House Resolution No. 501

Comprehensive Sports Nutrition Education Program for High School Athletes in Pennsylvania

Report prepared for the General Assembly of Pennsylvania Health and Human Services Committee, as delineated by HR 501

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SUMMARY

Research has clearly documented the beneficial effects of nutrition on exercise performance. What an athlete eats and drinks can affect health, body weight and composition, fuel availability during exercise, recovery time and the ability to train and compete at a higher level[1]. A well-balanced diet with the appropriate combination of nutrients and timing is critical in maximizing athletic performance. Despite the documented benefits, nutrition is the most commonly overlooked component in an adolescent athlete's training program. Foods that form the base of an optimal sports diet include plenty of whole grains, fruits, vegetables, dairy products, lean meats and proteins and fluids. However, few adolescents follow this type of diet plan.

High school (HS) athletes are particularly vulnerable to nutritional risks because of the rigorous demands of their sport, food preferences and eating styles, which predispose them to insufficient fueling, fatigue and injury. Providing sufficient energy is further complicated by adolescent growth spurts, body weight and composition demands of particular sports and higher energy costs of physical activities when compared to adults. In an attempt to be the best at their respective sports, adolescents may resort to unhealthy eating habits which not only impair athletic performance, but ultimately compromise their health, growth, and development.

Individuals advising HS athletes on nutrition for performance must be able to design sound and safe nutrition programs which meet the needs of today's youth athletes who participate in a variety of different sports, each presenting its own unique set of nutrition issues. Teaching student-athletes about the proper use of foods and fluids with the right nutrient combinations and given at the right time allows them to accomplish their goals and improve performance in a healthful way.

HR 501 was promulgated to prepare and recommend a sports nutrition educational program directed at teenage athletes that may be utilized by high school coaches and athletic directors in the Commonwealth of Pennsylvania. This report responds by delineating:

- Background on the issue
- Nutrition requirements of HS athletes

- The role of sports nutrition foods
- Dietary supplements, steroids and HS athletes
- Nutrition knowledge of HS athletes and coaches
- Current sports nutrition resources available
- Recommended plan for a sports nutrition education program for Pennsylvania HS athletes.

BACKGROUND ON THE ISSUE

Over the past 25 years, research has clearly documented the beneficial effects of nutrition on exercise performance. There is no doubt that what an athlete eats and drinks can affect health, body weight and composition, fuel availability during exercise, recovery time and the ability to train and compete at a higher level[1]. A well-balanced diet with the appropriate combination of nutrients and timing is critical in maximizing athletic performance. Despite the documented benefits, nutrition is the most commonly overlooked component in an adolescent athlete's training program. Foods that form the base of an optimal sports diet include plenty of whole grains, fruits, vegetables, dairy products, lean meats and proteins and fluids. However, few adolescents follow this type of diet plan. Unfortunately, a typical daily menu for many adolescents consists of sugar sweetened cereals, muffins, doughnuts (if breakfast is consumed), pizza, burgers, French fries for lunch, snack foods like candy and chips in the afternoon and evenings, and fast food meals on the go coming home from practice. Super-sized soft drinks, Vente lattes and flavored ice tea often provide the fluids to wash it all down. According to the Youth Risk Behavior Surveillance Survey (YRBSS) 2007 and Healthy People 2010 (HP 2010) midcourse data, few adolescents meet the Dietary Guidelines for Americans recommended servings for fruits, vegetables, whole grains, and dairy [2-4]. Furthermore, adolescents consume greater than 30% of calories from fat, which likely reduces the amounts of either or both carbohydrates and protein, two vital components of a sport nutrition diet. Additionally, the eating habits of teens consist of meal-skipping or erratic eating, snacking, reliance on fast foods [5]. These dietary habits of adolescents are not consistent with a sound sports nutrition diet that maximizes athletic performance and overall health and wellbeing.

High school (HS) athletes are particularly vulnerable to nutritional risks because of the rigorous demands of their sport, food preferences and eating styles, which predispose them to insufficient fueling, fatigue and injury. Providing sufficient energy is further complicated by adolescent growth spurts, body weight and composition demands of particular sports and higher energy costs of physical activities when compared to adults. Individuals advising student athletes on nutrition for performance must be able to design sound and safe nutrition programs which meet the needs of today's youth athletes who participate in a variety of different sports, each presenting its own unique set of nutrition issues. Examples of these requirements and the difficulties in meeting them include: a female cross country runner told to reduce her body fat quickly so she will run faster but who's time is gradually increasing each week, a baseball pitcher who daily eats convenience and fast foods but adds large amounts of protein powder in

an attempt to get stronger so he can throw a 90 mph fast ball, a wrestler trying to compete in a lower weight class who complains of extreme fatigue and lack of energy as the state tournament is about to begin, a gymnast who battles a reoccurring stress fracture in her foot and is forced to sit out of competition, the parent of an offensive lineman inquiring about using creatine supplements to increase muscle size and strength, and a soccer player with not enough leg power to chase down a break away at the end of her 3rd game of the week allowing in the winning goal. This group of real-life scenarios only begins to represent the complex nutritional issues faced by adolescent athletes, coaches and parents.

Increased sports participation and competitiveness, greater pressures by coaches and parents, and a preoccupation with body image, drive some athletes to resort to unhealthy weight-control practices, including food restriction, vomiting, over-exercising, diet pill use, voluntary dehydration, or inappropriate use of prescribed stimulants, insulin, nicotine, laxatives, or diuretics. These practices can result in a multitude of medical complications including delayed physical maturation and/or permanent growth impairment, menstrual abnormalities, disordered eating, infections, depression and changes in cardiovascular, endocrine, gastrointestinal, renal and thermoregulatory systems, none of which helps to improve physical performance. Studies examining female HS athletes across the country, found 20% met the criteria for disordered eating, 24% for menstrual irregularities and 22% for low bone mass.[6, 7] Optimizing energy intake for sports performance while controlling body weight, poses a significant challenge.

Athletes attempting to gain weight and lean mass, also often resort to unhealthy practices such as excessive amounts of dietary protein, amino acid supplements, or potentially unsafe, unproven dietary supplements. High school athletes in sports, such as football and basketball, often want to increase their body size and weight for strength and dominance. Athletes having higher body mass index (BMI) and body fat however, have reduced cardiovascular fitness, endurance and mobility. Further, there is evidence that increased size and weight make these athletes more susceptible to injury. Studies have shown that varsity and junior varsity HS football players with a higher percent body fat and increased BMI were associated with an increased risk of lower-extremity injuries. Overweight players were nine-fold more likely to sustain a second ankle sprain [8]. Additionally excess body weight carried through adolescence greatly increases an individual's chances of being overweight or obese as an adult, thereby increasing the risk for many deadly chronic diseases later in life.

In general, the diets of most adolescent athletes today are inadequate in fruits, vegetables, whole grains and low fat dairy. In addition, they consume diets high in fat and skip meals. In an attempt to be the best at their respective sports, adolescents may resort to unhealthy eating habits which not only impair athletic performance, but ultimately compromise their health, growth, and development. Teaching student-athletes about the proper use of foods and fluids with the right nutrient combinations and given at the right time will allow them to accomplish their goals and improve performance in a healthful way.

NUTRITION REQUIREMENTS FOR HS ATHLETES

Energy Requirements

Nutritional requirements to meet the demands of intense physical training and for optimizing performance in adolescent athletes include sufficient energy intake, adequate hydration and proper timing of meals/snacks. Youth athletes must consume adequate calories to not only support continued growth through adolescence, but also to properly fuel the body for intense physical training and competition. Unfortunately, few studies have directly measured the energy expenditure of adolescents performing intense physical activity. Estimates of energy expenditure are often extrapolated from adult data; however, there are errors inherent with this approach [9]. The dietary reference intake (DRI) equations are based on age, gender, and factors to accommodate for growth and level of physical activity [10]. The estimated energy expenditure formulas provide a general guideline for adolescent athletes to estimate their daily energy requirement. In general for adolescents 14-18 years categorized as active to very active, the DRI recommends between 35-65 calories per kilogram (kg) body weight (16-30 calories per pound). However, caution should be used in utilizing these guidelines to estimate the energy requirements of the youth athlete who engages in successive days of intense physical training and competition because the true energy requirements are most likely under-estimated [11].

Macronutrient (Carbohydrate, Protein and Fat) Requirements

Additionally, to meet the nutritional needs for intense physical training and health, the adolescent's diet should provide sufficient amounts of carbohydrate, protein and fat. Carbohydrates are the primary fuel utilized during intense physical training and the amount required depends on the athlete's body weight, intensity and duration of exercise, total daily energy expenditure, and environmental conditions. In general to meet the demands of moderate to heavy training up to 2 hours per day, athletes should consume between 5-8 grams of carbohydrate per kg body weight (2.3-3.6 grams carbohydrate per pound)[9, 11]. Athletes who train more than 2 hours per day will need additional carbohydrates (10-12 grams of carbohydrate per kg body weight per day)[9, 11].

Protein is an essential part of the athlete's diet. For adolescents, the recommendations are to consume approximately 0.9 grams of protein per kg body weight per day [10]. However, the average teenager usually consumes about 1.3 grams protein per kg body weight per day [12]. Few studies are available to address the issue of whether adolescent athletes need and/or would benefit from additional protein during periods of intense physical training [11]. Once again because of the lack of scientific data on youth athletes, the guidelines for adults are used to guide adolescent athletes. Novice athletes just embarking on a training program should consume between 1.0-1.5 g protein per kg body weight per day to minimize the losses associated with protein turnover. Youth participating in endurance training or sports may need slightly higher amounts than the DRI, ranging from 1.2-1.4 g protein per kg body weight per day for the repair of muscles damaged by intense training, the synthesis of enzymes stimulated by endurance training and as an additional source of fuel. Adolescent athletes engaging in sports requiring predominantly strength training may also require slightly higher amounts of protein of up to 1.7 grams protein per kg body weight per day [1, 12-14]. Youth athletes should include protein rich foods containing the essential amino acids (high biological value proteins) such as lean meats, fish, poultry, low fat milk, cheese, yogurt and eggs into their diets to meet the additional protein requirement for building and repairing lean muscle mass. While protein supplements can provide a convenient source of protein, to date, no studies have shown a performance advantage of ingesting protein supplements over natural, protein-containing foods [15].

Dietary recommendations for active individuals have typically focused on providing adequate intakes of carbohydrate and protein, and keeping fat intake to 20-30% of energy intake[1]. According to the YRBSS, 70% of adolescents consume greater than 30% of their calories from fat. Diets higher in fat (>30% of calories from fat), may compromise athletic performance and optimal recovery from physical training[9]. However, fat is a necessary component of the adolescent's diet and should be low in saturated and trans fats, while providing adequate amounts of essential fatty acids. In addition, low fat intakes (<15-17% of energy) are generally not recommended for active individuals[1, 14]. Low fat diets may not meet the energy demands for growth and development in the youth athlete and the energy needs for endurance performance.

TABLE 1: Nutrition Requirements for Intense Physical Training

Fundamentals of Nutrition	Nutritional Recommendation
Calories to fuel intense physical training and to support growth	• Female & males exercising < 90 mins/day 35-40 calories/kg body wt (16-18 calories/pound) • Female athletes exercise > 90 mins/day 42-51 calories/kg body wt(19-23 calories/pound) • Male athletes exercise > 90 mins/day 45-65 calories/kg body wt (20-30 calories/pound)
Carbohydrates (primary fuel utilized during intense physical training)	5-8 g carbohydrate per kg body wt (2.3-3.7 grams carbohydrate per pound body wt)
Protein	Aerobic or endurance sports 1.2-1.4 g protein per kg body wt (2.6-3.1 g protein per pound body wt) Strength training athletes 1.7 g protein per kg body wt (3.1 g protein per pound of body wt)
Fat	20- 30% of total calories Saturated fat <10 % of total calories
Vitamins & Minerals	100% DRI for vitamins & minerals Calcium 1300 mg/day Iron 11 mg/day males; 15 mg/day for females

Micronutrient Requirements

According to the American College of Sports Medicine and the American Dietetic Association, "in general, no vitamin and mineral supplements should be required if an athlete is consuming adequate energy from a variety of foods to maintain body weight. If an athlete is dieting, eliminating foods or food groups, is ill or recovering from injury, or has a specific micronutrient deficiency, a multivitamin/mineral supplement may be appropriate [16]. As is evident by consumption surveys such as the YRBSS, adolescents avoid and/or have very low

intake of fruit (23% met the minimum serving 2 fruits per day), vegetables (2% met the recommended 3 servings vegetables), dairy (14% met) and whole grains (10% met); therefore it is not surprising that reported vitamin intakes were below the DRI [9]. Nutrients reported most often in less-than-adequate amounts for the school-aged child include calcium, iron, zinc, vitamins A, C, E and B6 [9, 17]. Calcium is especially critical in adolescents, as inadequate consumption may place youth athletes at a risk for stress fractures and osteoporosis [9-11]. Adolescent athletes should be encouraged to consume sufficient fruits, vegetables, whole grains and low fat dairy to obtain adequate amounts of vitamins and minerals needed for overall health and optimal performance[11].

In general, the immune system is suppressed by intensive training, which worsens with successive days of training and inadequate nutrient intake. This increases the risk of infectious illness and injury during this time. Many nutrients or dietary factors (for example, vitamins C and E, glutamine, and zinc) have been proposed to aid in reducing the oxidative stress that results from high intensity exercise and thus boosting the immune system. However, none have proved to provide universal protection. The most recent evidence points to carbohydrate as one of the most promising nutritional immune protectors [11]. Consuming carbohydrate during and/or after a prolonged or high-intensity work-out has been shown to reduce the disturbance to immune system markers. Carbohydrate intake may be beneficial for a number of reasons. For example, it reduces the stress hormone response to exercise thus minimizing its effect on the immune system. It also supplies glucose to fuel the activity of many of the immune system white cells. Further, it allows for sufficient refueling of muscle glycogen (fuel) which will help to reduce muscular fatigue and injury.

Fluid Requirements

It is well documented in the scientific literature that exercise performance is optimal when athletes maintain fluid balance during exercise [1, 18]. Adolescents do not instinctively drink enough fluid to replace body water losses. To make matters worse, during exercise the thirst mechanism does not work well and is thus not a good indicator of when an athlete needs to drink more fluids [19]. Adequate fluid intake is critical during intense and long duration physical activity. Without sufficient fluid and electrolyte consumption, intense training may lead to dehydration. Significant scientific evidence documents the deleterious effects of hypohydration (reduced total body water) on exercise performance related to endurance, muscular strength, power, and high-intensity activities [20, 21]. Dehydration equivalent to 2% body mass loss degrades aerobic exercise and cognitive/mental performance in temperate-warm-hot-environments[16]. Greater levels of dehydration will further degrade exercise performance and increase the risk of heat related illnesses [16].

Providing fluid guidelines to youth athletes to incorporate into sports training and competition will improve athletic performance as well as keep them safe. Fluids should be available to youth athletes at all times. Fluid restriction should never be used to reduce weight or meet a certain weight class for sports competition. For youth athletes greater than 10 years, it is recommended that individuals consume 8 ounces 1-2 hours before activity, 6 ounces 15 minutes before activity, 8 ounces every 20 minutes during constant activity, and 16 ounces per pound lost during activity [1, 11, 22]. (See Table: 2)

Table 2: Fluid Guidelines for Youth Athletes (>10 years) during Intense Physical Training

Timing	Amount of Fluid	Type of Fluid
1-2 hours prior to training/event	8 ounces	Plain water
15 mins prior	6 ounces	In events lasting < 60 minutes, plain water In events > 60 minutes, sports drink
During: every 20 minutes	8 ounces	In events lasting < 60 minutes, plain water In events > 60 minutes, sports drink
After activity	16 ounces per pound lost	After intense physical training, recovery drink (fluids, carbohydrates, protein and electrolytes)

Recovery Nutrition & Nutrient Timing

Consuming adequate calories, macronutrients and fluids form the base of a sound sports nutrition diet. Nutrient timing, a strategy used in conjunction with this base diet, is adjusting the timing and delivery of nutrients to maximize muscle recovery. Proper timing and type of nutrients, will allow athletes to build more strength and lean mass in less time, but even more importantly in a safe and natural manner [23]. Precompetition strategies include dietary interventions that are implemented during the week prior to an event, as well as special tactics that are undertaken in the minutes or hours before the event begins. These nutrition strategies should target the specific physiological challenges that affect the performance of the athlete's sport. Strategies might aim to minimize fluid deficits, ensure fuel availability (delay time to fatigue and decrease risk of injury), prevent gastrointestinal discomfort, and aid in recovery. Nutrient availability is a critical factor in regulating the degree of muscle hypertrophy and refueling.

In events lasting longer than 40-60 minutes, athletes can improve performance by ingesting fluids and/or foods with water, carbohydrates and electrolytes [9, 11, 19] incrementally throughout the training or competition. The choice of food and fluids to be consumed during exercise will depend on a variety of factors including the nature and duration of the event, climatic conditions, pre-event nutritional status, and the physiological characteristics of the athlete. (See Table:3)

Eating and drinking after competition and training are critically important in maximizing recovery from exercise. Athletes who avoid food and fluid consumption post exercise will reduce their capacity to quickly replace used muscle fuel and thus impair performance in subsequent events or training sessions. In sports such as swimming, track and field, rowing, gymnastics, and wrestling, competition is conducted as a series of brief events often performed more than once a day separated by a few hours or less. In team sports like soccer, basketball, volleyball, field or ice hockey, baseball and softball, competitors may be required to undertake one or more lengthy events several times per week over a two month or more time period. Athletes who fail to refuel and/or rehydrate during these activities will not have the optimal level of energy the next day to train hard or compete. Optimizing recovery following training and competition will give athletes a competitive edge, as well as allow them to train harder, become fitter, stronger and faster, and reduce their risk of injury. (For specific recovery strategies see Table:3.)

TABLE 3: Nutrient Timing Before, During and After Training & Competition

Time Period	Carbohydrate	Protein
Days Before Competition	5-8 grams/kg body wt/day	1.2-1.7 g/kg body wt/day
Within 1 hour prior to training Hours before Competition • 1 hour • 2 hours • 3 hours • 4 or more hours	Prior to training 1.0 g/kg body wt Prior to competition 1.0 g/kg body wt 2.0 g/kg body wt 3.0 g/kg body wt 4.0 -4.5 g/kg body wt	Prior to training • Snack with protein, i.e. chocolate milk, low-fat cheese stick Prior to Competition • Consume meal/snack with low-moderate protein content
During Competition	30-60 g/every hour as food or fluid	Not applicable
After Competition • Within 30 minutes • 2 hours	1.0-1.5 g/kg body wt 1.5 g/kg body wt or consumption of a meal	Generally 6-20 grams protein (0.1-0.2 g/kg body wt)

THE ROLE OF SPORTS NUTRITION FOODS

The marketing and sale of sports nutrition foods and beverages has become a multibillion dollar industry. In 2006, nearly 500 new brands of energy drinks were introduced, and more than 7 million adolescents reported that they consumed an energy drink [24]. Athletes spend billions of dollars on a variety of sports nutrition foods and beverages each year in the hopes of improving athletic performance and/or health. Although some of these products can be beneficial, others may actually impair performance and health. It is important that youth athletes, coaches and parents are provided accurate reliable information to help discern which sports nutrition foods are beneficial and how they can be incorporated into a sound sports nutrition diet and training program.

Sports drinks

Sports drinks may be the sports nutrition food with the greatest potential to enhance performance in a wide variety of sporting situations. Sports drinks were developed in the United States in the 1960's when the University of Florida Gators began drinking a formulation of carbohydrates and electrolytes to enhance their performance and prevent dehydration [25]. Ideally, these beverages should contain carbohydrates (6-8%), sodium (10-25 mmol/l), and potassium 3-5 mmol/l) which facilitate the rapid delivery of fluid and fuel before, during and after exercise [9, 19]. Research has documented the many benefits of carbohydrate-electrolyte beverages including, improved physical performance in a variety of sporting events (endurance, high intensity exercise of ~1 hour duration, prolonged intermittent exercise i.e. team sports), enhanced immune function by reducing immunosuppression in the hours following exercise, increased voluntary intake of fluid (especially in youth athletes) and improved hydration status (by maintaining thirst drive and helping to reduce urine losses) [11, 18, 19]. In a review study

evaluating the effectiveness of currently available sports drinks, researchers found good evidence to suggest that consuming sports drinks will improve performance compared with consuming a placebo beverage, usually water. Additionally, there was little evidence that any one sports drink was superior to any of the other sports drinks on the market [26].

Important considerations in maintaining hydration status during intensive physical training include the amount and timing of fluids (previously discussed) and selecting the type of fluid to consume. Plain water is generally adequate for the individual who is exercising less than 60 minutes. If drinking plain water is difficult or unpalatable, a sports drink with 6-8% carbohydrate and electrolytes may be recommended to entice the adolescent to drink adequately. (See Table: 3 for more information)

In addition to considering the intensity and duration of physical training, the air temperature during the activity and the general health and body size of the individual are factors to consider in choosing between a sports drink and plain water. Athletes performing in hot climates for extended periods of time and who are engaging in intense physical training should have access to and be encouraged to drink sports drinks. Research has shown that voluntary fluid intake in children and adolescents is greater when flavored drinks such as sports drinks are offered instead of water [27-29]. Sports drinks however, do not have a regular place in the intake of minimally active adolescents who already may have a higher degree of body fat and who may be at increased risk of excessive caloric intake [30].

Recovery Drinks

In response to the evidence that providing certain nutrients timed appropriately after intense physical training improves recovery and performance, a number of recovery beverages have been introduced. Ideally a recovery beverage should be carbohydrate–rich, contain high biological value protein, fluid and micronutrients.

There has been growing interest in the potential use of milk as an exercise recovery beverage, especially after resistance training and endurance sports. Low-fat milk has a number of characteristics that theoretically make it potentially a good recovery beverage including, carbohydrates in similar amounts to many commercially available sports drinks, casein and whey (provide a large portion of essential amino acids which play an integral role in muscle protein synthesis), and a high concentration of electrolytes to replace those lost in sweat during exercise [31]. Based on the limited research, milk appears to be an effective post-exercise beverage (except for those who are lactose intolerant) that results in favorable acute alterations in building lean muscle mass and ameliorating the breakdown of muscle tissue after intense physical training [31-34]. Furthermore, low-fat milk has been shown to be as effective, if not more, than commercially available sports drinks as a rehydration beverage.

There are also a variety of other beverages marketed to aid in recovery from exercise. To optimally replace used muscle fuel, repair muscle damage, and restore fluids these beverages should contain carbohydrates, protein (ratio 3- 4 grams carbohydrates to 1g protein), and electrolytes.

Sports/Energy Bars and Shakes

Sports/energy bars and shakes are a more concentrated form of carbohydrate than sports drinks and provide a substantial fuel boost when consumed during or after exercise. Sports bars and shakes often provide a concentrated source of protein as well. They can be useful during prolonged training sessions, for athletes with high energy requirements, as a post-recovery food when access to food is limited, and/or if an athlete has minimal time to eat between events. Sports bars should be used for the specific conditions for which they are best suited rather than as a general snack. Natural whole food sources should always be considered as the first option for meals and snacks.

The names of some sports/energy bars and shakes may lead athletes to believe the sports nutrition foods have magical powers beyond those that whole foods can provide. The "magic" about energy bars and shakes are that they are convenient, compact, portable, ready-to-eat and durable. There can be however, several concerns if athletes are routinely using these bars and shakes as meal replacements and/or snacks. Energy bars may contain excessive sugar and calories which can contribute to weight gain and tooth decay. Many of them contain specialized ingredients such as guarana, taurine and gingseng, whose safety and effectiveness have not been tested in the adolescent population. Other standard ingredients can include fractionated palm oil (saturated fat), sugar alcohols and high fructose corn syrup which should be limited in the adolescent's diet [9] primarily for health reasons. Sports bars and shakes are often overused, leading to displacement of too many natural foods from the diet and an over-reliance on expensive alternatives.

Although sports bars and shakes have vitamins and minerals added, they will not provide growing teens with all the different nutrients their bodies need to grow, develop, and participate in sports. If eaten as a before, during or recovery meal, athletes also need to consume fluids to replace their fluid losses. Eating too many fortified bars or shakes in a day could potentially contribute to an excess of certain minerals. When used in sports situations, energy bars and shakes can be handy, but for day to day fueling, adolescents should be advised and guided to choose real food if possible [9].

Energy Drinks

Adolescent athletes are often drawn to another product, energy drinks, promising to answer their cry of fatigue and desire to be the best. In 2006, energy drink sales were a $5 billion dollar industry, with teens spending almost half or $2.3 billion annually [35]. Advertising of energy drinks is targeted primarily towards young males, with alluring product names. The advertising campaigns promote the psychoactive, performance-enhancing, and stimulant effects of energy drinks and appear to glorify drug use [36]. Athletes are enticed into purchasing and drinking these beverages by the promise of improved performance on the product label. For example, how many teen athletes will turn away from something that claims to *"electrify your body and mind during whatever activity you're doing; increase physical energy, improve overall sense of well-being, focus and alertness, all the while improving performance. Perfect for high-intensity sports, workouts, club going, studying, a high-adrenaline workplace, a morning wakeup call or anytime you need a voltage charge. It attacks energy and performance enhancement from every conceivable angle and it tastes delicious."*

The reality is this cloudy purple drink has scarier instructions than most prescription drugs, which are written in very tiny print on the product label often unnoticed. *"Drink only a quarter-bottle at a time, after 30 minutes, assess tolerance. Consume only if you are over 18 or less than 50 years of age. Do not have any other caffeine or be exposed to excessive heat after drinking. Avoid if you have blood-pressure problems, depression, cardiac arrhythmia, stroke; heart, liver, or thyroid disease; anxiety, seizure disorder, psychiatric disease, diabetes or if you are taking any prescription drug. Do not use if you are pregnant, nursing, prone to dehydration Reduce or discontinue use if sleeplessness, tremors, dizziness, nervousness, headaches, or heart palpitations occur."* The drink draws its powers from a long list of ingredients, which range from stimulants like caffeine and guarana, brain-enhancing drugs called nootropics to more than 4,000% of the daily requirement for Vitamin B12. These products are widely available (convenience stores, grocery stores, gyms, nutritional-supplement stores) and are what may appear to a trusting, believing adolescent to be the answer to their lack of energy and dull performance.

The Food and Drug Administration (FDA) has limited the caffeine content of sodas to 65 mg per 12 oz (18 mg/100ml); however energy drinks are not currently subject to the same FDA regulations. Energy drinks often contain between 14 to 31 mg caffeine per 100 ml (or anywhere from 50-505 mg caffeine per can or bottle) [36]. In addition other caffeine containing herbal ingredients such as guarana, yerbe mate, kola nut and cocoa, may not be included in the calculations of caffeine content [37], nonetheless they do contribute to the overall caffeine content of a beverage. From a policy prospective, there are currently no regulations that require the reporting of caffeine content on energy drink product labels. However, significant momentum is building for legislation requiring accurate labeling[37]. And, New Jersey education officials are considering a district-wide ban on energy drinks as a way to deter kids from consuming these beverages.

The excessive amounts of caffeine and sugar (up to 35 g sugar per 8 oz) raise concerns for adolescents consuming these drinks habitually. First, adolescents and children who may be inexperienced and less tolerant of the effects of caffeine may be at risk for caffeine intoxication. Further, the appeal of these beverages is the effect they have on stimulating the central nervous system. The promotion and use of caffeine as a stimulant, similar to a drug, sends a harmful message to adolescents and glamorizes and encourages drug use [36]. In a study examining caffeine use in adolescents, researchers reported 42% had a tolerance to caffeine, 78% described withdraw symptoms after cessation or reduction of caffeine intake, 39% reported desire or unsuccessful attempts to control use, and 17% endorsed use despite knowledge of physical or psychological problems associated with caffeine [38]. It is also of concern that athletes who consume caffeine loaded energy drinks before strenuous exercise could become dehydrated or develop cardiovascular difficulties because of the diuretic and stimulant effects of caffeine [35, 37].

Results are equivocal regarding the effect that energy drinks have on improving athletic performance in adults [39-41]. Any benefit realized from the consumption of energy drinks is likely attributable to the caffeine content in the drinks [40]. There are no scientific studies evaluating the effectiveness of energy drinks on performance in adolescents. If youth athletes perceive that energy drinks truly provide fuel to help them train and compete better, then they are

less likely to focus on consuming the right combination of foods and fluids that truly will impact athletic performance.

There is an ever increasing range of sports nutrition foods that are easily accessible to athletes and coaches. It is of primary importance for individuals advising student athletes to have a thorough working knowledge of the various sports foods in order to provide sound advice about appropriate situations for use, possible benefits, potential side effects and risks associated with use. Sports nutrition foods need to be evaluated with respect to safety and effectiveness for use specifically in the adolescent population. Currently most of the data in this area has been extrapolated from scientific studies examining adults. Given the sports nutrition foods available to adolescents, sports drinks and sports bars and shakes are safe and have potential benefit in improving performance as outlined above. The risk of consuming energy drinks however, outweighs the benefits and therefore they should not be advocated for use in youth athletes. Instead youth athletes should be taught and encouraged to get their energy "boost" from a healthy sports performance diet.

DIETARY SUPPLEMENTS, STEROIDS, AND HS ATHLETES

Basis of a Healthy Performance-Enhancing Diet is Food not Supplements

Educating and reinforcing to youth athletes about the vital role nutrition plays in optimizing athletic performance may deter them from seeking potentially unproven and unsafe means such as dietary supplements and illegal performance-enhancing substances to achieve success. Egrogenic aids are substances that are used to enhance athletic performance and can include compounds marketed as dietary or nutritional supplements and potentially illicit substances.

The regulation of dietary supplements (and some specialized foods such as energy drinks, as previously discussed) is a contentious area and can encompass issues of manufacture, labeling and marketing. Unlike conventional drugs, which must be approved by the Food and Drug Administration before being marketed, dietary supplements are basically sold under the honor system, in terms of substantiating claims. Because these substances are regulated in a different way, the potency and purity of the "nutritional" components are not always known. Although manufacturers are directed not to make unsupported claims about health or performance benefits, advertisements and testimonials show ample evidence that for some manufacturers, this aspect of supplement marketing is not enforced and is exploited. Most consumers are unaware that the regulation of such advertising is generally not imposed. Therefore, athletes, youth in particular, are likely to believe that claims about supplements are medically and scientifically supported, simply because they believe that untrue claims would not be allowed to exist. In addition, when coaches, elite professional athletes, and parents either advocate the use or use them themselves, adolescents view this as a signature of approval.

Popular Dietary Supplements Carry Warning Against Use in Adolescents

In an attempt to gain more muscle mass, increase speed, reduce body fat, improve appearance, and delay fatigue, HS athletes are experimenting with the multitude of dietary supplements that are touting the very outcomes they desire to achieve. Although virtually no

experimental research on either the ergogenic effects or adverse effects of performance-enhancing substances has been conducted in subjects younger than 18 years [42], millions of student athletes are buying and trying them in hopes of accomplishing their dreams. One of the most popular erogenic supplements is creatine (which carries a warning against use for individuals less than 18 years old) is being used by middle and HS athletes at all grade levels. Some alarming findings suggest that student athletes are using creatine in ways that are inconsistent with scientific recommendations for usage in adults. For example youth athletes are using creatine to aid in performance for sports where there are no purported benefits and they are consuming amounts inconsistent with the dosing recommendations [47]. Another study points to the lack of awareness regarding the risks and benefits of creatine use in the high school population [45]. Research has shown that adolescents who are limited in their basic nutrition knowledge did not possess the ability to decipher which dietary supplements were appropriate to consume, potentially harmful, or where these substances could be easily attained through the diet. This again points to the fact that adolescents lack the nutrition knowledge and support to properly evaluate how dietary supplements may affect performance and overall health.

Some dietary supplements have been used widely by professional and elite athletes for several decades. However, in recent years, research indicates that younger athletes are increasingly experimenting with these substances to improve both appearance and athletic abilities. Adolescents are intensely preoccupied with body image. Personal rewards perceived from enhancing size, strength, stamina, or body build are strong motivators in youth deciding to use performance-enhancing substances [42].

Unfortunately, with what seems like increasing frequency, we wake up to the morning news and hear about the death of a perfectly healthy young HS athlete who was taking sports supplements. What contributed to the death of such a vital young athletic person? Call it a perfect storm…what appears to a teen to be a benign drink, pill or powder, when washed down with an energy drink containing excess caffeine and other stimulants, before walking out onto the field engaging in a long intense physically exhausting training session often in high heat and humidity, with little fluid to drink, can result in fatal consequences. These stories appear on TV, in local papers, and national magazines. They basically tell the same story of some young player who died, the pro's and con's of supplements and the supplement industry, and then usually end with some directive aimed at health care professionals, coaches, parents and athletes themselves. As a result coaches talk to their players about these products but unfortunately they are not equipped with the necessary educational strategies and resources to really change the mindset of their athletes. Sports nutrition education programs that combine nutrition and drug education with training in personal skills to resist the social pressures that drive the use of performance enhancing substances have been successful in decreasing intention to use dietary supplements and more dangerous products such as anabolic steroids

Steroids

Ergogenic aids commonly used by youths today include creatine, growth hormone, ephedra alkaloids, anabolic-steroids, and steroid precursors (androstenedione and dehydroepiandrosterone), [43]. Reviewing the literature to date, it is clear that children are

exposed to these substances at younger ages than in the past, with use starting as early as middle school [44-46]. According to the YRBSS 2007, nationwide, 3.9% of students had taken steroid pills or shots without a doctor's prescription one or more times during their life (i.e., lifetime illegal steroid use). Use increases with increasing grade in HS athletes [2]. In a study conducted by researchers from Penn State, the usage of steroids in 12th grade male HS students was reported at 6.6% and over two thirds of users reported initiating use when they were 16 years or younger [48]. Studies examining the drug use patterns and perceptions of drug intervention programs among adolescent interscholastic athletes and nonathletes found there was no difference in the use of anabolic steroids between these two group [38] . Both athletes and nonathletes expressed limited knowledge of the dangers of these drugs[38]. Youth athletes use anabolic steroids in the hopes of increasing lean muscle mass and strength and for nonathletes it is the lure of improving overall appearance [49]. The evidence in the literature regarding the effect that anabolic steroids have on increasing muscle size and strength is not clear[49]. Factors confounding the interpretation of these studies include physical training, diet and genetics.

The scientific evidence is clear however, on the risks associated with use of anabolic steroids [49, 50]. In addition to the legion side effects (aggression, hypertension, hyperlipidemia, liver disease, dependency), in adolescents steroid use may cause cessation of skeletal growth and increased vulnerability to tendon rupture [50]. Equally of concern is the observation that teenage athletes may use prolonged and very high (supraphysiologic) doses increasing the risk associated with steroid use [42, 50]. When asked about the risks associated with using higher doses for longer periods of time, teen users reported not knowing the adverse effects or any safety issues related to higher doses. Further, they indicated a sense of "fearlessness", invincibility, and not being worried about what might happen in the future. Young people often feel that these chemicals are "natural" hormones which have been endorsed by their sports heroes, giving them a false sense of safety and belief in the effectiveness of these illegal performance enhancing substances.

The method most widely used to prevent use of dangerous performance-enhancing substances such as steroids and other anabolic-like agents are drug bans and drug testing. Drug testing and legal sanctions are intended to be deterrents but have little effect on most adolescents involved in sports [42]. The American Academy of Pediatrics urges parents, coaches, schools, and sports organizations to take a strong stance against the use of performance-enhancing substances[42]. The National Federation of High School Associations (NFHS) has issued the following statement on their national website, "In order to minimize health and safety risks to student-athletes, maintain ethical standards, and reduce liability risks, school personnel and coaches should never supply, recommend, endorse or permit the use of any drug, medication or food supplement solely for performance-enhancing purposes."

Historically, research on drug prevention programs suggests that presenting an unbalanced negative approach was not an effective strategy in reducing drug use among adolescents. Similarly, de-emphasizing the muscle building benefits and presenting only the negative effects of steroids presents a biased approach, therefore reducing credibility of program. There are two school- based educational programs that were developed based on the social learning theory, they use the established social unit (the sports team) to redirect the students' goal-directed behavior. Sports nutrition and strength training for performance enhancement are

stressed as healthy alternatives to steroid use. With team-centered programming, content can be gender-specific and address the causes and risks of substance abuse unique to male/female athletes.

The two programs are the Adolescents Training and Learning to Avoid Steroids (ATLAS) program for males and the Athletes Targeting Healthy Exercise & Nutrition Alternatives (ATHENA) program for females. Both programs use a coach and selected student athletes called "Squad Leaders" to deliver the scripted program information and prepared educational materials. There are 8-10 sessions, lasting 45 minutes, typically scheduled once per week during the season on "light" practice days. Coaches facilitate the program while Squad Leaders provide a majority of the instruction for their small group of teammates. Sessions include role-plays, student-created campaigns or public service announcements and instructional, interactive games. Athletes practice self monitoring of nutrition behaviors. Students learn attitudes and skills that will help them make healthy choices in sports throughout their lives [51].

Research examining the effect of the ATLAS program on high school football players found that those in the intervention group had less short- and long-term intent to use steroids, an increased knowledge of steroids including risks, and a greater belief in personal vulnerability to side effects. In addition, added benefits of the program were that it improved confidence in athletic abilities, increased self-esteem, reduced impulsivity, and increased awareness that parents and coaches were opposed to ergogenic substance usage [50, 52].

In the competitive world of high school sports, some youth athletes are turning to unsafe methods in order to gain an advantage over their competitors. These include drinking beverages marketed to stimulate their senses and boost their energy to dietary supplements and anabolic steroids promising to pack on lean muscle mass and melt away body fat. The diets of most adolescent athletes today are insufficient to promote optimal physical performance; this is due in part to the disconnect between diet and its impact on athletic performance, nutrition misinformation fueled by the press, media, internet, advertisements, supplement claims, and the lack of general and sports nutrition knowledge in youth athletes and their advisors.

High school athletes would benefit from nutrition education that specifically addresses their unique nutritional needs and concerns. Ideally, that education is provided by health professionals with education and training in sports nutrition. Teaching student-athletes about the proper use of foods and fluids with the right nutrient combinations and given at the right time will allow youth athletes to accomplish their goals and improve performance in the safest way possible.

NUTRITION KNOWLEDGE OF HS ATHLETES AND COACHES (AND OTHERS WHO ADVISE STUDENT ATHLETES)

Nationally, there have been a handful of research studies and surveys done examining the nutrition knowledge of adolescents. The consensus from these reports was that the mean scores on general nutrition surveys ranged from 39-55%, indicating an overall poor level of nutrition knowledge in adolescents [53-56]. Research also suggests that adolescents who are not properly

educated in nutrition will make less healthy food choices and their diets may be compromised[57].

In a national survey of Parents of High School Athletes conducted by the Benenson Strategy Group in 2005-2006, 80% believed information about proper nutrition for optimal performance is important to their teen's athletic success and yet only ~40% were confident their student athlete received enough sports nutrition information. Ninety percent of parents agreed HS sports programs need to do much more when it comes to educating student athletes about proper nutrition for training and competing. Parents overwhelmingly (93%) think HS coaches should take the lead in educating student athletes about sports nutrition. Athletes too, frequently identify coaches first, followed by athletic trainers, physicians, teammates and popular media as primary sources of nutrition information. In studies examining the nutrition knowledge, opinions and practices of collegiate coaches and athletic trainers, overall participants responded correctly to 67% of nutrition knowledge questions and 78% of coaches felt that they needed further knowledge before serving as the primary source of nutrition information for their teams and in order to give specific advice such as planning pre-competition meals [58].

High school athletes seek first the advice of coaches regarding the use of dietary supplements. A study examining misconceptions about dietary protein supplements, reported that high school football players who use protein supplements ("supplementers") scored higher on a Protein Supplement Misconceptions Index than those who did not supplement ("non supplementers"). Researchers found that greater misconceptions for "supplementers" may have resulted from the sources chosen for information and advice. Since coaches, parents, and friends were identified as the primary sources of advice about protein supplements, researchers concluded it would be valuable to provide nutrition education to these groups concurrently with educating youth athletes to dispel ongoing misconceptions regarding the need for and effectiveness of protein supplements [15]. In another study, 139 high school athletes completed an anonymous dietary supplement survey to examine use of dietary supplements, reasons for use, type of sport participation, and sources of information regarding dietary supplements. The results of the survey found 22.3% HS athletes reported currently taking dietary supplements. Of those who currently reported taking dietary supplements, sports performance was the primary reason for use. Thirty-eight percent of participants listed their coach as their best source of information on dietary supplements. The authors concluded by stating that coaches need to be educated and knowledgeable about dietary supplements so that adolescent athletes are receiving accurate information [44].

Given the many responsibilities of coaches and athletic trainers, it is understandable that attention to nutrition issues and planning is likely to be secondary. Sifting through the massive amount of conflicting sports nutrition information is daunting and time consuming. Coaches, athletic trainers, and others who advise student athletes should have access to accurate nutrition information from reputable sources for basic sports nutrition information. This information should be prepared by experts in sports nutrition using current, evidence-based best practice guidelines and could be provided as modules incorporated into the existing ATLAS and ATHENA drug prevention programs, as a series of videos or onsite seminars. School districts should also identify trained professionals in sports nutrition who can serve as a referral source

for higher risk, youth athletes with more serious issues such as disordered eating, diabetes, and obesity.

CURRENT SPORTS NUTRITION RESOURCES AVAILABLE

Across the Commonwealth, there are several federally and/or state funded programs such as Pennsylvania Advocates for Nutrition and Activity and PA Action for Healthy Kids that are designed to systematically target social and environmental factors that influence healthy eating and physical activity to support healthy lifestyle choices in the prevention of obesity and chronic disease in school-aged children. These programs have been quite successful at raising awareness, increasing knowledge, and changing the school and home environments in an attempt to promote healthy eating and physical activity in the youth in Pennsylvania. By educating about and advocating for an overall healthy eating plan for adolescents, a basis for a sound diet is established, upon which sports nutrition strategies can be taught and implemented to optimize athletic performance. The logical next step is to build upon these initiatives and expand the nutrition education and training to include sports nutrition for adolescents engaging in intense physical training.

Currently in Pennsylvania, the Department of Education (DOE) offers two curricular resources for educators to integrate into lessons in family and consumer sciences, math, statistics, science, health and physical education. The first is titled *Sports Nutrition Lessons for Adolescents* and is designed for middle and HS students to teach the role proper nutrition plays in optimizing athletic performance. There are 5 lessons: *Sports Drinks, Sports Bars and Energy Foods, Sports Diet, Protein Power* and *Recovery Carbs*. This curriculum was developed in 2001 and was peer reviewed by 3 registered dietitians who are certified specialists in sports dietetics. (For an overview of the lessons, see Appendix 1.)

The second DOE curriculum is *Body Weight and Body Image Lessons for Adolescents* and focuses on healthy eating practices, normal physical activity patterns, and positive body image to effectively help students attain lifelong healthy weight and physical activity habits. There are 7 lessons including *Normal Eating and Exercise, Eating Volumetrically, Portions are Out of Proportion, Food-Mood Connection, It's the Little Things that Count, Barbie, Ken and Action Toys,* and *Body Image Distortion*. This curriculum was reviewed by a variety of professionals including teachers, a school psychologist, and a statistician. It is recommended that future editions include a registered dietitian who specializes in disordered eating, on the team of curriculum reviewers. This individual will add value by evaluating the content and appropriateness of the information from a foods and nutrition prospective. (For an overview of the lessons, see Appendix 2.)

It is vital that these curricula are evidenced-based and contain the most up-to-date information on sports nutrition and body weight/body image in order equip student athletes with the knowledge and tools that they can use in planning and consuming a sound sports nutrition diet. Trained individuals in sports nutrition and other appropriate disciplines should review and update the curriculum annually. Schools across Pennsylvania should then be encouraged to adopt these lessons and integrate them as part of a stand-alone or interdisciplinary unit within the existing school curriculum. This is beneficial for two reasons, first it captures all HS students

both athletes and those who do not regularly participate in school sports but may be recreationally active. Secondly, it provides a sound base upon which to build sports specific guidelines that can be addressed within the individual athletic team setting.

There are also a number of web-based resources, written by health care professionals that provide reliable information. Examples include the Gatorade Sports Science Institute http://www.gssiweb.com, the Center for Excellence sponsored by Abbott Nutrition's EAS brand and the National High School Athletic Coaches Association (NHSACA) http://www.hscoaches.org, and the National Strength and Conditioning Association's (NSCA) Sports Nutrition Education Program sponsored by EAS http://www.nsca-lift.org. These resources serve to educate coaches, trainers parents, and student-athletes on general sports nutrition guidelines to enhance performance. The National Institute on Drug Abuse for Teens and the National Library of Medicine Dietary Supplements Labels Database are examples of excellent resources for coaches and athletes on avoiding illicit drugs and evaluating the safety of dietary supplements. From these and other reputable websites, a list of approved online resources on sports nutrition could be developed and included as part of the overall sports nutrition education program.

Although these resources provide very good written literature, they do not offer a comprehensive way to systematically implement current sports nutrition strategies to enhance performance and health in the wide variety of adolescent athletes of today with their unique sport-specific challenges. Reputable website resources however, can serve as valuable and usable references for student athletes, coaches and parents.

RECOMMENDED PLAN FOR A SPORTS NUTRITION EDUCATION PROGRAM FOR PENNSYLVANIA HS ATHLETES

Youth athletes are always looking for ways to improve performance. It is our job as health professionals, politicians, school administrators, parents and community members to provide them with the knowledge, skills and resources to find effective, safe and healthy ways to enhance their performance and health. Public health initiatives need to effectively and appropriately guide HS athletes on using a sound sports nutrition diet and strategies and provide them with the necessary resources so they turn away from choosing dangerous and unhealthy options such as banned substances and inappropriate dietary supplements. By nature human beings, especially adolescents, do not like being told what they cannot or should not do. We need to empower adolescent athletes with all the tools they need to make safe and healthy choices on their own that will accomplish their sports goals and dreams. To achieve this, it is recommended that an education plan be implemented in phases as follows:

Phase I: Updating and Implementing Existing Curricula

1) *Sports Nutrition Curricula Incorporated into Secondary Schools Across Pennsylvania*
   a) Update the current lessons (developed in 2001) and establish an annual curriculum update and review by identified professionals specializing in sports nutrition, education, coaching and athletics, and other areas as appropriate.

b) Consider adding a lesson on dietary supplements in the curriculum Sports Nutrition Lessons for Adolescents.
c) Formally implement the DOE Sports Nutrition Lessons for Adolescents and Body Weight & Body Image Lessons for Adolescents into the existing education plan in all high schools across the state of Pennsylvania. This would provide all students with basic nutrition guidelines for participation in physical activity and include topics such as a healthy training diet, nutrition for exercise recovery, precompetition meals, strategies to modify body composition, and the role of sports nutrition foods and evaluating dietary supplements. These original curricula have been distributed to 697 public high schools and middles schools across 501 school districts in Pennsylvania.
d) Funding will be required to update the existing lessons and develop the additional lesson on dietary supplements.

2) *Drug Prevention Programs ATLAS & ATHENA*
   a) Adopt the ATLAS & ATHENA programs. For more information, see Appendix 3.
   b) Funding will be needed to adopt these curricula. For pricing information, see Appendix 3.

Phase II: Development of Sports Nutrition Education Modules for Specific High School Sports

a) Develop sports-specific (high school team specific) sports nutrition education modules. Each sport-specific module would include the following information: nutrient requirements, common nutrition concerns (such as weight gain, weight loss, fatigue, overtraining), recovery nutrition, pre- and post event strategies, and appropriate use of sports nutrition foods/fluids and safety and efficacy of specific dietary supplements.
b) The Department of Sports Medicine & Nutrition (SMN) at the University of Pittsburgh houses academic programs in Athletic Training, Sports Medicine, Clinical Dietetics & Nutrition, and Wellness & Human Performance. Qualified faculty develop curriculum, teach didactic and supervised practice courses, and conduct research in the areas of sports performance and injury prevention. Three of the faculty (two Fulltime and one adjunct) are registered dietitians with certification in sports dietetics (Certified Specialist in Sports Dietetics). The SMN faculty have the expertise to develop the sports nutrition educational lessons in general sports nutrition, sport-specific or team sports, and ergogenic aids. SMN Faculty efforts for this project would need to be subsidized. For more information about the Department of SMN academic programs, faculty and research agenda, please see Appendix 4.

Phase III: Delivery of Sports Specific Nutrition Modules to Coaches, Athletic Trainers and Select High School Athletes

a) The SMN Faculty who oversee the nutrition and athletic training programs could coordinate the training sessions to educate identified school representatives including coaches, athletic trainers, school dietitians and athletes from schools across the state on

how to use and deliver the sports-specific nutrition modules. Trained school representatives would return to their individual school teams and deliver the sports specific nutrition modules either as stand-alone lessons or as part of the ATLAS or ATHENA programs. Peer-led education is a highly effective way to change behavior in adolescents.

b) Additional resources in the state to facilitate this process include the Pennsylvania Dietetic Association and the Pennsylvania Athletic Trainers' Society.

Phase IV: Evaluation of the Sports Nutrition Education Program

a) During the testimony for HR 501 on September 11, 2008, committee members as well as presenters identified a number of areas related to nutritional requirements and dietary supplement safety and effectiveness in adolescents engaging in intensive physical training that warrant scientific investigation. These include energy expenditure and protein, and fluid requirements during intense physical training. Additionally, there is a lack of research examining the safety and effectiveness of dietary supplements when used by individuals less than 18 years of age. Conducting scientific studies in these areas would begin to establish an evidence base to develop practice guidelines. These guidelines would be designed specifically to meet the needs of adolescents rather than extrapolating data and guidelines developed from adult studies. This is a research opportunity that will advance science in this area.
b) Representative Ross identified the need to conduct formal evaluations to examine the effectiveness of the Sports Nutrition Education Program.
c) The University of Pittsburgh and the Department of SMN are ideally equipped to conduct clinical trials to answer some of the key questions regarding adolescent nutritional needs during intense exercise and to evaluate the effectiveness of the *Sports Nutrition Education Program for High School Athletes & Coaches in Pennsylvania.*
d) Research activities would need to be subsidized.

Other Considerations:

1) It is recommended that school districts identify a professional trained in sports nutrition, such as a certified specialist in sports dietetics, who can consult with individual athletes identified by coaches, athletic trainers and/or parents to be high nutrition risk. These athletes could include those with diabetes, recurrent sports related injuries, severe overweight, disordered eating, or heavy use of dietary supplements.
2) A comprehensive list of approved reputable online resources on sports nutrition and ergogenic aids could be developed and disseminated to HS athletic departments to post on their school websites.

APPENDICES

Appendix 1: Sports Nutrition Lessons for Adolescents

Appendix 2: Body Weight and Body Image Lessons for Adolescents

Appendix 3: Adolescents Training & Learning to Avoid Steroids (ATLAS) and Athletes Targeting Healthy Exercise & Nutrition Alternatives (ATHENA)

Appendix 4: University of Pittsburgh, School of Health & Rehabilitation Sciences, Department of Sports Medicine and Nutrition Program Overview, Faculty and Research Agenda

Appendix 1

Sports Nutrition Lessons for Adolescents

Overview

Purpose of Curriculum

The five lessons in this curriculum are designed to promote healthful nutrition practices among 7-12th grade students participating in school or community-based athletics. The lessons target topics of interest and of importance to adolescents, such as sports bars and drinks, protein supplements, and recovery carbohydrates.

Curriculum Design

The curriculum contains five multidisciplinary lessons that can be taught in Family and Consumer Sciences (FCS), Health Education, Math, Statistics, and Science. Each lesson is keyed to the Pennsylvania education standards and includes a lesson plan, student worksheets, teacher answer sheets, transparency masters, background information for both students and teachers, and recommended resources. The information in each lesson is based on research findings and recommendations in the fields of nutrition and physical activity.

Lesson Titles	Subjects	Summary of Content	Examples of Lesson Objectives
Sports Drinks	• FCS • Health • Math • Science	Appraise sports drinks to determine their benefits to athletes and recreational exercisers	• Calculate percent of carbohydrate concentration in various drinks • Identify sodium and potassium values • Calculate the cost per serving • Create a sports drink in lab or at home
Sports Bars and Energy Foods	• FCS • Health	Examine the pros and cons of commercial sports bars versus other energy foods	• Identify pros and cons of sports bars • Compare and contrast economic cost and nutritional value of various bars • Create homemade sports bars in lab or at home
Sports Diet	• FCS • Health • Math	Examine the number of calories and nutrients recommended for different levels of intensity of physical activity	• Calculate recommended number of calories, protein, fat, and carbo-hydrates for specific levels of activity and body weights
Protein Power	• FCS • Health • Math • Statistics • Science	Appraise protein bars, powders, and shakes for protein content and compare them to fast foods, grocery store foods and convenience store foods	• Determine the amount of protein needed for strength training, aerobic training, and muscle weight gain • Calculate percent of protein by weight and cost per serving of supplements and protein-rich food products • Rank order and create a box and whisker plot and scatterplot of protein content and costs of products
Recovery Carbs	• FCS • Health • Math	Examine the critical importance of consuming carbohydrates immediately after exercise	• Calculate the amount (grams) of carbohydrates to be consumed within 30 minutes of competition • Examine a variety of foods for carbohydrate content • Design 4 recovery carb snacks to meet individual needs

Sports Nutrition Lessons for Adolescents, Pennsylvania Department of Education, © 2001. Developed by V. Star Campbell, 814-237-8711. Funded by a grant from USDA.

Appendix 2

Body Weight and Body Image Lessons for Adolescents

Overview

Purpose of Curriculum

The seven lessons in this curriculum are designed to help middle and high school students adopt healthful weight management practices, engage in appropriate physical activity patterns, and develop positive body image.

Curriculum Design

The curriculum contains seven multidisciplinary lessons that can be taught in Family and Consumer Sciences (FCS), Health Education, Math, and Statistics. Each lesson is keyed to the Pennsylvania education standards and includes a lesson plan, student worksheets, teacher answer sheets, transparency masters, background information for both students and teachers, and recommended resources. The information in each lesson is based on research findings and recommendations in the fields of nutrition, health, and physical activity.

Lesson Titles	Subjects	Summary of Content	Examples of Lesson Objectives
Normal Eating and Normal Exercise	• FCS • Health	Redefine the concepts of normal eating and normal exercise for adolescents and examine competent eating	• Define normal eating and normal exercise • Examine eating competency
Eating Volumetrically—Eating More for Less	• FCS • Health • Math	Examine the relationship between calories and weight (grams) of food in order to lower calories in the diet without decreasing amount of food consumed	• Calculate energy density of foods (calories divided by weight of food) • Develop a volumetric eating plan to increase satiety without increasing calories
Portions are Out of Proportion	• FCS • Health • Math • Statistics	Examine changes in mean portion sizes, mean serving sizes and calories of popular foods eaten by teenagers over past 7 years	• Calculate the differences in calories and gram weight of portions versus servings of popular foods • Conduct a z-test to determine significance in increase of portion sizes • Reorganize/generate new Food Guide Pyramid to address servings/portions
Food-Mood Connection	• FCS • Health	Examine food-mood connections which contribute to over- or under-eating and generate ideas for alternative behaviors	• Assess eating behaviors triggered by emotions • Record hunger & state of mood • Identify neurotransmitters, moods, and dietary interventions
It's the Little Things That Count	• FCS • Health • Math	Recognize the effects of modern day conveniences on energy expenditure	• Determine the differences in calories burned between using and not using modern conveniences • Examine factors that help and hinder physical activity levels
Barbie, Ken and Action Toys	• FCS • Health • Math	Examine discrepancies between toy doll body proportions and young adult body proportions	• Measure doll body parts and scale to reference heights and body part measurements of young adults
Body Image Distortions	• FCS • Health	Analyze four scenarios of teens with distorted body images	• Identify and address several types of body image distortions

Body Weight and Body Image Lessons for Adolescents, Pennsylvania Department of Education, © 2001.
Developed by V. Star Campbell, 814-237-8711. Funded by a grant from USDA.

APPENDIX 3

ATLAS & ATHENA Training Overview

ATLAS | ATHENA | Program Materials | Program Pricing Guide | **Training Overview**

Training is recommended prior to implementing ATLAS & ATHENA

The ATLAS and ATHENA team at the Center for Health Promotion Research of Oregon Health & Science University provides training for effective implementation of the ATLAS and ATHENA programs.

During training, participants learn the current trends in adolescent athlete substance abuse, underpinnings of effective drug prevention and health promotion, alternatives to drug use (sports nutrition and physical training) and the background and outcomes of ATLAS and ATHENA. Coaches and other prospective instructors will have practical experience learning to use the programs and integrating them into their usual team activities.

Trainings can be organized for ATLAS only, ATHENA only or both ATLAS and ATHENA.

Participants

- Minimum of 20
- Maximum of 100

2 trainers are required for up to 50 participants, 3 for 50-75 and 4 trainers for more than 75.

Time

Training is accomplished in approximately 5 hours, depending on the number of participants. Ongoing customer support is available for all participants.

Training Fees

For pricing information, please contact the Center for Health Promotion Research at: 503-418-4166; chpr@ohsu.edu.

http://www.ohsu.edu/hpsm/atlas_athena_training_pricing.cfm

ATLAS Program Pricing Guide

Product Description	Price	
ATLAS Coach Instructor Package	**$280.00**	Order Form

Instructional manual for the Coach/Instructor which includes background information, a guide to train the Squad Leaders, and the Ten Session Curriculum Guide. The package also includes one Team Workbook and an Athletes Guide. One Coach Instructor Package is needed per team.

ATLAS Squad Leader Package	**$11.00**	Order Form

The Squad Leader Package contains one Squad Leader Ten Session Curriculum Guide and one Athletes Guide. There should be one student Squad Leader for every five athletes on each team.

ATLAS Athlete Package	**$11.00**	Order Form

The Athlete Package includes one Team Workbook and an Athletes Guide. Each student who is not a Squad Leader should have a complete Athlete Package.

ATHENA Coach Instructor Package	**$280.00**	Order Form

Instructional manual for the Coach/Instructor which includes background information, a guide to train the Squad Leaders, and the Eight Session Curriculum Guide. The package also includes one Team Workbook and an Athletes Guide. One Coach Instructor Package is needed per team.

ATHENA Squad Leader Package	**$11.00**	Order Form

The Squad Leader Package contains one Squad Leader Eight Session Curriculum Guide and one Athletes Guide. There should be one student Squad Leader for every five athletes on each team.

ATHENA Athlete Package	**$11.00**	Order Form

The Athlete Package includes one Team Workbook and an Athletes Guide. Each student who is not a Squad Leader should have a complete Athlete Package.

Shipping and Handling	**11%**

This charge applies to the subtotal of materials purchased. Your payment must be secured before shipment. Check, purchase order or credit card (Visa or Mastercard only) payments are acceptable. Please allow 6 to 8 weeks for delivery.

http://www.ohsu.edu/hpsm/atlas_athena_program_pricing.cfm

APPENDIX 4

University of Pittsburgh

Department of Sports Medicine & Nutrition

SMN: Home | About | Clinical | Faculty | Research

About

What would you do as a student in the University of Pittsburgh's Department of Sports Medicine and Nutrition? Perhaps you would work alongside researchers to analyze how a baseball player's throwing motion may lead to chronic shoulder injuries, or find ways to help a soccer player prevent an acute anterior cruciate ligament injury . Maybe you would work one on one with athletes to examine how diet affects performance, counsel individuals on nutrition and lifestyle changes for health improvement or help create an appropriate exercise or nutrition regimen for someone with a chronic disease or disability.

What will you do as a graduate of one of our programs? Set the pace for sports medicine and nutrition.

Our students choose from three distinct areas of study: sports medicine/athletic training, clinical dietetics and nutrition or wellness and human performance . By combining these fields, we maximize research capabilities across the University and prepare quality clinicians in the fields of dietetics and athletic training.

Research

Our research delves into the science of human movement and nutrition strategies.

The Neuromuscular Research Laboratory (NMRL) is the department's research center located in the UPMC Center for Sports Medicine and is a contemporary applied research laboratory that provides the opportunity for faculty and students to study issues central to injury and disease prevention and management and the rehabilitation of athletic and physically active individuals.

The NMRL is dedicated to the science of human movement, studying models for sport and exercise injury prevention, treatment, rehabilitation, and performance enhancement. Injury and disease prevention is the central focus of the research agenda, which includes the study of gender-specific knee injury reduction paradigms that are supported by the Centers for Disease Control and Prevention, and research paradigms to study injury prevention and performance enhancement in the U.S. Army Special Operations and Naval Special Warfare (SEALs), both supported by the U.S. Department of Defense. Research on the upper extremity focuses on understanding injury mechanism associated with overhead activities in both overhead athletes and individuals with rotator cuff tears.

To this end the faculty members are developing a strong research initiative in the area of human performance, focusing on the use of exercise and nutrition as vehicles for enhancing physiological and metabolic aspects of physical activity and sports and operational performance.

Another central focus of the department's research is related to the role of exercise and nutrition strategies to enhance wellness while preventing and managing disease.

One specific focus area is behavioral intervention for the prevention and treatment of overweight and obesity—more specifically, investigating what individuals can do behaviorally to effect motivation to be physically active and consume a healthy diet, and to this end, relying on the most powerful technologies available for self-motivation and the measurement of one's own performance.

Faculty

Scott M. Lephart, PhD, ATC
Chair and Associate Professor
John Abt, PhD, ATC
Assistant Professor
Amy Aggelou, MA, ATC
Instructor, Clinical Coordinator, Athletic Training Education Program
Lori E. Cherok, MS, RD, LDN, CNSD
Instructor, Clinical Coordinator, Clinical Dietetics and Nutrition Program
Kevin Conley, PhD, ATC
Assistant Professor and Program Director, Athletic Training Education
Vice Chair
Kim Crawford, PhD, RD, CSSD, LDN
Assistant Professor, Coordinator, Graduate Studies in Clinical Dietetics and Nutrition
Judy Dodd, MS, RD, FADA
Assistant Professor
Diane Helsel, PhD, RD, LDN, CSSD
Assistant Professor
Greg Hovey, MS, CSCS
Instructor
Deborah A. Hutcheson, MS, RD, LDN, CNSD, CDE
Instructor, Program Director, Clinical Dietetics and Nutrition
Daryl Lawrence, MS
Visiting Instruct
Mita Lovalekar, MBBS, PhD, MPH
Assistant Professor
Lisa McDermott, MS, RD, CDE, LDN
Clinical Instructor
Qi Mi, PhD
Assistant Professor
Timothy Sell, PhD, PT
Assistant Professor
Coordinator, Graduate Studies in Sports Medicine

Secondary & Adjunct Faculty Appointments

Secondary
Robert Blanc, MS, ATC
Clinical Instructor/Head Athletic Trainer
Brian Bonnar, MS, ATC
Clinical Instructor/Athletic Trainer
James Cerullo, PhD, ATC
Clinical Instructor/Athletic Trainer
Jill Conley, MS, ATC
Clinical Instructor/Athletic Trainer
Tim Dunlavey, MS, ATC
Clinical Instructor/Athletic Trainer
Jennifer Pease, MA, ATC
Clinical Instructor/Athletic Trainer
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REFERENCES

1. Manore, M., *Nutrition and Physical Activity: Fueling the Active Individual*. 2004, President's Council on Physical Fitness and Sports Washington, DC.
2. CDC, *Morbity and Mortality Weekly Report Youth Risk Behavior Surveillance-United States 2007*, CDC, Editor. 2008: Washington DC. p. 24-27.
3. Services, U.D.o.H.a.H., *Healthy People 2010 Midcourse Review*. 2006, US Government Printing Office: Washington DC.
4. USDA, A.R.S., *Unpublished data from the 1994-1996 Continuing Survey of Food Intakes by Individuals*, USDA, Editor. 1998 February.
5. Samour, P., Helm, KK. and Lang, CE, *Handbook of Pediatric Nutrition*. 2nd ed. 2003, Sudbury, MA: Jones & Bartlett Publishers.
6. Nichols, J., Rauh, MJ., Lawson, MJ., Barrack, Ji, M. and Barkai, HS., *Prevalence of female athlete triad syndrome among high school athletes.* Archives Pedia & Adoles Medicine, 2006. **160**(2): p. 137-42.
7. Nichols, J., Rauh, MJ., Barrack, MT,. Barkai, HS. and Pernick, Y., *Disordered eating and menstrual irregularity in high school athletes in lean-build and nonlean build sports.* Inter J Sports Nutrition & Exer Metab, 2007. **17**(4): p. 364-77.
8. McGuine, T., *Sports injuries in high school athletes: a review of injury-risk and injury-prevention research.* Clinical Journal of Sports Medicine, 2006. **16**(6): p. 488-99.
9. Burke, L.a.D., V, *Clinical Sports Nutrition*. 3rd edition ed. 2006: The McGraw-Hill Companies.
10. Otten, J., Helwig, JP., and Meyers, LD., *Dietary Reference Intakes: The Essential Guide to Nutrient Requirements*, I.o. Medicine, Editor. 2006, National Academies Press: Washington, DC.
11. Dunford, M., *Sports Nutrition A Practice Manual for Professionals*. 4th edition ed. 2006: Diana Faulhaber.
12. Spear, B.a.P., M, *Sports Nutrition for Adolescents.* Building Block for Life, 2008. **31**(1): p. 1-8.
13. Unnithan, V.a.G., S, *Nutrition for the Pediatric Athlete.* Current Sports Medicine Reports, 2004. **3**: p. 206-211.
14. Cotugna, N., Vickery, CE. and McBee, S, *Sports Nutrition for Young Athletes.* J of School Nursing, 2005. **21**: p. 323-328.
15. Duellman, M., Lukaszuk, JM., Prawitz, AD. and Bradenburg, JP., *Protein supplement users among high school athletes have misconceptions about effectiveness.* J Strength Cond Res, 2008. **22**(4): p. 1124-9.
16. Association, A.C.o.S.M.a.t.A.D., *Position Stand.*
17. Steen, S., *Nutrition for Sport & Exercise*, ed. J.a.S. Berning, SN. 1998, Gaitherburg, MD: Aspen Publishers. 217-245.
18. Coyle, E., *Fluid and fuel intake during exercise.* J Sports Sci, 2004. **22**: p. 39-55.
19. Sawka, M., Burke, LM., Eichner, ER., Maughan, RJ., Montain, SJ and Sachenfeld, NS, *Exercise and Fluid Replacement.* Med Sci in Sports & Exer, 2007: p. 377-390.
20. Judelson, D., Maresh, CM., Anderson, JM., Armstrong, LE., Casa, DJ and Kraemer, WJ., *Hydration and muscular performance: does fluid balance affect strength, power and high-intensity endurance?* Sports Medicine, 2007. **37**(10): p. 907-21.
21. Shirreffs, S., *Symposium on "Performance, exercise and health" Hydration, fluids and performance.* Proc Nutr Soc, 2008. **17**: p. 1-6.
22. Bar-Or, O., *Children's response to exercise in hot climates: implications for performance and health.* Sports Sci Exchange, 1994. **4**: p. 1-4.
23. Ivy, J.a.P., R, *The Future of Sports Nutrition Nutrient Timing*, ed. C. Rosenberg. 2004, North Bergen, NJ: Basic Health Publications, Inc.

24. Worcester, S., *Energy drink sales hit $3 billion-at what health cost?* Pediatric News, 2007. **41**: p. 1-4.
25. Ryan-Krause, P., *The score on high-tech sports nutrition for adolescents.* J of Pediatric Health Care, 1998. **12**: p. 164-166.
26. Coombes, J.a.H., KL., *The effectiveness of commercially available sports drinks.* Sports Medicine, 2000. **29**(3): p. 181-209.
27. Meyer, F., Bar-Or, O., Salsberg, A. and Passe, D., *Hypohydration during exercise in children: effect on thirst, drink preferences and rehydration.* Int J Sport Nutr Exerc Metab, 1994. **4**: p. 22-35.
28. Bar-Or, O.a.W., B., *Water and electrolyte replenishment in the exercising child.* Int J Sport Nutr Exerc Metab, 1996. **6**: p. 93-8.
29. Minehan, M., Riley, MD. and Burke, LM, *Effect of flavor and awareness of kilojoule content of drinks on preference and fluid balance in team sports.* Int J Sport Nutr Exerc Metab, 2002. **12**(1): p. 81-92.
30. Meadows-Oliver, M.a.R.-K., P., *Powering up with Sports and Energy Drinks.* J of Pediatric Health Care, 2007. **21**(6): p. 413-416.
31. Roy, B., *Milk: the new sports drink? A Review.* J of Int Soc of Sports Nutr, 2008. **5**(15): p. 1-6.
32. Karp, J., Johnston, JD., Tecklenburg, S., Mickleborough, TD., Fly, AD. and Stager, JM., *Chocolate milk as a post-exercise recovery aid.* Int J Sport Nutr Exerc Metab, 2006. **16**(1): p. 78-91.
33. Shirreffs, S., Watson, P. and Maughan, RJ., *Milk as an effective post-exercise rehydration drink.* Br J Nutr, 2007. **98**(1): p. 173-80.
34. Hartman, J., Tang, JE, Wilkinson, SB., Tarnopolsky, MA., Lawrence, RL., Fullerton, AV and Phillips, SM., *Consumption of fat-free fluid milk after resistance exercise promotes greater lean mass accretion than does consumption of soy or carbohydrate in young, novice male weightlifters.* Am J Clin Nutr, 2007. **86**(2): p. 373-81.
35. Clauson, K., Shields, KM., McQueen, CE. and Persad, N., *Safety issues associated with commercially available energy drinks.* J Am Pharm Assoc, 2008. **48**: p. e55-e67.
36. Reissig, C., Strain, EC., Griffiths, RR, *Caffeinated energy drinks-A growing problem.* Drug Alcohol Depend, 2008. **20 (in press).**
37. Babu, K., Church, RJ. and Lewander, W., *Energy Drinks: The New Eye-Opener for Adolescents.* Clinical Ped Emerg Med, 2008. **9**: p. 35-42.
38. Naylor, A., Gardner, D. and Zaichkowsky, L., *Drug use patterns among high school athletes and nonathletes.* Adolescence, 2001. **36**(144): p. 627-39.
39. Forbes, S., Candow, DG., Little, JP., Magnus, C. and Chilibeck, PD., *Effect of Red Bull energy drink on repeated Wingate cycle performance and bench-press muscle endurance.* Int J Sport Nutr Exerc Metab, 2007. **17**(5): p. 433-44.
40. Alford, C., Cox, H., Wescott, R., *The effects of red bull energy drink on human performance and mood.* Amino Acids, 2001. **21**(2): p. 139-50.
41. Seidl, R., Peyrl, A., Nicham, R. and Hauser, E., *A taurine and caffeine-containing drink stimulates cognitive performance and well-being.* Amino Acids, 2000. **19**(3-4): p. 635-42.
42. Fitness, C.o.S.M.a., *Use of Performance-Enhancing Substances.* Pediatrics, 2005. **115**(4): p. 1103-6.
43. Calfee, R.a.F., P., *Popular ergogenic drugs and supplements in young athletes.* Pediatrics, 2006. **117**(3): p. e577-89.
44. Scofield, D.a.U., S., *Dietary supplement use among adolescent athletes in central Nebraska and their source of information.* J Strength Cond Res, 2006. **20**(2): p. 452-5.
45. McGuine, T., Sullivan, JC. and Bernhardt, DT., *Creatine supplementation in high school football players.* Clin J Sport Med, 2001. **11**(4): p. 247-53.

46. McGuine, T., Sullivan, JC and Bernhardt, DA, *Creatine supplementation in Wisconsin high school athletes.* WMJ, 2002. **101**(2): p. 25-30.
47. Ray, T., Eck, JC., Covington, LA., Murphy, RB., Williams, R. and Knudtson, J., *Use of oral creatine as an ergogenic aid for increased sports performance: perceptions of adolescent athletes.* Southern Medical J, 2001. **94**(6): p. 608-12.
48. Buckley, W., Vesalis, CE., Friedl, KE., Anderson, WA., Streit, AL. and Wright, JE, *Estimated prevalence of anabolic-androgenic steroid use among high school seniors.* JAMA, 1988. **260**(23): p. 3441-3445.
49. Greydanus, D.a.P., DR., *Sports doping in the adolescent athlete The hope, hype and hyperbole.* Pediatric Clinics of North America, 2002. **49**: p. 829-855.
50. Rosenfield, C., *The Use of Ergogenic Agents in High School Athletes.* J of School Nursing, 2005. **21**(6): p. 333-339.
51. Mathias, R., *Steroid Prevention Program Scores with Hight School Athletes,* in *NIDA Notes,* N.I.o.D. Abuse, Editor. 1997.
52. Goldberg, L., MacKinnon, DP., Elliot, DL., Moe, EL., Clarke, G. and Cheong, J., *The Adolescents Training and Learning to Avoid Steroids Program.* Archives Pedia & Adoles Medicine, 2000. **154**: p. 332-338.
53. Thakur, N.a.D.A., F, *Relationship of nutrition knowledge and obesity in adolescence.* Family Medicine, 1999. **31**: p. 122-127.
54. Douglas, P.a.D.J., *Nutrition knowledge and food practices of high school athletes.* JADA, 1884. **84**(10): p. 1198-202.
55. Skinner, J.a.W., MJ., *Nutrition knowledge of teen-agers.* J of School Health 1984. **54**(2): p. 71-4.
56. Perry-Hunnicut, C.a.N., IA, *Adolescent dietary practices and nutrition knowledge.* Health Values, 1993. **17**: p. 35-40.
57. Pirouznia, M., *The association between nutrition knowledge and eating behavior in male and female adolescents in the US.* Inter J Food Sci & Nutr, 2001. **52**: p. 127-132.
58. Smith-Rockwell, M., Nickols-Richardson, M. and Thye, FW. , *Nutrition knowledge, opinions, and practices of coaches and athletic trainers at a division 1 university.* Inter J Sports Nutrition & Exer Metab, 2001. **11**(2): p. 174-85.