SPARTA Pro: Dietary Protein Intake and Injury Rate Among High School Athletes

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LIST OF ABBREVIATIONS AND ACRONYMS

AI	Adequate Intake
AMDR	Acceptable Macronutrient Distribution Range
AMPM	Automated multiple pass method
ATHENA	Athletes Targeting Healthy Exercise & Nutrition Alternatives
ADP	Adenosine Diphosphate
ATP	Adenosine Triphosphate
DRI	Dietary Reference Intake
EAR	Estimated Average Requirement
EBW	Estimated Body Weight
FFQ	Food Frequency Questionnaire
NHANES	National Health and Nutrition Examination Survey
OHSU	Oregon Health & Science University
RDA	Recommended Daily Allowance
REE	Resting Energy Expenditure
SPARTA	Studies to Prevent and Reduce Trauma in Athletes
TEF	Thermic Effect of Food
WHO	World Health Organization

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Abstract

Sport related injuries affect approximately one third of US adolescent athletes, resulting in 2 million injuries annually. Most injury prevention research has focused on pre-season screening, rule modification, and protective equipment. However, high injury rates persist, suggesting the need for an expanded injury model that takes into consideration lifestyle factors and behaviors, which includes diet. This may be a productive line of research as adolescents' diets often are inadequate. Consequences of inadequate protein intake include increased lean tissue catabolism and weakened recovery response from exercise, potentially leading to increased injury risk. This purported relationship led us to test the hypothesis that protein intake is inversely related to frequency of sport related injuries among high school athletes.

A convenience sample of 270 adolescent athletes from 6 high schools completed anonymous surveys near the conclusion of the spring sport season (2009). Sports represented included women's lacrosse, volleyball, softball, tennis, and track and field and men's baseball, tennis, and track and field. The survey included the Block Kids Screener™ for their dietary assessment, and additional items for demographic, anthropometric, and sport related injury information. Data for males (n=127) and females (n=101) was analyzed separately. Descriptive statistics were used to characterize the sample, and two sample proportion z-tests were used to determine differences in injury rate among athletes consuming low, medium and high amounts of protein.

Independent t-tests were used to analyze differences in the mean dietary protein intake between those who reported and did not report injuries.

Participants had a mean (± SD) age of 16 ± 1 year. The mean BMI for males was the 68^{th} ± 25^{th} percentile and for females 60^{th} ± 22^{nd} percentile. Eighty-four percent of participants were white. The average energy and protein intake was 2070 ± 808 kcal/d and 97 ± 41 g/d for males and 1371 ± 534 kcal/d and 57 ± 25 g/d for females. The ratio of daily protein intake to body weight was 1.3 ± 0.6 g/kg/d for males and 1.0 ± 0.5 g/kg/d for females, compared to the 1.2-2.0 g/kg/d recommended for athletes. Self-reported energy and macronutrient intakes were lower than expected for adolescents.

Thirty-four percent of males and 31% of females were injured at least once during the sport season. Leg injuries were most common for both. Protein intake was not different among males consuming low, medium, or high amounts of protein when protein intake was indexed as g/d, g/kg/d, or g/1000 kcals. However, interestingly when protein intake was indexed to body weight, females in the low protein group had a significantly higher rate of injuries than the high protein group ($p = 0.0002$). Although total injuries were not related to protein intake among males, mean dietary protein intake for adolescent males reporting shin splints was significantly less than those without shin splint injuries ($p = 0.015$).

Findings are limited by the single sport season, relatively small participant numbers and instrument validity. Despite these limitations, results suggest a potential relationship between low protein intake and injuries. This is the initial

observation of this potentially important finding. Before secure recommendations can be made concerning adolescent athletes' protein intake future studies are needed with additional participants, better characterization of injury and validated tools to measure energy and macronutrient intake.

Significance

Sport related injuries affect approximately one third of US adolescents athletes, resulting in 2 million injuries, half a million doctor visits, and 30,000 hospitalizations each year (1, 3-5). Athletes participating in intermittent sports with frequent periods of stopping and starting such as basketball and football are among the largest populations to be seen for injuries resulting in emergency department visits (3). To date, most research surrounding injury prevention has focused on pre-season screening by assessment of musculoskeletal flexibility, and range of motion to identify intrinsic risk factors for sport injuries and to determine harmful practices through injury epidemiology and videotape review (6-11). Though important factors have been identified to reduce injury risks, such as the use of protective equipment, high injury rates among high school adolescents persist.

The persistence of the high incidence of sport related injuries among high school athletes suggests the need for new research that takes into consideration the contribution of other potential risk factors. Limited research has been conducted to describe the relationship between lifestyle factors and injury risks among high school athletes. Lifestyle factors that may increase risk for injury include: sport specialization; poor nutrition, specifically inadequate calcium, fruit and vegetable intake, and insufficient protein intake; insufficient sleep; substance use; disordered eating; and attitudes and beliefs such as, win-at-all costs, depression/anxiety, self-esteem/self-image, and negative media influences. Of these variables, dietary habits of high school athletes may be of particular

importance as inadequate nutrition, which is common among adolescents, may negatively impact growth, development, and athletic performance, all of which could potentially increase the risk for sport related injuries.

The role of dietary protein in athletic performance has been debated among experts since the 1840's (12, 13). However, it was not until the 1970's and 1980's that researchers validated the importance of higher protein and amino acid intakes on exercise metabolism in endurance and strength athletes (12). While this relationship was recognized, recommendations for protein intake varied greatly depending on several factors including age, gender, weight, type of sport, and duration of training/competition. In general, dietary protein recommendations for athletes fall between 1.2 - 2.0 g/kg/d. Other recommendations for protein intake for athletes have been made as a percentage of total energy intake, such that 10-15% of total energy intake should be derived from dietary protein (14). These dietary recommendations are even more speculative among adolescent athletes, as only two nitrogen balance studies to determine protein requirements have been conducted in male adolescent athletes (15, 16), and no studies have been conducted in female adolescent athletes. This study allowed us to evaluate the relationship between dietary protein intake and injury rate among adolescent athletes.

Specific Aims and Hypothesis

Study Objective

The purpose of this study was to investigate the relationship between protein intake and sport related injury among high school athletes. Data was collected from a convenience sample of adolescent athletes to assess protein intake as a risk factor for sport related injuries using a one-time, anonymous, retrospective, demographic, lifestyle, and injury history questionnaire and the BLOCK Kids Screener™. To test the hypothesis that athletes with low protein intakes would have more injuries than athletes with high protein intakes we carried out the following study aims:

Aim 1: Measure protein intake with an age appropriate food frequency questionnaire (BLOCK Kids Screener™).

Aim 2: Determine injury rate (type and frequency) by self-reported survey.

Aim 3: Compare differences in injury rate between groups consuming low, medium, and high amounts of protein, for males and females separately.

Chapter 1: Background

Dietary Energy and Macronutrient Recommendations for Adolescents

The estimated average requirement (EAR) of a nutrient takes into consideration gender and stage of the lifecycle and was established to meet the average daily requirement of 50% of healthy individuals in a population (17). The recommended daily allowance (RDA), which also accounts for gender and stage of lifecycle, is established to meet the average daily nutrient requirement of 97-98% of healthy individuals in a population. The RDA is equal to the EAR plus two standard deviations (17).

Recommended Dietary Intake of Energy

The Dietary Reference Intakes (DRIs) for total energy intake are age and gender specific. The recommendations for adolescents, 14 to 18 years of age, are 3152 kcal/d for males and 2368 kcal/d for females (17). Energy needs are influenced by level of activity, basal metabolic rate, and needs required to support growth and development during puberty (17). Recommendations for total energy intake also take into consideration height to better account for differences due to variability in timing of growth spurts and maturation. Recommendations for females between the ages of 15 and 18 years, are set at 2200 kcal/d or 13.5 kcal/cm. Recommendations for males in the same age range, are set at 3000 kcal/d or 17 kcal/cm (17). Current DRI's for energy were established to meet the needs of adolescents who engage in light to moderate activity. Those who

participate in moderate to vigorous levels of physical activity, such as athletes on competitive club or team sports, may need higher energy intakes.

Recommended Dietary Intake of Carbohydrate

The Recommended Dietary Allowance (RDA) for carbohydrate is based on the amount needed to maintain brain function. The RDA for males and females 14-18 years of age is 130 grams of carbohydrate per day. It is also recommended that 50% or more of total daily energy intake is derived from carbohydrate, with a maximum of 10 to 25% of energy derived from sweeteners including sucrose and high fructose corn syrup (17).

Recommended Dietary Intake of Fat

A Recommended Dietary Allowance (RDA) for fat in grams per day has not been determined, however an acceptable macronutrient distribution range (AMDR) for total dietary fat for children 4 to 18 years of age is 25 to 35 percent of total energy (17). The AMDR for n-6 polyunsaturated fatty acids (linoleic acid) is 5 to 10 percent of total energy and the AMDR for n-3 polyunsaturated fatty acids (α-linolenic acid) is 0.6 to 1.2 percent of total energy. Linoleic acid and α-linolenic acid also have adequate intake (AI) recommendations. The AI for linoleic acid for males and females is 17 and 12 g/d, respectively. The AI for α-linolenic acid for males and females is 1.6 and 1.1 g/d, respectively (17).

Recommended Dietary Intake of Protein

Dietary reference intakes for protein have been set for adolescents 14 to 18 years of age. The estimated average requirement (EAR) is used to assess the adequacy of population intakes as well as to calculate recommended daily allowances. The EAR for protein for 14 to 18 year old male and females is 0.73 g/kg/d and 0.71 g/kg/d, respectively (17). The RDAs for protein intake for adolescent males and females are 52 g/d and 46 g/d, respectively. The RDA for protein was also established in relation to body weight (g/kg/d) using the reference body weight for each age group. The reference weight for 14 to 18 year old males is 61 kilograms or 134 pounds. The reference weight for adolescent females 14 to 18 years of age is 54 kilograms or 119 pounds. Therefore the RDA for protein for male and female adolescents 14 to 18 years old is 0.85 g/kg/d. The AMDR for protein during adolescence is 10 to 30 percent of total energy intake. However, these recommendations do not take into account the increased physical demands placed on athletes and therefore may not be adequate for adolescent athletes playing competitive sports.

Dietary Protein Intake Among U.S. Adolescents

An analysis of protein intake in the United States was conducted using the National Health and Nutrition Examination Survey's (NHANES) data between 2003-2004 (18). Two 24-h diet recalls were administered, the first day of intake was collected in person at a Mobile Examination Center using an automated multiple pass method (AMPM). The second day of intake was recorded during a

telephone interview three to ten days after the first recorded intake. The two nonconsecutive dietary recalls were used to estimate usual protein intake which was reported in three ways: as grams of protein per day, as grams of protein per kilogram of body weight, and as percentage of energy from protein. For those individuals whose body mass index (BMI) was between the 5th and 85th percentile for age, ideal body weight was defined as their actual body weight. For those individuals whose BMI was less than the 5th percentile or greater than the 85th percentile for age, ideal body weight was defined as the weight corresponding to a BMI at the 5th or 85th percentile for age, respectively.

Nearly 8% of the 578 female adolescents surveyed reported consuming less than the estimated average requirement (EAR) for protein of 0.71 g/kg/d. When protein intake was expressed in grams per day the average intake was 68 ± 17 g/d, and 8.6% of the adolescent females surveyed did not meet the EAR. Of the 638 male participants surveyed, the mean protein intake was 97 ± 25 g/d, and fewer than 3% failed to meet the EAR.

Acceptable macronutrient distribution ranges (AMDR) for protein were used as a reference to compare to reported usual protein intake as a percentage of total energy intake. Fewer than 3% of adolescent males consumed amounts of protein below (< 10% of total energy) or above (> 30% of total energy) the AMDR. Where as approximately 3% of adolescent females consumed protein in amounts below the AMDR.

These results suggest that females in general may be at higher risk than males for not consuming protein in recommended amounts. Female adolescent

athletes may be at an even higher risk of inadequate protein intake due to higher protein requirements associated with the physiological demands of exercise. Though adolescent males in general appear to consume protein in recommended amounts, male adolescent athletes may need to be evaluated to ensure adequate protein is consumed to support the increased needs associated with competitive sports participation.

Importance of Adequate Protein Intake by Adolescent Athletes

One important reason for meeting protein requirements during puberty is the need to accumulate lean body mass during the teenage “growth spurt”. In addition, adolescents who are athletes require higher amounts of dietary protein to build, repair, and maintain body tissue. However, consensus about specific recommendations for protein intake has yet to be established as little research has been conducted in this population. Adolescent athletes, who engage in regular strenuous physical activity, require increased energy and nutrients to support positive nitrogen balance for proper growth and development, in addition to supporting increased needs for physiological demands (17). Insufficient protein intake on a consistent basis that results in negative nitrogen balance can be detrimental to adolescent health and result in compromised linear growth, sexual maturation, and reduced accumulation of lean body tissue (19).

Nitrogen balance is a measurement used to assess protein intake. Nitrogen balance is calculated by taking the total amount of nitrogen ingested (primarily as protein) and subtracting it from the total amount of nitrogen excreted

(primarily as urea). Nitrogen balance may be positive, negative, or neutral. Adjustments to protein intake can be made to keep the athlete in a state of positive nitrogen balance to support the demands of physical activity. A chronic state of negative nitrogen balance is detrimental to the athlete as it causes loss of protein from muscle to generate energy (20).

Substrate Oxidation and Athletes

The contraction of muscle during exercise requires energy. The amount of energy required to support this work increases as intensity and duration of exercise increases. At rest, skeletal muscle oxidizes a combination of fuel sources through aerobic catabolism (21) primarily as 80-90% fat, 5-18% carbohydrate and 2-5% protein (2). Adenosine triphosphate (ATP) is the primary source of energy for muscle and is responsible for initiating muscle contraction. Moving from a resting state to an exercising state increases muscular contraction cycles, ATP synthesis, and the amount of fuel oxidized, all of which contribute to an increase in total energy expenditure (21). Small stores of ATP that exist within the muscle are quickly depleted with the contraction of muscle when exercise is initiated, as one phosphate group is cleaved from ATP yielding adenosine diphosphate (ADP). The ATP-creatine phosphate (CP) system, replenishes ATP levels by transferring a high-energy phosphate from creatine phosphate to ADP. However, the creatine-phosphate source of high-energy phosphate is exhausted in less than ten seconds during high intensity exercise causing substrate oxidation to shift to alternative fuel sources (2).

During exercise the primary fuel sources for endurance athletes are muscle glycogen, muscle triglycerides, and plasma free fatty acids (2). Conversely, the primary fuel sources for sprint athletes and weightlifters are muscle creatine phosphate and muscle glycogen (21). Muscle glycogen, plasma glucose, plasma free fatty acids, and intramuscular triacylglycerols are all endogenous fuels used during exercise. The utilization of these substrates changes with intensity, duration, level of training, muscle glycogen stores, and replenishment of carbohydrate during exercise (2). As the duration of physical activity increases, less energy is contributed from the ATP-CP cycle and lactic acid and aerobic systems become the highest contributors of energy (2). The lactic acid system rapidly produces energy through incomplete break down of glucose to lactate, during which ADP is phosphorylated to regenerate ATP.

Exercise intensity is typically quantified by measuring the amount of oxygen consumed during a specific activity, in particular the max volume of oxygen consumed or VO_2 max. Maximum VO_2 consumption is defined as the exercise intensity achievable when an increase in intensity of exercise is not matched by an increase in the volume of oxygen consumed (2). At low intensity levels of exercise (25-30% VO_2 max) only a minimal amount of energy is derived from plasma glucose; primary substrates oxidized are muscle triacylglycerols and plasma fatty acids. Plasma fatty acids are the preferred substrates for up to 50% $V0_2$ max. With moderate intensity exercise (65% $V0_2$ max), substrate oxidation shifts to primarily muscle glycogen. At this intensity other fuel sources that contribute to energy are plasma free fatty acids and muscle triacylglycerides. At

high intensity exercise (85% $V0_2$ max) muscle glycogen remains the primary substrate oxidized, however the contribution of carbohydrate to total substrate metabolism increases drastically, as plasma glucose becomes the second highest source of substrate (2).

Unlike carbohydrate and fat, protein is not readily used by muscle to regenerate ATP during exercise. However protein plays a critical role in exercise as it functions to replenish the circulating amino acid pool. Protein and amino acids that are oxidized during exercise contribute to the total energy pool. In particular, branched chain amino acids; isoleucine, leucine and valine, are important for athletes as substrates to increase lean tissue mass and to repair muscle damage from exercise (14). Two hours of endurance exercise at 55% $V0_2$ max results in the oxidation of up to 86% of the daily requirement for leucine (22).

Metabolism of Protein in Athletes

Protein metabolism changes with exercise; therefore athletes require higher protein intakes than sedentary individuals (23). Figure 1 illustrates the different pathways in which protein is metabolized.

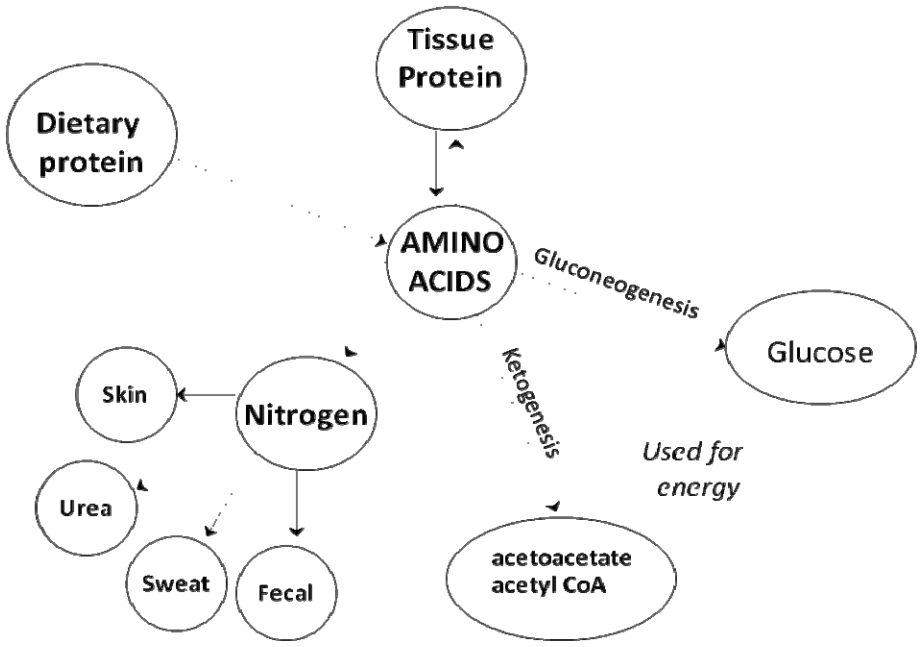

Figure 1: Metabolic Fate of Dietary Protein

Tissue protein is in a constant state of turnover as synthesis and degradation of protein are continuous. Therefore the amount of protein in tissue is a product of the rates at which protein synthesis and degradation occur. When protein degradation occurs as a result of exercise, the released amino acids are shunted through pathways such as amino acid oxidation, ketogenesis and gluconeogenesis. Ketogenesis and gluconeogenesis are pathways that produce energy from oxidized amino acids. Adequate intake of dietary protein enhances

the supply of amino acids and spares the degradation of protein from tissue for energy production. Adequate intake of protein is also important for athletes as it supports maintenance and repair of damaged muscle caused by exercise.

In addition to its role during exercise, protein plays essential functions in many physiological processes including hormone and enzyme production, transfer of nutrients throughout the body, and support and maintenance of connective tissue (24). Lemon et al., reviewed the role of protein during exercise and reported that in athletes who exercise as little as two hours a day, protein synthesis is reduced during exercise and for several hours afterwards (25). Thus, daily training without adequate protein intake would compromise muscle mass and tissue repair. Protein catabolism occurs during exercise as amino acids are utilized for energy as well as during recovery to repair and rebuild damaged muscle fibers (26). Therefore it is imperative that athletes consume adequate amounts of protein to replenish protein catabolized and support maintenance and repair of muscle tissue.

Dietary Protein Recommendations for Athletes

The importance of sports nutrition was recognized as early as 580 B.C. and since then many studies have investigated the relationship between diet and athletic performance (27). In 1995, Lemon suggested that the recommended daily allowance for protein of 0.8 gm/kg/d was insufficient to meet the needs of athletes who are continually active (12, 17). To address this concern, protein

intakes between 1.2 - 2.0 g/kg/d were suggested to meet the increased protein needs of athletes (12, 16, 28).

In 2002, Boisseau et al., (15) confirmed the need for higher protein intake recommendations through nitrogen balance studies in 15 year old adolescent males (n=19). The study objective was to assess protein intake and nitrogen balance in 8 healthy, non-active, male adolescents, and 11 adolescent male soccer players. The soccer players had been practicing for seven to nine hours a week for a minimum of one year. Data for nutrient intake and nitrogen balance was collected in the middle of the training season for the adolescent athletes, after about three months of training. Nutrient intake was assessed using seven day food record questionnaires and total energy expenditure was assessed using a daily physical activity questionnaire and the Harris-Benedict equation. Participants were instructed to continue with habitual eating habits prior to the study and had interaction with a study dietitian to ensure accurate qualitative and quantitative data on nutrient intakes from the questionnaires. A 24 hour urine sample was collected during the last day of the 7 day food record, corresponding to a training day for the adolescent soccer players. Urine samples were analyzed for urea nitrogen, and nitrogen balance was calculated as the mean daily protein intake (as nitrogen) minus the sum of the mean urinary nitrogen excretion, and estimated fecal nitrogen excretion and integumental nitrogen losses per day. Average total energy intake was similar between the non-active adolescents and soccer participants, 2151 kcal/d and 2345 kcal/d, respectively, however both groups consumed intakes lower than the age adjusted total energy

recommendation of 3200 kcal/d. Estimated total energy expenditure was lower in the non-active controls than the adolescent soccer players, 1712 kcal/d and 2175 kcal/d, respectively. Protein intake was higher in the soccer players, 101 g/d, than the non-active controls, 81 g/d. The results of this study showed that on average, the non-active control group was in a state of negative nitrogen balance and the soccer participants were in positive nitrogen balance, however nitrogen balance was not significantly different between groups. The results of this study also illustrated that positive nitrogen balance was achieved at a mean protein intake of 1.57 g/kg/d for both non-active and soccer participating adolescent males. This study indicates that the current protein recommendation for adolescents of 0.85 g/kg/d, is insufficient to meet the needs required during this stage of the lifecycle, whether a competitive athlete or not.

In another study conducted by Boisseau et al., dietary protein recommendations were investigated through nitrogen balance studies in 14 year old, healthy, male soccer players (16). Participants were trained soccer players who practiced 10 to 12 hours per week and played in one game per week. All participants were free of acute and chronic diseases, gastrointestinal disorders, and medications that altered protein and energy metabolism. Three diets with protein levels of 1.0, 1.2, and 1.4 g/kg/d were provided to the adolescent athletes who were housed at a training facility during the course of the study. The diets were administered in descending order of protein intake over three consecutive experimental periods. Each experimental period was 12-days long with an eight day adaptation period and a four day nitrogen balance period. Multiple four-day

food records corresponding to four-day continuous urine samples were collected for each experimental period. Urine samples were analyzed for urea nitrogen and nitrogen balance was calculated as the mean daily protein intake (as nitrogen) minus the sum of the mean urinary nitrogen excretion, estimated fecal nitrogen excretion and integumental nitrogen losses per day. The mean energy intake (± SEM) was 2668 ± 103 kcal/d, 2591 ± 103 kcal/d, and 2577 ± 143 kcal/d during the 1.0, 1.2, and 1.4 g/kg/d protein diets, respectively. The authors concluded that at energy equilibrium, subjects needed 1.04 g/kg/d of dietary protein to balance nitrogen losses. When a value of 11 mg N/kg/d was used to account for tissue protein deposition, a mean protein intake of 1.20 g/kg/d was calculated to represent the estimated average requirement (EAR) for boys 13 - 15 years of age (29). This value was used to calculate the recommended daily allowance (RDA) of 1.40 g/kg/d. The results of this study suggest that the current RDA for protein during adolescence, 0.85 g/kg/d, is inadequate to maintain nitrogen balance in adolescent male athletes.

In a study conducted by Tarnopolsky et al., nitrogen balance studies were used to determine protein requirements among men who were sedentary (n=7) or participating in strength training (n=6). The mean age of the strength training and sedentary men was 21.6 ± 1.5 and 24.5 ± 3.6 years, respectively. The men in the strength training group exercised for more than four days a week for at least two months prior to participation. Participants were assigned, in a random order, to one of three diets with varying levels of protein, low (0.86 g/kg/d), moderate (1.4 g/kg/d), and high (2.4 g/kg/d). Each diet period was 13 days long

and separated by a washout period of 3 to 30 days. The thirteen day experimental period consisted of a six day adaptation period to the assigned protein diet, a four day meat free diet when participants consumed foods from a checklist and 30% of energy and protein was provided through formula and supplements, and a three day nitrogen balance period when all foods and beverages consumed were packaged and weighed. During each thirteen day experimental period the sedentary men remained inactive, other than participating in activities of daily living. The strength training men participated in a mean of 9.7 ± 2.8 hours per week of physical activity.

On the low protein diet, five of the seven strength training men were in negative nitrogen balance (-2.4 ± 3.1 N g/d) and all of the sedentary men were in positive nitrogen balance (0.4 ± 1.2 N g/d). On the moderate protein diet the strength training men and sedentary men were in positive nitrogen balance (0.7 ± 1.5 N g/d) and (1.7 ± 1.2 N g/d), respectively. On the high protein diet the strength training men and sedentary men were in positive nitrogen balance (3.8 ± 2.3 N g/d) and (3.4 ± 1.4 N g/d), respectively. The minimum protein intake required to maintain nitrogen balance was 1.41 g/kg/d for strength training men and 0.69 g/kg/d for sedentary men. The recommended protein intake to maintain nitrogen balance in strength training and sedentary men was 1.76 g/kg/d and 0.89 g/kg/d, respectively (30).

Position Statement on Protein and Exercise

In 2007, the International Society of Sport's Nutrition published a position statement on protein and exercise that included seven specific recommendations for athletes (28):

1) Individuals who engage in regular exercise training require more dietary protein than sedentary individuals.
2) Protein intakes of 1.4-2.0 g/kg/day for physically active individuals are not only safe, but may improve the training adaptations to exercise.
3) When part of a balanced, nutrient-dense diet, protein intakes at this level are not detrimental to kidney function or bone metabolism in healthy, active persons.
4) While it is possible for physically active individuals to obtain their daily protein requirements through a varied, regular diet, supplemental protein in various forms are a practical way to ensure adequate and high-quality protein intake for athletes.
5) Different types and quality of protein can affect amino acid bioavailability following protein supplementation. The superiority of one protein type over another in terms of optimizing recovery and/or training adaptations remains to be convincingly demonstrated.
6) Appropriately timed protein intake is an important component of an overall exercise training program, essential for proper recovery, immune function, and the growth and maintenance of a lean body mass.

7) Under certain circumstances, specific amino acids supplements, such as branched-chain amino acids (BCAA's), may improve exercise performance and recovery from exercise.

These protein recommendations, established to meet the needs of athletes, are believed to be adequate to compensate for the protein/amino acids that are oxidized during exercise, while also providing substrate to increase lean tissue mass and to repair muscle damage (28). Particular to athletes engaging in intermittent sports (e.g., football, basketball, soccer, etc.) protein intakes in the middle of the 1.4-2.0 g/kg/d range are expected to be adequate (28). Increasing protein recommendations above the standard recommendation for healthy individuals can therefore decrease the potential risk of negative nitrogen balance, increased catabolism of tissue protein, and a weakened recovery response from exercise, all factors that could influence the risks of sport related injuries.

Adolescent Athletes and Sport Related Injuries

The prevalence of sport participation among 6 to 18 year old children and adolescents in the United States is estimated at 30-45 million (31). The most common etiological factor causing injury in young athletes is overuse, accounting for 50% of pediatric sports medicine visits (31). Injuries that are a result of overuse, e.g. "shin splints" or "little league elbow", are characterized by recurring stress coupled with insufficient rest (31-33). Sport-specialization is increasing in this population, such that many adolescent athletes are participating in one sport, year round. This can lead to recurrent injuries, overtraining, and burnout (31).

Involvement in a variety of sports results in fewer injuries and longer athletic participation (34).

Adolescent athletes undergo many physiological and developmental changes. During this stage of the life cycle they become more independent from parents and begin to cope with increased pressure from peers. Ensuring that adolescent athletes are meeting their nutritional needs to support physiological changes and the increased demands of exercise are of utmost importance for the adolescent's health. Suboptimal nutrition can lead to decreased stamina during exercise training and competition (35). Restriction of food, or foods in specific food groups, can lead to stunted growth, wasting of lean body mass, and changes in metabolism (36). Nutrition knowledge among athletes is often lacking and encompasses many misconceptions about protein, vitamins and minerals, and fluid needs (37). As a group, adolescents often have inadequate diets. Because nutrient requirements among athletes may be greater, and sport participants may have inaccurate beliefs about sport nutrition, whether intentional or not, suboptimal nutrition may increase the risk of sport related injuries among adolescent athletes.

Reducing the frequency of sport related injuries among adolescent athletes may require exploring additional factors related to injury, such as nutrition. The potential utility of this work was heightened when a health promotion/drug prevention program for female athletes significantly reduced injury. To address high rates of disordered eating and body shaping drug use in female adolescent athletes, researchers at the Oregon Health & Science

University (OHSU) created the program “Athletes Targeting Healthy Exercise & Nutrition Alternatives” (ATHENA). ATHENA is a peer-led, gender specific program administered to athletes during the sport season. This program is designed to teach female high school athletes about healthy sports nutrition and strength-training exercises to use as alternatives to disordered eating and body shaping drugs. Nine-hundred and twenty-eight female adolescent athletes from 40 different sport teams and eighteen high schools (nine experimental and nine control) from Northwest Oregon and Southwest Washington participated in this study. The intervention consisted of eight weekly 45 minute sessions that were gender-specific and focused on healthy sport nutrition, exercise training, sports performance and unhealthy behaviors such as drug use, negative media influences, and preventing depression. Compared to the control group, girls in the intervention group reported a reduction in the use of diet pills, steroids, amphetamines, and supplements, improved nutrition and healthy eating behaviors, reduction in risky behaviors such as riding in the car with a drunk driver and not wearing seatbelts, and reductions in intent to vomit to lose weight (38). It was also noted that girls in the intervention group had fewer sport related injuries than female athletes in the control group (38, 39).

These findings, in addition to the lack of effective injury prevention programs for young female and male athletes (40, 41) led to the development of “Studies to Prevent and Reduce Trauma in Athletes” (SPARTA). SPARTA is designed to determine the relationship among lifestyle variables, psychological factors and sport injury risk among high school athletes. SPARTA Pro, a sub-

study of SPARTA, is one of the first studies to investigate the association between protein intake and sport injury of high school athletes.

Chapter 2: Methods

General Design

SPARTA Pro used a retrospective, cross-sectional design to investigate the relationship between self-reported dietary protein intake and sport related injury among high school athletes. The primary aims of SPARTA-Pro were to measure protein and energy intake with an age appropriate food frequency questionnaire (FFQ), the BLOCK Kids Screener™, and to assess injury rate and characteristics using the SPARTA health, behavior and lifestyle survey. The working hypothesis was that protein intake is indirectly correlated to frequency of sport related injuries in high school athletes, such that athletes who consume lower amounts of protein will have higher rates of sport related injuries.

A one-time, anonymous, demographic, lifestyle, and injury history questionnaire and the BLOCK Kids Screener™ were administered to a convenience sample of male and female high school athletes in the spring of 2009. The study protocol and assessment tools were reviewed and approved by the OHSU Institutional Review Board. The questionnaires and administration methods were also approved by the administration at each participating high school.

Recruitment of Schools and Athletes

Recruitment of high schools and sport teams took place between March and May of 2009. High schools with previously established affiliations with

OHSU's Division of Health Promotion and Sports Medicine were recruited to participate. The study coordinator contacted school administrators and/or coaches by email and telephone to discuss the research objective and the study protocol. Copies of the lifestyle and food frequency questionnaires were sent to athletic directors and/or coaches as email attachments along with an informational letter to be distributed to the parents (Appendix A and B). Coaches were asked to provide the informational letters to spring sport team members to share with their parents. The informational letters described the study objective, the anonymous and voluntary nature of the survey, participation burden, and risk of emotional distress with participation, and provided contact information of SPARTA staff (Appendix A).

Study Participants

Male and female athletes enrolled in public high schools in Oregon and Southwest Washington who were members of a school sponsored spring sport team or an independent competitive "club" team that practiced and competed during the spring of 2009 were eligible to participate in this study. Student athletes were excluded if they were not participating in a spring sport at the time of data collection.

Survey Instruments

BLOCK Kids Screener™

The BLOCK Kids Screener™ was designed to evaluate dietary intake by food group in children and adolescents ranging from 4 to 17 years of age. The 42 item food frequency questionnaire assesses frequency and quantity of foods consumed over the past week. Frequency of food item consumption is discerned by response to one of six categories ranging from “none” or “never” to “every day”. The amount of food consumed from each item is determined by response categories for portion sizes of how much was eaten in one day. Age and gender were reported and used to designate food portion sizes in the nutrient analysis program. The BLOCK Kids Screener™ is used to measure intake of fruits, vegetables, breakfast cereals, juices, milk and cheese, protein sources, dessert foods, high fat snack foods and soft drinks. The screener takes approximately 10 to 15 minutes to complete. Completed questionnaires were sent to and processed by NutritionQuest (Berkeley, CA). Food intake data was reported as the average daily intake of energy (kcal/day), protein (g/day), carbohydrate (g/day), fat (g/day), and fiber (g/day) as well as the number of servings of specific food groups including: fruit/fruit juices, vegetables, potatoes, whole grains, meat/poultry/fish, dairy products, legumes, and beverages.

SPARTA Injury and Lifestyle Survey

The SPARTA injury and lifestyle survey is a 118 item questionnaire that represents a compilation of established, reliable measures developed and analyzed as part of previous studies (42-67). The survey was developed to assess sport related injuries and factors contributing to sport injury, including sport specialization, dietary intake, sleep pattern, substance use, disordered eating tendency, sport related attitudes and beliefs, depression/anxiety, and self-esteem/self-image. Participants were instructed to answer all questions based off of their current sport season taking place within the past two to three months. A majority of the questions were answered using a Likert scale with responses ranging from “strongly disagree” to “strongly agree”, “never” to “always”, or “rarely” to “all the time”. Other questions were answered by a numeric scale ranging from, “never” to “10+ times”. Questions about anthropometric and demographic information such as weight, height, grade in school, grade point average, and ethnic group were also included. To assess injuries, participants were asked to respond to questions regarding type or location of injury, whether they saw a health care provider as the result of the injury, how long until they were able to return to full participation in team practices and competition, and if the injury was a recurrent injury. Spring sport athletes were instructed to report only the injuries that occurred during the spring sport season. Participants were also asked to write a brief statement of how the injury occurred.

Survey Administration Procedure

Survey administration and data collection took place between April and May 2009. Surveys were administered during pre-scheduled meetings set up by SPARTA staff and coaches. Most of these meetings took place during a regularly scheduled team practice at the high school. The conditions in which the survey was administered varied by high school and sport team and included classroom, cafeteria, or field settings. Details of the specific conditions for each sport team that participated are documented in the SPARTA Data Collection Journal (Appendix C). Coaches were present at the time the surveys were administered to the student-athletes, however they were NOT involved in the questionnaire administration. Coaches were specifically instructed to refrain from talking with participants until after they had completed the survey. While the surveys were distributed, information and instructions were given to the students about the purpose of the study, that it was voluntary and anonymous, and where to use pencil or pen to complete the surveys. The administration protocol was developed by research staff to ensure consistency between survey administrators. Staff began by thanking participants for their time and explained the purpose of the study. Participants were instructed to remain seated while filling out the questionnaires and to raise their hand if they had questions or concerns. The anonymous and voluntary nature of the survey was explained and participants were instructed to refrain from writing their name or other identifiers on the surveys. Research staff explained that the BLOCK Kids Screener™ was to be filled out first and that they should respond to questions

based on foods that they had eaten over the past week. Students were instructed to estimate the frequency and quantity of each food consumed. Once the BLOCK Kids Screener™ was completed, athletes were asked to raise their hand so that research staff could collect the questionnaire and the pencil. Students were then given a pen and asked to complete the SPARTA Injury and Lifestyle Survey. SPARTA staff asked the participants to read the directions on the front page of the SPARTA survey before answering any questions and reminded participants to answer the questions based on their current spring sport season. The definition of a sport injury was described verbally to participants as well as in writing on the SPARTA survey. Research staff reminded students to check that surveys were complete and that all items were answered before turning them in. Participants were given a SPARTA pen and granola bar as token gifts for their time in completing the surveys.

Confidentiality and Implied Consent

Each SPARTA survey was identified with a unique number that matched the number of the corresponding BLOCK Kids Screener™. The two surveys were administered together so that the matching identification numbers were completed by the same participant. Due to the voluntary and anonymous nature of participation, completed surveys were considered to represent implied consent.

Data Cleaning and Management

Following collection of the completed questionnaires, research staff visually inspected each survey and darkened circles (e.g. those not filled in all of the way or that were light), erased graffiti (e.g. names, drawings, questions), flagged questionable surveys (e.g. missing items, questionable injury responses), and identified patterned responses (e.g. zigzagging). Surveys that had unrealistic responses (e.g. the first circle was darkened for every question in the survey) were discussed for validity and inclusion or exclusion with the principal investigator and data manager.

After the surveys were cleaned, they were inspected and scanned, using Optical Mark Recognition (OMR) technology, (TeleForm, version 9, Cardiff, CA) with a high speed duplexing scanner (Panasonic, KV-S2065L, Secaucus, NJ). Out of range and incorrect marks (e.g. more than 1 mark on a question), and marks that the software was less than 99% sure about were flagged and referred to the data manager for manual correction. Injury descriptions were manually entered by the data manager. A random sample of 2 percent of digital responses was compared to the original survey responses to calculate error rates. Errors were manually corrected by the data manager and re-scanned into the database. Error rates were less than 0.005%. The data obtained from the BLOCK Kids Screener™ were merged into a single database using SPSS (version 16, Chicago, IL) with data from the SPARTA injury and lifestyle survey.

Post-hoc Exclusion of Study Participants from Analysis

Research staff manually evaluated surveys for missing data to determine inclusion or exclusion of each participant based on completion of the survey. Only one survey was excluded due to several pages that were left completely blank, including the injury description questions. The validity of surveys was questioned if there was a pattern in responses such as zigzagging or straight line responses on several pages. Three surveys with patterned responses were excluded. Two participants with congenital disorders causing injuries were excluded from analysis as the injuries did not meet the definition of a sports injury for SPARTA. Thirty-six subjects that reported injuries from non-spring sport seasons and who were not spring sport athletes were also excluded. The number of surveys included in the final analysis was 228.

Calculations and Statistical Analysis

Statistical analysis was conducted using SPSS, version 16, Chicago, IL. Differences were considered significant when the p-value was < 0.05. Gender, age, weight, height, BMI, ethnicity, grade point average, and socioeconomic status are presented as means and standard deviations. Frequency of injury was assessed by total number of self reported injuries for that sport season at the time of data collection. Figure 2 illustrates the analytical framework used to compare injury rate among study participants grouped by relative protein intake in g/d, g/kg/d, and g/1000 kcal. Protein intake was divided into equal tertiles each representing one third of the study population. A z-test of two sample

proportions was used to analyze differences in the number of reported injuries among participants in the three tertiles of protein intake. All analysis were performed separately for males and females.

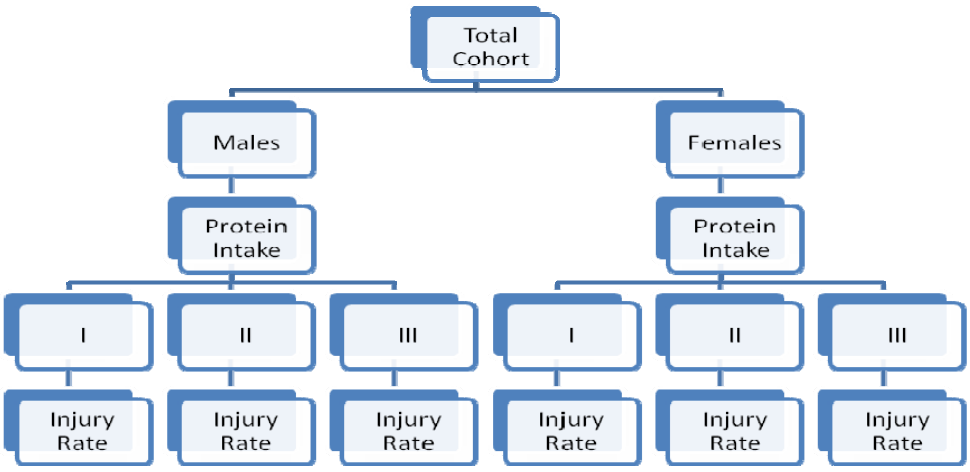

Figure 2: Injury Rate by Gender and Protein Intake

Figure 3 illustrates the analytical framework used to compare protein intake in grams/day, indexed to body weight, and indexed to energy intake between those who reported injuries and those who did not, for males and females separately. Independent sample t-tests were used for this analysis.

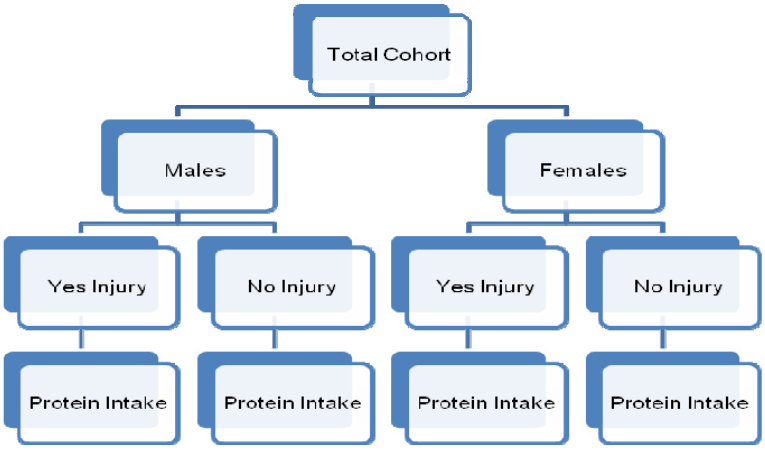

Figure 3: Protein Intake by Gender and Injury Status

Chapter 3: Results

Descriptive Statistics

Two hundred and seventy student athletes from six high schools in Oregon and Southwest Washington participated in the SPARTA PRO study. Of the students surveyed, 88 attended Estacada High School (Estacada, OR), 46 attended Woodburn High School (Woodburn, OR), 44 attended Gladstone High School (Gladstone, OR), 20 attended Heritage High School (Vancouver, WA), 17 attended Sheldon High School (Eugene, OR), and 13 attended Lake Oswego High School (Lake Oswego, OR). Surveys were excluded from analysis for various reasons including non-spring sport athletes (n=36), patterned responses (n=3), reported congenital disorders affecting participation (n=2), and missing data (n=1). Two hundred twenty eight surveys were determined to be valid and were included in the statistical analysis.

Participant characteristics, including anthropometric and demographic data, are presented in Table 1 for the total cohort (n=228), and for males (n=127) and females (n=101). The average age for males and females was 16 years with a range of 14 to greater than 18 years. The average weight of male participants was 76 ± 17 kg with a range of 47 to 159 kg. The average weight of female participants was 61 ± 9 kg with a range of 44 to 91 kg. The average BMI of male participants was 24 ± 5 kg/m^2 with a range of 17 to 45 kg/m^2. The percentage of male participants with a BMI less than the 5^{th} percentile was 0.8%, between the 5^{th} and 15^{th} percentile was 0.8%, between the 15^{th} and 85^{th} percentile was

62.3%, between the 85th and 95th percentile was 19.6%, and greater than the 95th percentile was 13.1%. A BMI < 5th percentile is considered to be underweight, 5th to the 84th is a healthy weight, 85th to the 94th is overweight, and ≥ 95th is obese. The average BMI of female participants was 22 ± 3 kg/m^2 with a range of 17 to 35 kg/m^2. No female participants had a BMI less than the 5th percentile. The percentage of female participants between the 5th and < 15th percentile was 1.1%, between the 15th and < 85th percentile was 85.6%, between the 85th and 95th percentile was 8.2%, and greater than the 95th percentile was 1%.

The majority of participants characterized themselves as “White” (84%), followed by "Hispanic/Latino" (12%), "American Indian" (4%), "Black/African American" (2.7%), "Asian" (2.2%), and "Native Hawaiian or other Pacific Islander" (0.9%). One participant did not complete this question and the value was determined to be “missing”. Another participant did not answer the question but wrote in “Saudi-Arabian”, the response for this question was also determined to be “missing”.

All grade levels were represented: sixty-five (29%) participants were in 9th grade, forty-nine (22%) were in 10th grade, seventy-two (32%) were in 11th grade, and forty-one (18%) were in 12th grade. The mean self-reported grade point average for male and female participants was 3.4 ± 0.7 and 3.7 ± 0.6 out of 4 units, respectively. Participants were asked to describe their participation in the national school lunch program and whether they paid full-price, reduced-price, or received school meals free of charge; if they didn’t know, or if they didn’t participate in the school lunch program. One hundred thirty out of 228 students

(57%) reported that they participated in the school lunch program. Of those who participated in the national school lunch program, sixty five students (50%) paid full price, twelve students (9%) paid a reduced price, and fifty three students (41%) received meals without charge.

Sport Team Participation Among Spring Sport Athletes

The SPARTA lifestyle and injury questionnaire provided data on team sport participation as illustrated in Table 2 and Table 3. Six sport teams including women's lacrosse, volleyball and softball, men's baseball, and men's and women's tennis and track and field are represented. Respondents who did not identify a specific sport team were grouped together under a miscellaneous sport classification. Of the 127 male participants, 16% participated in baseball, 9% participated in tennis, 28% participated in a spring sport but did not specify what team, and 46% participated in track and field. Of the 101 female participants, 9% participated in softball, 30% participated in lacrosse, 20% participated in club volleyball, 11% participated in tennis, 8% participated in a spring sport but did not specify what team, and 23% participated in track and field.

In general, the spectrum of sport participation was comparable between male and female athletes. Thirty-eight percent of males participated in 1 sport, 39% participated in 2 sports, 18% participated in 3 sports, and 4% participated in 4 or more sports per season. Six percent of male participants reported that they spent 0-5 hours per week in practice and competition, 28% of participants reported 6-10 hours per week, 43% of participants spent 11-15 hours per week,

and 22% of participants spent 16 or more hours per week in practice or competition. Three percent of male participants reported that they had practice or games 0-3 days per week, 54% reported practice or games 4-5 days per week, and 43% reported practice or games 6-7 days per week. Twenty-one percent of male participants participate on a sport team year round and, of those who did not participate year round, fifty percent of male participants participated for 1-3 months per year, 35% participated for 4-9 months per year, and 3% participated for 10-11 months per year. Fourteen percent of male participants participated in 1 high school sponsored team sport, 81% participated in 2-3 teams, and 4% participated in 4 or more teams.

Fifty-five percent of female subjects participated in 1 sport, 39% participated in 2 sports, 5% participated in 3 sports, and 1% participated in 4 or more sports per season. Eight percent of female participants reported 0-5 hours per week for practice and competition, 35% reported practice or games 6-10 hours per week, 47% reported practice or games 11-15 hours per week, and 11% reported practice or games 16 or more hours per week. Seven percent of female participants reported having games or practice 0-3 days per week, 59% reported having games or practice 4 to 5 days per week, and 34% reported having games or practice 6 to 7 days per week. Thirty percent of female participants participate on a sport team year round. Of those who did not participate year round, thirty-one percent participated on a team sport 1-3 months per year, 41% participated 4-9 months per year, and 7% participated 10-11 months per year. Thirty-eight percent of female athletes participated in 1 high

school sponsored team sport, 59% participated in 2-3 teams, and 3% participated in 4 or more teams.

Energy and Macronutrient Intake of Spring Sport Athletes

Self reported energy and macronutrient intakes collected from the BLOCK Kids Screener™ are presented in Table 4 for the total cohort, and for males and females. Average energy intake for the total cohort was 1761 ± 780 kcal/d; 2070 ± 808 kcal/d for male participants and 1371 ± 534 kcal/d for female participants.

Male participants reported an average protein intake of 97 ± 41 g/d with a range of 25 to 207 g/d. When protein intake was indexed to body weight, males reported an average intake of 1.3 ± 0.6 g/kg/d with a range of 0.36 to 3.3 g/kg/d. When protein intake was indexed to total energy intake male participants reported an average intake 47 ± 9 g/1000 kcal with a range of 25 to 79 g/1000 kcal. When protein intake was calculated as a percentage of total energy intake males reported an average of 19 ± 4 percent of energy from protein with a range of 10 to 32 percent of energy derived from protein. Male participants reported an average carbohydrate intake of 237 ± 99 g/d with a range of 75 to 607 g/d. When carbohydrate intake was indexed to total energy intake male participants reported an average intake of 115 ± 20 g/1000 kcal with a range of 67 to 173 g/1000 kcal. When carbohydrate intake was calculated as a percentage of total energy intake males reported an average of 46 ± 8 percent of energy from carbohydrate with a range of 27 to 69 percent of energy derived from carbohydrate. Male participants reported an average fat intake of 84 ± 35 g/d

with a range of 21 to 196 g/d. When fat intake was indexed to total energy intake male participants reported an average intake of 40 ± 5 g/1000 kcal with a range of 22 to 56 g/1000 kcal. When fat intake was calculated as a percentage of total energy intake males reported an average of 36 ± 5 percent of energy from fat with a range of 19 to 50 percent of energy derived from fat.

Female participants reported an average protein intake of 57 ± 25 g/d with a range of 22 to 198 g/d. When protein intake was indexed to body weight, females reported an average intake of 1.0 ± 0.5 g/kg/d with a range of 0.3 to 3.5 g/kg/d. When protein intake was indexed to total energy intake female participants reported an average intake of 42 ± 8 g/1000 kcal with a range of 27 to 73 g/1000 kcal. When protein intake was calculated as a percentage of total energy intake, females reported an average of 17 ± 3 percent of energy from protein with a range of 11 to 29 percent of energy derived from protein. Female participants reported an average carbohydrate intake of 174 ± 65 g/d with a range of 65 to 325 g/d. When carbohydrate intake was indexed to total energy intake, female participants reported an average intake of 129 ± 19 g/1000 kcal with a range of 83 to 167 g/1000 kcal. When carbohydrate intake was calculated as a percentage of total energy intake females reported an average of 52 ± 8 percent of energy from carbohydrate with a range of 33 to 67 percent of energy derived from carbohydrate. Female participants reported an average fat intake of 52 ± 25 g/d with a range of 18 to 148 g/d. When fat intake was indexed to total energy intake, female participants reported an average intake of 37 ± 6 g/1000 kcal with a range of 26 to 51 g/1000 kcal. When fat intake was calculated as a

percentage of total energy intake females reported an average of 33 ± 5 percent of energy from fat with a range of 23 to 46 percent of energy derived from fat.

Energy and Macronutrient Intake Based on Tertiles of Protein Intake

Energy and macronutrient intakes of males and females based on tertiles of protein intake (g/d) are presented in Table 5 and Table 6, respectively. Male participants in the lowest protein tertile reported an average energy intake of 1331 ± 340 kcal/d with a range of 719 to 2167 kcal/d. Male participants in the medium protein tertile reported an average energy intake of 2016 ± 299 kcal/d with a range of 1482 to 2632 kcal/d. Male participants in the highest protein tertile reported an average energy intake of 2867 ± 766 kcal/d with a range of 1594 to 4853 kcal/d. Male participants in the lowest protein tertile reported an average dietary protein intake of 56 ± 13 g/d with a range of 25 to 73 g/d. Male participants in the medium tertile reported an average dietary protein intake of 92 ± 10 g/d with a range of 75 to 110 g/d. Male participants in the highest protein tertile reported an average dietary protein intake of 145 ± 28 g/d with a range of 110 to 207 g/d. Male participants in the highest tertile consumed an average of 61% more protein than those in the lowest tertile. When protein intake was indexed to body weight, male participants in the lowest tertile reported an average dietary protein intake of 0.79 ± 0.25 g/kg/d. Male participants in the medium tertile reported an average dietary protein intake of 1.26 ± 0.31 g/kg/d. Male participants in the highest protein tertile reported an average dietary protein intake of 1.93 ± 0.46 g/kg/d. When protein intake was indexed to total energy

intake, male participants in the lowest protein tertile reported an average dietary protein intake of 43 ± 9 g/1000 kcal. Male participants in the medium protein tertile reported an average dietary protein intake of 46 ± 7 g/1000 kcal. Male participants in the highest protein tertile reported a dietary protein intake of 52 ± 9 g/1000 kcal. When protein intake was calculated as a percentage of total energy intake males in the low, medium, and high protein tertiles reported an average of 17 ± 4 percent, 18 ± 3 percent, and 21 ± 4 percent of energy from protein, respectively. Male participants in the low, medium, and high protein tertiles reported average carbohydrate intakes of 169 ± 66 g/d, 230 ± 50 g/d, and 312 ± 113 g/d, respectively. When carbohydrate intake was indexed to total energy, male participants in the low, medium, and high protein tertiles reported average carbohydrate intake of 125 ± 23 g/1000 kcal, 113 ± 15 g/1000 kcal, 107 ± 16 g/1000 kcal, respectively. When carbohydrate intake was calculated as a percentage of total energy intake males in the low, medium, and high protein tertiles reported an average of 50 ± 9 percent, 45 ± 6 percent, and 43 ± 6 percent of energy from carbohydrate, respectively. Male participants in the low, medium, and high protein tertiles reported average fat intakes of 50 ± 13 g/d, 84 ± 16 g/d, and 118 ± 33 g/d, respectively. When fat intake was indexed to total energy intake, male participants in the low, medium, and high protein tertiles reported average fat intakes of 38 ± 7 g/1000 kcal, 42 ± 5 g/1000 kcal, and 41 ± 4 g/1000 kcal, respectively. When fat intake was calculated as a percentage of total energy intake males in the low, medium, and high protein tertiles reported an

average of 34 ± 6 percent, 37 ± 4 percent, and 37 ± 4 percent of energy from fat, respectively.

Female participants in the low protein tertile reported an average energy intake of 879 ± 223 kcal/d with a range of 528 to 1324 kcal/d. Female participants in the medium protein tertile reported an average energy intake of 1335 ± 251 kcal/d with a range of 925 to 2046 kcal/d. Females in the high protein tertile reported an average energy intake of 1887 ± 488 kcal/d with a range of 950 to 3333 kcal/d. Female participants in the low protein tertile reported an average dietary protein intake of 34 ± 7 g/d with a range of 22 to 45 g/d. Female participants in the medium tertile reported an average dietary protein intake of 53 ± 5 g/d with a range of 45 to 62 g/d. Female participants in the high protein tertile reported an average dietary protein intake of 84 ± 24 g/d with a range of 63 to 198 g/d. Female participants in the high tertile consumed an average of 60% more protein than those in the low tertile. When protein intake was indexed to body weight, female participants in the low protein tertile reported an average dietary protein intake of 0.57 ± 0.15 g/kg/d. Female participants in the medium protein tertile reported an average dietary protein intake of 0.89 ± 0.16 g/kg/d. Female participants in the high protein tertile reported an average dietary protein intake of 1.45 ± 0.44 g/kg/d. When protein intake was indexed to total energy intake, female participants in the low protein tertile reported an average dietary protein intake of 39 ± 7 g/1000 kcal. Female participants in the medium protein tertile reported an average dietary protein intake of 41 ± 6 g/1000 kcal. Female participants in the high protein tertile reported an average dietary protein intake

of 46 ± 9 g/1000 kcal. When protein intake was calculated as a percentage of total energy intake in the protein tertile (g/d), females reported an average of 16 ± 3 percent, 16 ± 3 percent, and 18 ± 4 percent of energy from protein. Female participants in the low, medium, and high protein tertiles reported an average carbohydrate intake of 122 ± 34 g/d, 180 ± 53 g/d, and 219 ± 62 g/d, respectively. When carbohydrate intake was indexed to total energy intake, female participants in the low, medium, and high protein tertiles reported an average intake of 139 ±15 g/1000 kcal, 133 ±19 g/1000 kcal, and 116 ± 15 g/1000 kcal, respectively. When carbohydrate intake was calculated as a percentage of total energy intake females reported an average of 55 ± 6 percent, 53 ± 8 percent, and 46 ± 6 percent of energy from carbohydrate. Female participants in the low, medium, and high protein tertiles reported an average fat intake of 31 ± 10 g/d, 48 ± 10 g/d, and 78 ± 24 g/d, respectively. When dietary fat intake was indexed to total energy intake, female participants reported an average intake of 35 ± 5 g/1000 kcal, 36 ± 6 g/1000 kcal, and 41 ± 5 g/1000 kcal, in the low, medium, and high tertile, respectively. When fat intake was calculated as a percentage of total energy intake females reported an average of 31 ± 4 percent, 32 ± 6 percent, and 37 ± 4 percent of energy from fat.

Potential outliers for males and females using box plot analysis were identified but were not excluded from the data analysis (data not shown). A potential outlier was defined to have a value greater than two standard deviations above or below the mean. Of the 228 respondents, five males and two females were identified as potential outliers for energy intake and of these participants

one male and one female were also identified as potential outliers for protein intake. Outliers based on other nutrients were not determined. Tables 7 and 8 illustrate the dietary energy and macronutrient intake of male and female athletes, respectively, excluding those indentified as outliers and categorized by tertile of protein intake (g/d). Distribution of energy and macronutrients was comparable when outliers were included or excluded and, as a result, outliers were not excluded from the final statistical analysis.

Frequency of Sport Related Injuries Among Spring Sport Athletes

The frequency of sport related injuries by sport team and gender is illustrated in Table 9 and Table 10 for males and females, respectively. For the purpose of this study, an injury was defined as an injury that kept the athlete from playing that day or the next day or caused them to visit a trainer, doctor, nurse, physical therapist or other health care provider such as chiropractor. Forty-three of the 127 male participants (34%) and 31 of the 101 female participants (31%) were injured during the spring sport season. The percentage of males who reported at least one injury during the sport season included 25% of baseball participants (5 out of 20), 8% of tennis participants (1 out of 12), 33% of miscellaneous spring sport team participants (12 out of 36), and 42% of track and field participants (25 out of 59). The percentage of females who reported at least one injury during the sport season included 56% of softball participants (5 out of 9), 23% of lacrosse participants (7 out of 30), 10% of volleyball participants (2 out of 20), 9% of tennis participants (1 out of 11), 88% of miscellaneous spring sport

team participants (7 out of 8), and 39% of track and field participants (9 out of 23).

The frequency and site of sport related injuries by gender are summarized in Table 11. Of the forty-three male participants who reported an injury, 27 reported having one injury, 11 reported having 2 injuries, and 5 reported having 3 injuries in the spring sport season. Of the 31 female participants, 24 reported having one injury, 6 reported having 2 injuries, and 1 reported having 3 injuries in the spring sport season. Some injuries resulted in more than one site being injured, such that male participants reported 66 total sites injured and females reported 39 total sites injured. Leg injuries predominated in both groups. Male and female athletes both reported 62% of injuries as leg injuries of which shin splints, an overuse injury, were reported by 17% and 25% of males and females, respectively. Among male participants, 23% of injuries were arm injuries, 8% were head injuries, and 8% were back injuries. Among female participants, 28% of injuries were arm injuries, 10% were back injuries, and no head injuries were reported.

Relationship of Sport Related Injuries to Protein Intake

Injury rate related to relative protein intake for male and female adolescent athletes is illustrated in Figure 2 and summarized in Table 12. For males, there was no significant difference in percent of athletes reporting an injury among those in the low, medium, or high protein tertile. This relationship was true regardless of whether protein intake was considered in absolute amount (g/d),

when indexed to body weight (g/kg/d), or when indexed to energy intake (g/1000 kcal).

For females, there was no significant difference in percent of athletes reporting an injury among those in the low, medium, or high protein tertile when absolute protein intake (g/d) was considered. However, the percent of athletes reporting an injury was significantly different when protein intake was indexed to body weight and to energy intake. When protein intake was indexed to body weight (g/kg/d), the percent of athletes reporting injuries was significantly higher among those in tertile I than those in tertiles II or III ($p = 0.0265$; $p = 0.0002$, respectively); likewise the percent of athletes reporting injuries was lower in those in tertile II than those in tertile III ($p = 0.0380$). When protein intake was indexed to energy intake (g/1000 kcal) the percent of athletes reporting injuries was significantly higher among those in tertile II compared to tertile III ($p = 0.0086$), but not different from those in tertile I.

To further explore reasons for the differences observed among female athletes, anthropometric, sport injury, and practice/competition time was summarized based on tertile of protein intake (Table 13a-c). As expected, there were no apparent differences in these variables when tertiles were defined by absolute protein intake (g/d). However, when tertiles were defined by protein intake indexed to body weight (g/kg/d), those in tertile I tended to weigh more and have a higher average BMI percentile than those in tertile II or III; the average BMI percentile of those in tertile II also appeared to be higher than those in tertile III. When tertiles were defined by protein intake indexed to energy intake

(g/1000 kcal), average BMI and BMI percentile tended to be lower in tertile II than tertile I and III. Interestingly, playing time tended to be higher among those in tertiles II and III compared to those in tertile I. These trends in differences in body weight and playing/competition time may contribute to the differences in the frequency of sport related injuries seen among females. These relationships between sport injuries and lowest weight/BMI and highest hours of playing time/competition should be explored further.

Comparison of Protein Intake Among Athletes With and Without Injuries in the Spring Sport Season

When athletes were characterized based on those who reported injuries and those who did not, as illustrated in Figure 3, there were no significant differences in protein intake as absolute intake, indexed to body weight or indexed to energy intake (Table 14). The mean intake of protein for males who did not report injuries, 96 ± 40 g/d, was similar to the mean intake of protein for males who did report injuries, 100 ± 44 g/d ($p = 0.6$). The mean intake of protein for females who did not report injuries, 57 ± 22 g/d, was similar to the mean intake of dietary protein for females who did report injuries, 58 ± 32 g/d ($p = 0.9$). When dietary protein intake was indexed to body weight, the mean intake of protein for males who did not report injuries (1.3 ± 0.6 g/kg/d) was similar to the mean dietary protein intake for males who did report injuries (1.4 ± 0.6 g/kg/d) ($p = 0.6$). When dietary protein intake was indexed to body weight, the mean intake of dietary protein for females who did not report injuries (1.0 ± 0.4 g/kg/d) was

similar to the mean dietary protein intake for females who did report injuries (1.0 ± 0.6 g/kg/d) (p = 0.7). When dietary protein was indexed to energy intake the mean intake of protein for males who did not report injuries (47 ± 9 g/1000 kcal) was similar to the mean intake of protein for males who did report injuries (46 ± 10 g/1000 kcal) (p = 0.6). When dietary protein was indexed to energy intake the mean intake of dietary protein for females who did not report injuries (42 ± 8 g/1000 kcal) was similar to the mean intake of dietary protein for females who did report injuries (41 ± 7 g/1000 kcal) (p = 0.6).

To describe and compare the non-injured and injured subgroups in greater detail, average age, weight, participation in the national school lunch program, protein intake above or below the RDA, and frequency of not eating for a day or more to lose weight were compared (data not shown). Among those variables, only age of male athletes was different between the two groups. The mean age for male athletes who reported injuries, 16.5 ± 1.1 years, was significantly higher than the mean age of male athletes who did not report injuries, 15.9 ± 1.1 years (p = 0.006). The significance of this finding may be explained by older adolescent males playing at a higher intensity due to varsity level competition.

In addition, because shin splints were identified as the most frequent single injury, protein intake was examined for males and females, who reported shin splints compared to those who did not report a shin splint injury. The mean dietary protein intake for male athletes who reported shin splints (n=7) was significantly less than the mean dietary protein intake for male athletes who did not report a shin splint injury (n=120), 61 ± 37 g/d versus 99 ± 40 g/d (p = 0.015);

and 0.86 ± 0.44 g/kg/d versus 1.35 ± 0.58 g/kg/d (p = 0.031). There were no significant differences in protein intake of females who reported shin splints (n=7) compared to those who did not report a shin splint injury (n=94).

Evaluation of Estimated Energy Intake by BLOCK Kids Screener™

Based on the reported values of energy intake, with extremely low values for both males and females, it was important to assess underreporting of food intake in this population. To evaluate underreporting of food intake captured by the BLOCK Kids Screener™, a ratio of energy intake (EI) to resting energy expenditure (REE) was calculated, EI:REE. Total energy expenditure (TEE) is equal to the sum of resting energy expenditure (REE) plus the thermic effect of food (TEF) plus the energy expended in physical activity (PA) plus the energy required for growth. In general, REE is thought to comprise 40-60% of TEE, TEF is thought to comprise 8-15% of TEE, and PA and growth comprising the difference.

Estimated resting energy expenditure was calculated for each participant based on two gender and age specific prediction equations, the World Health Organization (68) and the Schofield (69) equations using self reported age, weight, and height values. Estimated total energy intake (EI) derived from the BLOCK Kids Screener™ was divided by the estimated resting energy expenditure calculated by the WHO and Schofield equations to determine a EI:REE ratio for each athlete. A value of 1.0 occurs when total energy intake is equal to resting energy expenditure, a situation that doesn’t occur under normal,

healthy condition. In the literature, underreporting of total energy intake is defined when the EI:REE ≤ 1.55 for sedentary individuals (70). An EI:REE value of 1.55 suggests that 55% of energy needs above that required for REE is available to support physical activity, thermic effect of food, and growth.

Males had a mean EI:REE ratio of 1.06 ± 0.43 and 1.06 ± 0.43 based on the WHO and Schofield equations, respectively. Females had a mean EI:REE ratio of 0.93 ± 0.38 and 0.93 ± 0.38 based on the WHO and Schofield equations, respectively. These values are highly unlikely and suggest that the amount of energy consumed is approximately equal to the amount of energy required to support REE, only. Overall, 89% of the EI:REE values were < 1.55 suggesting a high degree of underreporting of food intake and subsequently energy intake. This pattern was seen in both males and females. Forty-eight percent of males had an EI:REE ratio < 1.0, 39.4% had an EI:REE between 1.0 and 1.55, and only 12.6% had and EI:REE ≥ 1.55. Sixty-five percent of females had an EI:REE < 1.0, 27% had an EI:REE between 1.0 and 1.55, and only 7% had and EI:REE ≥ 1.55. These analyses suggest significant and wide spread underreporting of food intake or systematic error associated with the BLOCK Kids Screener™.

Chapter 4: Discussion

Summary

This study is the first to explore the relationship between protein intake and sport related injuries among adolescent athletes. There were no significant differences in the frequency of sport related injuries among males consuming low, medium, or high amounts of protein when evaluated based on absolute protein intake (g/d), indexed to body weight (g/kg/d), or when protein was indexed to energy intake (g/1000 kcal). However, when protein intake was indexed to body weight (g/kg/d) in females, they exhibited an inverse relationship between frequency of sport related injury and protein intake so that as protein intake increased, the frequency of sport related injuries decreased. Because we used a cross-sectional study design, cause and effect cannot be determined. To examine the observed relationship between protein intake and frequency of sport related injuries in females, other variables were evaluated including age, weight, height, BMI, and hours of practice and competition per week. Trends that demonstrated differences in body weight and playing time/competition may have contributed to the differences observed in the frequency of sport related injuries seen among females. Interestingly, a higher percentage of males reported spending more time in practice and competition yet sport injuries in males and females were comparable at 34% and 31%, respectively. None of the other variables appeared to explain the relationship between sport related injuries and protein intake in male adolescent athletes. However, the potential relationships

between sport injuries and weight and BMI and hours of playing time should be explored further.

Energy and macronutrient intakes were estimated using the BLOCK Kids Screener™, an instrument that has not been validated. When compared to national survey data, the BLOCK Kids Screener™ appeared to provide a reasonable estimate of protein intake. When considering the RDA for protein, 52 g/d for males, 9% of those surveyed did not meet the protein recommendation. However 50% of males did not meet the higher protein recommendations suggested for athletes (1.2-2.0 g/kg/d). Among females, the percent of those not meeting the RDA for protein, 46 g/d, or the protein recommendation for athletes was 36% and 73%, respectively.

While protein intake estimated by the BLOCK Kids Screener™ was comparable to NHANES data, total energy intake appeared to be low. Self reported energy intakes were 64% and 57% of recommended values for male and female adolescents, respectively. Underreporting usual food intake is a common concern especially when collecting information with a food frequency questionnaire. Contributing factors that may result in underreporting of food intake include lack of awareness of the foods consumed, an inability to accurately estimate portion size, ethnic differences between the food consumed and the food described in the questionnaire, and psychological issues relating to food and body weight (71). Underreporting total energy intake may also result from intentional non-disclosure of foods that are high in fat or that are perceived as “bad” (72). Eighty-nine percent of reported energy intake was considered to

be very low, as defined by a EI:REE ratio < 1.55. These results suggest that participants either underreported usual food intake or that there was systematic bias associated with the BLOCK Kids Screener™. The presumed inaccuracy in total energy intake may also contribute to the lack of a convincing relationship between injury rate and protein intake among adolescent athletes.

The overall prevalence of sport related injury in this study is comparable to other reported injury data (1). Thirty-four percent of male participants and 31% of female participants reported at least one injury during the spring sport season. Leg injuries, other than knee injuries, were most common for both male and female athletes. The percentage of sport related injuries in this study was slightly higher in males than female athletes and this finding differs from previously reported research that suggests female athletes have a higher incidence of injuries even when playing time and conditions are taken into account (73). Only spring sport athletes participated in this study, and perhaps when all high school sports are taken into account, the frequency and percentage of sport related injuries would be higher in females as suggested in the literature.

The high frequency of self reported shin splint injuries led to investigation of mean protein intake in those who reported shin splints compared to those who did not report an injury. The mean dietary protein intake in grams per day and indexed to body weight, for male athletes who reported shin splint injuries was significantly less than the mean dietary protein intake for male athletes who did not report an injury. The relationship between protein intake and shin splint injuries was not significant in female adolescent athletes. One reason for this

finding could be that athletes in negative nitrogen balance may be at increased risk for developing shin splints, a type of over-use injury, due to inadequate tissue repair between bouts of training. One reason that may contribute to the difference between male and female athletes is that male athletes tended to spend more time in practice and competition than female athletes. More practice and playing time may result in overuse, a common cause of shin splints. Though a cause and effect relationship cannot be drawn from these results, future studies should also examine other variables that could contribute to increased frequency of shin splint injuries, including pre-season training and conditioning, quality of athletic shoes, and condition of playing surface.

Although male athletes with shin splints had lower protein intakes, the relationship between frequency of injury and protein intake was only observed among females. Factors that affect genders differently may contribute to the frequency of sport injuries and protein intake. For instance, ingestion of protein supplements may be greater among male athletes (74). We did not measure types of protein or additional protein sources, and in general females appeared to have lower protein intakes. In addition, other variables such as micronutrient deficiencies; sleep habits; attitudes and beliefs; and/or substance use could have varied between genders and contributed to this observed difference.

The results from this study provide preliminary evidence of a relationship between protein intake and sport-related injuries, at least in female athletes. Based on these results, research should be conducted to further explore the relationship between protein intake and injuries in adolescent athletes.

Limitations of Study

Limitations must be acknowledged and taken into account when interpreting the data presented here and when designing future studies. The concerns about underreporting of food intake with use of the BLOCK Kids Screener™ have been discussed. The BLOCK Kids Screener™ assumes that adolescents are able to remember and estimate their usual food intake over the past week, both frequency of consumption and portion size. Our results challenge this assumption. The injury history and lifestyle questionnaire assumes that athletes can recall injuries that occurred over the spring sport season or approximately the past two to three months. While high school athletes may be able to do this, recall bias was recognized with this survey. In addition, the generalizability of these results may be limited due to lack of ethnic diversity among the sample studied; 84% of the total cohort identified themselves as white which may influence the findings reported here. Finally, this study only captured spring sport athletes and although a number of different sport teams were represented, those sports with the highest prevalence of sport injuries were not included. Also, while this study had a moderate total sample size, when athletes were divided by sport type, certain sports were only represented by a small number of athletes.

Future Directions

Further research on adolescent athletes and dietary and lifestyle habits should be conducted to determine other potential risk factors that contribute to sport related injuries. In particular, future studies should use validated tools to measure energy and macronutrient intake and sport related injury characteristics to better ascertain the relationships between diet, lifestyle and sport related injuries among adolescent athletes. Research that could be conducted to validate the BLOCK Kids Screener™ include comparisons of the screener with 24 hr diet recalls or diet records which could shed more light on whether there was a systematic error associated with this tool or if the participants of SPARTA routinely underreported usual food intake. Another important direction for future research includes the development of a tool to measure energy and macronutrient intake in adolescent athletes that specifically incorporates foods frequently consumed in this population such as protein bars or supplements. This could be accomplished with focus groups of adolescent athletes who have completed the BLOCK Kids Screener™ who could then suggest areas of improvement or potential areas of confusion related to this tool. For instance focus groups could produce a list of frequently consumed foods that are high in protein and a more specific screener for protein intake could be developed for use in studies of adolescent athletes. In addition, because the diets of adolescents are often inadequate in nutrients including: folate, calcium, iron, zinc, magnesium, fiber, vitamin A, vitamin E and vitamin B6 (75-77), these nutrients

should also be explored in future studies as potential determinants of sport related injuries among adolescent athletes.

SPARTA Pro only captured spring sport athletes, and therefore future research conducted in other sport seasons may increase the understanding of potential risk factors related to sport injuries in adolescent athletes. In addition, future work should also compare differences between adolescent athletes and age-matched sedentary controls to determine differences in diet and lifestyle factors.

Conclusions

This study was designed to test the hypothesis that athletes with low protein intakes would have more injuries than athletes with high protein intakes. For male adolescent athletes this hypothesis was rejected. However, we accepted this hypothesis for female athletes when protein intake was indexed to body weight (g/kg/d). A significant percentage of male and female athletes did not meet the protein intake recommended for athletes when assessed using the BLOCK Kids Screener™. Protein intake did not impact frequency of sport related injuries in male adolescent athletes. Conversely, in female athletes, when protein intake was indexed to body weight, an indirect relationship between protein intake and injuries was observed. Future studies are needed to confirm this relationship and to support the development of standardized dietary recommendations that reduce the risk of sport related injuries among adolescent athletes.

Clinical Applications

Assessing adequate energy and dietary protein intake in adolescent athletes should be considered when advising this population. Protein intake should be evaluated as absolute protein intake (g/d), indexed to body weight (g/kg/d), and calculated as a percentage of total energy intake (g/1000 kcal). Each measurement of protein intake sheds a slightly different light on protein status of the adolescent athlete and potential areas for dietary improvement. In addition to comparing dietary protein intake to the RDA established for healthy individuals, dietary recommendations should take into account the increased energy and nutrient requirements of adolescent athletes. Specific adolescent populations that may be at increased risk for inadequate protein intake include vegetarians and vegans, athletes who commonly restrict energy intake to make a weight class, those with disordered eating behaviors, and/or athletes who follow religious or cultural practices that may restrict certain food groups or have periods of fasting. For the vegetarian or vegan adolescent, providing a list of sources of protein that are alternatives to animal protein would be beneficial when counseling an athlete. Outlining the risks of restricting energy intake to make a weight division or to manipulate body weight, would be important to discuss with populations that typically practice this behavior such as wrestlers or gymnasts. Adolescent athletes who restrict energy intake and/or certain food groups due to disordered eating patterns may be at risk for inadequate protein intake, in addition to other macronutrient and micronutrient deficiencies. Adolescent athletes with disordered eating behaviors could benefit from

counseling to discuss the risks and consequences associated with disordered eating, including the short term and long term effects that negatively impact proper growth and development. Lastly, religious and cultural practices that restrict certain food groups or have extended periods of fasting could increase risk for inadequate protein intake in the adolescent athlete. This population may benefit from understanding good sources of protein that are compliant with their religious and cultural beliefs and also how to participate in a fast but ensure that nutrient dense foods are consumed before and after the fast to support their energy, macronutrient, and micronutrient needs for growth, development and physical activity.

Tables

Table 1. Anthropometric and Demographic Characteristics of High School Athletes

Characteristic	Total Cohort N= 228	Male N=127	Female N=101
Age (y)*	16 ± 1.2	16 ± 1.2	16 ± 1.3
Weight (kg)*	69 ± 16	76 ± 17	61 ± 9
Height (cm)*	173 ± 9.3	178 ± 7.8	167 ± 7.2
BMI (kg/m^2)*	23 ± 4	24 ± 5	22 ± 3
(BMI percentile)	64 ± 24	68 ± 25	60 ± 22
($<5^{th}$ percentile) (%)	0.5	0.8	0
($5\text{-}15^{th}$ percentile) (%)	0.9	0.8	1.1
($15\text{-}85^{th}$ percentile) (%)	73	62.3	85.6
($85\text{-}95^{th}$ percentile) (%)	15.1	19.6	8.2
($>95^{th}$ percentile) (%)	8.7	13.1	1
Racial/Ethnic Group Membership			
White (%)	84	81	87
Hispanic, Latino (%)	12	15.1	8
American Indian or Native Alaskan (%)	4.0	5.6	2
Black, African-American (%)	2.7	1.6	4
Asian (%)	2.2	1.6	3
Native Hawaiian or other Pacific Islander (%)	0.9	0.8	1

Grade in School			
9th (%)	29	27	31
10th (%)	22	25	17
11th (%)	32	32	31
12th (%)	18	16	21
Participation in National School Lunch Program			
Full price lunch (%)	28.5	32	25
Reduced price lunch (%)	5.3	7.1	3.0
Free lunch (%)	23	31	14
Don’t know (%)	1.3	1.6	1
Don’t buy school lunch (%)	42	29	57

* Mean ± SD

Table 2. Participation of High School Athletes in Spring Sports by Team

Sport	Total Cohort N=228	Males N=127	Females N=101
Softball (%)	4	0	9
Lacrosse (%)	8	0	30
Volleyball (%)	9	0	20
Baseball (%)	9	16	0
Tennis (%)	10	9	11
Spring Sport Misc (%)	19	28	8
Track & Field (%)	36	46	23

Table 3. Sport Team Participation Characteristics of High School Athletes

Sport Participation	Total Cohort N=228	Males N=127	Females N=101
Number of sports participated in per season			
1 sport (%)	46	38	55
2 sports (%)	39	39	39
3 sports (%)	12	18	5
≥4 sports (%)	3	4	1
Hours per week spent in practice and competition			
0-5 hrs (%)	7	6	8
6-10 hrs (%)	31	28	35
11-15 hrs (%)	45	43	47
≥16 hrs (%)	17	22	11
Days per week spent in practice and competition			
0-3 days (%)	5	3	7
4-5 days (%)	56	54	59
6-7 days (%)	39	43	34
Year round participation in a sport			
Yes (%)	25	21	30
No (%)	75	79	69
Months per year participating in a sport			
1-3 months (%)	42	50	31
4-9 months (%)	38	35	41

10-11 months (%)	5	3	7
Number of high school sport teams participated in per year			
1 team (%)	25	14	38
2-3 teams (%)	71	81	59
≥4 teams (%)	4	4	3

Table 4. Self Reported Energy and Macronutrient Intake of High School Athletes Using BLOCK Kids Screener™

	Total Cohort N=228	**Males N=127**	**Females N=101**
Energy intake (kcal/d)	1761 ± 780	2070 ± 808	1371 ± 534
Protein (g/d)	80 ± 40	97 ± 41	57 ± 25
(g/kg)	1.2 ± 0.6	1.3 ± 0.6	1.0 ± 0.5
(g/1000 kcal)	45 ± 9	47 ± 9	42 ± 8
(% total kcal)	18 ± 4	19 ± 4	17 ± 3
Carbohydrate (g/d)	209 ± 91	237 ± 99	174 ± 65
(g/1000 kcal)	121 ± 20	115 ± 20	129 ± 19
(% total kcal)	49 ± 8	46 ± 8	52 ± 8
Fat (g/d)	70 ± 35	84 ± 36	52 ± 25
(g/1000 kcal)	39 ± 6	40 ± 5	37 ± 6
(% total kcal)	35 ± 5	36 ± 5	33 ± 5

* Mean ± SD

Table 5. Energy and Macronutrient Intake of Male High School Athletes (n=127) Based on Tertiles of Protein Intake

Energy and Macronutrient	Tertiles of Protein Intake Based on g/d		
	Tertile I **< 74 g/d**	**Tertile II** **74 – 110 g/d**	**Tertile III** **> 110 g/d**
Energy intake (kcal/d)	1331 ± 340	2016 ± 299	2867 ± 766
(kcal/kg/d)	19 ± 6	28 ± 7	38 ±12
Protein (g/d)	56 ± 13	92 ± 10	145 ± 28
(g/kg)	0.79 ± 0.25	1.26 ± 0.31	1.93 ± 0.46
(g/1000 kcal)	43 ± 9	46 ± 7	52 ± 9
(% total kcal)	17 ± 4	18 ± 3	21 ± 4
Carbohydrate (g/d)	169 ± 66	230 ± 50	312 ± 113
(g/1000 kcal)	125 ± 23	113 ± 15	107 ± 16
(% total kcal)	50 ± 9	45 ± 6	43 ± 6
Fat (g/d)	50 ± 13	84 ± 16	118 ± 33
(g/1000 kcal)	38 ± 7	42 ± 5	41 ± 4
(% total kcal)	34 ± 6	37 ± 4	37 ± 4

* Mean ± SD

Table 6. Energy and Macronutrient Intake of Female High School Athletes (n=101) Based on Tertiles of Protein Intake

Energy and Macronutrient	Tertiles of Protein Intake Based on g/d		
	Tertile I **< 45 g/d**	**Tertile II** **45 – 63 g/d**	**Tertile III** **> 63 g/d**
Energy intake (kcal/d)	879 ± 223	1335 ± 251	1887 ± 488
(kcal/kg/d)	15 ± 4	22 ± 6	33 ± 9
Protein (g/d)	34 ± 7	53 ± 5	84 ± 24
(g/kg)	0.57 ± 0.15	0.89 ± 0.16	1.45 ± 0.44
(g/1000 kcal)	39 ± 7	41 ± 6	46 ± 9
(% total kcal)	16 ± 3	16 ± 3	18 ± 4
Carbohydrate (g/d)	122 ± 34	177 ± 50	216 ± 61
(g/1000 kcal)	139 ± 15	133 ± 19	117 ± 15
(% total kcal)	55 ± 6	53 ± 8	46 ± 6
Fat (g/d)	31 ± 10	47 ± 9	74 ± 19
(g/1000 kcal)	35 ± 5	36 ± 7	41 ± 5
(% total kcal)	31 ± 4	32 ± 6	37 ± 4

* Mean ± SD

Table 7. Energy and Macronutrient Intake of Male High School Athletes (n=122) Based on Tertiles of Protein Intake with Five Outliers Removed

Energy and Macronutrient	Tertiles of Protein Intake Based on g/d		
	Tertile I **< 72 g/d**	**Tertile II** **72 – 105 g/d**	**Tertile III** **> 105 g/d**
Energy intake (kcal/d)	1329 ± 344	1987 ± 312	2633 ± 549
(kcal/kg/d)	19 ± 7	28 ± 7	35 ± 10
Protein (g/d)	55 ± 13	90 ± 10	137 ± 25
(g/kg)	0.79 ± 0.25	1.2 ± 0.29	1.8 ± 0.48
(g/1000 kcal)	43 ± 9	46 ± 7	53 ± 9
(% total kcal)	17 ± 4	18 ± 3	21 ± 4
Carbohydrate (g/d)	169 ± 67	226 ± 52	282 ± 81
(g/1000 kcal)	125 ± 24	113 ± 15	106 ± 15
(% total kcal)	50 ± 9	45 ± 6	42 ± 6
Fat (g/d)	50 ± 13	83 ± 16	108 ± 26
(g/1000 kcal)	38 ± 7	42 ± 5	41 ± 4
(% total kcal)	34 ± 6	38 ± 4	37 ± 4

***Mean ± SD

****Numbers differ slightly from Table 5 due to exclusion of outliers

Table 8. Energy and Macronutrient Intake of Female High School Athletes (n=99) Based on Tertiles of Protein Intake with Two Outliers Removed

Energy and Macronutrient	Tertiles of Protein Intake Based on g/d		
	Tertile I **< 45 g/d**	**Tertile II** **45 – 62 g/d**	**Tertile III** **> 62 g/d**
Energy intake (kcal/d)	879 ± 223	1314 ± 221	1820 ± 390
(kcal/kg/d)	15 ± 4	22 ± 6	31 ± 8
Protein (g/d)	34 ± 7	53 ± 5	79 ± 12
(g/kg)	0.57 ± 0.15	0.89 ± 0.16	1.4 ± 0.24
(g/1000 kcal)	39 ± 7	41 ± 6	45 ± 9
(% total kcal)	16 ± 3	16 ± 2	18 ± 4
Carbohydrate (g/d)	122 ± 34	177 ± 50	216 ± 61
(g/1000 kcal)	139 ± 15	133 ± 19	117 ± 15
(% total kcal)	55 ± 6	53 ± 8	47 ± 6
Fat (g/d)	31 ± 10	47 ± 9	74 ± 19
(g/1000 kcal)	35 ± 5	36 ± 7	41 ± 5
(% total kcal)	31 ± 4	32 ± 6	36 ± 4

***Mean ± SD

**Numbers differ slightly from Table 6 due to exclusion of outliers

Table 9. Frequency of Sport Related Injuries in Male High School Athletes by Spring Sport Team

Number of Injuries by Sport Team	Number of Male Athletes Reporting Sport Related Injuries
Baseball (n=20) *	
0	15
1	4
2	1
Tennis (n=12)	
0	11
1	1
Spring Sport Misc (n=36)	
0	24
1	5
2	6
3	1
Track & Field (n=59)	
0	34
1	17
2	4
3	4

*****Values in parenthesis represent the number of male athletes participating in the designated sport.

Table 10. Frequency of Sport Related Injuries in Female High School Athletes by Spring Sport Team

Number of Injuries by Sport Team	Number of Female Athletes Reporting Sport Related Injuries
Softball (n=9) *	
0	4
1	4
2	1
Lacrosse (n=30)	
0	23
1	6
2	1
Volleyball (n=20)	
0	18
1	2
Tennis (n=11)	
0	10
1	1
Spring Sport Misc (n=8)	
0	1
1	5
2	1
3	1

Number of Injuries by Sport Team	**Number of Female Athletes Reporting Sport Related Injuries**
Track & Field (n=23)	
0	14
1	6
2	3

*****Values in parenthesis represent the number of female athletes participating in the designated sport.

Table 11. Frequency and Site of Sport Related Injuries Among High School Athletes

Site of Injury	Males (n=43)	Females (n=31)
Arm	15/66	11/39
Head	5/66	0
Leg	41/66	25/39
Knee	8/41	6/25
Shin Splints	7/41	7/25
Back	5/66	4/39

*Total sites injured for males = 66

*Total sites injured for females = 39

Table 12. Percent of Athletes Reporting Sport Related Injuries Based on Dietary Protein Intake

Tertile of Protein Intake	Percent of Athletes with Sport Related Injuries		
	Protein Intake		
	g/d	**g/kg/d**	**g/1000 kcal**
Male			
Tertile I (n=42) (low)	31%[a]	29%[a]	40%[a]
Tertile II (n=43) (medium)	35%[a]	33%[a]	26%[a]
Tertile III (n=42) (high)	36%[a]	40%[a]	36%[a]
Female *			
Tertile I (n= 32-33) (low)	27%[a]	63%[a]	29%[ab]
Tertile II (n=33-34) (medium)	41%[a]	39%[b]	45%[a]
Tertile III (n=32-34) (high)	24%[a]	19%[c]	18%[b]

Within columns, values with different superscripts are significantly different, $p < 0.05$

*****Sample size used to calculate protein intake as g/kg for females was 32, 33, 32, for tertiles I, II, and III, respectively, due to 4 participants not reporting weight.

Table 13a. Demographic and Sport Related Injury Characteristics of Athletes Consuming Relatively Low, Medium, and High Amounts of Protein

Characteristic	Males Protein Intake			Females Protein Intake		
	Tertile I	**Tertile II**	**Tertile III**	**Tertile I**	**Tertile II**	**Tertile III**
	< 74 g/d	**74 – 110 g/d**	**> 110 g/d**	**< 45 g/d**	**45 – 63 g/d**	**> 63 g/d**
Age (y)*	16 ± 1.2	16 ± 1.0	16 ± 1.3	16 ± 1.4	16 ± 1.2	16 ± 1.3
Weight (kg)*	74 ± 21	76 ± 18	77 ± 12	61 ± 10	61 ± 9	59 ± 9
Height (cm)*	175 ± 9	178 ± 8	180 ± 6	166 ± 7	167 ± 7	167 ± 7
BMI (kg/m^2)*	24 ± 6	24 ± 5	24 ± 3	22 ± 4	22 ± 3	21 ± 2
BMI percentile	63 ± 30	69 ± 25	72 ± 20	62 ± 24	63 ± 21	54 ± 20
($<15^{th}$) (%)	5	0	0	0	6	0
($15^{th} – 85^{th}$) (%)	60	67	63	88	81	91
($85^{th} – 95^{th}$) (%)	12.5	19	30	9	9	9
($>95^{th}$) (%)	22.5	14	8	3	3	0
# of injuries						
0	29	28	27	24	20	26
1	9	10	8	5	13	6
2	3	3	5	3	1	2
3	1	2	2	1	0	0
Hours per week spent in practice and competition						
<10 (%)	46	28	28	45	44	38
>10 (%)	54	72	71	55	56	62

*Mean ± SD

Table 13b. Demographic and Sport Related Injury Characteristics of Athletes Consuming Relatively Low, Medium, and High Amounts of Protein Indexed to Body Weight

Characteristic	Males Protein Intake			Females Protein Intake		
	Tertile I **< 0.99 g/kg/d**	**Tertile II** **0.99 – 1.50 g/kg/d**	**Tertile III** **> 1.50 g/kg/d**	**Tertile I** **< 0.75 g/kg/d**	**Tertile II** **0.75 – 1.12 g/kg/d**	**Tertile III** **> 1.12 g/kg/d**
Age (y)*	16 ± 1.2	16 ± 1.1	16 ± 1.1	16 ± 1.4	16 ± 1.3	16 ± 1.2
Weight (kg)*	86 ± 24	72 ± 11	70 ± 10	64 ± 11	59 ± 8	58 ± 8
Height (cm)*	178 ± 9	177 ± 8	178 ± 7	167 ± 8	167 ± 8	166 ± 6
BMI (kg/m^2)*	26 ± 6	23 ± 3	22 ± 2	23 ± 4	21 ± 2	21 ± 2
BMI percentile	76 ± 28	65 ± 25	63 ± 21	68 ± 23	58 ± 19	53 ± 20
($<15^{th}$) (%)	3	2	0	0	6	0
($15^{th} – 85^{th}$) (%)	40	71	78	78	91	91
($85^{th} – 95^{th}$) (%)	20	22	20	16	3	9
($>95^{th}$) (%)	38	5	2	6	0	0
# of injuries						
0	30	29	25	21	20	26
1	7	9	11	7	12	4
2	4	2	5	3	1	2
3	1	3	1	1	0	0
Hours per week spent in practice and competition						
<10 (%)	39	34	31	47	39	37
>10 (%)	61	68	69	53	60	62

*Mean ± SD

Table 13c. Demographic and Sport Related Injury Characteristics of Athletes Consuming Relatively Low, Medium, and High Amounts of Protein Indexed to Energy Intake

	Males			Females		
Macronutrient	**Tertile I < 43 g/1000kcal**	**Tertile II 43 – 50 g/1000kcal**	**Tertile III > 50 g/1000kcal**	**Tertile I <39 g/1000kcal**	**Tertile II 39 – 45 g/1000kcal**	**Tertile III > 45 g/1000kcal**
Age (y)*	16 ± 1.0	16 ± 1.3	16 ± 1.1	16 ± 1.3	16 ± 1.2	16 ± 1.4
Weight (kg)*	72 ± 12	79 ± 21	77 ± 17	61 ± 11	59 ± 8	61 ± 9
Height (cm)*	179 ± 6	177 ± 10	177 ± 7	167 ± 8	167 ± 6	166 ± 8
BMI (kg/m^2)*	22 ± 3	25 ± 5	25 ± 5	22 ± 4	21 ± 3	22 ± 3
BMI percentile	58 ± 27	73 ± 22	71 ± 25	62 ± 21	56 ± 22	60 ± 22
($<15^{th}$) (%)	5	0	0	0	7	0
($15^{th} – 85^{th}$) (%)	74	62	54	91	84	85
($85^{th} – 95^{th}$) (%)	15	17	29	3	10	15
($>95^{th}$) (%)	5	21	17	6	0	0
# of injuries						
0	25	32	27	24	18	28
1	10	7	10	8	10	6
2	5	3	3	2	4	0
3	2	1	2	0	1	0
Hours per week spent in practice and competition						
<10 (%)	19	44	38	65	30	32
>10 (%)	81	56	62	35	70	68

*Mean ± SD

Table 14. Relationship Between Injury Status and Protein Intake for Male and Female Adolescents

Protein Intake	**Injury Status**		**p-value**
Males	**Non-Injury n=84**	**Injury n=43**	
g/d	96 ± 40	100 ± 44	p = 0.6
g/kg/d	1.3 ± 0.6	1.4 ± 0.6	p = 0.6
g/1000 kcal	47 ± 9	46 ± 10	p = 0.6
Females	**Non-Injury n= 70**	**Injury n= 31**	**p-value**
g/d	57 ± 22	58 ± 32	p = 0.9
g/kg/d	0.99 ± 0.4	0.95 ± 0.6	p = 0.7
g/1000 kcal	42 ± 8	41 ± 7	p = 0.6

*****Mean ± SD

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Appendix A: Letter for Parent or Guardians of SPARTA Participants

SURVEY INFORMATION

Institutional Review Board # 2955

OREGON HEALTH & SCIENCE UNIVERSITY

Dear Parent or Guardian,

One of the goals of high school is helping students become healthy adults. OHSU researchers are studying ways to prevent injuries in athletes. As part of the research we are asking high school athletes to complete an ANONYMOUS survey. The survey includes questions about: injuries, eating & exercise habits, sleep, emotions and substance use. The survey takes 30 minutes to complete. The survey will be distributed by OHSU staff at your child's school.

Your child's participation in this study will be strictly **anonymous**. Neither their name nor any personal identifiers will be collected or associated with the survey. No coaches, teammates, or researchers will know the answers of any individuals participating in this study. No one from your school will have access to the surveys. Your child may choose **not** to take the survey, or to **not** answer specific questions, without affecting his or her relationship with their coach, team, school and Oregon Health & Science University.

There is no health risk associated with participating in the survey. Your child may experience emotional distress and personal discomfort while answering questions of a personal nature, and may choose to not answer any question(s) on the survey. There also are no direct benefits.

If you have any questions about this survey, please contact Dr. Elliot at 503 494-6554 or by email at elliotd@ohsu.edu. The Institutional Review Board of Oregon Health & Science University has approved this project, and they can be contacted with questions and concerns at 503 494-7887.

Thank you for your kind consideration and for helping us understand how best to help high school students become healthy adults.

Sincerely yours,

Diane Elliot, M.D.
Principal Investigator for the ATHENA program
Professor of Medicine

Appendix B: Intervention Materials

Survey Administration Instructions

(Read the following aloud)

Introductions & Purpose

- Thank you for your time and participation in our study. The purpose of this study is to help understand why student athletes are injured playing sports.
- If you have questions, raise your hand; there are no stupid questions. We are here to help.
- There are two parts to this survey. The first part will be questions about your diet and must be completed in pencil. When you have completed the first part raise your hand and we will collect the pencils and survey about your diet and provide you with a pen to complete the second part of the survey.
- Don't start yet, wait until we go over all the instructions
- Some of the questions you will see on the second part of the survey will ask you about sports injuries and sleep habits, this survey must be completed in pen. At the end we will collect the second part of the survey and the pen is yours to keep!
- By injury we mean anything that kept you from playing that day or the next day or anything causing you to visit a trainer, doctor, nurse or physical therapist. It takes a little time to write about your injuries, but this is the most important part of the survey

Anonymous & Voluntary

- DO NOT write your name on this survey. The answers you give will be private. No one will know what you write. No one at your school, including the coaches, will see your answers.
- Completing the survey is voluntary. You do not need to complete the survey or answer any individual questions. If you are not comfortable answering a question, just leave it blank.
- You may see us flipping through your survey when you hand it in, we are only checking to see if pages of the survey are stuck together and were not filled out. Again, your participation is voluntary and your answers are anonymous.

Length of Survey

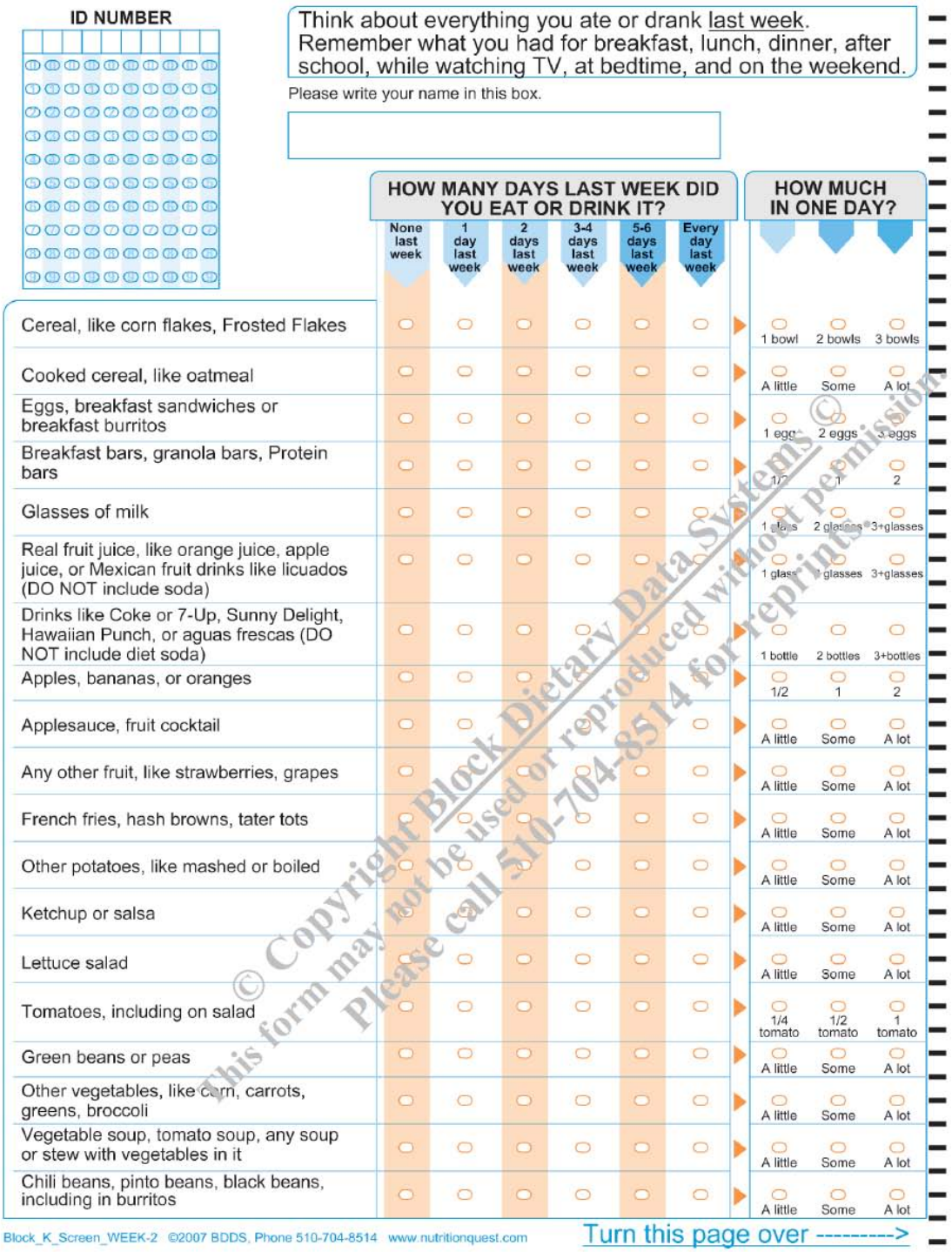
- Make sure to read every question. If you have a question, raise your hand and a research assistant will help you.
- We know this survey long. Your answers will help other young athletes. Thank you!

(Instructions for SPARTA staff)

<u>Where to Start</u>

- Pass out snacks as you are explaining the survey instructions
- Pass out **PENCILS** and **BOTH the BLOCK Kids Screener and SPARTA survey together** (ID #'s on both surveys need to go to the same participant as they are matched)
- Begin with the BLOCK Kids Screener (**PENCIL ONLY to be used for this screener**)
- FIRST have them fill out the "What kind of cereal did you eat?" and "What kind of milk do you drink?" section on the back of the BLOCK screener. **They can only choose ONE response for these questions**.
- SECOND have participants flip the screener over to the first page and begin filling out
- Collect BLOCK Kids Screener and **PENCILS** from participants
- Pass out SPARTA PENS and have them complete the SPARTA survey
- Surveys do not need to stay matched after they have been completed. Put completed BLOCK Kids Screeners in one manila envelope and the completed SPARTA surveys in a different manila envelope

BLOCK Kids Screener™ Last Week Version



ID NUMBER

Think about everything you ate or drank last week. Remember what you had for breakfast, lunch, dinner, after school, while watching TV, at bedtime, and on the weekend.

Please write your name in this box.

	HOW MANY DAYS LAST WEEK DID YOU EAT OR DRINK IT?						HOW MUCH IN ONE DAY?		
	None last week	1 day last week	2 days last week	3-4 days last week	5-6 days last week	Every day last week			
Cereal, like corn flakes, Frosted Flakes							1 bowl	2 bowls	3 bowls
Cooked cereal, like oatmeal							A little	Some	A lot
Eggs, breakfast sandwiches or breakfast burritos							1 egg	2 eggs	3 eggs
Breakfast bars, granola bars, Protein bars							1/2	1	2
Glasses of milk							1 glass	2 glasses	3+glasses
Real fruit juice, like orange juice, apple juice, or Mexican fruit drinks like licuados (DO NOT include soda)							1 glass	2 glasses	3+glasses
Drinks like Coke or 7-Up, Sunny Delight, Hawaiian Punch, or aguas frescas (DO NOT include diet soda)							1 bottle	2 bottles	3+bottles
Apples, bananas, or oranges							1/2	1	2
Applesauce, fruit cocktail							A little	Some	A lot
Any other fruit, like strawberries, grapes							A little	Some	A lot
French fries, hash browns, tater tots							A little	Some	A lot
Other potatoes, like mashed or boiled							A little	Some	A lot
Ketchup or salsa							A little	Some	A lot
Lettuce salad							A little	Some	A lot
Tomatoes, including on salad							1/4 tomato	1/2 tomato	1 tomato
Green beans or peas							A little	Some	A lot
Other vegetables, like corn, carrots, greens, broccoli							A little	Some	A lot
Vegetable soup, tomato soup, any soup or stew with vegetables in it							A little	Some	A lot
Chili beans, pinto beans, black beans, including in burritos							A little	Some	A lot

Turn this page over -------->

	HOW MANY DAYS LAST WEEK DID YOU EAT OR DRINK IT?						HOW MUCH IN ONE DAY?		
	None last week	1 day last week	2 days last week	3-4 days last week	5-6 days last week	Every day last week			
Refried beans	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Hamburgers, cheeseburgers	○	○	○	○	○	○	○ 1 small	○ 1 large	○ 2 large
Hot dogs, corn dogs, or sausage	○	○	○	○	○	○	○ 1	○ 2	○ 3
Lunch meat like boloney, ham, Lunchables	○	○	○	○	○	○	○ 1 slice	○ 2 slices	○ 3+ slices
Pizza or pizza pockets	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Spaghetti or ravioli with tomato sauce	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Macaroni and cheese	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Chicken, including nuggets, wings, tenders, also in sandwiches or stew	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Fish, fish sticks or sandwiches, tuna, shrimp	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Burritos or tacos	○	○	○	○	○	○	○ 1/2	○ 1	○ 2
Beef like roast, steak or in sandwiches	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Meat balls, meat loaf, beef stew, Hamburger Helper	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Pork, like chops, roast, ribs	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Popcorn	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Snack chips like potato chips, Doritos, Fritos, tortilla chips	○	○	○	○	○	○	○ A few	○ Small bag	○ Large bag
Ice cream	○	○	○	○	○	○	○ 1 scoop	○ 2 scoops	○ 3 scoops
Candy, candy bars	○	○	○	○	○	○	○ Mini	○ Small	○ Large
Cookies, donuts, cakes like Ho-Hos	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Cheese. Remember cheese in sandwiches or nachos with cheese or quesadillas	○	○	○	○	○	○	○ 1 slice	○ 2 slices	○ 3+ slices
Whole wheat bread or rolls (NOT white bread)	○	○	○	○	○	○	○ 1 slice	○ 2 slices	○ 3 slices

What kind of cereal did you eat?

- ○ Plain Cheerios, Grape Nuts, Shredded Wheat, Wheaties, Wheat Chex, Kix
- ○ Honey Nut Cheerios, Cap'n Crunch, Lucky Charms, Life, Golden Grahams, Frosted Mini Wheats, Raisin Bran
- ○ Other sweet cereals, like Frosted Flakes, Froot Loops
- ○ Any other cereal, like Corn Flakes, Rice Krispies

What kind of milk did you drink? ○ Whole milk ○ Reduced fat 2% milk ○ Low fat 1% milk ○ Nonfat milk ○ Chocolate milk ○ Soy milk ○ Lactaid milk ○ Don't know

Please tell us about yourself

Are you ○ Male ○ Female

How old are you? ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ 11 ○ 12 ○ 13 ○ 14 ○ 15 ○ 16 ○ 17

MW273665-1 321

About this survey:

This survey is to help understand why student athletes are injured playing sports.

DO NOT write your name on this survey. The answers you give will be private. No one will know what you write. No one at your school, including the coaches, will see your answers.

Completing the survey is voluntary. You do not need to complete the survey or answer any individual questions. If you are not comfortable answering a question, just leave it blank.

Make sure to read every question. If you have a question, raise your hand and a research assistant will help you.

Marking Directions:

- Mark your answers with a pen (NOT a pencil).
- Make dark marks that fill the circle, like this ○ ● ○
- Cross out an answer you want to change, like this ○ ✗ ●

THANK YOU for completing the SPARTA survey...

0217125929

We know this is long. Your answers will help other young athletes.

Thank you!

3026125920

About YOU

1. Are you a male or a female?

Male ○ 1 Female ○ 2

2. How old are you right now in years?

13 ○ 14 ○ 15 ○ 16 ○ 17 ○ 18+ ○

3. What is your grade in school?

9th ○ 10th ○ 11th ○ 12th ○

4. Mark the answer closest to your average grade point average (GPA) in the last year.

- 3.5 to 4.0 (B+ to A) ○ 4
- 3.0 to 3.4 (B- to B+) ○ 3
- 2.0 to 2.9 (C to C+) ○ 2
- 1.0 to 1.9 (D to C) ○ 1
- 0 to 0.9 (F to D) ○ 0

5. Which of the following groups best describes you? Mark all that apply.

- Asian ○
- Native Hawaiian or other Pacific Islander ○
- American Indian or Native Alaskan ○
- Hispanic, Latino ○
- Black, African-American ○
- White ○

6. If you buy lunch at school, is it:

- Full price ○ 1
- Reduced price ○ 2
- Free ○ 3
- Don't know ○ 4
- Don't buy school lunch ○ 5

7. How tall are you? ☐ feet ☐☐ inches

8. How much do you weigh? ☐☐☐ pounds

9. What would you like to weigh now? ☐☐☐ pounds

10. How do you describe your weight?

- Very underweight ○ 1
- Slightly underweight ○ 2
- About the right weight ○ 3
- Slightly overweight ○ 4
- Very overweight ○ 5

11. Are you currently trying to:

- Lose weight ○ 1
- Gain weight ○ 2
- Stay the same weight ○ 3
- I am not trying to do anything about my weight ○ 4

your Sport Injuries

Answer as if you were just ending your sport season.
Think about injuries you had during your sport season.

A sport injury is: anything that kept you from playing that day or the next day
OR
anything causing you to visit a trainer, doctor, nurse or physical therapist.

12. Did you have any sport injuries during your sport season?

No ○ 0 → If no injuries, skip to page 6.

Yes ○ 1 ↓

12a. If yes, how many times were you injured? ☐ Go to page 2 →

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More about your SPORT INJURIES

For each injury during your sport season, we are going to ask you some questions.

Injury No. 1

Describe sport injury number 1 and how it occurred.

For example: *I sprained my ankle running on wet field during warm up drills.*

Or - Player tackled me from behind and I twisted my body and fell hurting my back and hip.

a. For injury number 1 , what parts of your body were injured? Mark all that apply.

- Head (including concussions) or face ○
- Back or neck..... ○
- Arm - shoulder, elbow, wrist, or hand ○
- Leg - hip, thigh, knee, ankle, or foot ○

b. If you injured your leg, did you hurt your knee?

Yes ○ 1 No ○ 0 Did not injure leg ○ 9

c. Did you see a health care provider? If yes, mark all the people you saw for the injury.

- Doctor or nurse..... ○
- Physical therapist..... ○
- Team trainer..... ○
- Other _____ ○
- Did not see a health care provider ○

d. When did injury no. 1 happen?

During a practice or training?

Yes ○ 1 No ○ 0

During a game or competition?

Yes ○ 1 No ○ 0

e. Did the injury happen due to contact with another player or the ball?

Yes ○ 1 No ○ 0

f. How long before you could return to full participation?

- One day ○ 1
- About a week ○ 2
- 2 weeks to a month ○ 3
- Missed most of the season ○ 4

g. Have you ever had this exact same injury before?

Yes ○ 1 No ○ 0

↓

If yes, how long ago did you have this same injury?

- A few days or weeks ago ○ 1
- A few months ago ○ 2
- About a year ago ○ 3
- More than a year ago ○ 4

Injury No. 2

Describe sport injury number 2 and how it occurred.

For example: *I sprained my ankle running on wet field during warm up drills.*

Or - Player tackled me from behind and I twisted my body and fell hurting my back and hip.

a. For injury number 2 , what parts of your body were injured? Mark all that apply.

- Head (including concussions) or face ○
- Back or neck..... ○
- Arm - shoulder, elbow, wrist, or hand ○
- Leg - hip, thigh, knee, ankle, or foot ○

b. If you injured your leg, did you hurt your knee?

Yes ○ 1 No ○ 0 Did not injure leg ○ 9

c. Did you see a health care provider? If yes, mark all the people you saw for the injury.

- Doctor or nurse..... ○
- Physical therapist..... ○
- Team trainer..... ○
- Other _____ ○
- Did not see a health care provider ○

d. When did injury no. 2 happen?

During a practice or training?

Yes ○ 1 No ○ 0

During a game or competition?

Yes ○ 1 No ○ 0

e. Did the injury happen due to contact with another player or the ball?

Yes ○ 1 No ○ 0

f. How long before you could return to full participation?

- One day ○ 1
- About a week ○ 2
- 2 weeks to a month ○ 3
- Missed most of the season ○ 4

g. Have you ever had this exact same injury before?

Yes ○ 1 No ○ 0

↓

If yes, how long ago did you have this same injury?

- A few days or weeks ago ○ 1
- A few months ago ○ 2
- About a year ago ○ 3
- More than a year ago ○ 4

Turn the page for Injury Number 3 ⟶

Injury No. 3

Describe sport injury number 3 and how it occurred.

For example: *I sprained my ankle running on wet field during warm up drills.*

Or - Player tackled me from behind and I twisted my body and fell hurting my back and hip.

a. For injury number 3 , what parts of your body were injured? Mark all that apply.

- Head (including concussions) or face ○
- Back or neck..... ○
- Arm - shoulder, elbow, wrist, or hand ○
- Leg - hip, thigh, knee, ankle, or foot ○

b. If you injured your leg, did you hurt your knee?

Yes ○ 1 No ○ 0 Did not injure leg ○ 9

c. Did you see a health care provider? If yes, mark all the people you saw for the injury.

- Doctor or nurse..... ○
- Physical therapist..... ○
- Team trainer..... ○
- Other _____ ○
- Did not see a health care provider ○

d. When did injury no. 3 happen?

During a practice or training?

Yes ○ 1 No ○ 0

During a game or competition?

Yes ○ 1 No ○ 0

e. Did the injury happen due to contact with another player or the ball?

Yes ○ 1 No ○ 0

f. How long before you could return to full participation?

- One day ○ 1
- About a week ○ 2
- 2 weeks to a month ○ 3
- Missed most of the season ○ 4

g. Have you ever had this exact same injury before?

Yes ○ 1 No ○ 0

↓

If yes, how long ago did you have this same injury?

- A few days or weeks ago ○ 1
- A few months ago ○ 2
- About a year ago ○ 3
- More than a year ago ○ 4

Injury No. 4

Describe sport injury number 4 and how it occurred.

For example: *I sprained my ankle running on wet field during warm up drills.*

Or - Player tackled me from behind and I twisted my body and fell hurting my back and hip.

a. For injury number 4 , what parts of your body were injured? Mark all that apply.

- Head (including concussions) or face ○
- Back or neck..... ○
- Arm - shoulder, elbow, wrist, or hand ○
- Leg - hip, thigh, knee, ankle, or foot ○

b. If you injured your leg, did you hurt your knee?

Yes ○ 1 No ○ 0 Did not injure leg ○ 9

c. Did you see a health care provider? If yes, mark all the people you saw for the injury.

- Doctor or nurse..... ○
- Physical therapist..... ○
- Team trainer..... ○
- Other _____ ○
- Did not see a health care provider ○

d. When did injury no. 4 happen?

During a practice or training?

Yes ○ 1 No ○ 0

During a game or competition?

Yes ○ 1 No ○ 0

e. Did the injury happen due to contact with another player or the ball?

Yes ○ 1 No ○ 0

f. How long before you could return to full participation?

- One day ○ 1
- About a week ○ 2
- 2 weeks to a month ○ 3
- Missed most of the season ○ 4

g. Have you ever had this exact same injury before?

Yes ○ 1 No ○ 0

↓

If yes, how long ago did you have this same injury?

- A few days or weeks ago ○ 1
- A few months ago ○ 2
- About a year ago ○ 3
- More than a year ago ○ 4

Turn the page to continue the survey →

how YOU TRAIN

13. During the sport season, how many club or high school sports do you participate in?

- 1 sport ○ 1
- 2 sports ○ 2
- 3 sports ○ 3
- 4 or more sports ○ 4

14. When you are in season, how many hours a week do you play any sport (count practice and games)?

- 0 - 5 hours ○ 1
- 6 - 10 hours ○ 2
- 11 - 15 hours ○ 3
- 16+ hours ○ 4

15. How many days a week do you do your sport - this includes practices with your team and working out on your own for your sport?

- 0 - 3 days ○ 1
- 4 or 5 days ○ 2
- 6 or 7 days ○ 3

16. Do you do this team sport (have team trainings and games) year around?

- Yes ○ 1
- No ○ 0

17. If you do not do this sport year around, how many months a year do you do the sport?

- 1 - 3 months ○ 1
- 4 to 9 months ○ 2
- 10 or 11 months ○ 3

18. Are you a member of a club team (not high school) for this sport?

- Yes ○ 1
- No ○ 0

19. What grade were you in when you began playing this sport on a team?

- Kindergarten to 4th grade ○ 1
- 5th to 6th grade ○ 2
- 7th to 8th grade ○ 3
- 9th to 12th grade ○ 4

20. Do you plan on playing this sport for a college after high school?

- Yes ○ 1
- No ○ 0

21. How many team sports do you play for your high school over the course of the year?

- 1 team ○ 1
- 2 teams ○ 2
- 3 teams ○ 3
- 4 or more teams ○ 4

22. I know how to train with weights to become stronger.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

23. When I am training or competing, I try to drink extra fluids.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

24. When I am training or competing, I get thirsty.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

Emotions and YOU

25. When I compete in sports I feel nervous.

Not at all		Moderately		Very much so
1	2	3	4	5
○	○	○	○	○

26. When I compete in sports my body feels tense.

Not at all		Moderately		Very much so
1	2	3	4	5
○	○	○	○	○

27. When I compete in sports I feel tense in my stomach.

Not at all		Moderately		Very much so
1	2	3	4	5
○	○	○	○	○

28. I am concerned that I might not do as well in my sport as I should.

Not at all concerned		Moderately concerned		Very much concerned
1	2	3	4	5
○	○	○	○	○

29. I am concerned about performing poorly in my sport.

Not at all concerned		Moderately concerned		Very much concerned
1	2	3	4	5
○	○	○	○	○

30. I am concerned that others will be disappointed in my performance.

Not at all concerned		Moderately concerned		Very much concerned
1	2	3	4	5
○	○	○	○	○

31. During my sport season, I am sad.

Rarely		Sometimes		All the time
1	2	3	4	5
○	○	○	○	○

32. During my sport season, I feel like crying.

Rarely		Sometimes		All the time
1	2	3	4	5
○	○	○	○	○

33. During my sport season, things bother me.

Rarely		Sometimes		All the time
1	2	3	4	5
○	○	○	○	○

34. During my sport season, I feel alone.

Rarely		Sometimes		All the time
1	2	3	4	5
○	○	○	○	○

35. During my sport season, I have threatened to hurt people I know.

Not at all like me	A little like me	Somewhat like me	Very much like me	Completely like me
1	2	3	4	5
○	○	○	○	○

36. During my sport season, I get into fights more than most people.

Not at all like me	A little like me	Somewhat like me	Very much like me	Completely like me
1	2	3	4	5
○	○	○	○	○

37. During my sport season, I often find myself disagreeing with people.

Not at all like me	A little like me	Somewhat like me	Very much like me	Completely like me
1	2	3	4	5
○	○	○	○	○

38. During my sport season, I have trouble controlling my temper.

Not at all like me	A little like me	Somewhat like me	Very much like me	Completely like me
1	2	3	4	5
○	○	○	○	○

39. During my sport season, some of my friends think I am a hot head.

Not at all like me	A little like me	Somewhat like me	Very much like me	Completely like me
1	2	3	4	5
○	○	○	○	○

40. How often in the past year did you push, shove or hit a parent or another adult in your family?

Never	Once	2 - 3 times	4 - 5 times	6 - 9 times	10+ times
○	○	○	○	○	○
0	1	2	3	4	5

41. How often in the past year did you throw something at someone in your family when you were angry?

Never	Once	2 - 3 times	4 - 5 times	6 - 9 times	10+ times
○	○	○	○	○	○
0	1	2	3	4	5

42. During your sport season, how often have you been involved in a physical fight with a gang or group of friends?

Never	Once	2 - 3 times	4 - 5 times	6 - 9 times	10+ times
○	○	○	○	○	○
0	1	2	3	4	5

43. During my sport season, winning in competition makes me feel more powerful as a person.

Strongly Disagree		Don't disagree or agree		Strongly Agree
1	2	3	4	5
○	○	○	○	○

44. During my sport season, I find myself being competitive even in situations which do not call for competition.

Strongly Disagree		Don't disagree or agree		Strongly Agree
1	2	3	4	5
○	○	○	○	○

45. When competitors receive rewards for their accomplishments, I get jealous.

Strongly Disagree		Don't disagree or agree		Strongly Agree
1	2	3	4	5
○	○	○	○	○

46. Failing or losing in competition makes me feel less worthy as a person.

Strongly Disagree		Don't disagree or agree		Strongly Agree
1	2	3	4	5
○	○	○	○	○

47. During my sport season I am pretty happy with myself.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

48. During my sport season, I feel that I am a failure.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

49. I feel that many things about me are good.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

50. I'm able to do things as well as most people.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

51. During my sport season, I will do whatever it takes to win.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

52. When on a team, I want to win no matter what it takes.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

53. Playing team sports is all about winning.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

54. I hate being less than the best at things.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

55. I feel I must do things perfectly or not at all.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

56. During your sport season, how stressful were arguments at home(between your parents or between you and your parents)?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

57. During your sport season, how stressful was it when your parents did not understand you?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

58. During your sport season, how stressful was it making your relationship work with your boy or girlfriend?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

59. During your sport season, how stressful was the pressure to fit in with your peers?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

60. During your sport season, how stressful was being hassled for not fitting in?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

61. During your sport season, how stressful was being judged by your friends?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

62. During your sport season, how stressful was lack of respect from teachers?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

63. During your sport season, how stressful was it to not have enough time for activities outside of school hours?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

64. During your sport season, how stressful was it to not have enough time for fun?

Not at all stressful	A little stressful	Moderately stressful	Quite stressful	Very stressful
1	2	3	4	5
○	○	○	○	○

65. During my sport season, I feel very guilty after eating.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

66. Sometimes I eat a lot and feel I can't stop myself.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

67. I think about burning up calories when I exercise.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

68. During my sport season, I buy fattening food and eat it in secret.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

69. During my sport season, I feel that food controls my life.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

Your SLEEP Habits

70. How much sleep do you think you need each night to feel your best?

☐☐ hours and ☐☐ minutes

71. What time do you usually wake up on week days during your sport season?

☐☐ : ☐☐

72. What time do you usually go to sleep on week days during your sport season?

☐☐ : ☐☐

73. How many cups or cans of caffeinated drinks, such as energy drinks, coffee, coffee drinks, tea, iced tea, cola, and mountain dew do you typically drink each day?

None or 0	1 to 2	3 to 5	6 to 8	More than 8
○	○	○	○	○
0	1	2	3	4

74. During your sport season, how often do you fall asleep or get drowsy during class periods?

Never	Seldom	Sometimes	Frequently	Always
1	2	3	4	5
○	○	○	○	○

75. During your sport season, are you usually alert most of the day?

Never	Seldom	Sometimes	Frequently	Always
1	2	3	4	5
○	○	○	○	○

76. During your sport season, how often are you tired and grumpy during the day?

Never	Seldom	Sometimes	Frequently	Always
1	2	3	4	5
○	○	○	○	○

77. During your sport season, how often do you have trouble getting out of bed in the morning?

Never	Seldom	Sometimes	Frequently	Always
1	2	3	4	5
○	○	○	○	○

78. During your sport season, how often do you think that you need more sleep?

Never	Seldom	Sometimes	Frequently	Always
1	2	3	4	5
○	○	○	○	○

79. During my sport season, during the school day there are times when I realize that I have just fallen asleep.

Never	Seldom	Sometimes	Frequently	Always
1	2	3	4	5
○	○	○	○	○

80. During my sport season in the morning when I am in school, I fall asleep.

Never	Seldom	Sometimes	Frequently	Always
1	2	3	4	5
○	○	○	○	○

81. During my sport season, I feel drowsy if I ride in a car longer than 5 minutes.

Never	Seldom	Sometimes	Frequently	Always
1	2	3	4	5
○	○	○	○	○

82. I need more than one reminder to get up in the morning.

Never	Rarely	About once a week	A few days a week	Every day or almost every day
1	2	3	4	5
○	○	○	○	○

83. During my sport season, I fall asleep in school.

Never	Rarely	About once a week	A few days a week	Every day or almost every day
1	2	3	4	5
○	○	○	○	○

84. During my sport seaon, I feel cranky or irritable during the day.

Never	Rarely	About once a week	A few days a week	Every day or almost every day
1	2	3	4	5
○	○	○	○	○

85. During my sport season, I stay up past midnight.

Never	Rarely	About once a week	A few days a week	Every day or almost every day
1	2	3	4	5
○	○	○	○	○

86. During my sport season, I fall asleep doing homework or studying.

Never	Rarely	About once a week	A few days a week	Every day or almost every day
1	2	3	4	5
○	○	○	○	○

Substance Use

87. During your sport season:	Never	Once or twice during the sport season	A few times during the sport season	About once a week during the sport season	A few times a week during the sport season	Most days during the sport season
	0	1	2	3	4	5
a. How often have you smoked cigarettes?	○	○	○	○	○	○
b. How often have you used alcohol? This means beer, wine, wine coolers and liquor such as rum, gin, vodka or whiskey.	○	○	○	○	○	○
c. How often have you used alcohol to the point you were drunk?	○	○	○	○	○	○
d. How often have you used marijuana (grass, pot, weed, hashish)?	○	○	○	○	○	○
e. How often have you used appetite suppressants, fat burning pills, or diet pills to lose weight?	○	○	○	○	○	○
f. How often have you used water pills, diuretics, or laxatives to lose weight, especially water weight?	○	○	○	○	○	○
g. How many times have you made yourself vomit to lose weight?	○	○	○	○	○	○
h. How often have you taken anabolic steroids pills or shots?	○	○	○	○	○	○
i. How often have you used chewing tobacco, snuff, or dip?	○	○	○	○	○	○
j. How often have you not eaten for a day or more to lose weight?	○	○	○	○	○	○
k. How often have you used cocaine or crack? (Sometimes called coke, rock, flake or freebase.)	○	○	○	○	○	○
l. How often have you sniffed glues, paints, or sprays to get high?	○	○	○	○	○	○
m. How often have you used heroin? (Also called blacktar, horse, and smack.)	○	○	○	○	○	○
n. How often have you used methamphetamines? (Also called crank, crystal, meth, and tweek.)	○	○	○	○	○	○
o. How often have you used ecstasy (MDMA, X, or XTC)?	○	○	○	○	○	○
p. How often have you used prescription drugs that were not given to you by a doctor? (Like pain medications [codeine, OxyContin], tranquilizers, or stimulants [Ritalin Dexadrine].)	○	○	○	○	○	○
q. How often have you used cough suppressants or cold medications to get high? (Like Dex and Tussin.)	○	○	○	○	○	○
r. How often have you used muscle building supplements like muscle milk, protein powders, or creatine?	○	○	○	○	○	○
s. How often have you used energy drinks like Redbull or Rockstar?	○	○	○	○	○	○

88. During my sport season I drink less alcohol than at other times of the year.

Strongly Disagree			Don't disagree or agree			Strongly Agree	Never Use
1	2	3	4	5	6	7	0
○	○	○	○	○	○	○	○

89. During my sport season I use less drugs than at other times of the year.

Strongly Disagree			Don't disagree or agree			Strongly Agree	Never Use
1	2	3	4	5	6	7	0
○	○	○	○	○	○	○	○

90. In the future, I would vomit or use drugs to control my weight if more of my friends or teammates did this.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

91. In the future, I would consider using drugs to control my weight.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

92. I would use drugs or make myself vomit to lose weight, if that would help my team win or help me get a college athletic scholarship.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

General Health

93. In general, would you say your health is:

Poor	Fair	Good	Very Good	Excellent
○	○	○	○	○
1	2	3	4	5

94. During the past 30 days, how many days did poor physical or mental health keep you from doing your usual activities, like attending school or playing sports?

Number of days ☐☐ (Answer 0 to 30 days)

Screen Time

95. On an average school day, how many hours do you watch TV?

I do not watch TV on an average school day	○	0
Less than one hour per day	○	0.5
1 hour per day	○	1
2 hours per day	○	2
3 hours per day	○	3
4 hours per day	○	4
5 or more hours per day	○	5

96. On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Include activities such as Nintendo, Game Boy, PlayStation, Xbox, computer games, and the Internet)

I do not do that on an average school day	○	0
Less than one hour per day	○	0.5
1 hour per day	○	1
2 hours per day	○	2
3 hours per day	○	3
4 hours per day	○	4
5 or more hours per day	○	5

Just a few more pages!

How you EAT

97. How often are the following true:

	Never	Some-times	Usually	Always
	0	1	2	3
a. Fruits and vegetables are available in my home.	○	○	○	○
b. Vegetables are served at dinner in my home.	○	○	○	○
c. Milk is served at meals in my home.	○	○	○	○

98. I know how much protein I need to eat to repair and build muscle.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

99. I am aware of the calorie content of the foods I eat.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

100. Carbohydrates (like potatoes, bread, pasta and fruits) are used by muscles for energy.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

101. I choose healthy foods when I eat at a fast food restaurant (McDonalds, Burger King, etc.).

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

102. I know the basics of a good diet to help build my muscles.

Strongly Disagree			Don't disagree or agree			Strongly Agree
1	2	3	4	5	6	7
○	○	○	○	○	○	○

103. Are you a vegetarian?

a. Yes ○ 1

b. No ○ 0

104. If you are a vegetarian, do you eat any of the following? Mark all that apply.

Eggs	○
Dairy (such as milk and cheese)	○
Chicken	○
Fish	○

105. How often do you drink fruit or vegetable juice?

Never	○ 0
Less than once a week	○ 1
1-3 times a week	○ 2
4-6 times a week	○ 3
Once a day	○ 4
2 times a day	○ 5
3 or more times a day	○ 6

106. How often do you eat fruit?

Never	○ 0
Less than once a week	○ 1
1-3 times a week	○ 2
4-6 times a week	○ 3
Once a day	○ 4
2 times a day	○ 5
3 or more times a day	○ 6

107. In a typical day during your sport season, how many servings of fruit do you eat?

One serving is:
1 medium sized piece of fruit
1/2 cup fruit salad
1/4 cup raisins or dried fruit
3/4 cup of 100% orange, apple, or grapefruit juice (do not count fruit punch, lemonade, Sunnny Delight, or fruit drinks)

a. 0 servings ○ 0
b. 1 serving ○ 1
c. 2 servings ○ 2
d. 3 servings ○ 3
e. 4 or more servings ○ 4

108. In a typical day during your sport season, how many servings of vegetables do you eat?

One serving is:
1 medium carrot or other fresh vegetable
1 small bowl of green salad
1/2 cup of fresh or cooked vegetables
3/4 cup vegetable soup
(Do not count French fries, onion rings, potato chips or fried okra)

a. 0 servings ○ 0
b. 1 serving ○ 1
c. 2 servings ○ 2
d. 3 servings ○ 3
e. 4 or more servings ○ 4

You're almost done!
Keep going!

How you get calcium

109. During your sport season, how many times did you drink 100% orange juice? DO NOT count fruit drinks like Tang and Sunny D.

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 time per day
8 ○ 2 or more times per day

109a. Each time you drank orange juice, how much did you usually drink?

1 ○ Less than one cup
2 ○ 1 cup (8 ounces - size of a small juice glass)
3 ○ More than 1 cup
4 ○ Didn't drink orange juice

109b. How often was the orange juice you drank calcium fortified?

1 ○ Almost never or never
2 ○ Sometimes
3 ○ Almost always or always
4 ○ Don't know
5 ○ Didn't drink orange juice

110. During your sport season, how often did you drink milk as a beverage (NOT in cereal)?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 time per day
8 ○ 2 times per day
9 ○ 3 or more times per day

110a. Each time you drank milk, how much did you usually drink?

1 ○ Less than one cup
2 ○ 1 cup (8 ounces - size of a small carton)
3 ○ More than 1 cup
4 ○ Didn't drink milk

110b. What kind of milk did you usually drink?

1 ○ Whole milk
2 ○ 2% fat milk
3 ○ 1% fat milk
4 ○ Skim or nonfat milk
5 ○ Chocolate milk
6 ○ Soy or rice milk
7 ○ Don't know
8 ○ Didn't drink milk

111. During your sport season, how often did you eat yogurt?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 or more times per day

112. During your sport season, how often did you eat cold cereal?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 time per day
8 ○ 2 or more times per day

112a. Each time you ate cold cereal, how much did you usually eat?

1 ○ Less than 2 cups
2 ○ 2 cups
3 ○ More than 2 cups
4 ○ Didn't eat cold cereal

113. During your sport season, how often did you eat Mexican foods, such as tacos, tostados, burritos, tamales, fajitas, enchiladas, quesadillas, or chimichangas?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 or more times per day

113a. Each time you ate Mexican foods, how much did you usually eat?

1 ○ Less than 1 taco or burrito
2 ○ 1 taco or burrito
3 ○ More than 1 taco or burrito
4 ○ Didn't eat Mexican foods

114. During your sport season, how often did you eat pizza?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 or more times per day

114a. Each time you ate pizza, how much did you usually eat?

1 ○ 1 slice
2 ○ 2 slices or one mini pizza
3 ○ 3 or more slices
4 ○ Didn't eat pizza

115. During your sport season, how often did you eat macaroni and cheese?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 or more times per day

115a. Each time you ate macaroni and cheese, how much did you usually eat?

1 ○ Less than 1 cup
2 ○ 1 cup
3 ○ More than 1 cup
4 ○ Didn't eat macaroni and cheese

116. During your sport season, how often did you eat ice cream, ice cream bars, milk shakes, or frozen yogurt?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 or more times per day

116a. Each time you ate ice cream, ice cream bars, milk shakes, or frozen yogurt, how much did you usually eat?

1 ○ Less than 1 cup
2 ○ 1 cup (2 scoops)
3 ○ More than 1 cup
4 ○ Didn't eat ice cream

117. During your sport season, how often did you eat cheese (including on salads or in sandwiches or subs)?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 or more times per day

117a. Each time you ate cheese, how much did you usually eat?

1 ○ Less than 1 slice
2 ○ 1 slice
3 ○ More than 1 slice
4 ○ Didn't eat cheese

118. During your sport season, how often did you eat bread, toast or dinner rolls, including bread as part of a sandwich (DO NOT count buns with hamburgers or hot dogs)?

1 ○ Never or less than 1 time per month
2 ○ 1 time per month
3 ○ 2-3 times per month
4 ○ 1-2 times per week
5 ○ 3-4 times per week
6 ○ 5-6 times per week
7 ○ 1 time per day
8 ○ 2 or more times per day

118a. Each time you ate bread, toast or dinner rolls, how much did you usually eat?

1 ○ 1 slice or 1 dinner roll
2 ○ 2 slices or 2 dinner rolls
3 ○ More than 2 slices or 2 dinner rolls
4 ○ Didn't eat bread, toast or dinner rolls

The End - Thank You Very much!

Appendix C: Data Collection Field Notes

SPARTA Data Collection Journal

Friday April 24th: Women's LaCrosse @ Lake Oswego High School

- Where? LOHS cafeteria
- When? Before practice
- Quiet group until coach came in and started talking to kids about one of their teammates who had been in a car accident.
- Teammate that was in the car accident showed up 30 min into survey administration, I asked if she wanted to participate and she agreed.
- One athlete had ACL injury that previous Wednesday and was absent from practice. I was able to get her address from the coach and mailed her the BLOCK and SPARTA surveys with return addressed stamped envelope but have not heard from her.

Sunday April 26th: Women's Club Volleyball @ Heritage High School

- Where? Heritage HS classroom
- When? After practice
- Larger group, hard to fit everyone in the room.
- Athletes ate pizza and granola bars while listening to instructions for the survey.
- Athletes were loud and talkative, had to reinforce to stay focused and finish survey.
- Parent came in and sat down by daughter, had to ask him to respect the voluntary and anonymous nature of the survey (he agreed and waited in the hall).
- Coaches were kind of disruptive at the end as some athletes had finished and wanted to go home so team announcements were being made when some athletes had not finished the survey.

Tuesday May 5th: Men's Baseball @ Estacada High School

- Where? Estacada HS Commons (steps where kids eat lunch)
- When? Before practice
- One athlete had ADD and took 2 hours to complete the survey
- Had to ask assistant coach to respect voluntary/anonymous nature of the survey as he was trying to discuss the survey with an athlete still filling it questionnaire.

Wednesday May 6th: Men and Women's Track & Field @ Estacada High School

- Where? Estacada wrestling room (kids took survey on wrestling mats)
- When? Before practice
- Large group, sometimes difficult to keep athletes from talking or discussing the survey.
- 2 athletes with learning disabilities (Melissa Kumagai offered to read survey to 1 athlete so that he could finish); I had to read the calcium questions at the end to the other athlete who also needed help finishing.
- Athletes broke off into groups of 3-4, one group in particular was loud, talking and laughing. Had to reiterate to stay focused and respect fellow teammates.

Thursday May 7th: Men and Women's Track & Field @ Woodburn High School

- Where? Woodburn Track Equipment Shed
- When? Before practice
- Difficult space for athletes to take survey; crowded and dark
- Coaches were helpful in keeping team focused and quiet, but overall it was a very manageable, well behaved group
- Coach asked that one athlete not participate d/t severe learning disability

Friday May 8th: Women's LaCrosse @ Sheldon High School

- Where? Practice field, laying on track and sitting in bleachers
- When? Before practice preparing for tournament
- Girls very respectful and helpful
- Coach came midway through administration of survey
- Some discussion between athletes on occasion to clarify foods, etc.
- Went very smoothly

Friday May 8th: Men and Women's Tennis @ Estacada High School

- Where? Estacada HS Cafeteria
- When? Before practice
- Both boys and girls varsity players participated.
- 1 athlete was loud; distracting others by reading his survey out loud (had to constantly encourage him to stay focused).

- 1 athlete had many questions with the BLOCK survey; she measures all of her portions and seemed to be on a strict diet (encouraged her to answer the survey as best she could)

Friday May 15th: Women's Softball @ Estacada High School

- Where? Estacada Softball bleachers
- When? Middle of practice (team took a break to participate)
- Coach didn't really prepare team/inform them that SPARTA would be administering surveys (did not send out the parent letters I had given him)
- Athletes started batting when finished with survey; kind of distracting for those who took more time filling out survey.

Wednesday May 20th: Dynamic motion athletic weight training @ Gladstone HS

- Where? Gladstone HS classroom
- When? During school hours
- 2 different classes; A and B block periods
- Teacher gave a great introduction of our study and how much help they would be in participating
- Very focused and quiet
- Teacher in and out of the classroom while during administration; Teaching assistant stayed in classroom throughout which I think helped athletes to stay focused.
- A few athletes came in late but still participated and completed the survey in under 1 hour