over the course of 14 weeks; the participants' team affiliation data is shown in Figure 2. Of the 256 participants, 127 (49.61%) student-athletes were male and 129 (50.39%) student-athletes were female. The number of student-athletes sampled from each team is displayed in Figure 2. Data was sampled from 100% of student-athletes from Women's Soccer, Women's Softball, Women's Volleyball, Women's Gymnastics, Women's Cross Country, and Men's Cross Country. The percentage of team roster sampled for the remaining teams were as follows: Women's Track and Field: 96.15%, Baseball: 91.89%, Men's Track and Field: 90.48%, Men's Wrestling: 90.32%, and Men's Soccer: 73.08%. There was less than 100% of team data because not all the student-athletes on the roster choose to use the fueling stations.

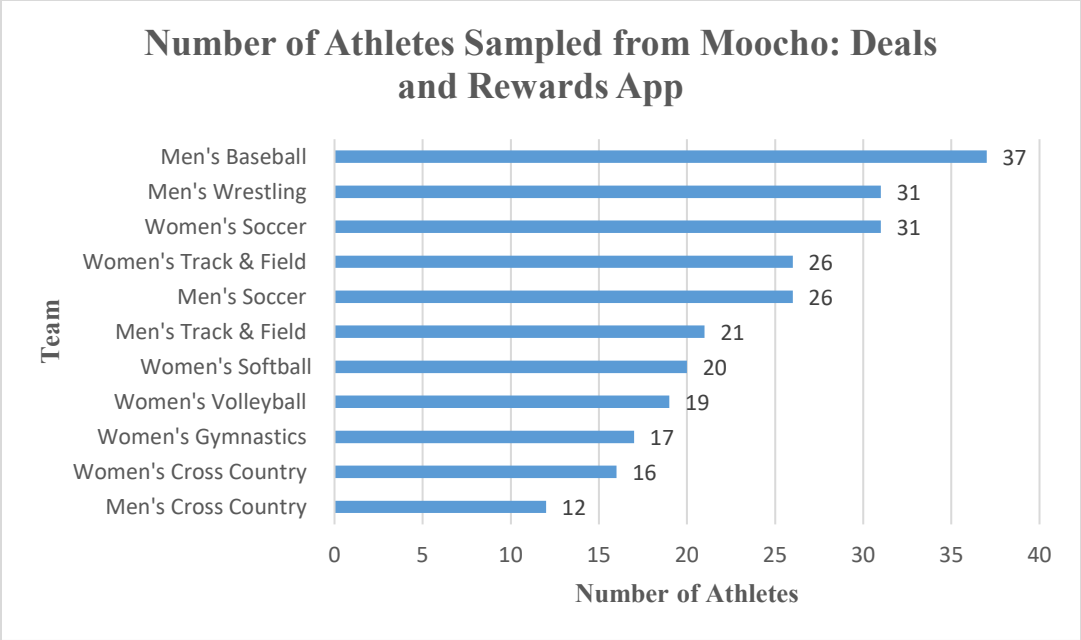

Figure 2 Number of Athletes Sampled from Moocho: Deals and Rewards App

On average, Baseball spent the highest amount of points spent per week followed by Women's Track & Field, and Men's Wrestling. The full data set can be found in Figure 3. Baseball spent 47.91% of their total points, Men's Wrestling spent 56.45%, Women's Soccer spent 52.58%, Women's Track & Field spent 59.81%, Men's Soccer spent 43.37%, Men's Track & Field spent 51.90%, Softball spent 50%, Women's Volleyball spent 49.61%, Women's Gymnastics spent 53.24%, Women's Cross Country spent 47.50%, and Men's Cross Country spent 27.71% of their total point for the week.

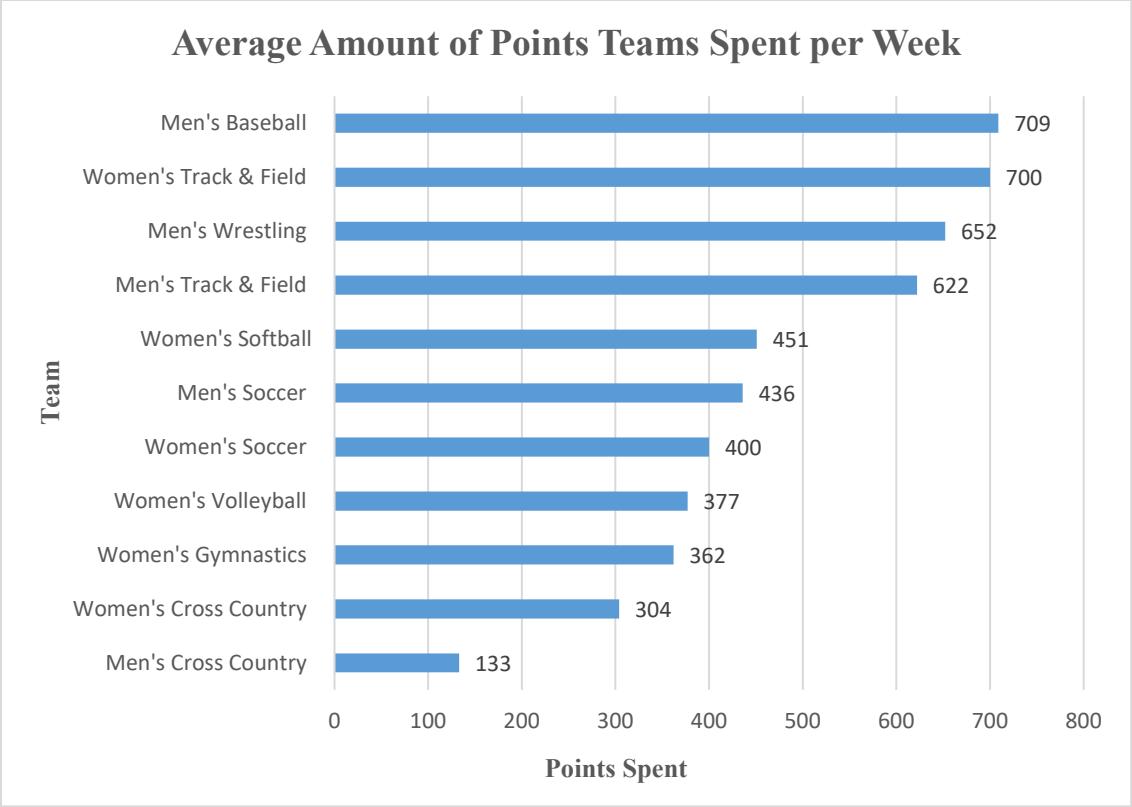

Figure 3 Average Amount of Points Teams Spent per Week

When looking at student-athletes across all teams, the student-athletes spent, on average, 20.10 points with a standard deviation of 8.52. The range was 37.29 and the minimum was .14 and the maximum was 37. 43

3.1.2 Survey Data

115 student-athletes from the University of Pittsburgh participated in the survey. 25 student-athletes reported being injured or redshirted and their data was excluded from the results. 64 (71%) were male and 26 (29%) were female. Participants team affiliation information is shown in Figure 4.

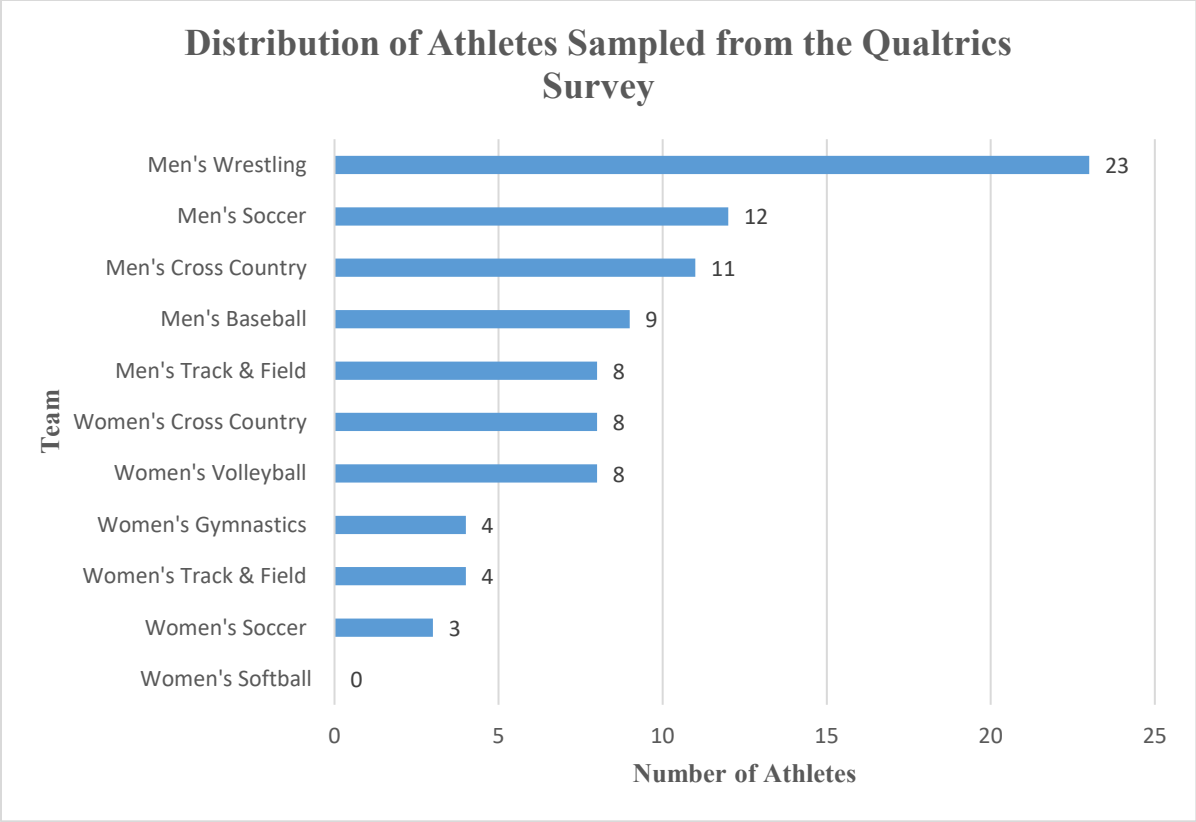

Figure 4 Distribution of Athletes Sampled from the Qualtrics Survey

The results for the amount of days the athletes purchase items from a fueling station per week and the number of times athletes purchase per day are listed in Figure 6and 7. The most popular response was 5 days per week with 43 responses (47.78%), followed by 4 day per week 33 (36.67%), 3 days per week with 10 responses (11.11%), 2 days per week with 2 responses (2.22%), and finally 1 day per week with 2 responses (2.22%). The most popular response for purchasing items in one day was 2 times a day, followed by 1 time a day, 4 times a day, 3 times a day, and 5 times a day.

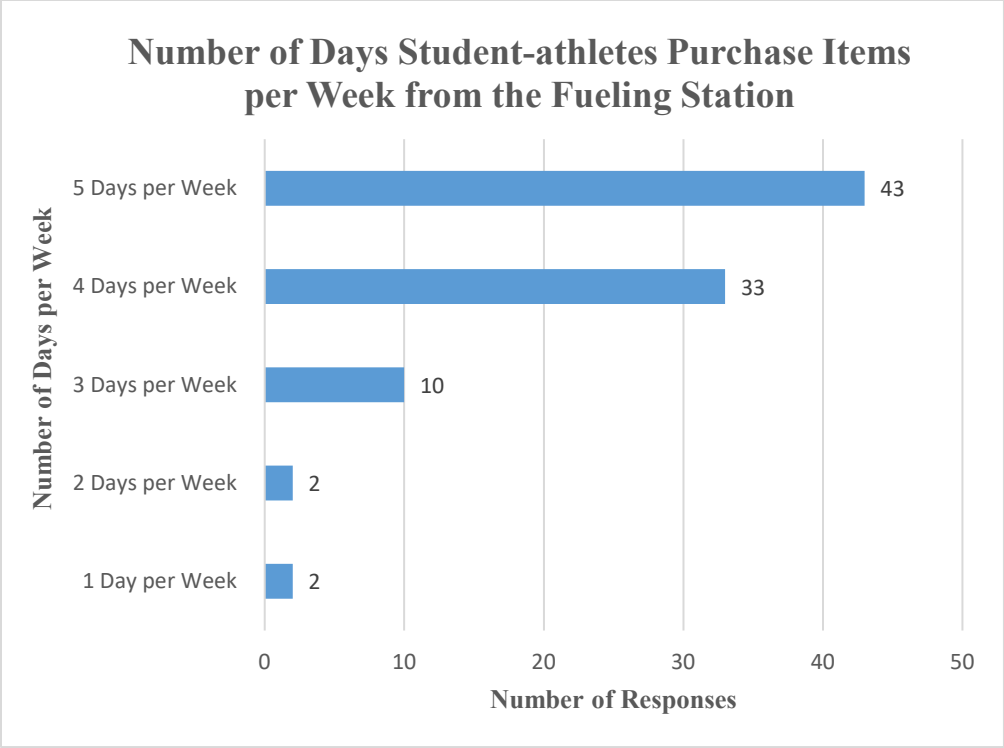

Figure 5 Number of days Student-athletes Purchase Items per Week from the Fueling Station

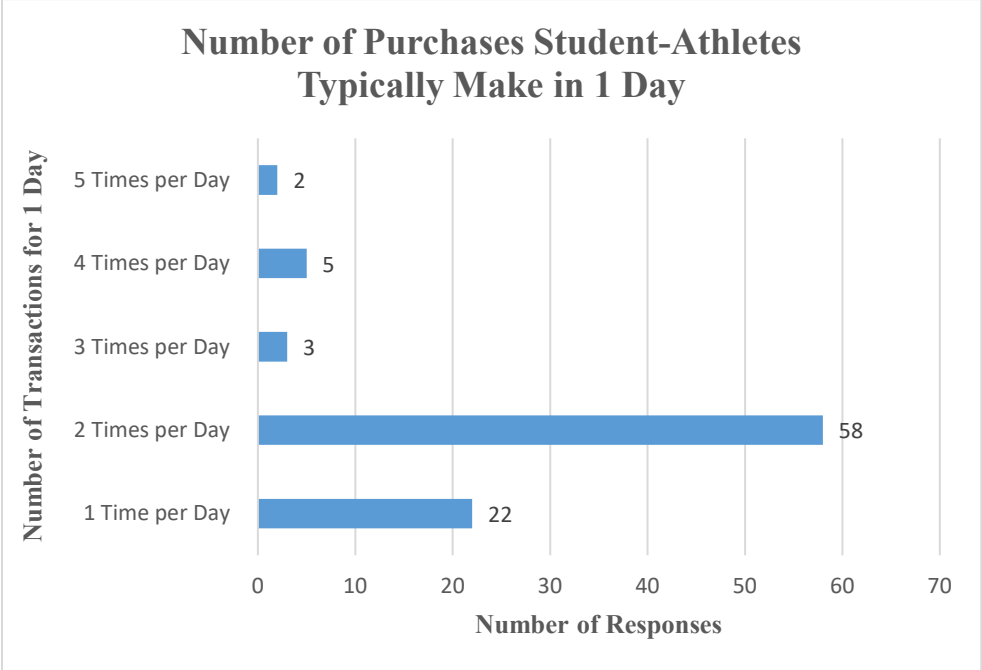

Figure 6 Number of Purchases Student-Athletes Typically Make in 1 Day

The most reported items purchased before practice were Uncrustables®, bananas, Chewy Bars, Breakfast Sandwiches and Greek Yogurt. The most reported items purchased after practice were Uncrustables®, Greek Yogurt, Chocolate Milk, and bananas. This data can be found in Figure 7 and Figure 8.

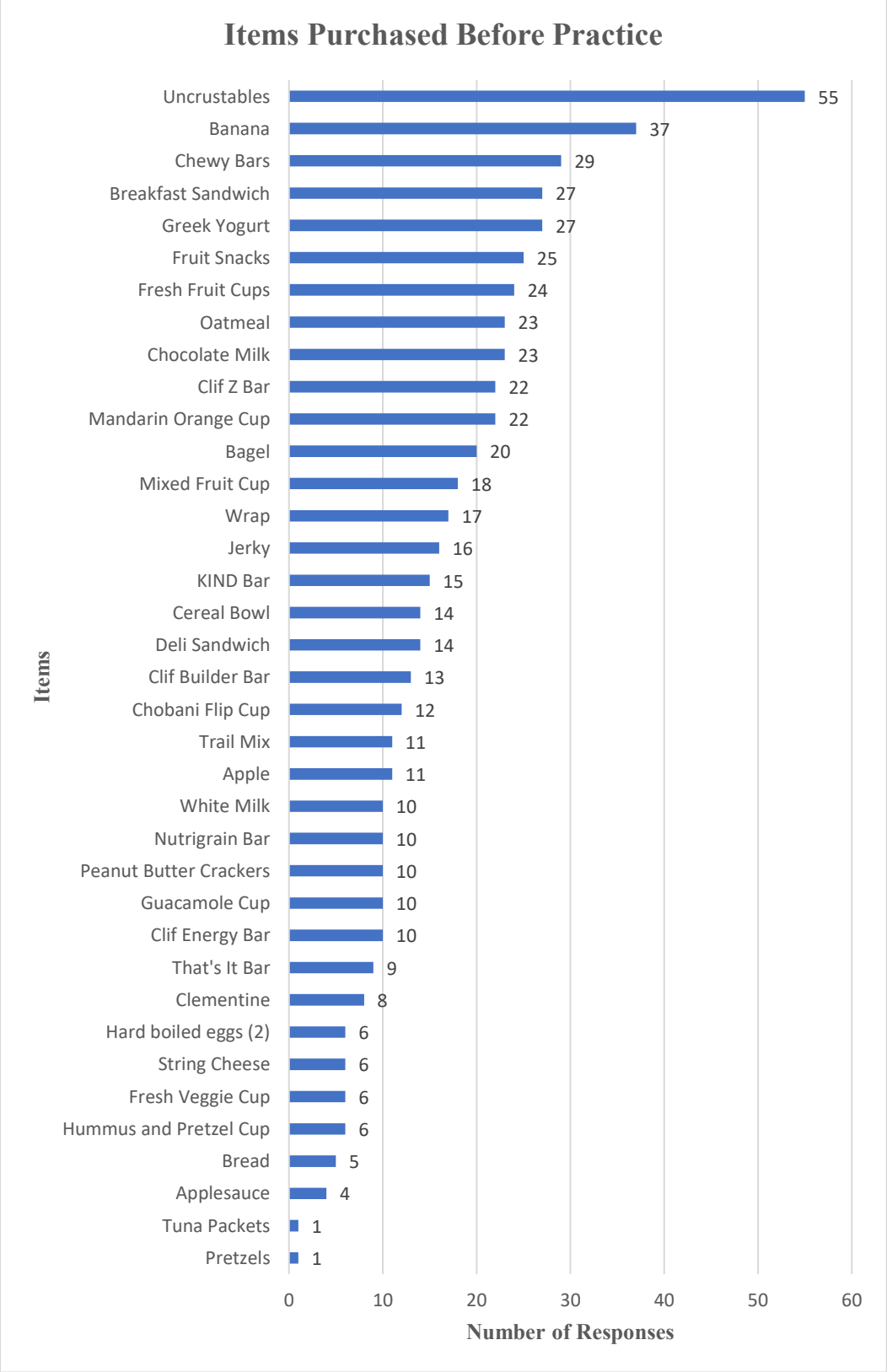

Figure 7 Items Purchased Before Practice

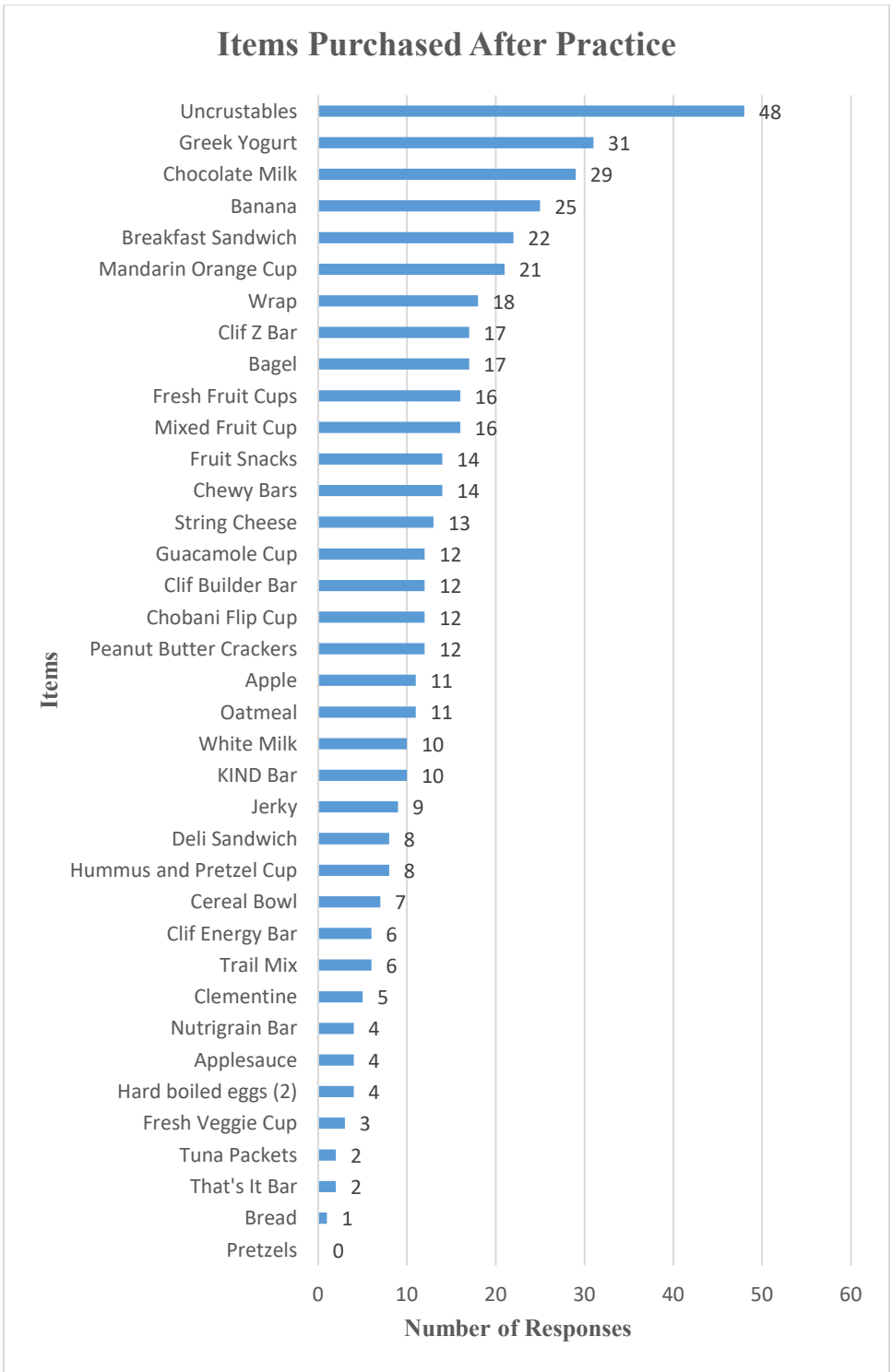

Figure 8 Items Purchased After Practice

Responses for when student-athletes typically purchase items can be found in Figure 9. The majority of student-athletes reported that they purchase items before and after practice, followed by before practice, and after practice

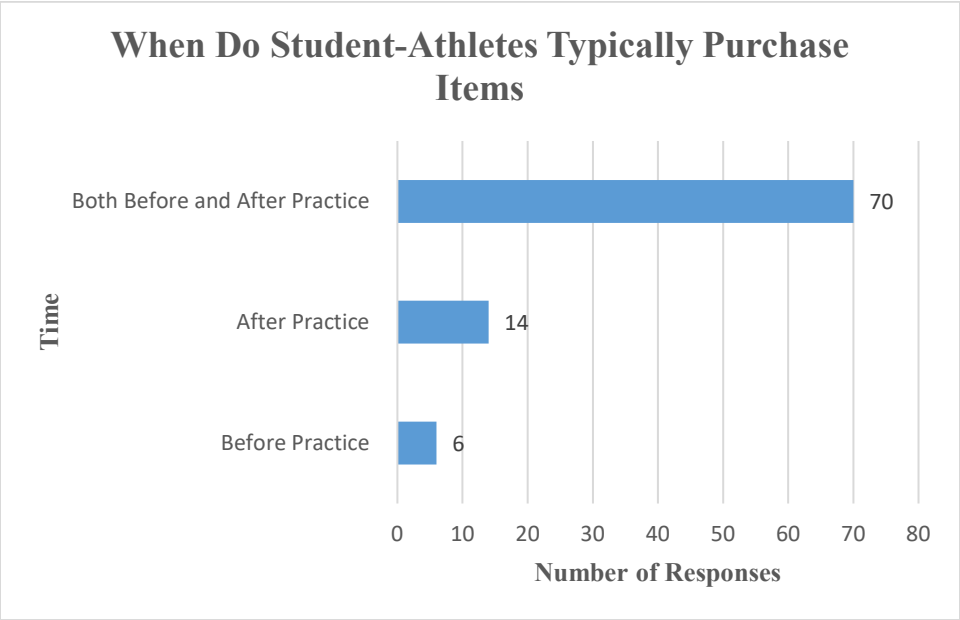

Figure 9 When Do Student-Athletes Typically Purchase Items

In response to the question about skipping traditional meals and using the Fueling Station instead, 41 (45.6%) of the participants stated they did and 49 (54.4%) stated the did not. The results for the reasons they skipped traditional meals are listed in Figure 10. Class was the most reported reason student-athletes were skipping meals, followed by living off campus, and convenience. The most reported traditional meal that were skipped was breakfast, followed by lunch, and dinner, see Figure 11.

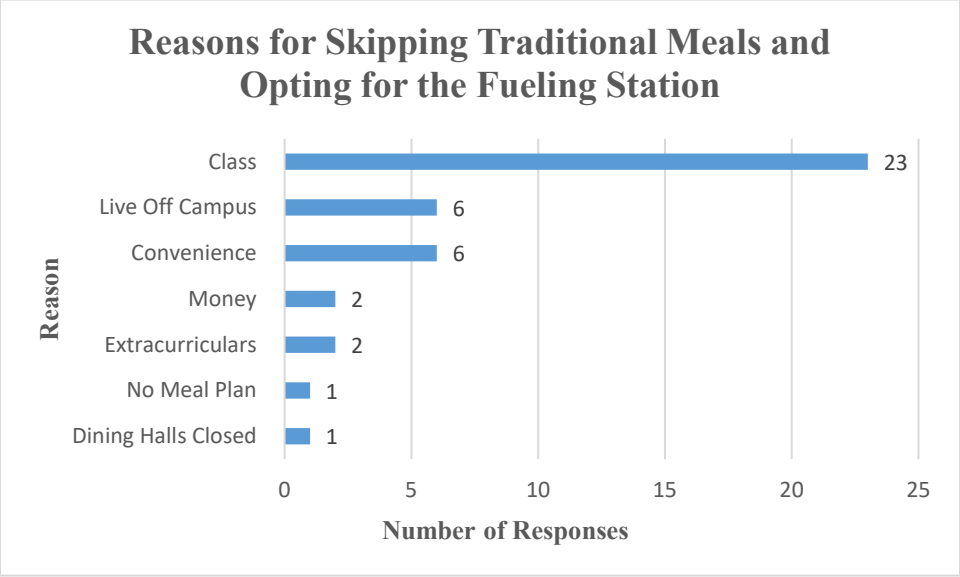

Figure 10 Reasons for Skipping Traditional Meals and Opting for the Fueling Station

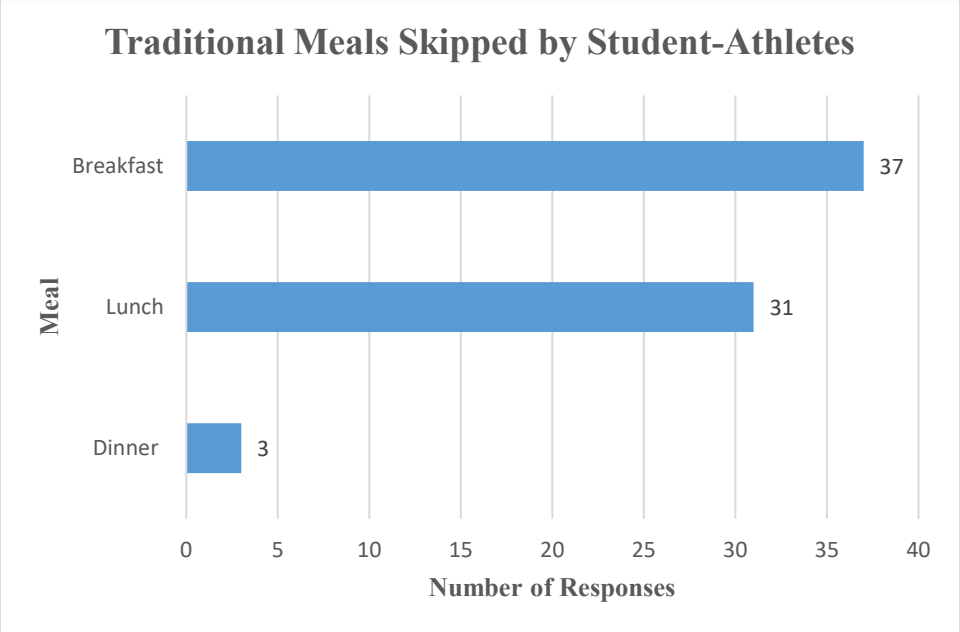

Figure 11 Traditional Meals Skipped by Student-Athletes

4.0 Discussion

Sports nutrition plays an integral role in the wellness and performance of an athlete. With the new NCAA food program student-athletes have more access to food and snacks than ever before and different organizations are addressing this rule change in different ways. The University of Pittsburgh implemented Fueling Stations across campus to provide healthy food items to their student athletes in various facilities. These stations aim to provide healthy and nutritious food items to student-athletes to help enhance their performance and fuel their recovery. The purpose of this study was to determine what foods were being purchased before and after practice, to determine the average amount of points being spent weekly by athletes, and to determine if student-athletes are using the Fueling Station to replace traditional meals. The results found that the student-athletes, on average, were not spending their allotted 40 points per week, that athletes were purchasing high carbohydrate options before practice and high protein and carbohydrate products after practice, and that student-athletes were indeed skipping traditional meals and opting to use the Fueling Station instead.

4.1.1 To Determine the Average Amount of Points a Student-athlete Spends per Week

The results from this study show that the average amount of points spent per week by student-athletes, do not reach the 40 points that are allotted each week. On average a student-athlete spent 20.10 points per week. This suggests that the student-athletes receive enough points each week to buy whatever they desire before and after activity. Even though the average amount of points spent is under 40, nearly a third of the sample does use all their points in one week. This

could indicate that some student-athletes need more points to help them fuel their performance. 34.83% of subjects stated they tend to spend all 40 points per week, while 65.17% stated they did not. The majority of these subjects, 87.10%, stated they spent all their points by Friday and 12.90% stated they used all their points by Thursday. This could be for a multitude of reasons, whether they are for travelling for sporting events or to take food home for the weekend. An argument could also be made to increase the number of points student-athletes receive if there were more products available or if the Fueling Stations catered full meals that would cost more. However, at this time, and with the current goals and operations of the Fueling Stations, the student-athletes are allotted an adequate amount of points to purchase whatever goods they want, whether to fuel their recovery and performance, for simply eating, or for taking back to their dorms or on the road. As far as we know this is the first study to evaluate the spending habits of student-athletes in a venue such as the Fueling Stations and on such a large scale. With further research and better recording technology, another study could be done to determine the exact number of items being purchased and when. This would help better evaluate the macronutrient break down the student-athletes are eating before and after practice. This information would be valuable, not just to athletics, but to other organizations and athletic facilities who want to supply their own student-athletes with nutritious food options.

However, these findings do not give enough insight on if the Fueling Stations and the data obtained from this study is limited in scope. To be fully utilized the student-athletes would be actively choosing to purchase items that fuel their performance and recovery and not just purchasing what they want to eat because they can. While the student-athletes have the ability to purchase any number of items it cannot be determined, without introducing new recording technology, if the student-athletes are using the items available to enhance their performance and

recovery or if the student-athletes are actually eating the items, stockpiling them, or giving them to someone else. Currently, the menu signs above the Fueling Stations list all the items that are available for purchase. Markers that inform the student-athletes on an item's carbohydrate, protein, and energy content are listed at all stations. If the student-athletes are unsure of what to purchase in order to meet ACSM guidelines[1,3,4] and to enhance their performance, an entire section could be added with items labelled in groups that will fulfil these requirements. For example, one food combination group could be one bagel and a small carton of white milk for a pre-exercise and 1 Greek yogurt and an apple for the post exercise snack. Of course, the possibilities for predetermined snack groups are numerous but providing some examples or predetermined groups could help the student-athlete better utilize the Fueling Stations and enhance their performance and fuel their recovery.

4.1.2 Food and Drink Items Division I Student-athletes Purchase Before and After Practice or Exercise

The most popular items being purchased before practice included Bananas, Chewy Bars, Chocolate Milk, Fruit Snacks Mandarin Orange Cups, Oatmeal, Bagels, Cereal Bowls, Greek Yogurt, Uncrustables®, Fresh Fruit Cups, and Breakfast sandwiches. The majority of these items, with the exception of the chocolate milk and Greek yogurt, are high in carbohydrates and have small amounts of protein and fat. With Uncrustables®, Bananas, and Chewy Bars being the highest reported items. The most popular items purchased after practice were the same as listed above but with the addition of Clif Z Bars and Deli Wraps. Uncrustables®, Greek Yogurt, Chocolate Milk were the highest reported items for after practice. Two of these items, the Greek yogurt and the chocolate milk, are high in protein and a good source of carbohydrates.

The majority of survey participants were male, and this would skew the findings of the current study towards the male demographic. This could help to explain the large percentage of respondents stating they use all 40 points each week, since men require more calories. It is known that there are gender differences in regards to the number of calories each sex needs. Women have a higher proportion of body fat compared to men, which means men burn more calories.[22] It has been speculated that the higher fat stores in women may allow them to use fat as an energy source during exercise.[22] Thus, women may require fewer calories to provide energy for their athletic performance.[22]

The conclusions drawn from these results suggest that the student-athletes are utilizing the Fueling Station to fuel their performance and enhance their recovery. The majority of student-athletes tend to purchase high carbohydrate items before practice, which assists in the maintaining of muscle glycogen stores. This, in turn, provides them with the fuel they need to have a productive a defective training session. Items purchased after practice were more protein heavy options, along with carbohydrate rich options, such as Greek yogurt and chocolate milk. The consumption of protein after activity helps promote muscle protein synthesis and the addition of carbohydrates replenishes muscle glycogen stores that were used up during exercise. These trend in purchases fall in line with the guidelines that the ACSM recommend for pre and post fueling. This pattern in item purchases suggests that the student-athletes have some basic understanding or education of sports nutrition and what their body needs to perform at the colligate level. However, it could be argued that student-athletes are purchasing these items because they have limited options available to them. More research is warranted to further investigate the items being purchased by student-athletes. A more accurate recording system would be needed to accurately track what student-athletes are purchasing and when. This would help narrow down the specific items that are the

most and least popular to help the Fueling Stations cater to the wants and needs of the student-athletes. Furthermore, while the University of Pittsburgh has a dedicated Sports Nutrition team, the knowledge student-athletes possess should be assessed. If the student-athletes do have low sports nutrition knowledge, they may will likely not utilize the Fueling Station to its fullest potential. This research could also provide clarity on areas where student-athletes lack knowledge, which could be improved, and the development of plans to educate them competently.

4.1.3 Student-athlete Use of the Fueling Station to Replace Traditional Meals

The results showed that there was less than a 10% difference (45.6% yes, 54.4% no) in regards to the survey question about using the Fueling Station to replace traditional meals. Of the 71 student-athletes who answered "yes" they stated they would replace breakfast (52.1%) and lunch (43.7%) with dinner being the least skipped meal (4.2%). Over one half of student-athletes cited class (56.10%) as the reason for replacing traditional meals with items from the fueling station. Living off campus and easy of convenience (14.3% for both) was also a popular reason among student-athletes. Multiple athletes stated that buying food from the Fueling Station was quick and convenient compared to going out and buying groceries. While others stated they had a lack of funds and purchasing items from the Fueling Station was a good option for them to get nutritional food items. This data suggests that the student-athletes have a tendency to use the fueling station regularly, on a weekly basis and in their day-to-day life. This implies that the frequency of student-athlete supports the idea that student-athletes are using the fueling stations to replace traditional meals.

Other variables may influence when a student-athletes purchases items such as, time, schedule, travel, or appetite. This may be due to the times that student-athletes train, which include

different activities such as weight lifting, receiving treatment, rehabilitation, or performance and technique work. This is a large amount of time student-athletes have to work into an already full class schedule. It is probable that many student-athletes see and use the fueling stations as a quick and healthy way to get food to replace meals with. This would eliminate the need for them to bring their own food items, which may otherwise be unhealthy, and remove the need for going elsewhere to get food. The majority of training for these student-athletes takes place in the early morning or afternoon, depending on each student-athlete's schedule. These training times would support the evidence that many student-athletes replace breakfast and lunch. Before or after training many student-athletes likely have class or other commitments and may not have the time or the resources to get food elsewhere. Dinner was the least popular traditional meals skipped and this may be due to the amount of time student-athletes have at the end of the day. It is more unlikely for student-athletes to have classes and they may have more time to go get food elsewhere or cook it themselves.

However, more student-athletes may replace traditional meals than was reported. This is due to no surveys were able to be administered to the Softball team because of their travel schedule and changes in practice times. Multiple attempts were made to meet with them but were unsuccessful because of their changes in practice times, venues, and lack of communication. This data also suggests that the student-athletes have a tendency to use the fueling station regularly, with the majority of student- athletes stating they use it every day multiple times a day. This implies that student-athletes actively choose to use the fueling stations procure food items instead of other sources. While many student-athletes state they purchase items typically twice a day, there were a number of student-athletes that reported they used the fueling station three to five times a day. This

would support the idea that student-athletes are using the fueling stations to replace traditional meals with items they purchase.

We can conclude from these results that the majority of student-athletes use the Fueling Station to replace breakfast or lunch for various reasons. This evidence supports the need for an increase in a variety of products so student-athletes can make a complete meal from several different products or a shift towards offering full meals at these locations. These changes could help student-athletes meet nutritional goals they may otherwise miss when they skip traditional meals. Having larger options or meals available would assist in the overall nutrition of the student-athletes but could also be tailored to ACSM guidelines and/or goals of the student-athletes. Meals or grouped items could be created to assist in the student-athletes body composition goals, whether to gain, maintain, or lose weight.

More research is needed to determine if a transition to full meals would be beneficial to student-athletes. Many student-athletes use the Fueling Stations because of class and how quickly they can purchase items. If full meals are provided, they would need to be prepared in the short window many student-athletes have between training and class. The effectiveness and plausibility of these meals would need to be pilot tested at one of the facilities. If this is not possible, research should be done to create grouping of items for student-athletes that could replace traditional meals. ACSM guidelines recommend fueling before and after activity and this could be a reflection of the student-athletes using the fueling station to their advantage. Current recommendations suggest a pre-exercise meal containing 200-300 grams of carbohydrates and some form of moderate protein. And a post-exercise meal should contain 1 -1.5 g/kg/BW/day and a large amount of protein, although the ACSM does not have a specific amount outlined at this time.

4.2 Limitations and Future Study Directions

One of the limitations of this study was that the data collection for the Qualtrics Survey data was done around the team practice times. We had to survey a large number of student-athletes at the same time, work around scheduling conflicts, practice changes, and teams travelling for events which meant some student-athletes did not have the time to complete the survey. This is clearly demonstrated in our inability to collect any surveys from the Women's Softball team due to their ever-changing schedule and their availability with travelling during the season. Another limitation was that the Moocho app does not record what the athletes purchase during a transaction and only records the amount of points spent. This could have been an accurate source for what the athletes were purchasing instead of relying on a survey. Therefore, the survey data, in relation to food items purchased before and after practice, may be grossly inaccurate due to under or over reporting. Third, the Fueling Station data was only collected during the 2019 - 2020 academic year, therefore it may not be representative of utilization during other times of the year. Another issue was the number of male respondents that participated in the Qualtrics survey. This is not representative of the student-athlete population, which is closer to a 50/50 split. This is due to the large number of respondents from the Men's Wrestling team and lack participation from other teams such as Women's Soccer and Women's Softball.

This study is a first step in evaluating the effect of the NCAA's new food program in Division I organizations and on their student-athletes. More research needs to be done on the food items student-athletes are purchasing and when to see if they meet their needs and ACSM guidelines. This includes introducing new technology that could track the food items for a more accurate representation of purchases. Furthermore, the amount of sport nutrition student-athletes has in regards to making informed decisions on what they are purchasing should be investigated.

This would assist in the education of student-athletes and help improve their decision making when it comes to their purchases. Finally, further research into these types of programs could lead the way for other organizations and the expansion of the program into Division II and III schools.

4.3 Conclusion

This study is first step in assessing the effectiveness of changes Division I organizations are implementing in response to the 2014 NCAA policy change on fueling of student-athletes. This study opens up the possibility to more research to be conducted involving the changes to NCAA policy and its effect on student-athletes as well has the methods from different organizations to meet this need. With sport nutrition playing a crucial role in an athlete's performance and recovery these new policies could impact student-athletes in unexpected ways. The ACSM has stated clear recommendations for athlete nutrition that should be considered when facilities are providing food options for their student-athletes. Guidelines for macronutrient intake and quality as well as nutrient timing are important for these facilities to inform their student-athletes of and actively promote. These facilities can give a distinct advantage to student-athletes, and their performance and training, if they are being utilized to their fullest potential. This study has found evidence that the Fueling Stations at the University of Pittsburgh student-athletes currently have an adequate amount of points per week for nutrition to enhance their performance and fuel their recovery. It must be noted that approximately a third of participants did use all 40 points a week and supplementing these student-athletes with additional points should be considered. This study provides evidence that suggest some student-athletes are using the Fueling Station to replace

traditional meals and that student-athletes tend to purchase items that assist in fueling their performance and recovery.

Appendix A Qualtrics Survey Document

NAME **TEAM**

AGE **GENDER** F M Other

Are you currently injured or hold red shirt status? YES NO

1. **How often do you sign out (use points)/purchase from the fueling stations per week? Please circle the one best answer.**

   1 day/week 2 days/ week 3 days/week 4 days/week 5 days/week

2. **How often do you sign out/purchase items from the Fueling Stations per day on average? Please circle the best one answer.**

   1 time/day 2 times/day 3 times/day 4 times/day 5 times/day 6 times/day

3. **When do you sign out/purchase items from the Fueling Stations? Please circle the best one answer.**

   Before practice After practice Outside of practice times Both before and after

4. **What do you typically sign out/purchase before practice or activity? Please circle all that apply.**

Apple	Hard Boiled Eggs (2)	Cereal Bowl	Uncrustables	Dele Sandwich
Banana	Mandarin Orange Cup	Greek Yogurt	Chobani Flip Cup	Wrap
Clementine	Mixed Fruit Cup	Clif Z Bar	Clif Builder Bar	Breakfast Sandwich
Bread	Nutrigrain Bar	Fresh Veggie Cup	Clif Energy Bar	
Chewy Bars	Oatmeal	Jerky	Fresh Fruit cup	
Chocolate Milk	Peanut Butter Crackers	KIND Bar	Guacamole Cup	
White Milk	String Cheese	That's It Bar	Pretzel and Hummus Cup	
Fruit Snacks	Bagel	Trail Mix	Tuna Packet	

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