Sports Nutrition for the Adolescent Athlete: The WAVE Pilot Study

by
Alissa Kummer

A THESIS

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Oregon State University

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the requirements for the
degree of

Honors Baccalaureate of Science in Nutrition and Health Sciences
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Melinda M. Manore

Purpose: This study examines the nutrition knowledge/behaviors of adolescent athletes before/after a sport nutrition intervention.

Methods: The WAVE pilot study intervention provided sport nutrition education to soccer players (n=26; 14-19y) through face-to-face lessons (Intervention group [IG]). Anthropometrics and the Sport Nutrition Questionnaire were done pre/post intervention, while the comparison group (CG; n=23) completed baseline data and received no lessons.

Results: Anthropometric data were similar between groups except for the CG females weighing more than IG (p=0.04). Athletes had high knowledge scores for hydration (IG=pre(87%)/post(97%); CG=79%), and selected appropriate pre- (high-carbohydrate: IG=>66%; CG=79%) and post-exercise foods (High-carbohydrate: IG=pre(56%)/post(64%); CG=69%; high-protein: IG=pre(58%)/post(48%); CG=62%). The lessons did not change nutrition behaviors. Water was selected as the primary fluid (IG=>96%; CG= 95%), and sports drink less often (IG=42-43%; CG=18%). Timing of pre-exercise meals did not change for the IG, with >87% eating >1-h before exercise and consumed high-carbohydrate foods (>69%) vs. CG (31% and 43%, respectively). Most

ate (IG~60%; CG-54%) 1-2h after exercise and selected similar protein (IG=pre(33%)/post(41%); CG=36%) and carbohydrate (IG=(63-64%); CG=64%) foods. **Conclusion**: The WAVE sport nutrition lessons did not change nutrition knowledge/behaviors in soccer players, but sample size was small and attendance variable. Athletes should improve timing/planning of meals/snacks around sport.

Key Words: athlete, adolescent, sport nutrition, knowledge, behavior

Corresponding e-mail address: kummera@onid.oregonstate.edu

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APPROVED:

Melinda M. Manore, Mentor, representing Nutrition

Siew-Sun Wong, Committee Member, representing Extension Family and Community Health Program

Megan Patton-Lopez, Committee Member, representing Extension Family and Community Health Program

Toni Doolen, Dean, University Honors College

I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

Alissa Kummer, Author

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INTRODUCTION

The energy and nutrient needs of physically active individuals are different from those of their sedentary counterparts. Athletes and highly active individuals need to make sure their diets are adequate in energy and nutrients to assure peak athletic performance while also supporting activities of daily living, maintenance of health, recovery from exercise, and the nutrient needs for growth. In adults, these nutritional needs are focused on replenishing glycogen, maintaining and building lean mass, and supporting performance demands. Total energy and nutrient intake must be great enough to support an anabolic state to avoid muscle mass degradation. The distribution of macronutrients will depend on the sport, training regimen, and intensity in which the individual is participating. Demand for some micronutrients may also increase. The athlete must be aware of these nutritional needs in order to support overall health and performance demands.

Young athletes have increased energy and nutrient needs, both to support their active lifestyle and for their physical and mental growth (Cotugna et al., 2005). These athletes also experience increasing levels of peer pressure and a desire for independence in making food choices (Cotugna et al., 2005). However, if proper nutritional habits are not followed, they may suffer the consequences of poor nutrition during these developmental years. Research shows that stunted growth, loss of lean body mass, and developmental delays can all occur due to poor nutrition in adolescent years (Purcell, 2013). Research also shows that delayed puberty, menstrual dysfunction, injury, illness, and obesity are effects of poor nutrition status in this population (Purcell, 2013). These negative health outcomes emphasize the importance of developing and maintaining food and nutrition knowledge and skills that can support adequate food choices and nutrition habits in the adolescent athlete.

Developing good dietary behaviors and habits requires knowledge of energy and nutrient needs and food selection and preparation. For the active adolescent, energy needs are largely determined from the demands of growth and athletic competition (Desbrow et al., 2014). Elite teen athletes who are international competitors will have different energy needs than recreational or moderately competitive athletes. Adolescents going through a high level of growth and physical maturity will also require different energy and nutrient needs than those who are not growing as rapidly or who have completed their growth (Desbrow et al., 2014). These individual differences and demands for energy make it difficult to develop predictive equations to estimate total energy requirements for active youth. The Sports Dietitians of Australia have concluded that the most effective way to monitor and determine energy needs for individual athletes is to assess energy intake and expenditure with height and weight relative to reference standards (Desbrow et al., 2014). If a young athlete has normal growth and weight, as determined by the United States Center for Disease Control (CDC) Growth Charts, then the adolescent is determined to have adequate energy and nutrient intake. Excess weight gain or the inability to meet growth standards for active adolescents will indicate energy and nutrient imbalances, and the need for nutrition intervention. Thus, individual assessment is essential for forming appropriate nutrition strategies for the individual youth athlete. Specific nutrition plans take into account the unique energy and nutrient needs of each athlete.

To date there are three nutrition education programs that integrate sports nutrition concepts into their educational framework. These programs reflect the current research for specific nutrition interventions for active adolescents. Bulleted below are descriptions of these programs, audiences they target, and outcomes if available (Table 1).

- Oregon Health and Science University (Portland, OR) developed the Athletes Targeting Healthy Exercise and Nutrition Alternatives (ATHENA) program for young female high school athletes (Elliot et al., 2004). This program used a peer-led, team based intervention covering the topics of disordered eating, body-shaping drugs such as anabolic steroids, amphetamines, and muscle building supplements, and diet pills. The program also addressed healthy sport nutrition, effective exercise training, the effect of drugs and other unhealthy behaviors on sport performance, the media's use of female body image, and depression prevention. Results of the ATHENA program showed that the intervention group had lower use of diet pills ($p<0.5$), a trend towards stopping diet pills ($p=0.7$), increased awareness of protein intake ($p<0.005$) and greater confidence in strength-training skills ($p<0.005$). Overall, the ATHENA intervention showed that peer-led lessons involving sports teams are an effective method for promoting healthy behaviors.
- The Patient-centered Assessment and Counseling for Exercise plus Nutrition (PACE+) program was developed at the University of California at San Diego (Prochaska et al., 2000; Patrick et al., 2001). PACE+ has a subsection called PACE+: Counseling Adolescents for Exercise and Nutrition that focuses on promotion and maintenance of physical activity and healthy nutrition for child or adolescent (non-athlete) patients in the outpatient clinics from which the study recruited. These participants were patients of their primary care physicians in these clinics, but did not exclusively have any medical problems. The four main goals of PACE+ for adolescents program

are to increase moderate and vigorous physical activity in minutes per week, decrease servings of high-fat foods per day, and servings of fruit and vegetables per day. PACE+ uses three components to the intervention: interactive computer programs, health provider counseling, and extended follow-up by either phone or mail. Data were collected pre- and post-intervention. Assessed at four months, the results of the PACE+ study showed moderate improvements in physical activity and dietary habits compared to baseline measurements. Overall, fat intake decreased by 12%, fruit and vegetable intake increased by 18%, and vigorous and moderate physical activity increased by 10% and 17%, respectively.

- Drexel University has also developed a general nutrition education program for children from kindergarten through high school. This program, which was developed with the United States Department of Agriculture Supplemental Nutrition Assistance Program (USDA SNAP), offers nutrition lessons for educators and resources for parents and students to learn about health lifestyles (Drexel University, 2015). The high school-level nutrition lessons cover many important aspects of nutrition education, including lessons about fast food, drinks, breakfast, snacks, and sport nutrition. The lesson plan and corresponding Microsoft Power Point file are available on the website for public use (Drexel University, 2015; see Table 1). The sport nutrition lesson focuses on teaching the importance of the MyPlate system implemented by the USDA, physical activity requirements for adolescents, the importance of carbohydrate and protein for athletic success, meal timing and choices before

and after athletic events, healthful snack choices, the importance of breakfast, vitamin and mineral importance, and hydration requirements for water and sports drinks. Overall, this program provides high school students a snapshot of the key factors of sport nutrition. Program evaluation data are not available.

The above three programs incorporate aspects of sports nutrition lessons for adolescents (mean age: 14-15y). Only the ATHENA and PACE+ programs also incorporate physical activity education in their lessons. The ATHENA program also teaches young athletes about general nutrition and other health behaviors, such as drug use and body image. Neither the PACE+ nor the Eat Right Now programs incorporate these types of material in their lessons. The emphasis on physical activity and healthful nutrition behaviors in the programs has the potential to make significant positive impacts of the lives of study participants.

Table 1: Summary of the current sport nutrition educational programs that target active adolescent populations.

Author, Year	**Program**	**Subjects**	**Intervention**	**Results**
Elliot et al., 2004	ATHENA: Athletes Targeting Healthy Exercise and Nutrition Alternatives	High school students (n=928); 40 sports teams Mean age: 15y	8 weekly 45-min. sessions, with team practice activities. Gender-specific, peer-lead, scripted lessons covering sports nutrition, exercise training, drug use, body image and the media, and depression prevention.	Stopped current diet pill use and new use of diet pills decreased; reduced health-harming behaviors; increase in strength-training, self-efficacy, and healthy eating behaviors.
Patrick et al., 2001	PACE+: Counseling Adolescents for Exercise and Nutrition	Pediatric patients (n=117; aged 11-18y; mean age=14y). Recruited from 4 outpatient clinics; no noted medical issues in these patients.	Baseline computer-based diet and PA assessments collected, goal setting done, and 12-months of mail and telephone counseling.	Moderate PA and fruit and vegetable intake increased; fat intake decreased over time; Vigorous PA did not improve.
-Drexel University, 2015 http://deptapp08.drexel.edu/nutritioneducation/p-students.html.	Eat Right Now: Nutrition Education for a Healthier Future	No data available	No data available	No data available

PA = physical activity

Active youth present additional factors that must be considered when providing sport nutrition education. First, the rate of growth is an important consideration, especially when working with highly active adolescents. Fluid needs must also account for the lower sweat rate of youth (Gisolfi and Lamb, 1989) and increased core body temperature that can occur with dehydration (Bar-Or, 2000). Limited research has focused on the energy and nutrient needs of adolescent athletes 15-18 years of age. Thus, research that investigates the specific needs of adolescent athletes is necessary to provide evidence-based nutrition recommendations for this group.

Limited research has focused solely on sport nutrition education for adolescent athletes. Previous nutrition education programs (Table 1) incorporate a wide range of nutrition and healthy lifestyle behaviors in their programs, including some sport nutrition. The WAVE- Ripples for Change: Obesity Prevention in Active Youth (WAVE) research project is an obesity prevention study for active youth using real and virtual world experiential learning (The Wave~Ripples for Change). This classroom and virtual world-based approach to teaching specific sport nutrition concepts to adolescent athletes is unique. The target population for this pilot study was male and female high school soccer players. One specific aspect of the pilot study was to develop a youth sport nutrition curriculum that was delivered using four face-to-face sessions with the athletes and their coaches. The lessons for year one of the pilot program include hydration, pre-, during-, and post-exercise nutrition. These lessons are the focus of this thesis.

This thesis compares changes in sport nutrition knowledge and behaviors before and after an intervention that included four face-to-face lessons in high school soccer players. The Sport Nutrition Questionnaire (see appendix A) was used to measure these

changes. Demographic data were also collected pre/post-intervention. The same baseline data were collected from a comparison group at baseline. The specific research questions addressed by this thesis are given in Table 2. Selected questions from the Sport Nutrition Questionnaire were used to answer the following research questions (see Table 3).

Table 2: Research Questions

Q #	**Research Questions**
1	What are the most common fluids that adolescent athletes consume before, during, and after exercise? [all participants] Do choices change pre- and post-intervention?
2	What are the most common pre-exercise meal/food habits of adolescent athletes (e.g. meal timing and food choices)? [all participants] Do choices change pre- and post-intervention?
3	What are the most common post-exercise meal/food habits of adolescent athletes (e.g. meal timing and food choices)? [all participants] Do choices change pre- and post-intervention?
4	What factors (e.g. knowledge, motivation) limit adolescent athletes in making healthful food choices? [all participants] Do outcomes change pre- and post-intervention?

Table 3: Sport Nutrition Questionnaire (SNQ) questions and related research questions they address

Question from the Sport Nutrition Questionnaire (SNQ #)	**Research question Addressed (#):**
Mark any of the following fluids that you usually drink just before, during, or after exercise. (SNQ # 8,9,10)	1, 4
How soon before a match or a practice do you last eat? (SNQ #12)	2, 4
How soon after a match or a practice do you first eat? (SNQ #13)	3, 4
If you do not eat soon after exercise, what factors prevent you from doing so? (SNQ #14)	3, 4
Please mark any of the following foods that are typical of the last food you ate before you exercise. (SNQ #15)	2, 4
Please mark any of the following foods that are typical of the first food that you eat after you exercise. (SNQ #16)	3, 4
Which of the following food choices would be best 3-4 hours before a game? (SNQ #23)	4
Which of the following food choices would be best 1-2 hours after a game? (SNQ #24)	4
During exercise longer than 1 hour, consuming sports drinks (e.g., / Powerade, Gatorade) offer benefits (SNQ #27)	4
You only need to drink when you are thirsty. (SNQ #28)	4
Dehydration can reduce performance. (SNQ #29)	4

LITERATURE REVIEW

The timing and composition of fluid and fuel consumption surrounding exercise is critical for optimal athletic performance. Pre-, during, and post-exercise fuel and fluids play an influential role in an athlete's day-to-day training and performance when competing. For adolescent athletes, particularly those in high-intensity intermittent type sports, meeting macronutrient needs is important. High intensity exercise increases the use of endogenous carbohydrate as a fuel source and requires protein to build and repair muscle tissue. Adolescent athletes in various stages of growth will have different macronutrient profiles and different total energy needs. This literature review will include only research addressing endurance and high-intensity intermittent type exercise. These types of exercise correlate best with the training that adolescent soccer players participate in, and serve as the best basis for making recommendations.

PRE-EXERCISE AND DURING EXERCISE NUTRITION

Entering into an exercise session or sport performance well hydrated and fueled is essential for maximal athletic performance. In this section, the optimal volume and timing of fluid and carbohydrate before and during exercise are reviewed. Hydration topics will cover the goals and recommendations of pre- and during exercise hydration. Carbohydrate topics include the timing, volume, and composition of pre-exercise carbohydrate meals. These recommendations are outlined in Table 4.

Hydration

Maintaining adequate hydration status is important for health and exercise performance in adolescent athletes. The goal of pre-exercise hydration is to assure that the athlete begins the exercise session euhydrated (Sawka et al., 2007). This process

should begin at least four hours before activity begins, with close monitoring of urine output during practice sessions to establish hydration goals (Sawka et al., 2007). Hyperhydration is not encouraged, as it will increase the likelihood of having to void during the exercise session, and offers no physiologic or performance advantage (Sawka et al., 2007).

The main goal of during exercise fluid intake is to avoid dehydration greater than a 2% loss in body weight (Sawka et al., 2007). Fluid losses, represented as ≥4% decrease in body weight, have the potential to detrimentally effect performance and lead to heat exhaustion or stroke (Desbrow et al., 2014). It is difficult to create general hydration plans for active youth due to the amount of individual variation in sweat rate, heat acclimatization, among other factors (Sawka et al., 2007). In general, ad libitum fluid intake is encouraged, with personal monitoring of body weight changes during exercise (Sawka et al., 2007).

Typically, consumption of sports drinks as a replacement for water are unnecessary due to lower sweat sodium losses in adolescents, and the potential for excessive energy consumption (Desbrow et al., 2014). However, carbohydrate and electrolyte-based sports drinks may offer benefits to athletes involved in prolonged, vigorous exercise or events where recovery time is short (Desbrow et al., 2014). This is especially true if athletes are exercising in the heat. Sports drinks can also offer benefits in enhancing drinking in young athletes. In a review by Bar-Or (2000), young, untrained boys (9-12y) showed that adding grape flavoring to water enhanced drinking by 45%. When subjects consumed a grape-flavored sports drink with carbohydrate and NaCl, drinking increased another 46% (Bar-Or, 2000). The increased drinking that sports drinks

can trigger in young athletes can help delay or prevent dehydration and offer performance and health benefits.

Carbohydrate

Carbohydrate is a key nutrient in the pre-exercise meal since it is an important energy substrate during exercise. Thus, carbohydrate intake must be adequate to assure glycogen replacement and maintenance of blood glucose to maximize exercise performance. The timing and volume of carbohydrate ingestion, the type of carbohydrate, and the glycemic index of pre-exercise meals are discussed below. This section includes carbohydrate ingested as meals and fluid both before and during exercise.

Research has shown that carbohydrate consumption in the 1-4 hours prior to exercise can have a beneficial effect on athletic performance (Jeukendrup, 2011). For example, Nicholas et al. (1995) found a 33% improvement in intermittent exercise capacity when a 6.9% carbohydrate solution was consumed immediately prior to (5 mL/kg) and during (2 mL/kg every 15 min) a shuttle running test. Phillips (2012) also showed a 24% mean improvement in Intermittent Shuttle Test times when ingesting a 6% maltodextrin solution (2 mL/kg body mass after each 15-minute block). Shuttle running is a similar type of physical work to playing soccer.

Timing and volume of carbohydrate intake: The timing and volume of carbohydrate ingestion prior to exercise is important for both maximizing exercise performance and minimizing gastrointestinal discomfort (Rodriguez et al., 2009; Burke et al., 2011). Galloway et al. (2014) examined the effects of both timing and carbohydrate concentration on high-intensity exercise capacity. They found that a carbohydrate drink containing 32 g of carbohydrate (6.4% carbohydrate) ingested 30 minutes before exercise decreased time to exhaustion by 14-17%. These results are similar to the carbohydrate

feeding recommendation made by Burke et al. (2011) of 1-4 grams of carbohydrate per kilogram body weight consumed 1-4 hours prior to exercise. General recommendations given in the Position Stand on Nutrition and Athletic Performance from the American College of Sports Medicine, Academy of Nutrition and Dietetics, and the Dietitians of Canada are that the consumption of larger meals further from exercise and smaller, carbohydrate rich meals closer to exercise (Rodriguez et al., 2009).

Concentration of carbohydrate: The carbohydrate concentration of a sport drink affects absorption and, thus, how quickly the carbohydrate is available for energy. Phillips (2012) examined the effect of sport drinks varying in carbohydrate content on time to exhaustion. Results showed that a 6% carbohydrate drink increased time to exhaustion by 34% compared to a 10% carbohydrate solution, and by 15% when compared to a 2% carbohydrate solution. Their results suggest that there is a non-linear relationship between concentration of carbohydrate and performance, with a moderate concentration (6% carbohydrate solution) of carbohydrate resulting in higher endurance capacity.

The percentage of energy from carbohydrate and the total grams of carbohydrate (g/kg) in the diet can also influence endurance performance. Williams and Rollo (2015) reported that a diet containing 65% of energy from carbohydrate per day increased high-intensity running by 30% during a soccer match compared to a diet containing only 30%. Research over the last two decades clearly indicates that athletes need carbohydrate for top performance (Rodrigues et al, 2009; Thomas et al 2016), but the exact amount needed will depend on the sport, training and competition routines and time of recovery.

POST-EXERCISE NUTRITION

Post-exercise nutrition, or recovery nutrition, plays a key role in replenishing glycogen stores and providing the energy and nutrients needed for building and repair of tissues. Protein, carbohydrate, and fat all need to be part of the post-exercise meal, with carbohydrate and protein playing important physiological roles in recovery from exercise. Carbohydrate helps to replenish the body's stores of glycogen, thus, preparing the athlete for the next exercise session, while protein is necessary for tissue building and repair during the recovery process (Desbrow et al., 2014). Thus, the post-exercise meal should contain appropriate amount of carbohydrate and protein and be consumed as soon as convenient after an exercise session to obtain the greatest recovery benefits (Desbrow et al., 2014). In this section the roles and recommendations for carbohydrate and protein in the post-exercise refueling period are given.

Carbohydrate

Dietary carbohydrate is essential for glycogen replacement. If the recovery time from the end of one exercise bout to the start of the next is greater than 24 hours, then dietary carbohydrate intake from an energy adequate diet is sufficient to replace glycogen losses (Betts et al., 2010). If glycogen stores need to be replaced quickly, then ingesting carbohydrate at 0.25-1.0 g/kg body weight/hour immediately after exercise will restore muscle glycogen levels faster, and therefore exercise capacity (Betts et al., 2010). The type of monosaccharide consumed affects absorption, metabolism, and storage of carbohydrate as glycogen. In general, high glycemic index carbohydrate-containing foods (e.g. white bread and sports drinks) speeds glycogen storage in muscle and liver tissue. General carbohydrate recommendations post-exercise, type of carbohydrate, and glycemic index of post-exercise meals are discussed below.

Carbohydrate recommendations: There are two position statements providing carbohydrate recommendations post-exercise (Table 4). The joint position statement of the Academy of Nutrition and Dietetics, American College of Sports Medicine and the Dietitians of Canada states that carbohydrate (1.0-1.5 g/carbohydrate/kg body weight) should be consumed within 30 minutes after completing exercise at 2 hour intervals for six hours (Rodriguez et al., 2009). The recent Sports Dieticians of Australia position statement gives a similar carbohydrate recommendation for immediate recovery at 1.0-1.2 g carbohydrate/kg body weight/hour (Desbrow et al., 2014). However, the exact amount of carbohydrate an athlete consumes will depend on body size, when the next bout of exercise will occur, personal preference, food selection, and gastrointestinal comfort.

Type of carbohydrate: The type of carbohydrate consumed determines the ability of the body to digest, absorb and convert this carbohydrate into glycogen after exercise. Post-exercise diets high in monosaccharides are easy to digest, are absorbed quickly decrease recovery time, since they are easily converted to glycogen. A combination of glucose and fructose has also been found to result in high rates of glycogen synthesis (Betts et al., 2010). The use of multiple carbohydrate forms takes advantage of multiple transporters for absorption, increasing the potential for carbohydrate uptake, formation of glycogen and promoting recovery.

Glycemic index of carbohydrate foods: The glycemic index of the foods ingested after exercise can also impact carbohydrate availability for glycogen. High glycemic index foods increase glycogen synthesis in the first six hours after exercise compared with low glycemic index foods (O'Reilly et al., 2010). This is potentially due to the

elevated insulin response that occurs with the ingestion of high glycemic index foods (Betts et al., 2010). Insulin increases glucose uptake after exercise and facilitates endogenous carbohydrate storage (Betts et al., 2010). However, not all research is supportive of the necessity of consuming high glycemic index foods post-exercise. Others report that ingesting low glycemic index foods after exercise can improve an individual's capacity for continuous exercise later that day (Wu and Williams, 2006). O'Reilly et al. (2010) showed that when the recovery time is 20 hours or greater, low and high glycemic index foods show similar promotion of levels of glycogen synthesis. Further research is need before specific recommendations can be made regarding the optimal glycemic index of the post-exercise meal and glycogen repletion rates.

Protein

Protein is an essential component of body tissue. The protein consumed post-exercise is used to rebuild muscle tissue and restore nitrogen balance (Rodriguez et al., 2009). Active adolescents need higher protein intakes (g/kg) compared to active adults due to their overall demands for growth and development (Desbrow et al., 2014). This section will examine the contributions of protein to skeletal muscle synthesis and the effects of protein intake on insulin expression. Protein recommendations for the recovery period are also included.

Skeletal muscle synthesis. Protein is an important substrate for lean tissue accretion (Desbrow et al., 2014). Howarth et al. (2009) showed that ingestion of protein with carbohydrate increased skeletal muscle synthesis rate and whole body net protein balance when compared to ingestion of drinks matched for carbohydrate or energy intake. In particular, chocolate milk has been extolled as a beneficial exercise recovery drink due to its combination of carbohydrate and protein. Lunn et al. (2011) showed that 480 mL of

chocolate milk consumed after exercise increases muscle fractional synthesis rate by 38% and suppressed whole-body protein turnover compared to an isocaloric carbohydrate-only control beverage. This increased anabolic state is induced when the milk is consumed as a single bolus or in multiple feedings, both of which elicit the same metabolic response (Lunn et al., 2011). Thus, protein intake post-exercise is important for lean tissue repair and recovery from exercise.

Protein intake and insulin expression. A review article by Betts et al. (2010) examined the relationship between protein intake and insulin expression. Increased protein intake can increase insulin expression, thereby increasing the rate of glycogen synthesis during recovery. Protein ingested at the rate of approximately 0.3 g protein per kg body weight per hour appears to be effective at increasing circulating insulin levels. An increase in insulin would predict an increase in glucose uptake to muscle and liver cells, creating a mechanism by which glycogen synthesis can be accelerated. Conversely, others have reported glycogen synthesis is unrelated to the protein level in recovery mixtures (Howarth et al., 2009). Thus, further research is needed to clearly elucidate the relationships between protein ingestion, insulin expression, and glycogen synthesis.

Protein recommendations. The protein recommendations for athletes and active individuals are based on nitrogen balance and tracer metabolism studies, which are expensive and time consuming. Results of this research has shown that protein requirements depend on an athlete's training type, intensity, and duration, as well as age and developmental level. In active adults, nitrogen balance studies have placed protein requirements for endurance athletes between 1.2-1.4 g/kg/day (Rodriguez et al., 2009). Studies on adolescent sprinters and soccer players have shown that increased protein

intakes (1.35-1.6 g/kg/day) achieve nitrogen balance in this population (Desbrow et al., 2014). It is crucial for active adolescents to ingest adequate protein post-exercise in order to meet their increased protein needs for growth and exercise recovery.

CONCLUSIONS

For the adolescent athlete, adequate energy and nutrition is essential for growth and to repair muscle tissue after exercise is over. Since adolescent athletes are often responsible for their own meals and food selection, it is important to have the nutrition knowledge and resources available to make proper decisions to meet energy and nutrient requirements. Table 4 outlines the current sport nutrition recommendations for fluids and pre-, during, and post-exercise carbohydrate and protein intake. The Rodriguez et al. (2009) paper is the past joint Position Stand focused on adults from the American Dietetic Association, Dieticians of Canada, and the American College of Sports Medicine. This Position Stand was used to make the recommendations for the lessons provided to the high soccer players in this pilot study. The Thomas et al (2016) paper is the most recent joint position stand from these organizations. Finally, the Desbrow et al. (2014) paper is the current Position Stand of the Sports Dieticians of Australia and is the only Position Stand focused on active adolescents aged 12-18 years.

Table 4: Current nutrition recommendations for active adolescents and adults

	Fluids	**Pre-Exercise CHO**	**During Exercise CHO**	**Post-Exercise CHO and PRO**
Desbrow et al., 2014	Cool and appropriate fluid before, during, and after exercise. During exercise: total weight deficit <2% BW	No pre-exercise guidelines. If training 1-3 h/d: 6-10 g CHO/kg BW/day	Exercise lasting 0-75 min: none or very little Exercise lasting 75min-2.5 h: 30-60 g CHO/h	0-4 h post-exercise: 1.0-1.2 g CHO/kg BW/h; include high-quality protein in the post-exercise meal
Rodriguez et al., 2009	Pre-exercise: 5-7 mL/kg BW 1-4 h pre-exercise During Exercise: avoid water deficit >2% BW Post-Exercise: 16-24 oz. fluid/lb. BW lost	3-4 h pre-exercise: 200-300 g CHO from food	Concentration: 6-8% CHO for events <1-h 0.7 g CHO/kg BW/h for longer events (30-60g/h CHO)	0-30 min after exercise: 1.0-1.5 g CHO/kg BW at 2-h intervals, up to 6-h; include PRO in post-exercise meal
Thomas et al., 2016	2-4 h pre-exercise: 5-10 mL fluid/kg BW During Exercise: 0.4-0.8 L/h; total weight deficit <2% BW Post-exercise: 1.25-1.5 L fluid/1 kg BW lost	Pre-exercise: 1-4 g CHO/kg BW 1-4 h before exercise.	1-2.5 h "stop and go" or endurance exercise: 30-60 g CHO/h	1-1.2 g CHO/kg BW/h for first 4-h then resume daily fuel needs 0.25-0.3 g PRO/kg BW (15-25 g) 0-2 h post-exercise

BW= Body Weight; CHO= carbohydrate; PRO= protein; h= hour(s); min= minute(s); oz.= ounce; lb.= pound

Table 5: Research Examining Dietary Intake of Athletes in Different Sports

Reference	**Population**	**Methods**	**Dietary Intake**
Mutsumi et al., 2012	Male English football league players (n=24; mean age =)	4-d food record diary. Qualitative interviews of players	High variability in energy intake (2648-4606 kcal/d) Mean CHO: 505 g/d
Russell et al., 2011	Male professional soccer players (n=10; mean=17 y)	7-d dietary intake and activity record	Low kcal/d: 2831 (788 kcal/d deficit) 56% kcal/d CHO 16% kcal/d PRO 31% kcal/d FAT Mean fluid intake: 3.2 L/d
Shriver et al., 2013	Female NCAA Division I athletes, various sports (n=52; >18 y)	24-h diet recall; 3-d diet record; Nutrition Questionnaire	Less than 3 meals/d= 29% Less than 2 snacks/d =27% Fluids: 60% 1-2 cups pre-exercise 58% < 2 cups during-exercise 44% 3-5 cups post-exercise

NYPANS= National Youth Physical Activity and Nutrition Survey, BC= British Columbia, CHO= carbohydrate; PRO= protein; NCAA= National Collegiate Athletic Association; BW= body weight; RD= registered dietician

Table 6: Research Examining Nutrition Knowledge of High School and College Athletes in Various Sports

Reference	**Population**	**Methods**	**Nutrition Knowledge Outcomes**
Galanti et al., 2015	Male cyclists (n=17; 14-16 y) Soccer players (n=30; 15-16 y)	Nutrition knowledge questionnaire about type of food, portion and frequency of certain foods, and possible supplement use	Balanced energy intake between meals (% of total energy for the day: Breakfast=12% kcal; Lunch=31%; Dinner=36%) and snacks (6.7% kcal). Good choices of foods/nutrient, but reported total energy intake was low for active males (2,738 kcal/d). Cyclists: High CHO (391 g/d) and PRO (98 g/d) intake Soccer players: greater FAT intake (119 g/d)
Hornstrom et al., 2011	Female collegiate softball players in the MAC (n=185; 30% freshman, 25% sophomores, 24% juniors, 18% seniors, 2% 5th year seniors)	Nutrition knowledge questionnaire, general and sport nutrition questions	Knowledge score=45.7/80 possible (57%) Choice score=19.4/28 (69%), higher scores less healthful. Practices score=2.8/5 possible (56%) Attitude toward sport-enhancing diet=1.9/6 (32%), lower score means more positive nutrition attitude
Jonnalagadda et al., 2001	Male freshman football players at a NCAA Division I school (n=31; 18.2 y)	Self-administered nutrition screening questionnaire	Mean score for nutrition attitudes and beliefs: 5.55/11 (50%)
Nikolaidis and Theodoropou, 2014	Male and female soccer players (n=185; 21.3 y)	11-item nutrition knowledge questionnaire	Mean score of NKQ: 5.4/11 (49%) Agreed that CHO and FAT are the main energy sources; 75% of questions answered correctly. Agreed that "dehydration decreases performance"

Reading et al., 1999	Male adolescent and young adult hockey players (n=175; 10-21 y)	Pre/post-intervention nutrition knowledge assessments Intervention: 4 modules of nutrition education (2 weeks)	Pre-intervention score: 19.9/45 (44%) (n=175) Post-intervention score: 22.0/45 (49%) (n=33)
Walsh et al., 2011	Male rugby players (n=203; 15-18 y) 68% had 10-20% BF	Nutrition knowledge and behaviors survey	Mean nutrition knowledge score= 59.6% Hydration: mean score=76.4% Energy and refueling: mean score= 57.1%
Zawila et al., 2003	Female collegiate cross-country runners at NCAA Division I, II, III colleges in Illinois and Michigan (n=60; 18-22 y)	Nutrition questionnaire with quantitative and qualitative parts	Greater than 70% correct in hydration, iron, and functional foods; Scores higher for athlete component (p=.02) than general nutrition.

MAC=Mid-American Conference, CHO= carbohydrate; PRO= protein; NCAA= National Collegiate Athletic Association; BF= body fat; NKQ= Nutrition Knowledge Questionnaire

Table 7: Research Examining Pre-, During, and Post-Exercise and Hydration Behaviors of Adolescent Athletes

Reference	**Population**	**Methods**	**Results**			
			Pre-exercise food behaviors	**During exercise fluid behaviors**	**Post-exercise food behaviors**	**Hydration behaviors**
Aerenhouts et al., 2008	Male/female Flemish sprinters (n=60; 12-18y)	7-day food record, PA questionnaire for activity level	56% (n=34) participants had a strategy (<2 h pre-comp.); easily digestible CHO (pasta, banana) All participants had breakfast daily: 54% females; 67% males chose cereals	25% (n=15) participants had during exercise strategies; water and isotonic sports drinks	Males: water and high-CHO foods (banana, bread); 18% (n=11) participants had post-competition strategy: fluid + CHO replenishment	All consumed water and isotonic sports drinks before and during exercise.
Baker et al., 2014	Male/female skill/team-sport athletes (n=29; 14-19 y); (tennis, basketball, soccer, baseball, golf, lacrosse, football)	24-h period observed and recorded by RD during meals and practices; food and fluid; Snack intake self-reported	Soccer athletes: 80% adequate CHO intake. All athletes: 1.4 g CHO/kg in 4 h pre-ex	Soccer athletes: 20% adequate CHO intake. All athletes: 19.9 g CHO/h (6% CHO sports drink)	Soccer athletes: 90% adequate CHO intake, 100% adequate PRO intake. All athletes: 1.2 g CHO/kg 31.6 g PRO 1-h post-ex	N/A

Bergeron et al., 2006	Male/female tennis players (n=14; 15 y) Trained and acclimated to warm climates	2x 120-min tennis-specific training sessions. Two trials drinking either plain water or 6% CHO-E drink	N/A	Water intake: 1737 mL CHO-E intake: 1897 mL	N/A	Athletes were dehydrated prior to training; need to drink more coming into the training sessions Lower core body temp in CHO-E trial
Walsh et al., 2011	Male rugby players (n=203; 15-18 y); 68% had 10-20% BF	Nutrition knowledge and behaviors survey	26.6% ate within 1-h of exercise; 81% ate high PRO foods, 96% ate high CHO foods	N/A	61.6% ate within 30-min of finishing exercise; 85.7% ate high CHO foods; 85.7% ate high-PRO foods	38.4% used sports drinks before, 13.8% during, 46.3% after exercise; Water: 87.7% before, 97% during, 80.3% after

CHO-E= carbohydrate-electrolyte drink; CHO= carbohydrate; PRO= protein; BW= body weight; BF= Body fat

METHODS

This thesis project was part of a larger study for WAVE~ Ripples for Change obesity prevention program for adolescent athletes, funded by the USDA National Institute of Food and Agriculture (NIFA). Data for this thesis were collected during year 1 of the pilot study, August through October 2014.

Subjects

The WAVE Project Pilot Year 1 recruited student-athletes from three high schools in the central Willamette Valley in Oregon, USA. The project recruited specifically from the Lebanon High School (LHS) girls' varsity and junior varsity soccer teams, Corvallis High School (CHS) boys' junior varsity soccer team, and the Crescent Valley High School (CVHS) boys' junior varsity and girls' varsity soccer teams. Members of these teams were presented with the opportunity to participate in the WAVE program. Voluntary consent to participate was obtained from athletes and their legal guardians. The study was approved by the Oregon State University (OSU) Institutional Review Board.

Timeline

The timeline for the project is outlined in Table 8.

Table 8: Timeline for WAVE Pilot Year 1

Date	**Intervention Group**	**Comparison Group**
August 2014	Anthropometric Assessments (ht, wt, % body fat); Sport Nutrition Questionnaire	Completed anthropometric Assessments and Sport Nutrition Questionnaire
August-October 2014	Sport Nutrition Lessons (n=4)	Receive sport nutrition information through newsletters
October 2014	Sport Nutrition Questionnaire	No activities

Study Procedures

The study participants were recruited into either the intervention or the comparison group. The intervention group included the CVHS boys' junior varsity and girls' varsity soccer teams. Anthropometric and nutrition knowledge assessments were done before and after four face-to-face sport nutrition lessons during Year 1 (soccer season) of the WAVE pilot program. The face-to-face lessons focused on hydration, pre-, during-, and post-exercise nutrition. These lessons aimed to increase the players' knowledge of sports nutrition applicable to soccer and to encourage healthy lifestyle choices. The lessons were delivered at the end of the student's normal afternoon practice time. The sport nutrition lesson plans are included in Appendix B of this document. The topics and objectives of the lessons are listed in Table 9.

The comparison group included the CHS and LHS soccer teams. At baseline, the same data were collected from this group as the intervention group. The comparison group received no face-to-face lessons, but did receive sports nutrition information in the form of newsletters. One data point (August, 2014) will be used to represent the data collected from this group.

Anthropometric Assessments

Height (cm), weight (kg), and body fat (percentage) were measured in August and again in October 2014 for the intervention group and August only for the comparison group. A Stadiometer (Seca #217, Chino, CA) was used for height measurements, while the TANITA Body Composition Analyzer (Tanita # TBF-300A, Arlington Heights, IL) was used for weight and body fat percentage measurements.

Sport Nutrition Questionnaire

WAVE project researchers adapted the Sport Nutrition Questionnaire from a similar validated questionnaire developed by Walsh et al. (2011) in high school rugby players. The questionnaire included 42 questions addressing sports nutrition knowledge and behaviors (See appendix A). This thesis evaluates only those questions that pertain to pre-, during, or post-exercise nutrition knowledge and habits (Table 3).

Data Analysis

All data were made anonymous before data analysis. Descriptive statistics (mean and standard deviation) were used to summarize height, weight, body mass index (BMI; kg/m^2) and body fat percentage by sex. Independent t-tests were used to compare anthropometric data at baseline between the intervention and comparison groups. Responses to the Sport Nutrition Questionnaire are reported as frequencies, but no statistical analyses were done pre/post intervention or with the comparison groups due to the small samples sizes. Only baseline data were collected from the comparison group. The α value was set at $p<0.5$ for statistically significant.

Table 9: Sport Nutrition topics and lesson objectives

Lesson #	**Week #**	**Topic**	**Objectives**
1	4	Hydration	1. Recognize factors influencing fluid needs 2. Calculate fluid needs (pre, during, post) 3. Choose healthy beverages for hydration and weight management 4. Recognize signs and symptoms of dehydration 5. Recognize and apply understanding of self-assessment of hydration status
2	5	Pre-Exercise Nutrition	1. Describe pre-exercise nutrition needs relating to energy & macronutrients 2. Identify critical pre-exercise time periods for nutrient intake 3. Choose foods appropriate for different pre-exercise times 4. Create a list of pre-exercise food options
3	6	During Exercise Nutrition	1. Choose foods and beverages appropriate to during exercise 2. Create a strategy for during exercise nutrition 3. Create a during exercise food option 4. Recognize the symptoms of during exercise fatigue relating to fueling.
4	7	Post-Exercise Nutrition	1. Use food labels to determine CHO & PRO content 2. Determine CHO & PRO needs post-exercise 3. Choose foods appropriate for post-ex recovery 4. Create a customized post-ex snack plan, including composition and timing of snack

CHO= carbohydrate; PRO= protein

RESULTS

Subject Characteristics

Overall, 26 were recruited into the intervention group and 27 into the comparison group, but not all participants completed all parts of the intervention (see Table 10). For the participants that responded, most (84%) indicated their ethnicity as white. Table 11 provides the anthropometric data for each of the groups. At baseline, there were no differences between groups for any anthropometric parameters, except for weight in the females (p=0.04)

Nutrition Knowledge

Proper hydration is essential for athletic performance. When asked if consuming sports drinks for exercise lasting longer more than one hour could improve performance, 65% and 42% of the intervention and comparison group, respectively, agreed, while 23-27% of both groups were unsure (Table 18). Overall, 96% of the intervention group chose "true" for this question at the October assessment, representing a 40% improvement from baseline (Table 18). In addition, the majority (Intervention: pre=100%, post=96%; Comparison=96%) of all participants chose the correct answer, "false", in response to the question "You only need to drink when you are thirsty" (Table 18). The majority (Intervention: pre=96%, post=100%; Comparison=100%) of all participants chose the correct answer, "true" in response to "Dehydration can reduce performance" (Table 18).

For endurance and stop-and-go sports like soccer, carbohydrate is important in the pre-exercise meal. Participants were given a selection of high/low carbohydrate foods and asked to select the best food for a pre-game meal. Overall, both groups (Intervention:

pre=66%, post=70%; Comparison=79%) selected the high carbohydrate options (banana and pasta salad with vegetables) (Figures 6, 7 and 8). A similar question was asked about the post-exercise meal choices, with carbohydrate and protein foods being the best choices. Again, both groups selected the high carbohydrate (Intervention: pre=56%, post=64%; Comparison=69%) and higher protein options (Intervention: pre=58%, post=48%; Comparison=62%) (Figures 6, 7, and 8).

Nutrition Behaviors

To determine participants' ability to apply sport nutrition knowledge to practice, they were asked about their fluid consumption habits before, during, and after exercise. Recommendations from Desbrow et al. (2014) suggest that adolescent athletes should consume water as their primary beverage choice during and surrounding exercise, and limit sports drink consumption. In general, sports drinks are recommended when exercise is greater than one hour, especially in high temperature environments (Sawka et al., 2007). All participants in both groups reported drinking water before exercise (Intervention: pre=100%, post=100%; Comparison=96%) (Table 12; Figure 1). Sports drinks were used less frequently before, during, and after exercise (Intervention: pre=43%, post=42%; Comparison=18%) (Table 12).

Consuming a high-carbohydrate pre-exercise meal 1-4 hours before exercise helps the athlete meet total energy needs and top off glycogen stores. Participants were asked about their pre-exercise meal timing and food choices. Overall, both groups reported similar timing of food intake before exercise. Most intervention participants (pre=92%, post=87%) ate more than 1-hour before exercise, while fewer comparison participants reported eating during this time (Comparison=31%) (Figure 2). The participants were not

asked about exact timing of meals and snacks around sport. Both groups also chose the carbohydrate-based foods most frequently for pre-exercise meals (bread, bagel, roll, or wrap (intervention pre=65%, post=83%; comparison= 58%); fruit (intervention pre=73%, post=65%; comparison= 28%)) (Figures 3 and 5). There were no changes in the pre- and post-assessment responses for the intervention group (Tables 13 and 15).

A carbohydrate and protein-based post-exercise meal serves to help an athlete meet total daily energy needs, restore muscle glycogen levels, and provided protein for building and repair of muscle tissue. Rodriguez et al. (2009) recommends that athletes consume a recovery meal/snack within 30 minutes of completing exercise (Table 4). Participants were asked how quickly they ate after exercise and the types of food they usually consume. Overall, both groups reported similar timing of food intake after exercise, with the majority (Intervention: pre=65%, post=61%; Comparison=54%) eating between 1-2 hours after exercise (Table 13). The reasons for not eating sooner after exercise were also similar between groups, with the most common responses being "I am not hungry" (intervention pre= 54%, post=35%; comparison= 23%) and "I usually do not have food with me" (intervention pre=35%, post=52%; comparison= 46%) (Table 14). Participants reported eating similar foods post-exercise, which were higher in protein (meat, fish, chicken; cheese) (intervention pre=52%, post=63%; comparison=69%) and carbohydrate (bread, bagel, roll, wrap; pasta, rice, potato; fruit) (intervention pre=63%, post=64%; comparison=64%) (Tables 15 and 16). Overall responses were similar pre- and post-lessons in the intervention group (Tables 13, 14 and 15).

DISCUSSION

This study examined changes in nutrition knowledge and behaviors in high school soccer players (15-18 y) before and after a sports nutrition education intervention. In addition, baseline data between the intervention and comparison group were compared. Limited research has examined the sport nutrition knowledge and behaviors of adolescent athletes (Tables 1, 6, and 7). To our knowledge, this is the first study to assess nutrition knowledge and behaviors of adolescent soccer players before and after a sport nutrition education-focused intervention. The Sport Nutrition Questionnaire asked about food and beverage selection, but did not quantify the amount of foods and beverages consumed pre-, during, and post-exercise.

Fluid behaviors. At baseline, the majority (≥92%) of all study participants reported consuming water and a third consumed sports drinks before, during, and after exercise (Figure 1). These results comply with the recommendations by Desbrow et al. (2014) that adolescent athletes consume mainly water pre-, during, and post-exercise, and limit sports drink intake. Because we did not directly measure fluid intake we cannot determine if the participants met their specific needs or matched sweat rates.

Das et al. (2012) measured the self-reported fluid habits of 526 non-athletic university students (16-35y) and reported that males and females each drank 2-3 liters of fluid per day. This study was not athlete-specific. The author reports higher overall fluid intake than previously reported in the literature for this age group. However, participants reported believing many myths about drinking water, which indicates that more nutrition education on fluid consumption is needed for this population. In adolescent tennis players, Bergeron et al. (2006) found that athletes entered into training sessions with high

urine specific gravities (mean=1.025), an indication of dehydration, thus, indicating a need for higher fluid consumption throughout the day. Normal specific gravity for urine is 1.002-1.030 with normally functioning kidneys (Nall, 2015).

Pre-Exercise. The majority (>80%) of participants in the WAVE study ate more than 1-hour before exercise and included carbohydrate foods in this meal. This aligns with the recommendation by Rodriguez et al. (2009) and Thomas et al (2016) that foods consumed pre-exercise be high in carbohydrate.

Few studies have investigated the current pre-exercise nutrition habits of adolescent athletes. Aerenhouts et al. (2008) monitored food intake of elite Flemish sprinters (n=60, 12-18y) using 7-day food records to determine if nutrient intakes were in accordance with the Belgian Health Council recommended dietary intakes. They found that all participants ate breakfast daily, composed primarily of high carbohydrate foods. A bread-based meal was preferred for lunch when afternoon training and competition were scheduled. However, few participants (n=15; 25%) reported having nutrition strategies specific for training. Before and during training, mainly plain water and isotonic sports drinks were consumed. Before competition, 56% of participants consumed easily digestible whole carbohydrate foods in the 2-h before competition. The high-carbohydrate food choices of the athletes in this study are similar to the soccer players in the WAVE project, who selected these foods (e.g. bread, bagel, pasta, rice, potato) 62% of the time for pre-exercise meals.

Post-Exercise. Although it is recommended that athletes eat a meal or snack 30 minutes after exercise, only one-third of the intervention participants ate in the half-hour after exercise (pre=31%; post=35%). Most participants first ate 1-2 hours after exercise and

consumed foods high in carbohydrate and protein, in accordance with the recommendations by Rodriguez et al. (2009), Thomas et al. (2016), and Desbrow et al. (2014). For these athletes, if sessions were at least 24-hour apart, glycogen stores would be replenished (Betts and Williams, 2010; Parkin et al., 1997) and there would be potentially little impact on muscle tissue growth and recovery. Rasmussen et al. (2000) showed no differences in muscle net balance or muscle protein synthesis when an essential amino acid beverage was consumed either one or three hours after a resistance training session.

Few studies have examined the post-exercise nutrition habits of adolescent athletes. As reported by Aerenhouts et al. (2008), only 13% of the adolescent Flemish sprinters (n=8) had a post-training nutrition plan, and only 18% (n=11) had a post-competition nutrition plan. The post-exercise nutrition plans involved drinking water or other fluids and consuming high-carbohydrate foods such as bananas and bread immediately after training. Compared to 63% of all WAVE participants, fewer participants in the Aerenhouts et al. (2008) study consumed carbohydrate-rich foods after exercise. Baker et al. (2014) examined the nutrition and hydration behaviors of male and female athletes of skill and team sports (n=29). All athletes reported consuming an average of 1.2 g carbohydrate/kg and 32 g protein in the 1-hour post-exercise. The intake levels reported by these athletes are in accordance with the recommendations by Desbrow et al. (2014) and the recent joint ACSM, Academy and Dietitians of Canada Position Statement (Thomas et al., 2016).

Sport nutrition knowledge. The participants in the WAVE study reported appropriately to hydration questions (percentage correct: intervention (87%); comparison (79%)) (Table

18). These results are similar to those reported by Walsh et al. (2011) and Zawila et al. (2003). Walsh et al. (2011) found that adolescent male rugby players had a mean nutrition knowledge score for hydration of 76.4%, compared to 59.6% for overall nutrition knowledge and 57.1% for energy and refueling knowledge. Similarly, Zawila et al. (2003) found that in female collegiate cross-country runners, greater than 70% answered hydration questions correctly compared to other nutrition sections of a questionnaire.

However, in contrast to the high level of hydration knowledge reported by athletes, multiple studies have demonstrated that young athletes (high school/college) have poor sport nutrition knowledge (Torres-McGehee et al., 2012; Rosenbloom et al., 2002; Walsh et al., 2011). For example, 62% of the young male rugby players in the study by Walsh et al. (2011) believed that a low-carbohydrate option, such as steak and salad, was a suitable post-exercise recovery meal and only 27% ate in the hour prior to exercise. In the WAVE intervention group, the majority (>50%) of WAVE participants chose high-carbohydrate foods to consume after exercise (Tables 15 and 16). In addition, less than 15% of athletes reported eating in the hour before exercise (Table 13). Eating in the hour before exercise is not discouraged; however, athletes must be aware that less carbohydrate can be absorbed with less time before exercise and high protein, fat, and intake may not be well tolerated (Table 4).

Research examining nutrition knowledge of United States collegiate athletes typically shows low scores for correct responses (Torres-McGehee et al., 2012; Rosenbloom et al., 2002). Torres-McGehee et al., (2012) found that 91% of their student-athletes had inadequate nutrition knowledge. Athletes had an average score of 55% on all

nutrition questions, 52% on micro/macronutrient knowledge, and 55% on hydration knowledge. Rosenbloom et al. (2002) also reported low nutrition knowledge scores (5.8/11; 53%) in collegiate athletes of various sports in response to true/false statements concerning macro/micronutrients and hydration. In contrast to previous research, the WAVE study participants showed high hydration, pre-, and post-exercise food choice knowledge (Tables 17 and 18). Generally, >90% of participants responded correctly to hydration knowledge questions (Table 18), and ≥48% chose appropriate pre- and post-exercise foods (Table 17).

The WAVE Sport Nutrition Questionnaire primarily asked about athletes' nutrition behaviors, and had limited nutrition knowledge questions. Other research studies used questions to gauge ratings of nutrition knowledge (Torres-McGehee et al., 2012) and true/false questions (Rosenboom et al., 2002).

Study Strengths

Strengths of this study include a well-designed assessment protocol, strong research design, and the use of an adolescent athlete population. The Sport Nutrition Questionnaire is evidence-based and asks clear questions of the participants. The research design used for the WAVE pilot study included both an intervention and control group. Schools were assigned to groups based on willingness to participate, convenience and timing of recruitment.

Study Limitations

By design, the pilot study included a small number of participants to test the methods and instruments to be used in the larger WAVE study. Thus, the sample size was small. The Intervention group was more evenly distributed males (n=10) and females (August n=16;

October n=13), while the comparison group was primarily female (males=6; females=20). This contributed to the difficulty in comparing males and females.

The Sport Nutrition Questionnaire used self-report data from the study participants, which can be biased if participants report behaviors they do not actually practice.

Table 10: Intervention and Comparison Groups: Distribution of survey participants from August and October assessments

	August		October	
	Male	Female	Male	Female
CVHS Intervention Group (n=26 August; n=23 October)	10	16	10	13
	August			
	Male		Female	
CHS (male) and LHS (female) Comparison Group (n=26 August)	6		20*	

CVHS= Crescent Valley High School, CHS= Corvallis High School, LHS= Lebanon High School

*one female athlete is missing compared to the anthropometric n-size in table 8

Table 11: Intervention and Comparison Groups: Baseline Anthropometric data

	Intervention (n=25)		Comparison (n=27)			
	Male (SD) (n=10)	Female (SD) (n=15*)	Male (SD) (n=6)	Female (SD) (n=21)	P-Values	
					Male	Female
Height (m)	1.8 (0.1)	1.6 (0.1)	1.8 (0.0)	1.6 (0.1)	0.93	0.58
Weight (kg)	61.8 (4.7)	55.6 (6.2)	58.0 (5.6)	63.1 (14.3)	0.21	0.04
BMI (kg/m^2)	20.3 (1.8)	20.9 (1.9)	19.0 (1.8)	23.3 (4.9)	0.19	0.05
Body Fat (%)	10.4 (4.6)	20.2 (5.9)	8.2 (1.4)	25.1 (9.6)	0.18	0.07

BMI= Body mass index (kg/m^2)

*one female athlete is missing from anthropometric data in the intervention group

Table 12: Pre/Post Intervention and Comparison Group Responses: Fluid Use

	Intervention August Assessment (n=26)		Intervention October Assessment (n=23)		Comparison August Assessment (n=26)	
	Use water and/or non-caloric flavored water	Use sports drinks or diluted fruit juice	Use water and/or non-caloric flavored water	Use sports drinks or diluted fruit juice	Use water and/or non-caloric flavored water	Use sports drinks or diluted fruit juice
Pre-Exercise	26 (100%)	12 (46%)	23 (100%)	9 (39%)	25 (96%)	7 (27%)
During-Exercise	25 (96%)	11 (42%)	22 (96%)	10 (43%)	25 (96%)	3 (12%)
Post-Exercise	25 (96%)	11 (42%)	21 (91%)	10 (43%)	24 (92%)	4 (15%)

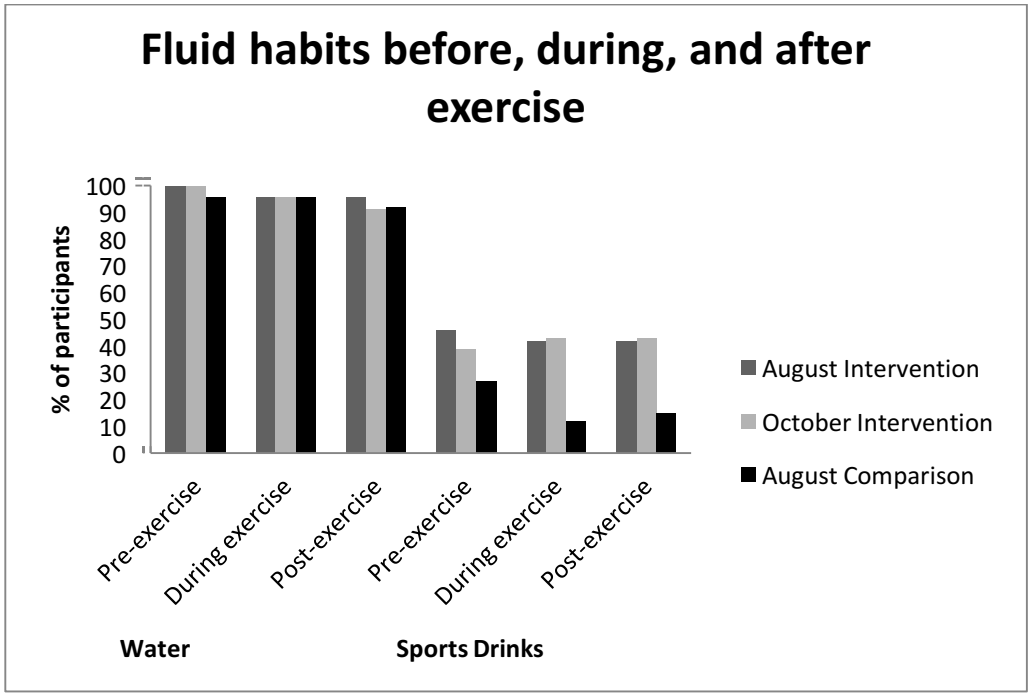

Figure 1: Pre/Post Intervention and Comparison Group Responses: Fluid Use

Table 13: Pre/Post Intervention and Comparison Group Responses: Eating Before/After Exercise

	Intervention		Comparison
	August Assessment (n=26)	October Assessment (n=23)	August Assessment (n=26)
>1 h before	24 (92%)	20 (87%)	8 (31%)
≤ 1 h before	2 (8%)	3 (13%)	18 (69%)
≤30 min after	8 (31%)	8 (35%)	12 (46%)
1-2 h after	17 (65%)	14 (61%)	14 (54%)
2+ h after	1 (4%)	1 (4%)	0 (0%)

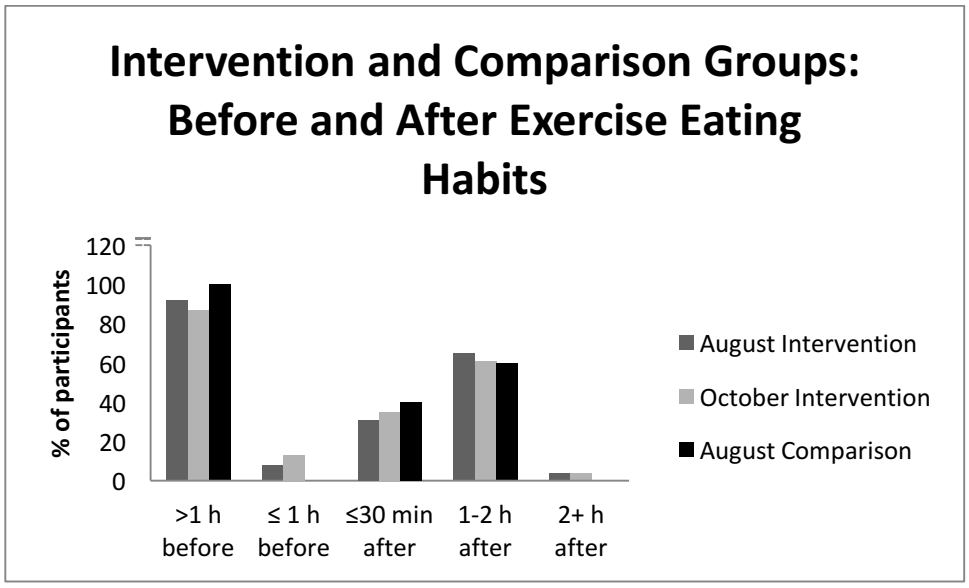

Figure 2: Pre/Post Intervention and Comparison Group Responses: Eating Before/After Exercise

Table 14: Pre/Post Intervention and Comparison Group Responses: Post-Exercise Eating Behaviors

	Intervention		Comparison
	August Assessment (n=26)	October Assessment (n=23)	August Assessment (n=26)
I am not hungry	14 (54%)	8 (35%)	6 (23%)
I don't have time to eat	2 (8%)	1 (4%)	5 (19%)
I usually do not have food with me	9 (35%)	12 (52%)	12 (46%)

Table 15: Pre/Post Intervention Responses: Pre/Post-Exercise Food Choices

	August Assessment (n=26)		October Assessment (n=23)	
	Pre-Exercise	Post-Exercise	Pre-Exercise	Post-Exercise
PROTEIN				
Meat, fish, chicken	12 (46%)	18 (69%)	7 (30%)	18 (78%)
Beans	1 (4%)	5 (19%)	4 (17%)	9 (39%)
Eggs	8 (31%)	5 (19%)	7 (30%)	6 (26%)
Protein shake	2 (8%)	6 (23%)	2 (9%)	5 (22%)
GRAINS/CEREALS				
Bread, bagel, roll, wrap	17 (65%)	17 (65%)	19 (83%)	13 (57%)
Pasta, rice, potato	10 (38%)	18 (69%)	8 (35%)	15 (65%)
Breakfast cereal	5 (19%)	1 (4%)	6 (26%)	4 (17%)
Energy or cereal bar	8 (31%)	3 (12%)	10 (43%)	4 (17%)
DAIRY				
Yogurt, milk	7 (27%)	8 (31%)	5 (22%)	8 (35%)
Cheese	4 (15%)	9 (35%)	5 (22%)	11 (48%)
PRODUCE				
Fruit	19 (73%)	14 (54%)	15 (65%)	16 (70%)

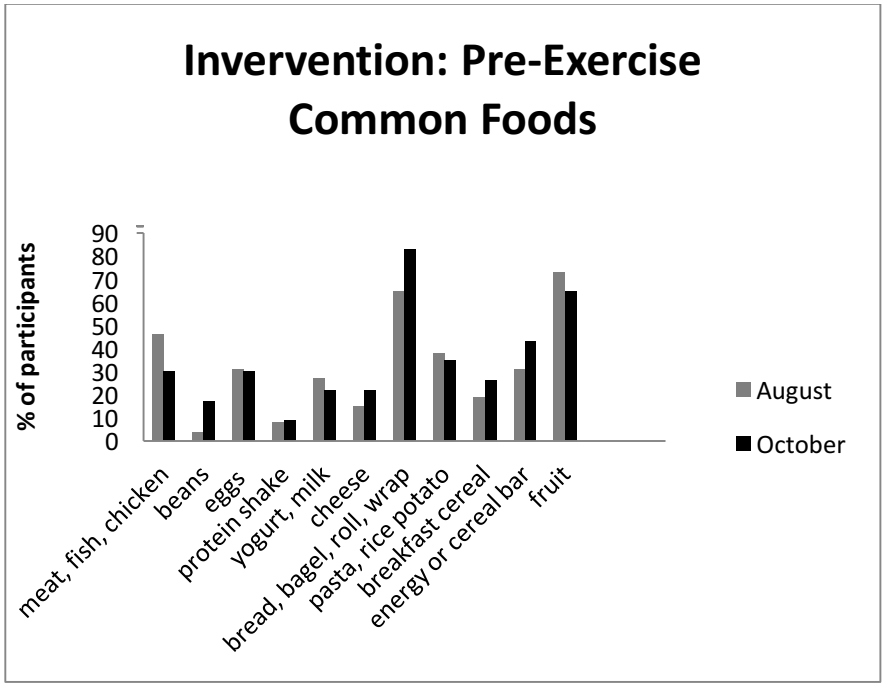

Figure 3: Pre/Post Intervention Responses: Pre-Exercise Food Choices

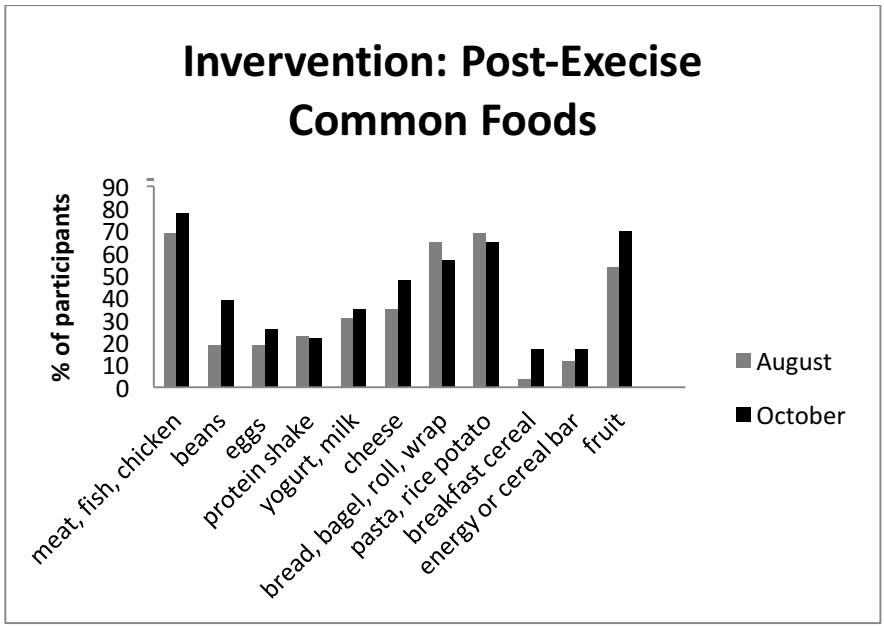

Figure 4: Pre/Post Intervention Responses: Post-Exercise Food Choices

Table 16: Comparison Group Responses: Pre/Post-Exercise Food Choices

	August Assessment (n 26)	
	Pre-Exercise	Post-Exercise
PROTEIN		
Meat, fish, chicken	9 (35%)	18 (69%)
Beans	2 (8%)	5 (19%)
Eggs	0 (0%)	3 (12%)
Protein shake	0 (0%)	2 (8%)
GRAINS/CEREALS		
Bread, bagel, roll, wrap	15 (58%)	13 (50%)
Pasta, rice, potato	6 (23%)	19 (73%)
Breakfast cereal	3 (12%)	3 (12%)
Energy or cereal bar	10 (38%)	2 (8%)
DAIRY		
Yogurt, milk	8 (31%)	10 (38%)
Cheese	13 (50%)	18 (69%)
PRODUCE		
Fruit	15 (28%)	18 (69%)

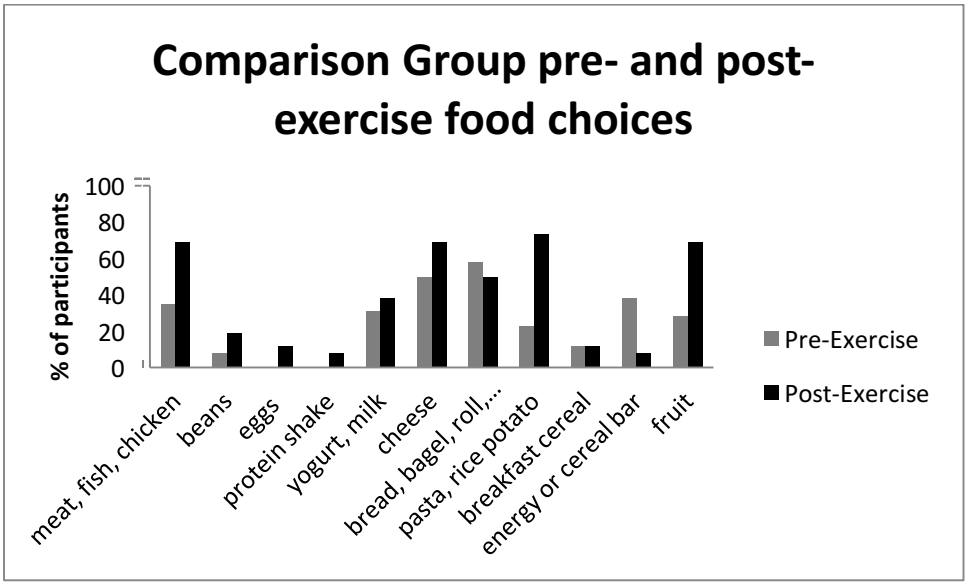

Figure 5: Comparison Group Responses: Pre/Post-Exercise Food Choices

Table 17: Intervention and Comparison Group Responses: Nutrition Knowledge Food Choices Pre/Post-Exercise

	Intervention August Assessment (n=26)		Intervention October Assessment (n=23)		Comparison August Assessment (n=26)	
	Pre-Exercise	Post-Exercise	Pre-Exercise	Post-Exercise	Pre-Exercise	Post-Exercise
Banana	16 (62%)	14 (54%)	14 (61%)	13 (57%)	22 (85%)	19 (73%)
Candy Bar	0 (0%)	0 (0%)	1 (4%)	2 (9%)	2 (8%)	2 (8%)
Hamburger with fries	1 (4%)	5 (19%)	3 (13%)	5 (22%)	0 (0%)	8 (31%)
Pasta salad with vegetables	18 (69%)	15 (58%)	18 (78%)	16 (70%)	19 (73%)	17 (65%)
Protein shake	7 (27%)	15 (58%)	6 (26%)	11 (48%)	15 (58%)	16 (62%)

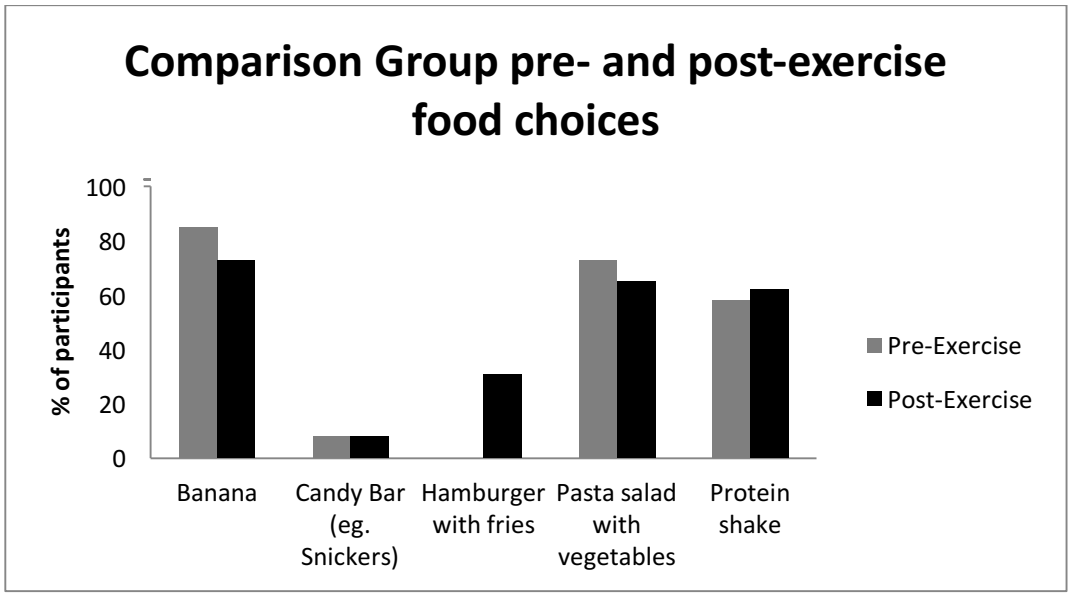

Figure 6: Comparison Group Responses: Nutrition Knowledge Food Choices Pre/Post-Exercise

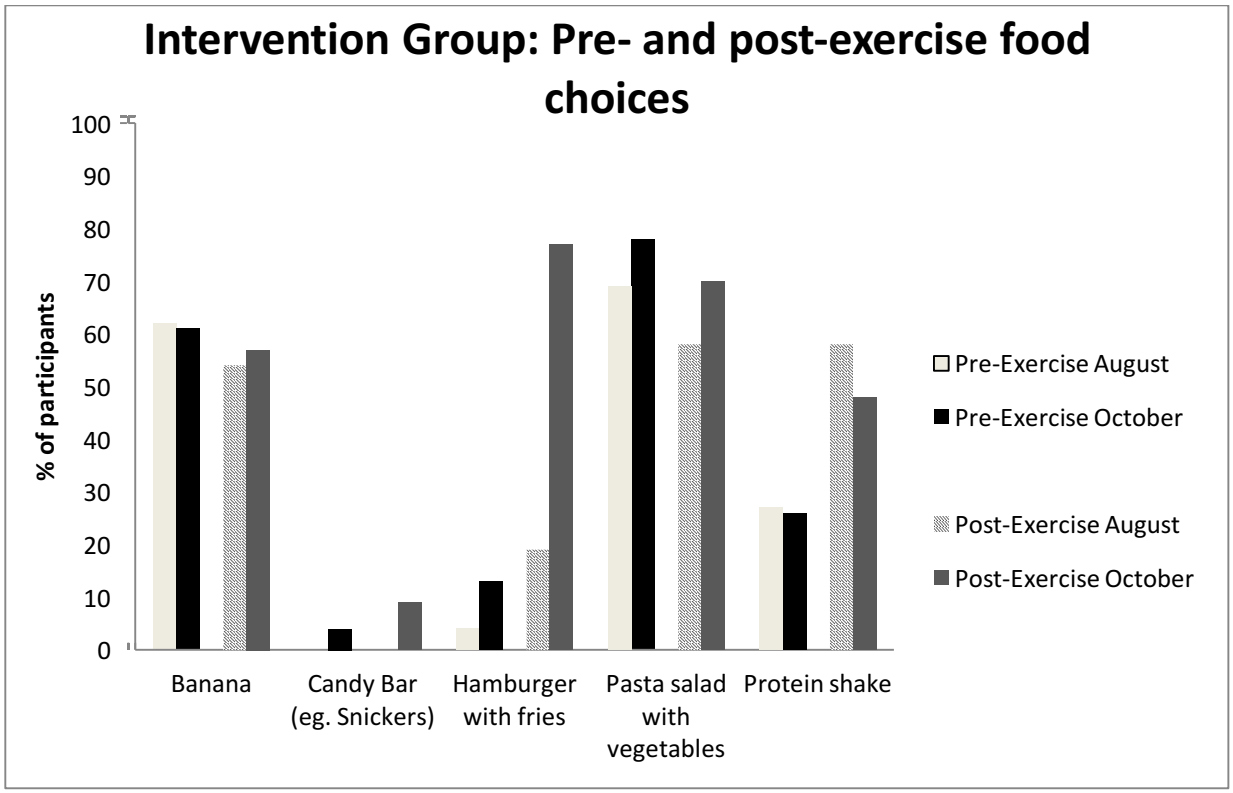

Figure 7: Pre/Post Intervention Group Responses: Nutrition Knowledge Food Choices Pre/Post-Exercise.

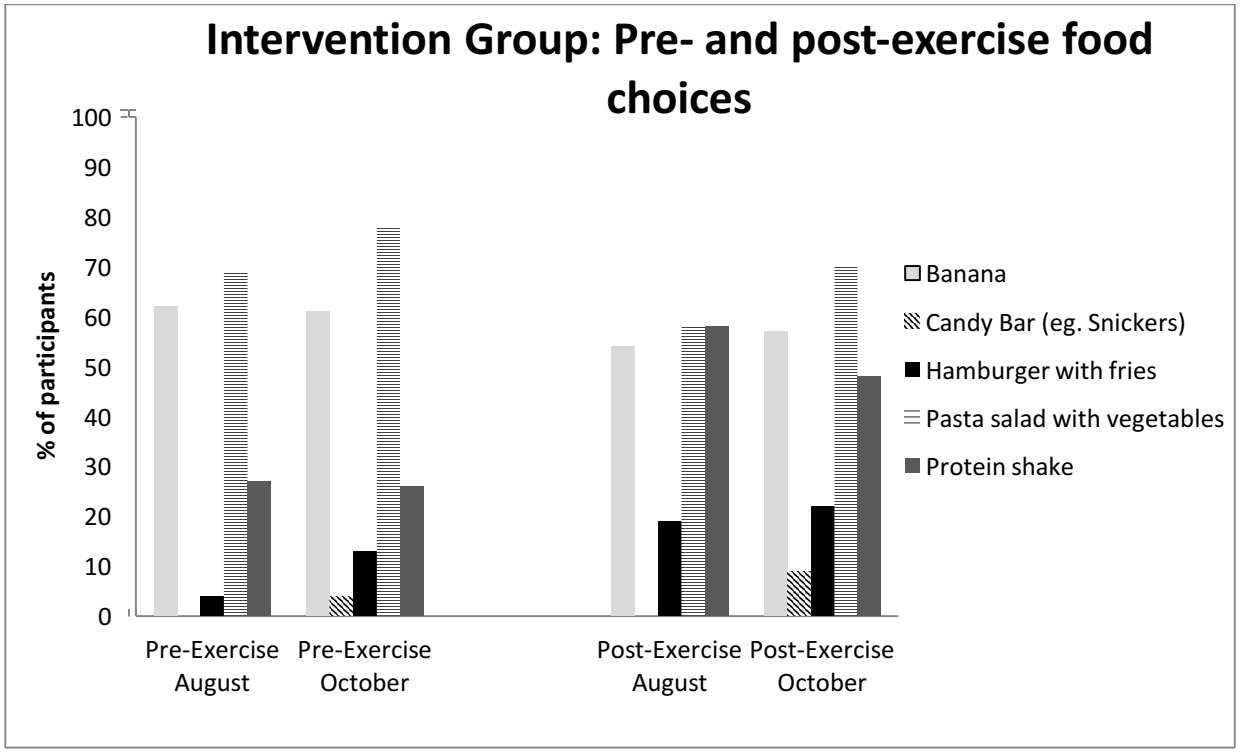

Figure 8: Pre/Post Intervention Group Responses: Nutrition Knowledge Food Choices Pre/Post-Exercise Version 2

Table 18: Pre/Post Intervention and Comparison Group Reponses: Hydration Knowledge

			Sports drinks benefit during exercise > 1 h (Q #27)	Drink only when thirsty (Q #28)	Dehydration can reduce performance (Q #29)
Intervention	**August Assessment (n=26)**	**True**	17* (65%)	0 (0%)	25* (96%)
		False	2 (8%)	26* (100%)	1 (4%)
		Don't know	6 (27%)	0 (0%)	0 (0%)
	October Assessment (n=23)	**True**	22* (96%)	0 (0%)	23* (100%)
		False	1 (4%)	22* (96%)	0 (0%)
		Don't know	0 (0%)	1 (4%)	0 (0%)
Comparison	**August Assessment (n=26)**	**True**	11* (42%)	0 (0%)	26* (100%)
		False	9 (35%)	25*◦ (96%)	0 (0%)
		Don't know	6 (23%)	0 (0%)	0 (0%)

*correct answer

◦one participant did not respond to this question

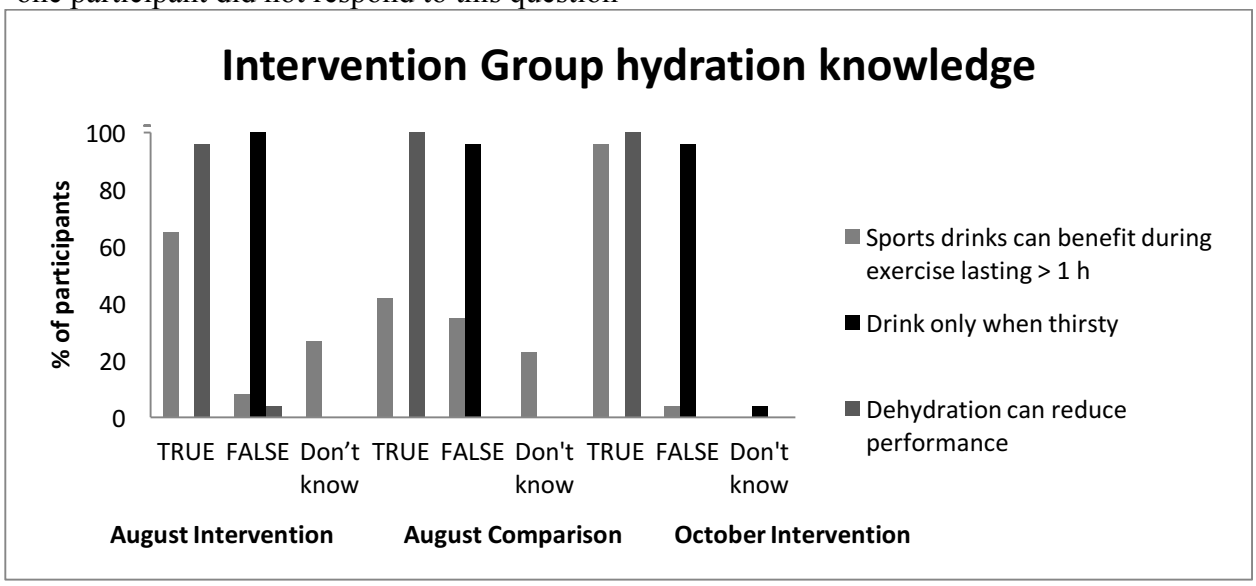

Figure 9: Pre/Post Intervention and Comparison Group Responses: Hydration Knowledge

CONCLUSION

The WAVE Sport Nutrition Questionnaire (Intervention: pre n=26, post n=23; Comparison n=26) completed in August and October 2014 evaluates the effect of Sport Nutrition Lessons delivered between August and October 2014. The questionnaire was used to answer the research questions given in Table 2. The answers to the research questions posed in this pilot study are given in Table 19.

Overall, study participants had reasonable knowledge of pre- and post-exercise hydration and food choices, and their nutrition habits reflect this knowledge. Most participants (≥96%) responded correctly on two-thirds of the hydration knowledge questions, with ≥91% drinking water before, during, and after exercise. Food choices focus on high-carbohydrate foods (bananas, pasta, and bread) for pre-exercise meals, and high-carbohydrate and high-protein foods (protein shake, meat, cheese) for the post-exercise meal. These choices support the recommendations by Thomas et al. (2016), which provides the 2016 join ACSM, Academy and Dietitians of Canada Position Statement for Nutrition and Athletic Performance.

Participants' recovery nutrition behaviors did not follow the sport nutrition lessons and recommendations for eating post-exercise. Few intervention participants reported eating in the half-hour after exercise (pre=31%; post=35%), despite the nutrition lessons emphasizing the importance of meal/snack timing for good recovery. These findings support previous research concerning sports nutrition knowledge in adolescent athletes.

We found few changes in the nutrition knowledge and behavior responses pre- and post-intervention. Numerous factors can account for these outcomes. The small

sample size in the pilot study, especially in the comparison group, means that the results will be less representative of the population of adolescent soccer players. The athletes participating in this study do not compete at an elite level, thus, it is a possibility that sport nutrition strategies to optimize athletic performance are not a concern for them at this time. Therefore, implementing the nutrition lessons into their lives was not a priority. It is possible that more elite athletes of the same age and maturity level would consider sport nutrition strategies of more importance. Coaches are an important resource for athletes. However, coaches infrequently attended the WAVE sport nutrition lessons, although they were encouraged to attend. Zinn et al. (2006) found that only 56% of New Zealand premier rugby coaches (n=168) responded correctly to a sport nutrition knowledge questionnaire. Coaches' engagement in sport nutrition for their athletes is critical for athletes to begin incorporating sport nutrition strategies into their training regimen.

The pilot study for the WAVE project measured the nutrition knowledge and behaviors of adolescent athletes. Further research with this population is needed to determine their level of sport nutrition knowledge and specific sport nutrition nutrient and energy needs.

Table 19: Research Questions and Answers

Q #	Research Questions
1	What are the most common fluids that adolescent athletes consume before, during, and after exercise? [all participants] Do choices change pre- and post-intervention? • Most participants (≥96%) consume water before, during, and after exercise • Approximately one third of participants reported consuming sports drinks before, during, and after exercise • Choices (e.g. use of water or sports drinks) did not change pre- and post-intervention
2	What are the most common pre-exercise meal/food habits of adolescent athletes (e.g. meal timing and food choices)? [all participants] Do choices change pre- and post-intervention? • Most participants (62%) consume high carbohydrate foods before exercise • Most participants (70%) eat more than one hour before exercise • Food choices (e.g. carbohydrate foods) did not change pre- and post-intervention
3	What are the most common post-exercise meal/food habits of adolescent athletes (e.g. meal timing and food choices)? [all participants] Do choices change pre- and post-intervention? • Most participants (≥52%) consume high carbohydrate and high protein choices after exercise • Most participants (≥54%) eat between one and two hours after exercise • Food choices (e.g. carbohydrate and protein foods) did not change pre- and post-intervention
4	What factors (e.g. knowledge, motivation) limit adolescent athletes in making healthful food choices? [all participants] Do outcomes change pre- and post-intervention? • <u>Hydration:</u> Athletes appear to have adequate hydration knowledge (88%) and are making appropriate hydration choices (≥96%) • <u>Pre-Exercise:</u> Athletes appear to have adequate pre-exercise food choice nutrition knowledge (71%), and are choosing appropriate foods before exercise (62%) o Most athletes eat more than one hour before exercise (70%), but how long before was not asked • <u>Post-Exercise:</u> Athletes appear to have adequate post-exercise food

	choice knowledge (61%), and are choosing appropriate foods post-exercise (≥52%) o Most athletes eat 1-2 hours after exercise (≥54%), despite nutrition lessons and recommendations to eat within 30 minutes of completing exercise • It appears that the athletes in the WAVE study have adequate sport nutrition knowledge and behaviors • More support from coaches on behalf of the students could be helpful

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APPENDIX A

WAVE~Ripples for Change
Sport Nutrition Knowledge Questionnaire

1. Sports Nutrition Knowledge Survey: We would like to know more about your diet behavior, attitudes toward nutrition, nutrition knowledge, and nutrition advice you have received. Your responses are voluntary (meaning you don't have to complete this form if you do not want to). You can leave any question blank, and you can also choose not to complete the questions once you begin.
2. Full Name
3. How often do you eat breakfast?
    a. 5-6 days per week
    b. 2-3 days per week
    c. Less than 2 days per week
    d. Never
    e. I don't eat breakfast but I eat a mid-morning snack before lunch
4. What type of lunch do you normally eat?
    a. Packed lunch from home
    b. I go home for lunch
    c. I buy lunch at school
    d. I buy lunch outside school
    e. I don't have lunch
5. What type of dinner (i.e., main meal) do you normally eat?
    a. Homemade meal
    b. Takeaway (for example: fast food or deli foods)
    c. Meal from a restaurant
    d. I don't have dinner
    e. Other (please specify)
6. Do you usually snack between your meals?
    a. Everyday
    b. Often but not everyday
    c. A few times a week
    d. No
7. If yes, what type of snacks do you eat?
    a. Cookies, cakes, muffins, scones, sweets (e.g. candy bars)
    b. Chips , popcorn, pretzels
    c. Fresh fruit, real fruit smoothies, real fruit juice
    d. Breakfast cereal, cereal, or cereal bars (e.g. granola bars)
    e. Energy or sport bars (e.g. higher protein bars)
    f. Bread, bagels, crackers
    g. Yogurt, milk, cheese, pudding
8. Mark any of the following fluids that you usually drink just before exercise
    a. Water (plain, tap or bottled) and/or non-caloric flavored water
    b. Coffee/coffee drinks
    c. Sports drink or diluted fruit drink/juice
    d. Soft drinks (e.g. Coca-Cola, Mountain Dew)

e. Diet drinks (e.g. Diet 7up)
f. 100% fruit juice (e.g.. Orange or Apple juice)
g. Fruit flavored drinks (e.g. Punch, Sunny-D)
h. Energy drinks (e.g. Red Bull, Monster, Rockstar)
i. Sports drinks (please specify brand) _____
j. Other (please specify)____
k. None

9. Mark any of the following fluids that you usually drink during exercise
   a. Water (plain, tap or bottled) and/or non-caloric flavored water
   b. Coffee or coffee drinks
   c. Sports drink or diluted fruit drink/juice
   d. Soft drinks (e.g. Coca-Cola, Mountain Dew)
   e. Diet drinks (e.g. Diet 7up)
   f. 100% fruit juice (e.g.. Orange or Apple juice)
   g. Fruit flavored drinks (e.g. Punch, Sunny-D)
   h. Energy drinks (e.g. Red Bull, Monster, Rockstar)
   i. Sports drinks (please specify brand) _____
   j. Other (please specify)____
   k. None
10. Mark any of the following fluids that you usually drink one hour after exercise
   a. Water (plain, tap or bottled) and/or non-caloric flavored water
   b. Coffee or coffee drinks
   c. Sports drink or diluted fruit drink/juice
   d. Soft drinks (e.g. Coca-Cola, Mountain Dew)
   e. Diet drinks (e.g. Diet 7up)
   f. 100% fruit juice (e.g.. Orange or Apple juice)
   g. Fruit flavored drinks (e.g. Punch, Sunny-D)
   h. Energy drinks (e.g. Red Bull, Monster, Rockstar)
   i. Sports drinks (please specify brand) _____
   j. Other (please specify)____
   k. None
11. Do you drink alcohol, e.g, beer, wine, mixed or flavored alcohol / drinks, etc?
   a. Yes, how often _____ (please specify)
   b. No
12. How soon before a match/game or training/practice do you last eat?
   a. 1 hour or less before a game
   b. More than 1 hour before
13. How soon after a match/game or training/practice do you first eat?
   a. ½ an hour or less after
   b. Between 1 and 2 hours
   c. More than 2 hours after
14. If you do not eat soon after exercise, what factors prevent you from doing so?
   a. I am not hungry
   b. I don't have time to eat
   c. I usually do not have any food with me
   d. Other _____ (please specify)

15. Please mark any of the following foods that are typical of the last food you ate before you exercise
    a. Meat, fish, chicken
    b. Beans
    c. Cheese
    d. Eggs
    e. Bread, bagel, roll, wrap
    f. French fries
    g. Chips (potato or tortilla chips)
    h. Pasta, rice, potato
    i. Breakfast cereal
    j. Yogurt, milk
    k. Protein shake
    l. Scone or muffin
    m. Energy or cereal bar _____ (please specify)
    n. Chocolate
    o. Fruit
    p. Vegetables
    q. Sandwich, pBJ
    r. Other _____ (please specify)
16. Please mark any of the following foods that are typical of the first food you eat after you exercise
    a. Meat, fish, chicken
    b. Beans
    c. Cheese
    d. Eggs
    e. Bread, bagel, roll, wrap
    f. French fries
    g. Chips (potato or tortilla chips)
    h. Pasta, rice, potato
    i. Breakfast cereal
    j. Yogurt, milk
    k. Protein shake
    l. Scone or muffin
    m. Energy or cereal bar _____ (please specify)
    n. Chocolate
    o. Fruit
    p. Vegetables
    q. Sandwich, pBJ
    r. Other _____ (please specify)
17. Mark any of the following nutrition supplements that you are currently taking on a regular basis
    a. Protein shakes or supplements (amino acids, whey or casein protein powder)
    b. Herbal products e.g., ginseng, Echinacea
    c. Vitamins, minerals (multivitamin, calcium, iron, B-12, B-complex, Vit C)

d. Meal replacement shake (e.g. Slim Fast, Gatorade Nutrition Shake, Carnation Instant Breakfast)
e. Other (please specify)_____

18. How do you rate the importance of what you eat and drink to your performance?
    a. Very important
    b. Important
    c. Of some importance
    d. Of no importance
19. As a soccer player, I have
    a. Different nutrition requirements than other people my age
    b. The same nutritional requirements as other people my age
    c. I don't know if my nutritional needs are the same or not
20. Mark which one of the following statement that applies to you
    a. I have trouble knowing what I should eat
    b. I feel my diet/eating plan meets my nutritional requirements
    c. I try and follow an eating plan that I believe will improve my sporting performance
    d. I feel under pressure from teammates, coaches, and others to follow a particular diet
21. Read the following statements and mark the box that best describes what you think
    a. Increasing muscle mass (bulk) is essential to improving soccer performance
    b. I think nutrition supplements are necessary to support my training program
22. After a training or a match/game:
23. Which of the following food choices would be best 3-4 hours BEFORE a game? (check all that apply)
    a. 1 banana
    b. 1 candy bar (e.g. snickers)
    c. Hamburger with fries
    d. Pasta salad with vegetables
    e. Protein shake
24. Which of the following food choices would be best 1-2 hours AFTER a game? (check all that apply)
    a. 1 banana
    b. 1 candy bar (e.g. snickers)
    c. Hamburger with fries
    d. Pasta salad with vegetables
    e. Protein shake
25. You should not eat carbohydrate (e.g., breads, pastas, potatoes) after 5 pm or you will get fat.
    a. True
    b. False
    c. I don't know
26. From what you eat and drink, you should get most of your energy (more than 50% calories) from carbohydrates

a. True
b. False
c. I don't know

27. During exercise longer than 1 hour, consuming sports drinks (e.g., Powerade, Gatorade) offer benefits
    a. True
    b. False
    c. I don't know
28. You only need to drink when you are thirsty.
    a. True
    b. False
    c. I don't know
29. Dehydration can reduce performance.
    a. True
    b. False
    c. I don't know
30. It is better to get vitamins and minerals from supplements than from food.
    a. True
    b. False
    c. I don't know
31. You can trust all of the claims made about sport supplements, e.g., this rapidly builds muscle.
    a. True
    b. False
    c. I don't know
32. Most people can't get all the vitamins and minerals they need from food, so they should take a supplement.
    a. True
    b. False
    c. I don't know
33. If you eat more protein than you need, it is likely to be stored as fat.
    a. True
    b. False
    c. I don't know
34. The more protein you eat, the more muscle you build.
    a. Absolutely true
    b. Partially true
    c. False
    d. Don't know
35. Have you ever sought out for dietary advice for sports?
    a. Yes
    b. No
36. If yes, where did you look for this advice?
    a. Magazines, books
    b. Internet
    c. Sporting organizations

d. Friends, teammates
e. Family member, parent, MD, or primary care provider
f. Coach, trainer
g. Other (please specify)_____

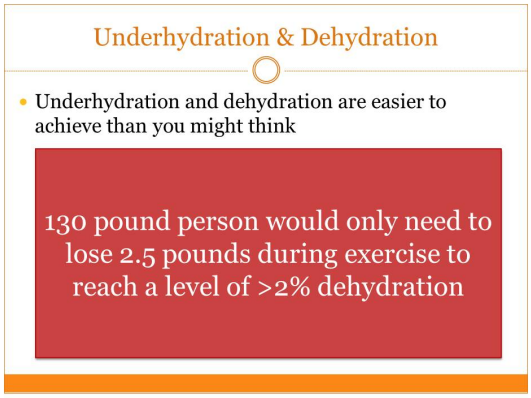
37. If you have been given advice about diet, what were you told to do?
    a. Fill in _____
38. Do you think the advice you received was useful?
    a. Yes
    b. No
39. Do you feel you could benefit from advice about nutrition?
    a. Yes
    b. No
40. If yes, what areas do you think you need most information on? (check all that apply)
    a. Advice on losing weight
    b. Advice on gaining weight
    c. Match/game day dietary advice
    d. Training/practice day dietary advice
    e. General healthy eating advice while training
    f. Advice on hydration and what to drink while training and on match/game day
    g. Suitable snacks
    h. Recipes, cooking skills
    i. Other
41. How would you like this information to be delivered? (check all that apply)
    a. Informational sheets
    b. Internet Web site, links
    c. Videos or audio clips
    d. Informational talks
    e. School magazine
    f. Group discussion
    g. Through coaches or expert guest speakers
    h. Other
42. Do you have any comments to add?

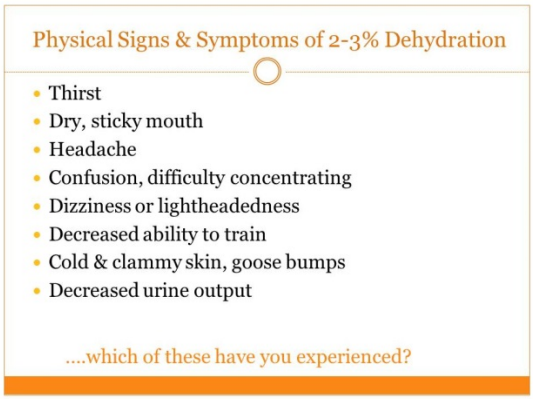
APPENDIX B

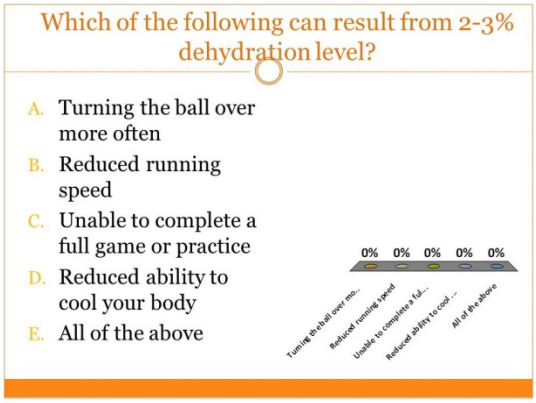
WAVE Sport Nutrition Lesson Presentations

The following Microsoft Powerpoint presentations were used in the face-to-face lessons administered to the intervention group August-October 2014.

Lesson 1: Hydration





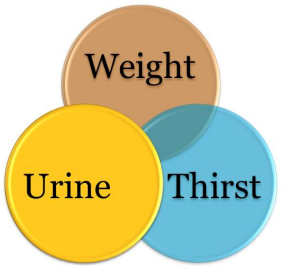


Now that we know how to recognize signs and symptoms of dehydration…

What clues do we look for in order to delay or prevent dehydration?

Are you adequately hydrated?

Say WUT?



Cheuvront, SN and Sawka, MN (2005) GSSI Sports Science Exchange

Assessing Hydration Status – "WUT" is the answer.

- Weight lost during exercise is primarily water.
- We lose water via breathing, urine and sweat
- Some sweat more than others
- The Question: How much do you lose and how much is too much…?

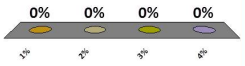
Adapted from: Cheuvront, SN and Sawka, MN (2005) GSSI Sports Science Exchange

Case Study:

Case Study: Pat the Soccer Player	
Pat's weight before exercise	150 pounds
A 2% level of dehydration is equivalent to how many pounds of weight?	2% weight loss = 150 x 0.02 = 3.0
Your Turn: What does 2% dehydration mean for you?	
What is your body weight in pounds?	2% = 3.0 pounds 3% = 4.5 pounds
Pat's weight after a 2 hour practice in a [illegible] would indicate a 1%, 2%, and 3% level of fluid loss/dehydration?	1% = 146 pounds 2% = 3% =
Weight Change? (pre wt. - post practice wt.)	4 pounds lost
Is Pat dehydrated at a 2% or higher level?	Yes! % dehydration = 2.5%
How much water does Pat need to consume following practice to REPLACE what was lost?	4 pounds x 2 cups per pound = **8 cups fluid lost** 8 cups x 1.5 = **12 cups needed for replacement**

Review: What % level of dehydration do you want to stay below?

A. 1%
B. 2%
C. 3%
D. 4%

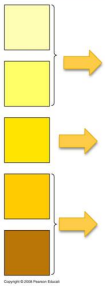


Assessing Hydration Status – "WUT" is the answer.

- Method #2: Assessing Urine Color
- What color was your urine the last time you looked?
- Urine color changes with hydration status

Adapted from: Cheuvront, SN and Sawka, MN (2005) GSSI Sports Science Exchange

Three Levels of Dehydration

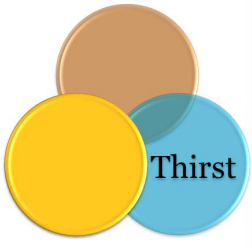


What is the goal for urine color?
- Level 1: straw/watered down lemonade color
- Why not clear?

The darker the urine, the more dehydrated you are. WHY?
- ↓ water content → ↑ concentration

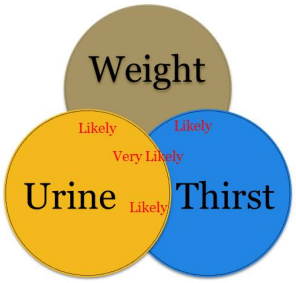
Assessing Hydration Status – "WUT" is the answer.

- Method #3- Thirst
- Thirst cues work well for during the day, but…
- During exercise, if you are you **THIRSTY** you're probably already 1-2% dehydrated.
- Thirst lags behind need.
  - And, thirst is easily turned off by drinking even a little water.
- Thirst: Water vs Gatorade



Adapted from: Cheuvront, SN and Sawka, MN (2005) GSSI Sports Science Exchange

Assessing Hydration Status – "WUT" is the answer.



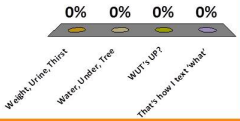
Cheuvront, SN and Sawka, MN (2005) GSSI Sports Science Exchange

WHEN & WHAT TO DRINK:

- Throughout the day: Drink fluids; don't wait until you are thirsty!
- Before Sports: Drink 1-2 cups of cool water at least 4 hours before sports. May need addition 1-2 cups at 1-2 hours prior if urine color is still dark.
- During Sports: Drink ½ -1 cup of cool water or sports drink every 20 minutes. For exercise lasting > 60 minutes, incorporate a sports drink.
- After Sports: Within the following 2 hours, drink 2-3 cups of cool water or sports drink for every pound of body weight you lost during exercise.

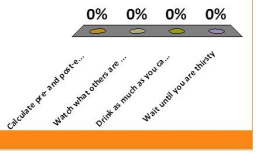
Review: In reference to hydration, what does 'WUT' stand for?

A. Weight, Urine, Thirst
B. Water, Under, Tree
C. WUT's UP?
D. That's how I text 'what'



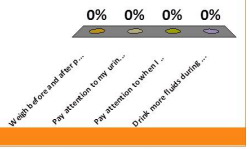
Review: Which of the following is the best way to know your own level of dehydration?

A. Calculate pre- and post-exercise weight
B. Make sure your urine is always clear
C. Wait until your mom tells you to drink water
D. Wait until you are thirsty



Weekly goal: Which one will you try?

A. Weigh before and after practice
B. Pay attention to my urine color during the day
C. Pay attention to when I am thirsty during the day
D. Drink more fluids during practice



Well Done!

- Keep in mind that everyone is different and as a result will need different amounts of fluid.
- Everyone has taste preferences that impact what he or she prefers to eat or drink.
- Put it into practice: Try any new beverages out as a part of a training session, not before or during a game.
- Next week: Pre-Exercise Nutrition

Go CVHS!!

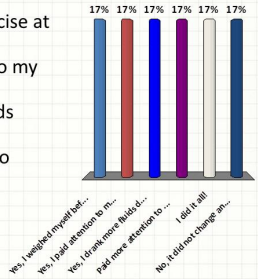
Lesson 2: Pre-Exercise Nutrition

WELCOME BACK

WAVE Project
Nutrition Coach:
Darcie Hill

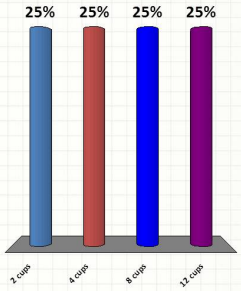
Did your awareness about hydration impact your behavior?

A. Yes, I weighed myself before and after exercise at least once
B. Yes, I paid attention to my urine color
C. Yes, I drank more fluids during practice
D. Paid more attention to when I was thirsty
E. I did it all!
F. No, it did not change anything I did



Let's say that Pat lost 4 pounds during practice, how much fluid does she/he need to consume after practice?

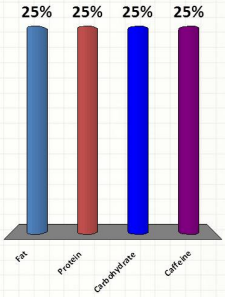
A. 2 cups
B. 4 cups
C. 8 cups
D. 12 cups



Today's Topic:
Pre-Exercise Fueling

Which of the following is the most important macronutrient to fuel your body for soccer?

A. Fat
B. Protein
C. Carbohydrate
D. Caffeine

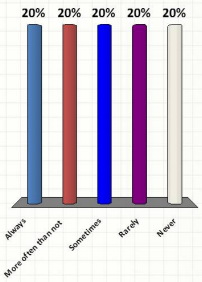


How often do you have a pre-exercise snack within 2 hours of your game or practice?

For those who do consume one– Why?

For those who don't– Why not?

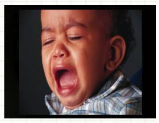
A majority of your reasons may have to do with your own experience…
negative or positive.



Your Experience…

- Have you ever eaten too much before a practice or game?
  - What did you eat? How did you feel?
- Has anyone ever gotten hungry during practice or a game?
  - What did you eat? How did you feel?
- There are a variety of signs and symptoms of an under-fueled athlete…

Symptoms of an Under-fueled Athlete:



- Breakthrough hunger during practice
- Lacking regular speed, endurance, skill, strength
- Unable to complete the practice or game
- Cranky, frustrated, lacking focus

How to prevent this?

- Some foods work well when eaten close to exercise and some do not
  - There is a way to sort foods based on their ingredients so you know **when** to eat it, **what** to eat, and **how much** of it to eat.

Nutrient Timing:

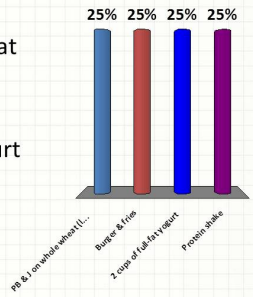
- The times we should consume food and fluids to best enhance sport performance and reduce digestive discomfort.
  - This effects:
    - → **WHEN** we eat
    - → **WHAT** we eat
    - → **HOW** much we eat
  - **The GOAL**: to "top off" fuel and hydration levels in the body

WHEN, WHAT, & HOW MUCH

< 1 hour	1-2 hours	3-4 hours	>4 hours
Keep it simple: water, sugars and starch	Water, Carbohydrates, low fiber	Mini Meal with fluids	Pre-Game Meal
Keep the protein, fat and fiber very low	Lower fat and protein	A little more protein, fat and fiber	Fluids, starch, lean PRO, low fat, some fiber
100-200 kcals	200-300 kcals	300-400 kcals	400+ kcals
Examples: Sports drink, banana –OR- Chewy granola bar, water	Examples: Power bar & fruit -OR- bagel with jam and water	Examples: Whole wheat turkey sandwich w/ mayo, fruit, fluids	Examples: Whole wheat turkey sandwich, fruit, crackers and fluids

Given what you now know, which of these might be a good choice for 2 hours prior to exercise?

A. PB & J on whole wheat (light on PB)
B. Burger & fries
C. 2 cups of full-fat yogurt
D. Protein shake



Activity: Find the Best Fit for Each Food

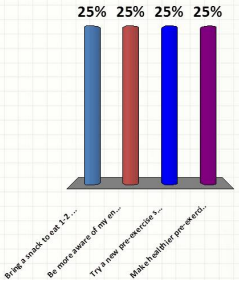
Example Food & Wrapper:

Reminder: Nutrient Timing

< 1 hour	1-2 hours	3-4 hours	>4 hours
Keep it simple: water, sugars and starch	Water, Carbohydrates, low fiber	Mini Meal with fluids	Pre-Game Meal
Keep the protein, fat and fiber very low	Lower fat and protein	A little more protein, fat and fiber	Fluids, starch, lean PRO, low fat, some fiber
100-200 kcals	200-300 kcals	300-400 kcals	400+ kcals
Examples: Sport drink, banana –OR- Chewy granola bar, water	Examples: Power bar, fruit –OR- bagel with jam	Examples: Whole wheat turkey sandwich w/mayo, fruit, fluids	Examples: Whole wheat turkey sandwich, fruit, crackers, and fluids

What will be your goal this week?

A. Bring a snack to eat 1-2 hours before practice.
B. Be more aware of my energy level during practice.
C. Try a new pre-exercise snack at practice from the options presented.
D. Make healthier pre-exercise snack choices.

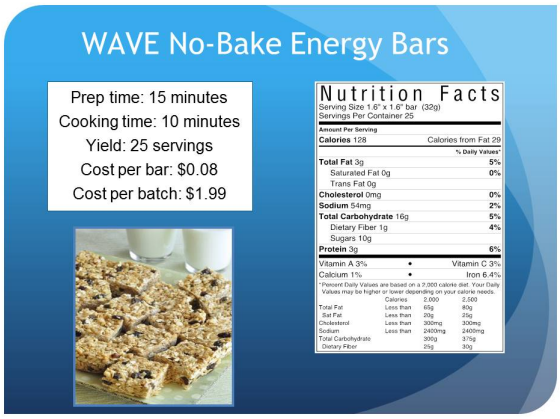


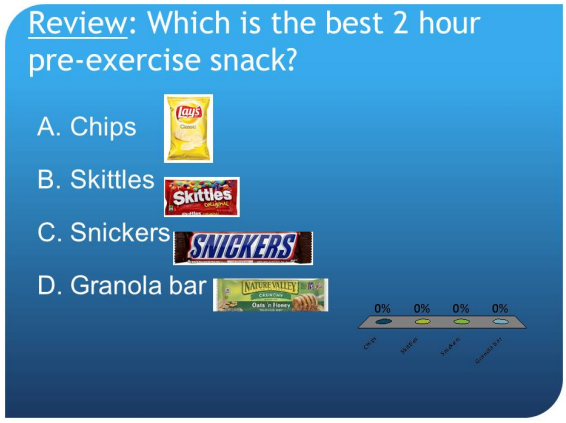
Everyone's Different

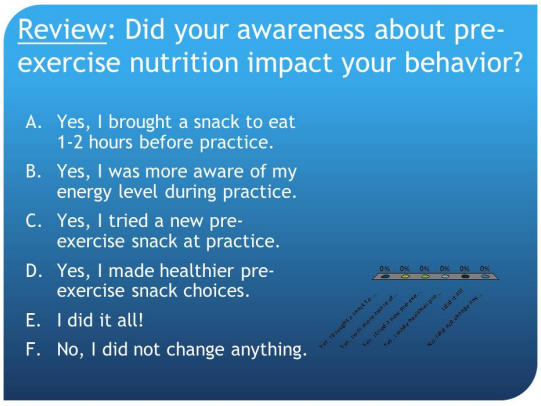
- What's best depends on each individual's digestive system
  - → Some can have a sandwich 30 minutes before practice and be fine
  - → Others would have to consume the sandwich at least 2 hours before practice
- <u>Put it into practice</u>: Whatever you decide to try, try it in practice first.
  - → If it works for you… Game time!!!
- <u>Next week</u>: During-Exercise Nutrition

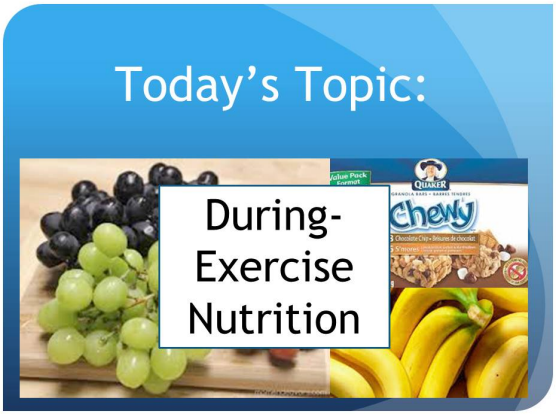
Eat Smart…
Play Hard…
Go Raiders!

Lesson 3: During Exercise Nutrition



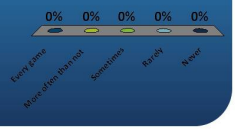






How often do you consume a carbohydrate-containing beverage or food DURING your game?

A. Every game
B. More often than not
C. Sometimes
D. Rarely
E. Never



Which of the following can occur from inadequate fueling during-exercise?

- Inadequate fueling during exercise can result in:
  - Limited improvement from training
  - Inconsistent performance
    - → Lower performance level
- Overall, a less focused, slower, more frustrated & fatigued player
- Increased risk of injury & illness…

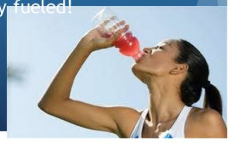
Example of Inadequate Fueling During-Exercise:

"The Crawl"

http://youtu.be/MTn1v5TGK_w#aid=P9A_ylXtIlo

How to Prevent Underfueling During Exercise:

1. Always be prepared: Bring fuel for practices & games
2. For exercise lasting > 1 hour:
   - ✓ Consume carbohydrates during the event (drink or food)
   - ✓ Goal: 30-60g of carbohydrate per hour
   - ✓ Our bodies can absorb about 60g of carb per hour
   - ✓ Another reason to be diligent & consistent on keeping your body adequately fueled!
3. Individualize your own plan



ACTIVITY: During Exercise Fueling Needs

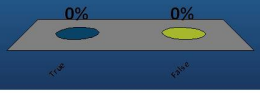
During Exercise Carbohydrate (CHO) & Hydration Recommendations			
Exercise Duration		**During exercise CHO needs**	**During Exercise Hydration**
A	60 or less minutes	None (if you have pre-fueled well)	Water every 20 minutes
B	Greater than 60 minutes	30-60 grams of carbohydrate per hour. Choose 30 for lower intensity and stop-and-go sports, and choose 60 grams per hour for higher intensity, and continuous exercise.	½ - 1 cup water or sports drink* every 20 minutes
C	4 hours or more and at lower intensities	60-90 g of CHO per hour, and may include a little protein.	½ - 1 cup water or sports drink* every 20 minutes

Calculate During Exercise Carbohydrate Needs:			
Question		**Your Answer**	
1	How long is your average practice or game (include warm up)?	_____ Hours	
2	How many grams of carbohydrate are needed per hour based on your exercise duration (#1) (circle one option)	None 60 g/hr.	30 g/hr. 60-90 g/hr.
3	#1 (duration of exercise) x #2 (carbohydrate per hour recommendation) = grams of carbohydrate needed for your exercise session	#1 x #2 =	

→ Choose Food & Beverage Options For You…

REVIEW: During a 90 minute event(EX: soccer game including warm-up), consuming a carbohydrate-containing sports drink will help performance.

A. True
B. False



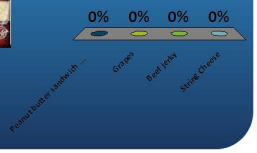
Review: In order to maintain or improve your performance, which of the following would be the best half-time snack?

A. Peanut butter sandwich crackers

B. Grapes

C. Beef jerky

D. String Cheese



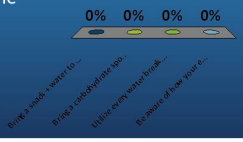
What will your goal(s) be this week?

A. Bring a snack + water to consume during practice and games.

B. Bring a carbohydrate sport drink to consume during practice and games.

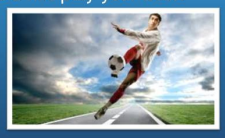
C. Utilize every water break during practice to consume water + sports drink.

D. Be aware of how your energy level may differ during the 1st half compared to the 2nd half.



Think about this...

- Even the best pre-game meal cannot provide enough energy to fuel your entire soccer practice or game.
- Fueling DURING exercise provides you with the energy you need to finish strong.
- RULE OUT inadequate fueling and hydration as a reason you did not play your best.



- Pay attention to your symptoms & do what works best for you!
- Next Week: Post-Exercise "Recovery" Nutrition

Go CVHS Soccer!!!

Lesson 4: Post-Exercise Nutrition

WAVE Sports Nutrition

Nutrition Coach: Darcie Hill

Recovery Parfaits

- How are fruit, yogurt, and nuts good recovery foods?
  - **Yogurt:** high quality milk protein. Our bodies use protein to rebuild and repair muscle tissue after exercise
  - **Granola:** carb, protein & healthy fat
  - **Fruit:** source of carbohydrate
- Recovery Parfait Recipe & Nutrition Info.
  - **Recommended Serving:**
    - ¾ cup (6oz) non-fat Greek vanilla yogurt
    - ½ cup fruit = ½ banana (can also sub other fruit)
    - ¼ cup granola

Nutrition Facts

Serving Size (255g)
Servings Per Container 1

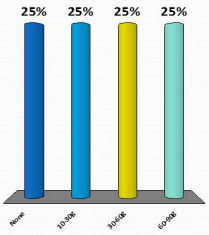
Amount Per Serving

Calories 260	Calories from Fat 15
	% Daily Value*
Total Fat 1.5g	2%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 80mg	3%
Total Carbohydrate 44g	15%
Dietary Fiber 4g	16%
Sugars 23g	
Protein 20g	

- Nutrition Facts are based on the use of bananas as the fruit
- NOTE: Amount varied by individual and sport.

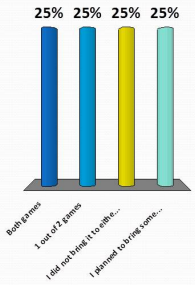
Review: When your activity lasts at least an hour, how many grams of carbohydrate (CHO) should you try to consume throughout the event?

A. None
B. 10-30 g CHO
C. 30-60 g CHO
D. 60-90 g CHO



Review: Did your awareness about pre-exercise nutrition impact your behavior?

A. Yes, I brought a snack + water to have during practice and games.
B. Yes, I brought a CHO sport drink to have during practice and games.
C. Yes, I utilize every water break during practice to consume water and/or sports drink.
D. Yes, I was more aware of how my energy level differed during the 1st half compared to the 2nd half.
E. I did it all!
F. No, I did not change anything ☹

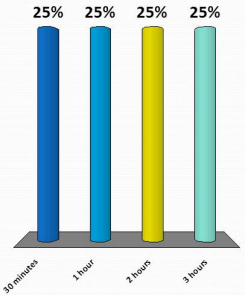


Today's Topic:

Post-Exercise/Recovery Nutrition

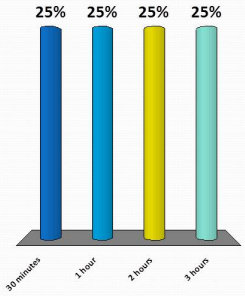
How quickly do **YOU** usually consume a snack or meal after your games?

A. 30 minutes
B. 1 hour
C. 2 hours
D. 3 hours



How soon after exercise should you consume a meal or a snack?

A. 30 minutes
B. 1 hour
C. 2 hours
D. 3 hours



Fundamentals of Recovery Nutrition

- General recommendation:
  - ~0.5-0.7g of CHO per pound BW for each hour of exercise
    -AND-
  - ~15-25 grams of protein (PRO)
- Recommendation varies on body size, sport and how quickly you need to recover.

Position of the American Dietetic Association, Dietetics of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance Before, During and After Exercise- Adapting the joint position statement into practical guidelines. 2009. *Journal of ADA.* 109(3):509-527.

Activity: Recovery Nutrition

What is your current body weight?				
How Long/Intense was your exercise? **(circle one)**	60 minutes or less	60-90 minutes	90+ minutes, or very high intensity training >60 minutes	> 60 minutes or very intense but (can't eat much full amount needed right after practice)
Calculate your carbohydrate needs for recovery. BW x 0.5-0.7 g =	Not likely to need rapid recovery nutrition. Consume a balanced meal within 2-3 hours.	0.5-0.7 g of CHO per pound of body weight, within 30 min _____	0.5-0.7 g of CHO per pound of body weight, within 30 min. and a high CHO food again at 3 and 6 hours post. _____	Consume ***50 grams*** of carbohydrate, eat a high CHO meal within 2 hours
Protein needs for recovery do not need individualization	No additional protein needed. Consume a balanced meal within 2-3 hours.	15-25 g	15-25 g	7-14 g (repeat within 2 hours)

Recovery Nutrition Activity

Using the wrappers provided, and their nutrition information, design a recovery snack that meets recovery nutrition guidelines:

- **~0.5-0.7g CHO/pound of body weight (BW)**
- **~15-25g PRO**

What's Next?

- This will be our last in-class lesson for the year
- What did you enjoyed the most? Anything you were hoping to learn but didn't? Anything else you would like to share with me?
- Next week will be our final assessments
- Booster lessons- TBD

Go CVHS!!

APPENDIX C

WAVE Lesson Plans

The following sport nutrition lessons were developed prior to the face-to-face lessons delivered to the intervention group. The lessons are similar in nature to those delivered in the face-to-face lessons.

WAVE Lesson Plan

Week 4

Pre-exercise Knowledge Delivery

Timing	Activity	Activity Detail
	Materials	20 copies each handout 3,5 White board and markers in the classroom 20 pencils 20 blank index cards 20 bananas 20 small calculators
	Preparation	All materials collected in a bin All handouts printed One banana, pencil, and notecard at each seat Classroom should be in a conformation that facilitates discussion and group work
5'	Activity 1: Discussion: Personal nutrition routines	Instructor: *Welcome back, I hope that this last week has gone well for you and your nutrition goals. Today we will be talking about how best to fuel before practice and games. Does anyone have a nutrition routine before exercising? Certain foods you feel you should eat or cannot eat?* Students have time to reply Some further questions to ask students who volunteer information: *How do you normally feel during practice?* *What types of foods do you eat for lunch?* *Do you normally have a snack before a 3 or 4 pm practice session?* *Now that we have thought about our personal habits before exercise, we will discuss how nutrient timing can affect performance.*
20'	Activity 2: Discussion: Nutrient digestion and timing	*Has anyone heard of the term nutrient timing?* Take a pause, students may not answer *"Nutrient timing" is how we can place foods around exercise to best fuel our muscles, and avoid any discomfort due to indigestion.*

First, can anyone tell me one of the key macronutrients?

Wait for student responses, each macronutrient is suggested by one student
Write the macronutrients on the board as students get them correct (CHO,PRO, FAT)

Carbohydrate is the main fuel for our body when we are exercising. Protein is a building block for muscles, and fat is an energy-dense fuel, but digests more slowly than carbohydrate. Now, which would be a better snack before a game- a peanut butter and jelly sandwich or a bowl of ice cream?

Student responses

Would your answer change if I said that there was more energy, as in calories, in the ice cream than in the sandwich? Why would the sandwich be a better idea?

Student responses
(answers to look for: ice cream has more fat, does not digest as quickly as the sandwich, ice cream would not sit on the stomach very well)

Good. Now what could you say about fat digestion from what you just figured out? I mentioned this a little bit earlier!

(fat takes a long time to digest)

What about carhohydrate digestion? What can you tell me about that?

(CHO digests faster, energy from it faster)

Any questions?

Now we have to be careful with fiber. This is a complex type of carbohydrate, but it takes longer to digest than a simple carbohydrate. What are some examples of foods that have simple carbohydrates and some that have fiber?

(Simple CHO: bread, pasta, etc)
(Fiber: fruits, veggies)

Good. Now if we had to plan meals for an athlete four hours before practice, what would we put right before practice, maybe

		an hour out? (CHO- PB and J sandwich, bagel and honey) *What could this athlete be ok to eat four hours away from practice?* (Larger meal, could have some more fat, fiber) *Good! And remember, a lot of this depends on individual digestion, some people can have a sandwich 30 minutes before practice and be fine, and other people could only eat that 2 hours before practice.*
10'	Activity 3: Worksheet: Handout #5	Instructor distributes handouts. *Now that we have discussed timing of nutrients, we will look at some handouts with ideas for your own pre-exercise nutrition. If you look at handout 5, you will see that there are some calculations to be done. This is to determine a personalized intake pre-practice, so you have a general idea of what you might need. If you don't know exactly how much you weigh, that's fine, just get an approximation.* *We will have some time now to work on this, if you have any questions let me know.*
10'	Activity 4: Discussion: Consequences of poor fueling	*How was the worksheet for everyone? What do you think are some consequences of poor fueling?* Students respond Potential answers: gastrointestinal discomfort, sluggishness, tired, bloated *Has anyone ever experienced the effects of poor fueling?* Students respond *These are all good examples of a lack of energy stored in the muscles. The less is in the muscles as glycogen before exercise, the less quickly energy will be available, and the more performance will decrease.*
5'	Closure	*Does anyone have any questions about the material we discussed today? What are some nutrition goals that you have for this next week to improve your pre-exercise nutrition?* *Raise your hand if you will try:* *1) Eating a pre-exercise snack* *2) Eat a more healthful pre-exercise snack*

3) *Eat a more healthful lunch*
4) *Be more aware of my choices before I go to practice.*

Have a good week!

WAVE Lesson Plan

Week 5

Pre-exercise Nutrition Application

Timing	Activity	Activity Detail
	Materials	Food materials - Packaged food wrappers: - Energy bars (Cliff bar, Powerbar, Nature Valley, Luna bar) - Fruit flavored regular low-fat or skim yogurt - Bread (white, wheat, whole wheat) - Peanut butter (Jiff, Fred Meyer plain creamy) - Hummus - Wheat thins (regular, reduced fat) - Granola (Quaker honey and oat) - Cheerios (regular) - Pizza (frozen) - Non-packaged food models: - Fruit: apple, banana - Vegetables: carrots, cucumber 20 pencils 20 blank index cards White board and markers in classroom 20 handouts: Pre-Exercise Nutrition Activity 20 personal nutrition booklets
	Preparation	- Collect all materials - All handouts printed - Food labels separated into 5-6 folders. Each folder should have a combination of foods for 4+ hrs, 2-4 hrs, and <1 hr pre-exercise - Pencil, index card, and handout placed at each seat - Food label folder placed at each table
5'	Intro	*Hello everyone! Did you all have a good week?* *Today, we will be applying the concepts that we learned about last week for pre-exercise nutrition. First, what are some key points to remember about pre-exercise nutrition?* Students respond, answers to look for: larger meals further away from practice, smaller towards practice, carbohydrate and protein important nutrients
15'	Activity 1: Snack decision	*These are important to keep in mind as we go through today. Today we will be doing an activity with the handouts and folders on each table. Inside each folder there are food lables-*

	making	*some are good to each further from practice and some closer to practice. You will be choosing different foods to fill in the time spots on the handout in front of you.* Give students time to browse the different items, answer questions as needed *What did you get for 4+ hours before practice? Why did you pick those foods?* Pick a group to respond Instructor should proceed through each section of the assignment, ask groups of students what they got for the section and why.
10'	Activity 2: Discussion: Obstacles and solutions to pre-ex nutrition	*We are going to discuss obstacles to finding good nutrition before practice. What are some obstacles that you have experienced in getting good nutrition before practice?* Students respond Instructor should facilitate a discussion of obstacles and solutions based on the following questions and potential solutions. Student responses are necessary Potential discussion questions: How many people eat a well-balanced breakfast/lunch/snacks before practice? Does anyone ever go to practice hungry? Why do you think this happens? Can you identify obstacles to getting quality food before practice that you or someone else has experienced? Tournaments and difficulty with food choices? Suggested solutions: Time (class, sleep, homework, family, friends) - Solutions: Have a list of foods available that do not take much preparation time Materials (grocery store, ingredients) - Solutions: Go with parents to store and make sure there are good foods bought Dietary restrictions/ allergies - Solutions: talk to your doctor and understand what types of foods are off limits, create alternatives to limit cravings. Also can limit the availability of restricted foods by asking parents to not buy them No place to store perishable food away from home - Solutions: Eat perishable foods early in day, have a knowledge of snacks that do not need refrigeration

15'	Activity 3: Personal pre-event nutrition plans	*Now we will apply this information even more.* Assistants begin handing out the personal nutrition plan booklets *We are handing out personal nutrition booklets that you will use now, in a couple of weeks, and then as a nutrition reference as long as you like. Today, we will just be filling out the pre-exercise nutrition plan section.* Instructor gives a brief explanation of the first few reference pages, then shows how the pre-exercise plan will work *You can get started, and if you have any questions let me know.* Remainder of time is spent on the booklets
5'	Closure	*We will hang onto the booklets, so that they do not get lost in the span of two weeks. See you next week!* Assistants or instructor should circle the room and collect bookelts

WAVE Lesson Plan

Week 6

Post-Exercise Knowledge Delivery

Timing	Activity	Activity Detail
	Materials	Sample snack wrappers - Packaged food wrappers: - Energy bars (Cliff bar, Powerbar, Nature Valley, Luna bar) - Fruit flavored regular low-fat or skim yogurt - Bread (white, wheat, whole wheat) - Peanut butter (Jiff, Fred Meyer plain creamy) - Hummus - Granola (Quaker honey and oat) - Wheat thins (regular and reduced fat) - Cheerios (regular) - Pizza (frozen) Non-packaged food information - Fruit: apple, banana - Vegetables: carrots, cucumber Classroom whiteboards and whiteboard markers Handout #4, #5 20 blank index cards 20 pencils 20 calculators
	Preparation	Whiteboards should be cleared of other distracting material. The guidelines for optimal CHO and PRO post-exercise should be recorded on the board, large enough for all students to see. - This information is: 80-100 g CHO, 15-25 g PRO Write the carbohydrate and protein information for the non-packaged food on the board. - 1 apple: 25 g CHO, 0 g PRO - 1 banana: 27 g CHO, 1 g PRO - ½ cup carrots: 6 g CHO, 1 g PRO - ½ cup cucumber: 2 g CHO, 0 g PRO Pencil, index card, and handouts placed at each seat Food label packets placed at each table
5'	Introduction	*Hello, welcome back. How have the goals for pre-exercise nutrition worked out. How many people have reached one or more of their goals?* Students raise hands, comment

		How many people felt that their practices went better with a better lunch or snack before practice? Students raise hands, comment *This is great! Today we will be moving on from pre-exercise nutrition to post-exercise nutrition. Post exercise nutrition includes everything from the minute you end practice up until the next practice, essentially. There is a constant recovery and preparation process. For today, we will be focusing on the 4-6 hours right after practice, and what will best help you recover in that time frame.*
15'	Activity 1: Food labels for high/low PRO + CHO	*What comes to mind when you hear "recovery nutrition"?* Students respond *What macronutrients do you think should be included in a good recovery snack or meal?* Students respond *These are good suggestions! Carbohydrate and protein are the main ingredients we want to get in right after practice or a game. Carbohydrate will help re-fuel our muscle glycogen stores, and the protein will help rebuild any muscle tissue that we worked hard during exercise, making us stronger for the next practice.* *It is suggested that you try to get 80-100 grams of carbohydrate and 15-25 grams of protein after a workout. This will change a bit with your weight, and we will be calculating that a bit later.* *In this activity, we will be looking at the same food label packets that we did last class, this time with a post-exercise mindset. Each group choose three good snacks for right after practice that have about the right amount of carbohydrate and protein.* Students look through packets, make choices *What are some ideas that you have?* Instructor chooses groups to present some of their ideas *This is good! You are all getting the right idea.*
10'	Activity 2: Handout #5	*Our next activity is the second part of the handout that we looked at a couple weeks ago, in pre-exercise nutrition. Each of*

	part 2	*you will be calculating your post-exercise needs based on an approximate weight. Go ahead and get started!* Students have time to work on the activity, instructor answers questions *Is everyone nearly done? How do your personal values compare to the 80-100 g carbohydrate, and 15-25 grams protein? Are you in the higher or lower end of the range? How does this compare to the foods that you chose for the post-exercise snack? Would that snack be too big? Too small?* Instructor can ask some or all of these questions to individuals who volunteer personal information. *Does anyone have any questions on anything we have done so far?*
10'	Activity 3: Nutrition during exercise: Handout #4	*This next activity will be more focused on during exercise nutrition, which is another important part of your sports nutrition diet. Does anyone regularly eat or drink anything other than water during practice or games? How do you feel during exercise when you do this?* Students respond *Good responses. We will look a little closer at this now.* Instructor/ assistants pass out Handout #4 *We are passing out this next handout, which will serve as a reference for you as we talk about nutrition during exercise. As you look at it, there is some general information at the top about pre-and post- exercise nutrition, and then at the bottom there is information about during exercise carbohydrate intake.* *In general, foods that are mainly carbohydrate and easy to digest are suggested. Why might this be?* Students reply: not feel sick during exercise, so that the body can access the nutrients *Exactly. Do you think you would need food during a 30 minute practice, or just plenty of water?* Students respond: NO, just plenty of water

		Why not? Students respond- they may not know *This is because there is plenty of glycogen - the carbohydrate that is stored in the muscles that is easy to use for energy- in the body to last for 2-3 hours of pretty hard exercise. It is a good idea, though, to start having small snacks after about 1 hour of moderate to intense exercise. Why do you think this is? How would it help performance?* Students respond: enhances endurance, can supplement the muscle glycogen, etc *Very good! Are there any questions about how this works, or about eating during exercise in general?*
5'	Closure	*What are some goals you have for this next week for your during and post exercise nutrition? You can pick as many of the following as you would like:* 1) Drink some Gatorade during long practices 2) Bring a small carbohydrate snack for half-time of games 3) Bring a snack with carbohydrate and protein for after practice 4) Have a full meal with carbohydrate and protein within 30 minutes to 1 hour after practice *Have a good week!*

WAVE Lesson Plan

Week 7

Post-Exercise Knowledge Application

Timing	Activity	Activity Detail
	Materials	Food materials - Bananas - Greek yogurt- 1% milkfat - Frozen berry medley - Sliced almonds - Plastic cups - Plastic spoons - Serving spoons for berries, almonds and yogurt - 2 bowls for berries and almonds - Measuring utensils- ½ C, ¼ C, tsp, tbsp. - Ice chest/cooler 20 personal nutrition plan booklets 20 pencils 20 blank index cards
	Preparation	All materials packed Pencil and index card at each seat ½ C yogurt in each plastic cup Berries in a bowl with serving spoon Almonds in bowl with serving spoon All food materials on clean surfaces accessible by all students
5'	Intro	*Hello everyone! Today we are going to be doing post-exercise nutrition again, but a little differently than last week. We will be making our own recovery snacks! Everyone, as you come in, head over to the counter to make your snacks, my assistants will be helping you out.*
25'	Activity 1: Hands on snack prep	Students file through the line for the yogurt parfaits Assistants help with food distribution When students have food, they will go to their seats
15'	Activity 2: Personal post-event nutrition plans	*Now that we all have some food, let's see how we did with those nutrition goals. How many people met some or all of their goals? Did you feel better in the next practice with better recovery the day before? Any other experiences?* Students respond *We are going to go onto the next activity, if you are eating still*

		that's fine. Assistants begin handing out the personal nutrition plan booklets *Right now you are getting your personal nutrition booklets back that we worked on a couple weeks ago in pre-exercise nutrition. Just as we did at the end of the pre-exercise nutrition lessons, we will now be applying our knowledge of post-exercise nutrition to ourselves, and making personal plans. Once you have your booklet, you may begin. We have the rest of the class time to work on the post-exercise plans*. Instructor and assistants move about the room, prompting students and answering questions
5'	Closure	*We are going to answer some of the questions that we have been receiving on the notecards in the last few minutes that we have today.* Instructor should have 3-5 question cards that they have selected to answer, and answer these questions with appropriate nutrition knowledge. *Any questions that anyone has right now?* Students have time to respond *We will see you all next week!*