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Exploring the Self-Reported Dietary Habits and Physical Activity Between Athletes and Non-Athletes in Four Central Florida Public High Schools

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EXPLORING THE SELF-REPORTED DIETARY HABITS AND PHYSICAL ACTIVITY BETWEEN ATHLETES AND NON-ATHLETES IN FOUR CENTRAL FLORIDA PUBLIC HIGH SCHOOLS

by

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ABSTRACT

The federal reimbursable meals offered in American school cafeterias have recently been revised with improved nutrition standards yet may not meet the needs of student athletes who require additional energy intake. While many epidemiological studies report high numbers of adolescents who are overweight or obese, there are close to eight million high school students involved in interscholastic sports—more now than ever before. Therefore, the purpose of this research is to establish participation rates in the federal school meals programs in a local Central Florida school district between athlete and non-athlete high school populations. Additionally, the study aimed to establish athlete and non-athlete participation rates in the federal free/reduced lunch program and determine the average number of hours spent in physical activity between athlete and non-athletes in one week. An online questionnaire was developed to assess students' self-reported energy intake and energy expenditure through sport participation and physical activity acquired during leisure time. Results of the study revealed no significance difference in federal school breakfast or lunch consumption rates between athletes and non-athletes. The study also revealed similar participation rates in the free and reduced lunch program between athlete and non-athletes when purchasing school lunches. Additionally, while non-athletes reported more average hours acquiring physical activity in their leisure time than athletes did, athletes accrued more average hours of overall physical activity due to time spent in interscholastic sport practice. Lastly, results determined significant differences in Body Mass Index (BMI) with athletes having lower BMIs than non-athletes. If meals policies evolve to be more accurately reflective of energy intake needs of athletes and non-athletes, school meals could appropriately fuel student performance in the classroom, the athletic field, and beyond.

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LIST OF ABBREVIATIONS

ACSM	American College of Sports Medicine
AI	Adequate Intake
AND	Academy of Nutrition and Dietetics
AMDR	Acceptable Macronutrient Distribution Ranges
AMA	American Medical Association
AHA	American Heart Association
AAP	American Academy of Pediatrics
ATP	Adenosine Triphosphate
BMD	bone mineral density
CDC	Center for Disease Control and Prevention
DC	Dietitians of Canada
DRI	Dietary Reference Intake
EA	Energy Availability
EAR	Estimated Average Requirement
EER	Estimated Energy Expenditure
EI	Energy Intake
FAT	Female Athlete Triad
FDOE	Florida Department of Education
FEEA	Florida Equal Education Act
HHFKA	Healthy, Hunger-Free Kids Act
HOPE	Health Opportunities through Physical Education
IOC	International Olympic Committee
IOM	National Academy of Sciences' Institute of Medicine
kcal	kilocalorie
LTAD	Long Term Athlete Development Model
LTND	Long Term Nutrition Development Model

MTF	Monitoring the Future Program
NHANES	National Health and Nutrition Examination Survey
NCAA	National Collegiate Athletic Association
NCES	National Center for Education Statistics
NFHS	National Federation of State High School Associations
NSLP	National School Lunch Program
NYPANS	National Youth Physical Activity and Nutrition Study
PE	Physical Education class
RED-S	Relative Energy Deficiency in Sport
RD	Registered Dietitian
RDA	Recommended Daily Allowance
SBP	National School Breakfast Program
SES	Socioeconomic Status
SNDA	School Nutrition Dietary Assessment Survey
SPSS	Statistical Package for the Social Sciences
TEE	Total Energy Expenditure
TDEE	Total Daily Energy Expenditure
UL	Tolerable Upper Intake Levels
US HHS	United States Department of Health and Human Services
USDA	United States Department of Agriculture
USDA FNS	United States Department of Agriculture Food and Nutrition Services
WHO	World Health Organization
YRBSS	Youth Risk Behavior Surveillance Survey
YES	Youth, Education and Society Program

CHAPTER ONE: INTRODUCTION

From 2016 to 2017, close to eight million students across the country participated in high school athletics, an increase of over 100,000 students from the previous year (National Federation of State High School Associations [NFHS], 2018b). According to the National Center for Education Statistics (NCES) (2018), 15.1 million students attended public high school for the 2017 school year. Based on these numbers, approximately 53% of high school students compete on interscholastic sports teams nationwide. Yet despite the growing number of youth participation in school sports and the heightened need for proper nutrition and energy intake created by high amounts of physical activity, the United States Department of Agriculture Food and Nutrition Services Department (USDA FNS) has recently reprioritized school meals policies to address the obesity epidemic. Revisions resulted from several epidemiological studies that report concerning percentages of American school-aged children as overweight or obese.

While the improved nutrition standards more clearly align with the Dietary Reference Intakes (DRIs) and the Dietary Guidelines for Americans, the reimbursable school breakfast (SBP) and lunches (NSLP) may neglect the needs of a large population of student athletes whose bodies require energy intake at meal times to match energy expenditure during training. For example, while reducing the caloric content of meals may be beneficial for youth in need of weight management, as the United States Department of Agriculture (USDA) (2016a) has done as a part of their new meals guidelines, student athletes require additional energy intake beyond that of their sedentary counterparts to match energy expenditure in training (American College of Sports Medicine [ACSM], 2015; Thomas, Erdman, & Burke, 2016). Caloric requirements of student athletes whose physical activity is classified as moderate to vigorous nearly double

compared to sedentary counterparts. Female athletes require approximately 50kcal/kg/d or more while sedentary females only require approximately 30kcal/kg/d (Macedonia & Dunford, 2009, p. 71). The same goes for vigorously active males who require twice the number of kilocalories in a day compared to sedentary males, an increase from 31kcal/kg/d to 60kcal/kg/d. Variations in kilocalorie needs are also dependent on individual anthropometrics and sport modalities (Macedonia & Dunford, 2009, p. 71). Therefore, student athletes must consume adequate levels of nutrient-dense kilocalories to match energy expenditure occurring during sports to promote athletic performance and normal adolescent development. Additionally, current calorie ranges of breakfasts and lunches for the age-grade groupings were established based upon data collected as a part of the National Health and Nutrition Examination Survey (NHANES) study in 2003-2004. This study examined a sample size of 1,181 adolescents between the ages of 12-19 years old who wore accelerometers (Troiano et al., 2008, p. 182). This study presented the sole data set utilized to describe the physical activity habits of all American school children when calculating calorie ranges for school meals, and no follow up study was reported. Furthermore, the school-based reimbursable meal is currently presented by the USDA as appropriate for American school children, yet professionals from the USDA and Institute of Medicine of the National Academies (IOM) concede that the current standards are a starting point in improving the diets of a diverse and vulnerable student population (IOM, 2008, p. 2). This implies a need for continued scientific research, improved meals policies and improved nutrition standards appropriate for a greater audience of students who consume school lunches.

If the federal meals program is meant to be effective for American school children, it becomes prudent to research, cultivate and implement nutrition policy for a diversified population, including physically active students, as they constitute a significant percentage of the

student population in many American high schools. If meals policies can evolve to more accurately reflect the energy intake needs of athletes and non-athletes, school meals would fight obesity as well as fuel student performance in the classroom, the athletic field, and beyond.

Purpose of Research & Research Questions

The purpose of this paper is to explore the self-reported dietary habits and physical activity between interscholastic athletes and non-athletes in four Central Florida public high schools. Specifically, the primary aim of this study is to investigate the number of high school student athletes vs non-athletes who regularly consume school meals and to investigate the percentage of athletes and non-athletes who purchased free or reduced-price lunches. A secondary aim of this study is to compare the number of hours per week high school athletes participate in physical activity compared to non-athletes in order to determine if there is evidence to support the need for more energy-dense meal options for athlete populations. Research questions include the following:

- Is there a difference between athlete and non-athlete consumption rates of school-provided meals?
- Is there a difference between athlete and non-athlete participation rates in the federal free/reduced lunch program?
- Is there a difference in the average number of hours athletes and non-athletes report acquiring physical activity in leisure time in one week?
- What is the average number of total hours athletes and non-athletes report spending in physical activity in one week?

CHAPTER TWO: LITERATURE REVIEW

This section highlights adolescents' critical period of growth and development through presenting the energy intake needs within the general and athletic population and the importance of energy availability as documented by professional nutrition organizations and research institutes within the sports nutrition profession. Additionally, current literature on the adolescent growth spurt and the increased need for energy during puberty will be examined. Finally, current USDA meals polices will be presented, examining the scientific literature utilized by the USDA to support its practices and future reforms.

Energy Intake Recommendations for the General Adolescent Population

Dietary Reference Intakes – Institute of Medicine

With the onset of the obesity epidemic, there needs to be prioritized consideration given to "matching appropriate intake to energy expenditure" (Gidding et al., 2005, p. 546). Recommendations regarding appropriate intake amounts according to physical activity level (PAL) are made by several professional organizations. The Dietary Reference Intakes (DRI) from the Food and Nutrition Board of the National Academies' Institute of Medicine (IOM) presents extensive scientific research concerning the basis for nutrient intake according to PAL, chronological age, and Total Energy Expenditure (TEE). Male estimated energy requirements (EER) range from 2090 kcal/day for sedentary adolescents to 3283kcal/day for very active 14 year old boys, 2223- 3499kcal/day for 15 year old boys, 2320-3663kcal/day for 16 year old boys, 2366-3754kcal/day for 17 year old boys, and 2383-3804kcal/day for 18 year old adolescent males (IOM, 2005).

Table 1
DRI Estimated Energy Requirement (ERR) for Boys 14-18 Years of Age

Male Age (years)	Sedentary PAL kcal	Low Active PAL kcal	Active PAL kcal	Very Active PAL kcal
14	2090	2459	2829	3283
15	2223	2618	3013	3499
16	2320	2736	3152	3663
17	2366	2796	3226	3754
18	2383	2823	3263	3804

SOURCE: IOM, 2005

Female EER ranges from 1718 kcal/day for sedentary girls to 2831kcal/day for very active 14 year old girls, 1731-2870kcal/day for 15 year old girls, 1729-2883kcal/day for 16 year old girls, 1710-2871kcal/day for 17 year old girls, and 1690-2958kcal/day for 18 year old adolescent females (IOM, 2005).

Table 2
DRI Estimated Energy Requirement (ERR) for Girls 14-18 Years of Age

Female Age (years)	Sedentary PAL kcal	Low Active PAL kcal	Active PAL kcal	Very Active PAL kcal
14	1718	2036	2334	2831
15	1731	2057	2362	2870
16	1729	2059	2368	2883
17	1710	2042	2353	2871
18	1690	2024	2336	2858

SOURCE: IOM, 2005

Recommendations regarding energy-yielding macronutrients are established from adult studies and are recommended for 14-18 year old males and females without consideration of PAL. The Recommended Daily Allowance (RDA) for carbohydrates is 130g/day. No RDA exists for total fat consumption (IOM, 2005). In its place, the Adequate Intake (AI) for linoleic

acids or polyunsaturated fats is 16g/day for males and 17g/day for females, as there is no current data to support DRI for total fat consumption (IOM, 2005). Protein recommendations for adolescents between the ages of 14-18 years old is described as "nitrogen equilibrium plus protein deposition" (IOM, 2005, p. 12). Established Acceptable Macronutrient Distribution Ranges (AMDR) for each of the macronutrients have clear recommendations for daily energy intake and recommend fats represent about 20-35% of a person's daily intake, carbohydrates 45-65%, and proteins 10-35% of daily energy intake (IOM, 2005).

Table 3
DRI Established AMDR

AMDR Macronutrient	% Daily Intake
Carbohydrates	$45-65\%$
Fat	$20-35\%$
Protein	$15-35\%$

SOURCE: IOM, 2005

Dietary Guidelines for Americans – United States Department of Agriculture

The USDA and the U.S. Department of Health and Human Services (US HHS) (2010) publish the Dietary Guidelines for Americans every five years in order to help Americans make healthy choices in their daily lives. The most recent updates recommend male adolescents 14 years of age acquire 2000kcal/day for sedentary lifestyles, 2400kcal/day for active lifestyles, and 2800kcal/day for active lifestyles (USDA & US HHS, 2010). Male adolescents 15 years of age require 2200kcal/day for sedentary lifestyles, 2600kcal/day for active lifestyles, and 3000kcal/day for active lifestyles (USDA & US HHS, 2010). Male adolescents between the ages of 16 and 18 require 2400kcal/day for sedentary lifestyles, 2800kcal/day for active lifestyles, and

3200kcal/day for active lifestyles (USDA & US HHS, 2010). Female adolescents between 14 and 18 years old require 1800kcal/day for sedentary lifestyles, 2000kcal/day for active lifestyles, and 2400kcal/day for active lifestyles (USDA & US HHS, 2010).

Table 4
DGA Estimated Daily kCalorie Needs by Age, Gender, and Physical Activity Level

Age (years)	Male/ Sedentary	Male/ Moderately Active	Male/ Active	Female/ Sedentary	Female/ Moderately Active	Female/ Active
14	2000	2400	2800	1800	2000	2400
15	2200	2600	3000	1800	2000	2400
16-18	2400	2800	3200	1800	2000	2400
19-20	2600	2800	3000	2000	2200	2400

SOURCE: USDA & US HHS, 2010

AMDRs represented by the USDA for 14-18 year old male and females reflect ranges for the energy yielding macronutrients (USDA & US HHS, 2010). The carbohydrates AMDR is 45%-65% or 130g/day for both genders (USDA & US HHS, 2010). The AMDR for fats is 25%-35% or 11g/day for females and 16g/day for males (USDA & US HHS, 2010). The AMDR for protein is 10%-30% or 46g/day for females and 56g/day for males (USDA & US HHS, 2010).

Table 5
DGA AMDR of Macronutrients

Macronutrient	AMDR % Daily Intake
Carbohydrates	$45-65\%$
Fat	$25-35\%$
Protein	$10-30\%$

SOURCE: USDA & US HHS, 2010

Consensus Statement – American Heart Association

A consensus statement from the American Heart Association (AHA) was endorsed by the American Academy of Pediatrics (AAP) regarding primordial prevention through promotion of appropriate energy and nutritional intake of children and adolescent populations (Gidding et al., 2005). Adequate energy intake for 14-18 year old sedentary females is 1800 kcal/day and 2200kcal/day for sedentary males (Gidding et al., 2005). Children who are more physically active will require additional calories. Adolescents participating in moderate physical activity require an additional 200 kcal/day and an additional 200-400 kcal/day if very physically active (Gidding et al., 2005).

Table 6
AHA Daily Estimated Calories by Age and Gender

Age (years)	Male/ Sedentary	Male/ Moderately Active	Male/ Very Active	Female/ Sedentary	Female/ Moderately Active	Female/ Very Active
14-18	2200	+0-200 kcal	+200-400kcal	1800	+0-200 kcal	+200-400kcal

SOURCE: Gidding et al., 2005

Why Intake is Crucial for Athletic Adolescent Populations

Energy Intake and Energy Availability

While scientific inquiry involving young populations is still growing, research from several sports science and nutrition organizations stress the importance of appropriate nourishment in a student athlete's development due to high levels of energy expenditure. According to the National Collegiate Athletic Association (NCAA) (2013), "Nutrition is critical for both academic and sports performance" (para. 2). Such a comment stems from science that

states that exercise is fueled by energy intake (EI) in the form of kilocalories and key nutrients present in foods which impact the aerobic and anaerobic energy systems within the human body. During physical activity, immediate energy is supplied by phosphagen and glycolytic energy systems which depend largely on immediate storages of adenosine triphosphate (ATP), the energy currency of the cell. When exercise persists, ATP supplies become depleted and therefore regenerate glycoticaly or oxidatively. ATP regeneration is aided by the presence of proper nutrient intake in the form of previously consumed calories and nutrients. Proper fueling therefore requires consuming a variety of nutrient-dense foods throughout the day to ensure maximum exposure to both energy yielding and non-energy yielding nutrients such as carbohydrates, fats, protein, vitamins, minerals, and water. Since the human body requires energy for other biological processes in addition to physical activity such as digesting food, breathing, and circulating blood, appropriate EI can be achieved by matching consumption of nutrient-dense kilocalories to the amount of total daily energy expenditure (TDEE) that occurs within 24 hours. As such, proper EI, or a shortage of EI, will affect a student's energy availability (EA) which is "the amount of energy left over and available to support the body's health, daily activity, growth and training" (NCAA, 2014, p. 1). Energy availability (EA) is more clearly summarized as "the amount of energy available to the body to perform all other functions after the cost of exercise is subtracted" (Thomas et al., 2016, p. 512).

Managing Energy Levels

Managing energy levels throughout the day is especially crucial for physically active students, as low EA can result in hormonal, metabolic, and functional disruptions (NCAA, 2014, p. 2). Major organizations within the sport nutrition arena agree that athletic performance and recovery, regardless of age or sport, hinges on proper nutrient intake and timing. Principal

institutions such as the IOM, Academy of Nutrition and Dietetics (AND), Dieticians of Canada (DC), the ACSM, and the International Olympic Committee (IOC) provide nutritional guidelines in order "to promote optimal health and performance across different scenarios of training and competitive sport" (Thomas et al., 2016, p. 543). According to these professional bodies, sufficient caloric intake is the cornerstone of the athlete's diet. Adequate EI supports optimal body functions to aid functions such as activities of daily living, physical activity, normal growth and development, and normal physiological functioning (Thomas et al., 2016). Optimum EI is also important to ensure that nutrient intake exceeds energy requirements of the human body during physical activity. TDEE must be matched by adequate EI or risk performance decreases due to impaired physiological functioning. Athletes who lack energy availability or suffer an energy deficit due to inadequate consumption of kilocalories, too much energy expenditure, or both can suffer physiological consequences such as impaired cognitive functioning, reduced endurance, increased injury risk, decreased coordination and concentration, irritability, depression, decreased muscle strength, and more (Thomas et al., 2016). Inversely, chronically excessive EI causes a myriad of health conditions such as obesity, hypertension, and metabolic disease in addition to hindered athletic performance. Therefore, what a student consumes, or neglects to consume, can affect how successful they are in the classroom and on the sports field. While adolescent kilocalorie and precise nutrient needs for physically active adolescent populations are topics of relatively new research, these basic concepts regarding replenishment of ATP, EI, and EA are applicable to any physically active population.

Energy Intake Recommendations for the Adolescent Athletic Population

Position Stance – AND, DC, ACSM

Authors from principal institutions recognize specific practices to properly fuel physically active athletes. Because energy availability is an important foundation for the health and success of active athletic populations, the position paper from the AND, DC and ACSM specifically addresses the energy needs of athletes regarding the type, amount, and timing of food, fluids, and supplements (Thomas et al., 2016). Authors agree that the U. S. Dietary Guidelines for Americans and DRIs underestimate the energy intake requirement of athletes and do not take into consideration the various body sizes and accurate levels of physical activity that active athletes partake in (Thomas et al., 2016). Energy requirements should be calculated by either the Cunningham or the Harris Benedict equations (Thomas et al., 2016). Energy requirements will also vary according to sport and training program phase. Athletes who are not aware of personal energy requirements and intake over time risk hormonal disruptions and low bone mineral density (BMD), possibly resulting in Female Athlete Triad (FAT) or Relative Energy Deficiency in Sports (RED-S) (Thomas et al., 2016). Barriers to successful management of a healthy body weight and composition include limited access to healthy foods, limited opportunity to prepare one's own meals, no daily eating routine, exposure to buffet-style eating with unlimited choices, and exposure to energy-dense foods (Thomas et al., 2016). Maintaining a healthy weight and body composition through vigorous training or sport competition requires frequent follow ups by coaches and sports dieticians that revisit planned nutrition practices and periodized training programs. Additionally, coaches and dieticians should help athletes set short- and long-term goals with individualized diet and training prescriptions based on specific,

purposeful training and dietary practices, trial and error, and what has worked in the past for the athlete.

Position Stance – Sports Dieticians of Australia

Australian professionals came together for a consensus statement to address energy needs and energy and non-energy yielding requirements for adolescent competitors (Desbrow et al., 2014, p. 570). Authors defined the adolescent competitor as being either the elite level athlete, the athlete who is participating in multiple sports in subsequent or overlapping seasons, or any athlete with sporting commitments that go beyond general activity levels (Desbrow et al., 2014, p. 570). With such active involvement, special energy needs become apparent as adolescence is a time of significant growth that includes altered body composition, fluctuating hormonal and metabolic changes, and maturation of organs. Consequently, athletes have special energy needs and must consider appropriate energy intake to power activity during sports competition in addition to having adequate energy required for normal growth and development. Authors state when considering energy recommendations for athletes, predictive equations should be used as a guide when calculating for energy intake needs as chronically low levels of energy intake can cause issues such as delayed puberty, menstrual irregularities, poor bone health, increased risk of injury, FAT, and RED-S among other issues (Desbrow et al., 2014, p. 572). Likewise, chronically high levels of overconsumption of energy can cause risk of overweight and obesity, chronic health conditions such as hyperlipidemia, Type II diabetes, atherosclerosis, and hypertension (Desbrow et al., 2014, p. 572). As no prediction equations exist to accurately determine the energy needs of the adolescent athlete, monitoring energy intake, expenditure, and availability should be done regularly over the course of a lifetime to check for deficiencies in

growth as compared to objective standards for height, weight, skinfold, and others as set by the Center for Disease Control and Prevention (CDC).

Nutritional Concerns for the Adolescent Competitor – Gatorade Sports Science Institute

Nutrition is considered a major component of a young athlete's training as it has the capacity to impact growth and development, assist the athlete in achieving optimal performance, and possibly prevent injury that can occur from nutritional deficiencies. Authors from the Gatorade Sports Science Institute in Barrington, Illinois, summarize specific nutritional practices for endurance, strength and weight class, and team sport athletes using Estimated Average Requirements (EAR) from the DRI values from the USDA (Petrie, Stover, & Horswill, 2004, p. 620). Authors concede that athletes highly involved in sports competition and practice have energy needs above the set DRIs, yet establishing set standards for athletes is difficult mostly due to interindividual variability as well as the fluctuating onset of adolescent puberty.

Team Physician Consensus Statement – ACSM

The ACSM created a consensus statement to help educate team physicians on key nutritional practices as pertinent to their role in the development of successful and healthy athletes. The ACSM strongly articulates that registered dieticians (RD) are the only professionals who have acquired minimum educational training and standards in which to act as sports dieticians (ACSM, 2013). However, as team physicians are often involved in the care and treatment of athletes, understanding general nutrition practices recommended by RDs is important in a physician's role as a sports healthcare provider. Therefore, as nutrition and energy balance are key in optimal athletic performance, athletes need to consume adequate amount of calories to match the body weight desired as necessary for competition and energy demands of their sport. Authors note that many athletes often begin sports participation in an energy deficient

state (ACSM, 2013). Chronically inadequate energy intake can result in loss of muscle mass, risk bone integrity, cause early onset of fatigue, and risk injury and illness (ACSM, 2013). Additionally, chronic intake of excessive calories can result in added pounds which also risks early onset of fatigue and risk injury and reduced performance. During in-season training, energy requirements may be increased as caloric expenditure often exceeds that of energy consumed. Out-of-season training may decrease energy intake requirements as to maintain performance and recovery and promote a healthy body weight. Supplementation for any micro or macronutrient, beyond what is consumed through balanced dietary practices, is not necessary.

Long Term Nutritional Developmental Model – Fukuda et al.

Research compiled by Fukuda, Kendall, Hetrick, and Stout (2017) discusses adolescent athlete nutrition as important in leading a healthy and active lifestyle. Authors discuss the "Daily Nutrition Model" that presents the importance of appropriate energy intake and consuming proper daily values of energy yielding and non-energy yielding nutrients (Fukuda et al., 2013, p. 186). Sedentary children ages 9-13 should consume approximately 1,415kcal/day and up to 3,000kcal/day for very active children (Fukuda et al., 2013, p. 188). Authors recommend 3800kcal/day for 14-19 year old active adolescents (Fukuda et al., 2013, p. 188). Additionally, approximately 55-60% of an adolescent athlete's total daily energy intake should derive from carbohydrates, 12-15% should come from lean protein sources, and 25-30% should derive from healthy fats (Fukuda et al., 2013, p. 188). Iron, calcium, Vitamin D, and proper hydration are of further importance to aid in bone mineral density and hemoglobin production and are recommended in the same amounts for both genders (Fukuda et al., 2013, p. 190). A majority of this article builds on the previously published "Long Term Athlete Development (LTAD) Model" by Bayli, Way, and Higgs (2013) which creates stages of sports specific training

according to appropriate skills and ability as determined by chronological age (p. 1). The nutritional strategies established by Fukuda et al. (2017) emphasizes a Long Term Nutritional Development (LTND) Model as a means to parallel the LTAD and cultivate athletic potential with consideration toward biological growth. While chronological age is used to define the stages, overlap of phases occurs because phases are considered more appropriately as planned "windows of opportunity" because biological and training ages must be taken into consideration for each individual athlete (Fukuda et al., 2013, p. 186).

The first two stages of nutritional development, "Eat to Develop" and "Learn to Eat" focus on young children's basic nutrition consumption, appropriate macro and micro nutrient consumption, proper food selection and balancing consumption of different healthy food options, learning moderation, portion control and snacking techniques to support lifestyle habits upon maturation (Fukuda et al., 2013, p. 186). "Eat to Grow" marks the stage associated with the onset of puberty and the adolescent growth spurt, a critical time where energy needs must be matched or exceed expenditure amounts (Fukuda et al., 2013, p. 187). Beginning at this stage, athletes have increased energy intake requirements due to the nature of energy expenditure during athletic training. Athletes between the ages of 11 and 16 should give specific attention to match consumption rates to training load (Fukuda et al., 2013, p. 187). Therefore, authors recommend an additional 500kcal/day in addition to consuming appropriate amounts of iron and calcium, especially for female athletes due to due to increased hormonal interactions during puberty (Fukuda et al., 2013, p. 187). During the "Eat to Train" phase, the cessation of the adolescent growth spurt is mostly complete for females but still occurring in male athletes. Athletes in this stage are generally competitive athletes between the ages of 16-23, and energy availability is of concern due to the increased training demands and recovery needs (Fukuda et al., 2013, p. 187).

"Eat to Win" marks the final stage where small nutritional and training adjustments are made for elite athletes regarding peak sports performance (Fukuda et al., 2013, p. 188). Authors end by stressing the importance of nutrient timing to optimize athlete's training goals and suggest electrolytes, carbohydrates, and protein as key factors in post-exercise recovery (Fukuda et al., 2013, p. 192).

Nutritional Requirements of the Child and Teenage Athlete – Hoch et al.

Hoch, Goosen, and Kertschmer (2008) write on the nutritional requirements for children and adolescent athletes. Youth and adolescence is a critical period of growth, and nutritional deficiencies can have major consequences for athletic and academic performance. Therefore, appropriate nutrient consumption is important for physically active children to meet their needs for growth, tissue maintenance, and physical and intellectual performance. Additionally, while elementary nutrition is vital, basic nutritional practices must be expanded upon to enhance athletic performance, reduce fatigue and susceptibility to injury or sickness, and allow athletes to train longer and harder and recover faster (Hoch et al., 2008, p. 373). Authors pulled resources from the IOM and the USDA to endorse energy allowances for daily consumption and AMDRs for the energy-yielding macronutrients for adolescent athletes. High school boys require 3000-6000kcal/day, and girls require 2200-4000kcal/day (Hoch et al., 2008, p. 376). Tables were not inclusive of PAL. The AMDR for athletes is as follows: carbohydrates 55-60%, with an RDA of 130g/day to adequately supply the glucose needs of the brain, protein 12-15%, and 20-25% for fats as they are used as a secondary fuel source after carbohydrates (Hoch et al., 2008, p. 377).

Table 7
AMDR for Macronutrients

Macronutrient	AMDR % Daily Intake
Carbohydrates	55 – 60%
Fat	20 – 55%
Protein	12 – 15%

Source: Juzwiak, Paschoal, & Lopez, 2000

Additionally, authors stress the importance of nutrient timing, especially for pre and post competition meals, as consumption of appropriate nutrients effects maintenance of energy levels during competition and recovery. Non-energy yielding substances such as calcium, vitamin D, iron, and fluids are all expressed as key nutrients that should be supplemented in an athlete's diet through normal foods, meals, and beverages as much as possible.

Nutrition for the Young Athlete – Meyer et al.

Meyer, O'Connor, and Shirreffs (2007) express the need for adequate adolescent energy intake not only to meet normal growth and development but also due to research that shows children's energy requirements are higher than adult requirements. Additionally, DRI in regard to energy intake should be used as a guide as PAL categories are vague. Authors suggest monitoring growth, body mass, and other anthropometric variables to assess if energy requirements are being met according to the needs of the developing athlete (Meyer et al., 2007, p. 3). Meyer et al. (2007) discuss appropriate adolescent intake of carbohydrates, protein and fats, as well as iron, calcium, and hydration needs. No AMDR is provided for carbohydrate intake; however, authors suggest following "adequate intake of these foods as recommended by public health agencies worldwide due to their association with a reduced risk of disease" (Meyer et al., 2007, p. 4). This recommendation stems from the knowledge that children have smaller

muscle glycogen stores and also have a decreased anaerobic capacity as compared to adults. Carbs are an important nutrient in fueling optimal athletic and academic performance and should be a major portion of an athlete's daily diet. Fat intake recommendations comes from the AHA and should represent 25-35% of daily energy (Meyer et al., 2007, p. 5). Authors note that while children oxidize fats more readily than adults, there is no evidence to suggest that even athletes participating in endurance events consume more fats that the recommended AMDR (Meyer et al., 2007, p. 5). When ensuring positive nitrogen balance through protein consumption, authors recommend consumption of 1.7g/kg/d for adults, adolescents, and children (Meyer et al., 2007, p. 6). Appropriate intake of iron, calcium, and euhydration were recommended as valuable in contributing to the overall health, wellness, and performance of young athletes (Meyer et al., 2007, p. 7).

Nutrition and Physical Activity – Juzwiak et al.

Juzwiak, Paschoal, and Lopez (2000) discuss the importance of physical activity beginning at an early age as well as proper diet to meet nutritional requirements. When considering nutritional factors, it is important to keep in mind the quest for greater independence during this stage of life impacting dietary choices, the influence of peers, training times, and snack intake. As such, energy balance should be a constant concern to prevent development of developmental issues related to chronic negative energy balance. Authors present AMDRs for macronutrients: 55-60% carbohydrates, 12-15% protein, 25-30% lipids, and equations to predict energy expenditure per day based on weight in kilograms (Juzwiak et al., 2000, p. S352).

Energy Intake and the Adolescent Growth Spurt

Adolescence is a time when students experience the onset of puberty. This is a time where student's energy needs vary greatly, depending on rate of growth, gender, mode of

involvement, and body composition (Whitney & Rolfes, 2013, p. 539). Basic nutrition principles dictate that EI requirements of a growing and developing adolescent increases during the years leading up to puberty and peaks during adolescent puberty. It is a critical period when hormones produce distinct growing patterns between males and females, such as changes in skeletal growth, lean muscle mass, and fat stores. Females typically enter into and complete puberty before males, and the rate of timing and tempo at which the different stages of puberty occur vary widely even among healthy children (Rogol, Clark, & Roemmich, 2000, p. 523). With this period of extensive growth, energy needs and nutritional intake are of the utmost significance, other than during pregnancy and lactation (Whitney & Rolfes, 2013, p. 539). Petrie, Stover, and Horswill (2004) concur stating that "the onset of the growth spurt is a major impetus for increased energy requirements" in children and adolescent athletes (Petrie, Stover, & Horswill, 2004, p. 621). Hormonal fluctuations paired with greater independence in food choices, dietary habits and physical activity can impact EI consumption patterns and should be carefully considered when addressing the needs of physically active high school students.

Growth at Puberty – Rogol et al.

Adolescence is a time when students begin to experience changes and exercise their independence in regard to food choices, dietary habits and physical activity. Often, this is the time adolescents get to experience more freedom when making personal choices than ever before. According to Whitney and Rolfes (2013), "They are not fed, they eat; they are not sent out to play, they choose to go" (p. 539). The onset of puberty causes marked bodily changes between males and females in skeletal growth, lean muscle mass, and fat stores. Rogol, Roemmich, and Clark (2002) present factors impacting growth and development of pre-pubertal and pubertal adolescents. While growth is relatively stable during childhood, development

accelerates rapidly at the onset of adolescence. Nutritional status is of vital importance during these stages of growth. Undernutrition affects vital growth such as muscle development, bone growth, the formation of teeth and later menarche in females (Rogol et al., 2002, p. 193). Additionally, “a moderate degree of obesity is associated with early sexual maturation (Rogol et al., 2002, p. 193). Furthermore, pubertal growth is a time where adolescents experience the most linear growth since infancy (Rogol et al., 2002, p. 195). Termed “the adolescent growth spurt,” it is a time of significant increased energy consumption, weight gain, changes in body composition, and hormonal regulation that must be fueled by proper nutrition as it is a major determinant in normal growth (Rogol et al., 2002, p. 196).

Effect of Diet and Physical Activity – Rogol et al.

Rogol, Clark, and Roemmich (2000) discuss the effects of sports training and adequate energy intake on growth during puberty. Research in this paper presents concern regarding possible effects of excessive sports competition and training on the timing and progression of puberty caused by intense participation and ultimately, lack of adequate nutrition. Studies discussed in this paper by Theintz et al. (1993), Lindhom et al. (1994), and Bernadot and Czerwinski (1991) presented growth retardations in female gymnasts such as being shorter, lighter, and having less body fat than female athletes participating in less strenuous sports like tennis or swimming (as cited in Rogol et al., 2000). Research from Claessens et al. (1992), Theintz et al. (1999), and Baxter-Jones et al. (1994) found first menarche to occur later in female gymnasts than in the control population (as cited in Rogol et al., 2000). Furthermore, delayed menarche in females impacts bone mineral density during a time where adolescent bodies develop more than 90% of their total adult bone mass (Rogol et al., 2000). In adolescent male athletes, most of the focus on growth retardation is placed on wrestlers as athletes in this sport

manipulate caloric intake through sometimes extreme tactics such as dieting, severe exercise, dehydration and other methods (Rogol et al., 2000). Despite the severe energy drain created by energy consumption and training for this particular male-dominated sport, reports on the effects of growth and maturation are inconclusive as the specific deficits in anthropometric measures increased at the end of the sport season and balanced out any deficits in weight, fat mass and percentage of body fat during the actual wrestling season (Rogol et al., 2000). Authors highlight that nutrition and dieting during puberty can be major factors resulting in disordered growth, especially in sports that place a heavy emphasis on weight control.

Puberty and Observed Energy Intake – Shomaker et al.

Shomaker et al. (2010) designed a study to directly measure the energy intake of children and adolescents at different stages of puberty. According to the National Health and Nutrition Examination Surveys, most males self-reported an increase in energy consumption during adolescence and subsequently reported energy intake greater than that of female self-reported intake (as cited in Shomaker et al., 2010, p. 123). This statistic caused authors to design a study that would enable researchers to directly observe if males actually consumed more energy than females during the different stages of puberty. Therefore, the energy intake of both normal weight and overweight adolescent males and females in pre-puberty, early-mid puberty, and late puberty was directly observed with the involvement of 204 participants ranging from 8-17 years of age. Participants fasted the night before the study, reported to the outpatient clinic in the morning, and were fed a portioned breakfast of 280 kilocalories consisting of 240g apple juice, 1 English muffin, and 6g of butter (Shomaker et al., 2010, p. 124). Subjects then participated in sedentary activities at the clinic such as reading, arts and crafts, and video games for six hours. When it was time to eat, subjects were taken to a room and a buffet test meal consisting of

assorted foods and beverages was presented. Subjects were told one of two prompts: “Eat as much as you would at a normal meal” or “Let yourself go and eat as much as you want” (Shomaker et al., 2010, p. 124). The amount of each food item and beverage was weighed pre and post meal and energy content and macronutrient composition was determined by the food manufacturer or the USDA National Nutrient Database for Standard Reference. Results revealed males consumed more absolute total energy than females at all stages of puberty (Shomaker et al., 2010, p. 125). Energy intake increased for both sexes as stages of puberty progressed (Shomaker et al., 2010, p. 125). Of particular interest, timing of significant increases of energy consumption was very different between the sexes. Males consumed the most during late puberty which coincides with the male adolescent growth spurt, and females consumed the most during early-midpuberty, a time of the female adolescent growth spurt (Shomaker et al., 2010, p. 125). Findings also showed nonwhites consumed more than white subjects, overweight youth consumed more than nonoverweight subjects, and there was greater intake with the prompt “Let yourself go” (Shomaker et al., 2010, p. 125). Researchers concluded that professionals in the health industry consider stage of puberty, timing of the adolescent growth spurt, sex, and age when factoring appropriate energy intake for adolescent populations.

Energy Expenditure Recommendations for the General Adolescent Population

Position Stances – CDC, WHO, ACSM, AHA, US HHS

Professional organizations and government agencies within the health and wellness sector unanimously agree that daily exercise and physical activity are essential in the growth and development of a healthy child. Strong evidence has demonstrated multiple health benefits stemming from regular exercise including cardiorespiratory fitness, improved strength and bone health, and weight management (US HHS, 2008, p. F7-1). Organizations such as but not limited

to the AAP, the ACSM, the AHA, the CDC, the US HHS, and the World Health Organization (WHO) all agree that children and adolescents should participate in 60 min/day of moderate to vigorously intense physical activity (AAP, 2014; ACSM, 2015; AHA, 2016; CDC, 2008; US HHS, 2008; WHO, 2018). Additionally, youth populations should be participating in muscle and bone strengthening activities 2-3 days a week (AAP, 2014; ACSM, 2015; AHA, 2016; CDC, 2008; US HHS, 2008; WHO, 2018). Muscle strengthening activities could incorporate resistance training with weights or body weight exercises with proper supervision and instruction. Activities that improve bone mineral density can be accomplished through impact exercises like running, hoping, jumping, bounding, and skipping. While the adolescent age ranges for physical activity recommendations vary slightly among the different organizations, the message remains that children through the age of 18 should be active every day of the week in order to maintain a healthy heart, lungs, bones and muscles (AAP, 2014; ACSM, 2015; AHA, 2016; CDC, 2008; US HHS, 2008; WHO, 2018).

In order to accomplish this goal, physical activity can be achieved in a variety of methods through the use of games, free play, recess, physical education (PE) classes, and sports team participation and competition. Time spent in activity can be divided into shorter time segments, should be developmentally appropriate, and focus on maintaining at least a moderate if not vigorous intensity, or a combination of both. Sedentary behaviors such as increased screen time and extended sitting are discouraged (AAP, 2014; ACSM, 2015; AHA, 2016; CDC, 2008; US HHS, 2008; WHO, 2018).

Sports and Physical Activity Participation Statistics of the General Adolescent Population

Sports Participation and PE in American Secondary Schools – Johnston et al.

Johnston, Delva, and O'Malley (2007) reviewed current levels of participation in physical education (PE) class and interscholastic and intramural sports team participation for high school students. Because adolescents spend so much of their time at school, and as schools provide a "unique setting for opportunities to encourage and facilitate physical activity," authors felt it important to examine and track what American schools are doing to facilitate youth participation in PE and team sports sponsored by the school (Johnston et al., 2007, p. S196). Researchers examined levels of physical activity participation and how participation varied by grade level, ethnic/racial background and socioeconomic status (SES). Two survey methods required school administrators to report data on student participation. The Monitoring the Future (MTF) and Youth, Education and Society (YES) studies provided nationally representative samples of data reflective of eighth, tenth, and twelfth grade student's physical activity participation. Results showed a sharp decline in participation in PE classes from eighth (91%) to twelfth (34%) grades (Johnston et al., 2007, p. S204). There was no compensatory increase across grades in sports participation that might offset the effects of reduced levels of PE participation. Inversely, participation in interscholastic sports among the three grades shows consistent participation as students progress from eighth grade to twelfth grade. Based on data from school administrators, approximately 37.4% of boys and 33.3% of girls in eighth, tenth and twelfth grades participate in interscholastic sports (Johnston et al., 2007, p. S198). Roughly 66% of secondary school students do not participate in any sort of school sponsored sport (Johnston et al., 2007, p. S198). In regard to participation and racial background, schools with higher black and Hispanic populations had less participation in interscholastic sports. Schools with students of

lower SES had the lowest rates of interscholastic participation (Johnston et al., 2007, p. S198). While this study's results show physical activity participation varies according to race, SES, and age, participation in interscholastic sports is relatively consistent throughout all high school grades, and may be one area to guide students into to encourage energy expenditure throughout their youth and adulthood.

NYPANS – CDC

Healthy People 2020 (HP2020), released in 2010 by the CDC, outlines health objectives to aid in improving America's health and wellness. In regard to youth populations, HP2020 objectives set goals for American adolescent populations to acquire at least 60 minutes per day of aerobic activity and perform muscle-strengthening activity at least three or more days a week. To measure youth objectives regarding physical activity, the CDC utilized the 2010 National Youth Physical Activity and Nutrition Study (NYPANS) which provided height and weight measurements as to calculate body mass index (BMI) and data from a survey that measured physical activity and nutrition behaviors among adolescent ninth to twelfth grade students. In the spring of 2010, students completed an anonymous survey during a normal class period of which 9,701 completed surveys were used in reporting the data (CDC, 2011, p. 773). As reported in the figure/table provided below, 15.3% of ninth to twelfth grade students surveyed met objective PA3.1 regarding aerobic activity, 51% met objective PA3.2 regarding muscle-strengthening activity, and 12.2% met objective PA3.3 combining both aerobic and muscle strengthening activity (CDC, 2011, p. 773).

Table 8
Healthy People 2020 Survey Results

HP2020 OBJ #	RECOMMENDATION	TARGET	% MET
PA3.1	≥ 60 minutes of aerobic physical activity per day	20.2%	15.3%
PA3.2	≥ 3 days a week of muscle-strengthening activity	undefined	51%
PA3.3	aerobic physical activity and muscle-strengthening activity combined	undefined	12.2%

SOURCE: CDC, 2011

The results report that "approximately one out of ten U.S. high school students met the HP2020 objective for both aerobic and muscle-strengthening activity recommendation" and is in part a result of so few students achieving PA3.1 regarding aerobic activity (CDC, 2011, p. 773). Additionally, meeting the recommendation for aerobic activity was lower in female students, students in upper grades, and students who were classified as obese. Therefore researchers recommend health efforts be aimed at these specific populations to improve the likelihood of participation in aerobic and muscle-strengthening activities.

Youth Risk Behavior Surveillance Survey – Kann et al.

The Youth Risk Behavior Surveillance System (YRBSS) was developed by the CDC to monitor health behaviors among youth and young adults. The YRBSS is a school-based, national, state and large urban school district survey conducted with students in grades 9-12 from all 50 states including the District of Columbia. The CDC conducts the survey biennially in order to "compare the prevalence of health behaviors among subpopulations of students; assess trends in health behaviors over time," and is the primary data in which to monitor the progress toward achieving 21 national health objectives for *Healthy People 2020* by the CDC (Kann et al., 2015, p. 1).

The 2015 YRBSS summarizes results of 118 health behaviors including obesity, overweight and asthma statistics and reports data from 15,713 completed questionnaires from 125 public and private schools (Kann et al., 2015). Of importance to this paper, 14.3% of surveyed high school students reported no physical activity in the seven days before the survey (Kann et al., 2015). This statistic was mostly representative of black females in the twelfth grade. 48.6% of high school students reported performing physical activity at least 60 minutes per day on five or more days in the seven days before the survey (Kann et al., 2015). This statistic was mostly representative of white males in ninth grade. 27.1% of high school students reported being physically active for at least 60 minutes per day on all seven days prior to the survey (Kann et al., 2015). This statistic was mostly representative of white males in ninth grade. 53.4% of the surveyed high school students reported having participated in weight training or muscle strengthening exercises in at least three or more days during the seven days before the survey (Kann et al., 2015). 57.6% of students reported playing on at least one sports team run by their school or community groups in the 12 months before the survey (Kann et al., 2015). This number is mostly representative of white males in ninth grade.

Sports and Physical Activity Participation Statistics of the Adolescent Athletic Population

National Interscholastic Participation Statistics – NFHS

The National Federation of State High School Associations (NFHS) is a body of professionals who serve the athletic and activity associations for high schools in all 50 states and the District of Columbia. The NFHS serves as the national authority that "promotes and protects the defining values of education-based high school athletics and activities in collaboration with member state associations" (NFHS, 2018a, para. 3). Each year, the NFHS conducts and releases participation statistics from the High School Athletics Participation Survey which shares

comprehensive statistics regarding high school sports offered, the number of high schools offering said sports, number of participants according to gender, and presents this data in several different formats. The report also presents athletic participation survey totals for the entire nation for every year dating back to 1971. The total number of high school students across the nation who participate in interscholastic sports has increased every year since 1990. The latest report presents information from the 2016-2017 school year which shows national participation in high school athletics increased from 7,866,265 participants in the 2015-2016 school year to 7,963,535 participants in the 2016-2017 school year (NFHS, 2018b). It is the largest one-year jump in overall participation since the 2008-2009 school year (NFHS, 2018b). Additionally, the number of female participants has increased every year since 1990. Female participation reached an all-time high for the 2017 school year and is the largest one-year participation jump since the 2000-2001 school year (NFHS, 2018b).

Florida Educational Equity Act – Central Florida School District

Legislation regarding the Florida Educational Equity Act (FEEA) requires school districts in Florida to submit annual reports which reports compliance (or noncompliance) regarding equal opportunity for students and state employees. A portion of a school district's report includes information ensuring equal access to and gender equity in athletics. Spreadsheets reflective of sports participation rates categorized by sport, interscholastic sport team (varsity, junior varsity, freshman, and B-teams), and gender are reported for each district high school. The spreadsheet for each high school shows total participants by team and gender and reports total student enrollment for the school, as well as participation percentages. According to the 2016-2017 FEEA report published by the Central Florida School District participating in this study, there are 8,775 high school athletes in the district (Florida Department of Education [FDOE],

2017). 37% of the high school student population in the participating district are athletes on a sports team at their high school. Additionally these student athletes represent 11% of the overall student population for the district (FDOE, 2017).

USDA SBP and NSLP Program Specifications

SBP and NSLP Purpose

The United States Department of Agriculture's Food and Nutrition Services (USDA FSN) along with guidance from the IOM, administers the School Breakfast Program (SBP) and the National School Lunch Program (NSLP) for schools, public and private, across the country in an attempt to minimize food insecurity for school aged children in American classrooms. The National School Lunch Act was originally created in 1946 and established the first school lunch program for schools across the country (USDA, 2016b, p. 4088). Later in 1966 the Child Nutrition Act created the school breakfast pilot program and was permanently authorized by Congress in 1975 as the School Breakfast Program (SBP) (USDA, 2016b, p. 4088). Together the NSLP and the SBP "hold the potential to provide nearly all the nation's schoolchildren with access to nutritious, low-cost meals to support their growth, development, and health" (IOM, 2008, p. 1). Additionally, both programs provide a safety net to students who suffer from food insecurity or inadequate intake. Together the USDA and the IOM play key roles in implementing researched, scientific and modernized guidelines aimed at improving the health and nutrition of students who consume school meals (IOM, 2008).

SBP and NSLP Participation Statistics

In 2010, 99% of public U.S. schools and 83% of U.S. public and private schools combined offered NSLP to students (IOM, 2008, p. 1). Of the approximately 50 million American students who attend public school, roughly 32 million students participate in school

meal programs every day (NCES, 2016; USDA FNS, 2012). Schools that meet the federal guidelines for school meals receive revenue from the USDA for operating, purchasing and managing costs associated with their food services department. While participation in the federal meals program is voluntary, districts who operate school cafeterias independently of SBP & NSLP do not receive federal funding and are not required to follow regulated meal planning.

Motives for Recent Revisions

The most current revisions to policies for the reimbursable meal for breakfast and lunch have been in response to streamlining standards to match the Dietary Reference Intakes (DRI) and the Dietary Guidelines for Americans. Additionally policy updates were influenced by concerns regarding the growing obesity problem and the development of chronic diseases within the United States general population, specifically adolescents. The IOM and the USDA state that "because of the amount of time children spend at school and the proportion of their dietary intake that can be derived from school meals, school meals must be structured in such a way that they do not contribute to childhood obesity" (IOM, 2008, p. 63). Obesity is an epidemic affecting school age children at an alarming rate. The number of obese children in the United States has tripled since 1970, with one in five children categorized as overweight or obese (Fryar, Carroll & Ogden, 2014). According to a study conducted by the CDC from 2011-2014, the prevalence of obesity in youth was 17% (Ogden, Carroll, Fryar, & Flegal, 2015, p. 1). Children with obesity are at higher risk for the development of other chronic health complications such as diabetes, cancer, sleep apnea, bone and joint problems, risk factors for heart disease, and more (CDC, 2017). Additionally, children who are obese through puberty are more likely to remain obese as adults, which links such individuals to serious health complications such as metabolic syndrome, heart disease, certain cancers, and other health issues (CDC, 2017).

Current SBP and NSLP Meal Policies

The updated standards through The 2010 Healthy, Hunger-Free Kids Act (HHFKA) seek to achieve a balance of allowing for appropriate calories and nutrient intake while avoiding excessive energy intake in order to support the needs of children suffering from inadequate intakes (IOM, 2008, p. 55). The updated school meals nutrition standards include increased amounts of fruits, vegetables and enriched grain products, and decreased calories, fats, and sodium present in school meals. Current law requires meals to provide one-third of the RDA for lunch and one-fourth of the RDA for breakfast (IOM, 2008, p. 22). Additionally recent updates place calorie ranges on reimbursable meals for breakfast and lunch that dictate minimum and maximum kilocalories an elementary, middle and high school student can consume per meal. Calorie range values apply to the "average daily calorie content of meals offered across a 5-day school week" (IOM, 2008, p. 71). High school breakfasts range between 450-600 kilocalories and lunches range between 750-850 kilocalories. Implementing ranges aids in "reducing the prevalence of inadequate and excessive intakes of food, nutrients and calories" (IOM, 2008, p. 4) and "reflect the best judgement of the committee based on current evidence for the energy requirements of schoolchildren" (IOM, 2008 p. 13). Nutrient targets were formulated around the guidelines from the DRIs.

Table 9
NSLP and SBP
Summary of Proposed Updates

• Offer fruits and vegetables as two separate meal components
• Offer fruit daily at breakfast and lunch
• Offer vegetables daily at lunch, including specific vegetable subgroups weekly (dark green, orange, legumes, and others as defined in the 2005 Dietary Guidelines and a limited quantity of starchy vegetables throughout the week
• Offer whole grains: half of the grains would be whole grain-rich upon implementation of the rule and all grains would be whole-grain rich two years post implementation
• Offer a daily meat/meal alternate at breakfast
• Offer fluid milk that is fat-free (unflavored and flavored) and low-fat (unflavored only)
• Offer meals that meet specific calorie ranges for each age/grade group
• Reduce the sodium content of meals gradually over a 10-year period through two intermediate sodium targets at two and four years post implementation
• Prepare meals using food products or ingredients that contain zero grams of trans-fat per serving
• Require students to select a fruit or a vegetable as part of the reimbursable meal
• Use a single food-based menu planning approach
• Use narrower age/grade groups for menu planning

Source: USDA, 2016b

Establishment of Calorie Ranges

In order to implement appropriate caloric intake standards for school meals based on the determined age-grade groupings for elementary, middle and high school students, a committee composed of professionals within the IOM and USDA first sought to establish EERs of school aged children using the age and gender specific EER equations from the DRI. Since the equation required variables such as height, weight, age, gender and PAL, experts pulled data from several resources to provide the required variables. Median heights and weights from the 2000 CDC growth charts were used because this data was determined by the committee as reference standards for healthy U.S. children (IOM, 2008, p. 41). To establish estimated PAL levels and determine an accurate PAL coefficient, data collected from 2003-2004 National Health and

Nutrition Examination Survey (NHANES) was analyzed by Troiano et al. (2008) and provided the first objective measure of physical activity of the U.S. population using accelerometers (p. 182). Participants from across the nation were interviewed, given a health examination, and instructed to wear an accelerometer for seven days post-health examination. Accelerometers tracked the number of minutes participants spent in moderate or vigorous physical activity. The study analyzed mean time of physical activity in one day, time spent in moderate or vigorous physical activity, and adherence to physical activity recommendations by professional organizations such as the CDC, WHO, and ACSM, among others. Of the 9643 individuals interviewed and examined, 4867 participants had four or more valid days of monitor wear whose data was used for results of the study. Of the 4867 subjects, 1181 were male and female adolescents between the ages of 12-19. Results of the study showed physical activity declines as age increases, particularly from childhood to adolescence (Troiano et al., 2008, p. 184). Additionally adherence to the recommended physical activity guidelines was only 6-8% for adolescents, with the gender difference increasing from adherence prevalence at 12% for boys and only 3% for girls (Troiano et al., 2008, p. 186). Additionally mean levels of moderate activity for the adolescent population were 'low' and mean duration of vigorous activity was almost nonexistent at three minutes or less (Troiano et al., 2008, p. 186).

Based on results from Troiano et al. (2008) as reported in the 2003-2004 NHANES, committee members determined the average total daily minutes of engagement in moderate to vigorous activities in youth populations in the U. S. are representative of the 'active' to 'low active' PAL categories (IOM, 2008, p. 43). PAL coefficients for 'low active' males is 1.13 and 'low active' females is 1.16 (IOM, 2008, p. 43). The PAL coefficient for 'active' males is 1.26 and 'active' females is 1.31 (IOM, 2008; Appendix F Table F-3). With the required variables of

height, weight, and PAL coefficients defined, experts used the EER equation from the DRI to establish EERs for children for each age from 5-18 and according to gender (IOM, 2008; Appendix F Table F-4). Next, mean daily calorie requirements were established for the age-grade groupings for males, females, and males and females combined, ages 5-10, ages 11-13, and ages 14-18 (IOM, 2008, p. 44). Next, the committee rounded the mean daily calorie requirements for males and females combined to set an established required calorie intake amount by age-grade group (IOM, 2008, p. 70). The mean calorie intake for the age-grade group of 14-18 year olds for males and females combined is 2400 kcal/day (IOM, 2008, p. 70).

To determine target calorie ranges for the different school meals, the committee reviewed data from the third School Nutrition Dietary Assessment Student (SNDA-III) as well as the 2003-2004 NHANES. Both studies reflected similar findings regarding school children's caloric consumption at school breakfast and lunch times; children who participated in the SBP consumed 19-24% or ¼ of their daily calories from breakfast and children who participated in the NSLP consumed 30-34% or 1/3 of their daily caloric intake from lunch (IOM, 2008; USDA FNS, 2007). Based on the results of the SNDA-III, the committee agreed to establish minimum and maximum caloric ranges of school breakfast and lunch, rather than one calorie goal for meals, to "more accurately represent the proportion of calories obtained by school aged children from meals and snacks" (IOM, 2008, p. 70). To establish the preliminary minimum and maximum of the calorie range for breakfast for the age-grade group of 14-18 year olds, the committee multiplied the mean daily calorie amount by 19% or 2400kcal x 0.19 = 452kcal and by 24% or 2400kcal x 0.24 = 576kcal (IOM, 2008, p. 44). Both products were then rounded to the nearest 50 to establish the preliminary SBP calorie range of 450-600kcal for 14-18 year olds (IOM, 2008, p. 44). To establish the minimum and maximum calorie range for NSLP for the

same age-grade group, the committee multiplied the mean daily calorie amount by 30% or 2400kcal x 0.3 = 720kcal and by 34% or 2400kcal x 0.34 = 816kcal (IOM, 2008, p. 44). Both products were then rounded to the nearest 100 to establish the preliminary NSLP calorie range of 700-800kcal (IOM, 2008, p. 44).

USDA FNS Office of Research and Analysis Reports

SNDA – IV 2010

The USDA FNS Department periodically monitors school meals through the School Nutrition Dietary Assessment Study (SNDA). This nutrition monitoring survey seeks to collect national data on the nutritional quality of meals being served and consumed in schools that offer the SBP and NSLP to its students, as well as data on district and school policies and program operations. The purpose of the study is to provide school food service personnel, RDs, policy makers and Congress with "evidence-based research regarding the progress of planning and offering nutritious meals to American students" (USDA FNS, 2012). Data from the most recent SNDA was gathered during the 2009-2010 school year from a nationally representative sample of schools and school districts and was used as baseline for measuring future improvements regarding school meals (USDA FNS, 2012). Because the SNDA-IV was conducted prior to the implementation of the HHFKA of 2010, data was compared to the previous meals standards, the School Meals Initiative (SMI) nutrition standards and aided in the creation of the HHFKA (2010). Currently, there is no advertised anticipated date of release for the SNDA-V, which will provide nationally representative data regarding current SBP and NSLP meal offerings and consumption statistics.

NHANES 2005 – 2010

The National Health and Nutrition Examination Survey (NHANES) is an annual survey by the CDC to collect information on nutrition and physical activity topics of the year. Data collected from the NHANES in 2010 provided "a comprehensive picture of the nutrient intakes, food choices and diet quality of the USDA NSLP participants" (CDC, 2015). Participants completed a 24-hour dietary recall, completed a household interview, a health survey, and participated in a physical examination in order for researchers to "assess the adequacy of nutrient intakes of school children by income class and NSLP-participant status" (CDC, 2015). While the results of this study are reflective of nutrient and consumption trends prior to implementation of the HHFKA of 2010 and do not reflect current data regarding school meals after 2010, the report provides evidence suggesting particular focus on efforts regarding older children, as data showed they are the greatest risk for inadequate nutrient intakes. The report also states all school children need increased consumption of nutrient dense foods, and reduced consumption of empty calories, saturated fats and sodium. Finally the NHANES concluded that the NSLP is an important source of nutrition, particularly for low-income children, as all participants generally consumed more healthful food at lunch than nonparticipants (CDC, 2015). While the CDC annually publishes NHANES surveys and results, the USDA FNS has no later reports posted on their website that provide data regarding current SBP/NSLP statistics for the general adolescent population reflective of standards from the HHFKA of 2010 and beyond.

Peer Reviewed Research on Federal School Meals and the Student Athlete

There is a variety of existing research regarding federal SBP and NSLP meals and its impact on school aged children. Available research addresses themes such as decreasing food insecurity, improving daily diets, increased consumption of nutrients, increased intake of dietary

fats, decreased consumption of sugar, improved attendance and reduced tardiness, and improvement of scores on achievement tests, among other topics. Bhattacharya and Currie (2001) found that consumption of NSLP leads to healthier diets in children. Burghardt, Devaney, and Gordon (1995) report that consuming lunches from the NSLP provides children with increased nutrient intakes. Gleason and Suitor (2003) report that students who consume NSLP lunches increase their consumption of 6 dietary nutrients, reduce sugar intake, but also increase their consumption of dietary fats. In regard to a possible relationship between consumption of NSLP and body anthropometrics, Vermeersch et al. (1984) found that children ages 10 and younger who consumed NSLP lunches were less likely to fall under the 25th percentile for height and weight. Meyers, Sampson, Weitzman, Rogers, and Kayne (1989) studied the effects of SBP breakfast consumption on academic achievement and found those who consumed SBP breakfast earned higher test scores and accumulated less tardies and school absences.

However, in light of the 2010 federal meals policies implemented relatively recently through the HHFKA, there is a disparity in published research that represents the most current meals patterns. The results of the aforementioned studies present data representative of federal meal patterns prior to 2010 and the new legislation through the HHFKA. This means much of the research currently available is reflective of meals and meals polices that are out of date and the research is not accurately representative of meals that school children are currently being offered. Additionally, no research was found regarding the impact of or relationship between consumption of school meals and athletes.

Current School Meals for High School Students

High school students, athlete and non-athlete, are offered the same meal through the SBP and NSLP. Students who consume the SBP reimbursable school meal at breakfast are offered 1

cup of fruit, 1 ounce of whole grains, and 1 fluid cup of low-fat or fat-free milk for breakfast (IOM, 2008, p. 9). The average daily amount of calories for a five-day school week high school breakfast must be at least 450 kilocalories and no more than the maximum value of 600 kilocalories (IOM, 2008, p. 9). For the NSLP reimbursable school meal at lunch, students are offered 1 cup of fruit, 1 cup of vegetables, 2 ounces of whole grains, 10 ounces of meat or a meat alternative, and 1 fluid cup of low-fat or fat-free milk at lunch (IOM, 2008, p. 9). The average daily amount of calories for a 5-day school week high school lunch must be at least 750 kilocalories and no more than the maximum value of 850 kilocalories (IOM, 2008, p. 9). Both meals were designed to offer calories that meet the needs of students who are physically 'active' or 'low active' based off data collected from a 2003-2004 nationally representative sample (Troiano et al., 2008). Current meals and calorie ranges do not plan for students who exceed these physical activity levels (IOM, 2008, p. 71).

Table 10
HHFKA 2010
Breakfast Meal Pattern

	Grades K-5[a]	Grades 6-8[a]	Grades 9-12[a]
Amount of Food Per Week[b] (Minimum per Day)			
Fruits (cups)[cd]	5 (1)[e]	5 (1)[e]	5 (1)[e]
Vegetables (cups)[cd]	0	0	0
Dark green [f]	0	0	0
Red/orange [f]	0	0	0
Beans/peas (legumes) [f]	0	0	0
Starchy [f]	0	0	0
Other [fg]	0	0	0
Additional Vegetables to Reach Total	0	0	0
Grains (oz eq)	7 (1)	8 (1)	9 (1)
Meats/Meat Alternatives (oz eq)	0[k]	0[k]	0[k]
Fluid Milk (cups)	5 (1)	5 (1)	5 (1)
Other Specifications: Daily Amount Based on the Average for a 5-Day Week			
Min-Max Calories (kcal)[mno]	350-500	400-550	450-600
Saturated fat (% of total calories)[no]	<10	<10	<10
Sodium (mg)[np] Target 1, 2014-2015	≤540mg	≤600mg	≤640mg
Target 2, 2017-2018	≤485mg	≤535mg	≤570mg
Final Target, 2022-2023	≤430mg	≤470mg	≤500mg
Trans fat[np]: Nutrition label or manufacturer must indicate zero grams of trans fat per serving			

a In the SBP, the above age-grade groups are required beginning July 1, 2013 (SY 2013-2014). In SY 2012-2013 only, schools may continue to use the meal pattern for grades K-12 (see 220.23)

b Food items included in each food group and subgroup and amount equivalents. Minimum creditable serving is 1/8 cup

c One quarter-cup of dried fruit counts as ½ cup of fruit; 1 cup of leafy greens counts as ½ cup of vegetables. No more than half of the fruit or vegetable offerings may be in the form of juice. All juice must be 100% full-strength

d For breakfast, vegetables may be substituted for fruits, but the first two cups per week of any such substitution must be from the dark green, red/orange, beans and peas(legumes) or "Other vegetables" subgroups as defined in 210.10(c)(2)(ii).

e The fruit quantity requirement for the SBP (5 cups/week and a minimum of 1 cup/day) is effective July 1, 2014 (SY 2014-2015).

f Larger amounts of these vegetables may be served.

g This category consists of "Other vegetables" and defined in 210.10(c)(2)(ii)(E). For the purposes of the NSLP, "Other vegetables" requirement may be met with any additional amounts form the dark green, red/orange, and beans/peas (legumes) vegetable subgroups and defined in 210.10(c)(2)(iii).

h Any vegetable subgroup may be offered to meet the total weekly vegetable requirement

i At least half the grains offered must be whole grain-rich in the NSLP beginning July 1, 2012 (SY2012-2013), and in the SBP beginning July 1, 2013 (SY2013-2014). All grains must be whole grain-rich in both the NSLP and the SBP beginning July 1, 2014 (SY2014-2015).

j In the SBP, the grain ranges must be offered beginning July 1, 2013 (SY2013-2014).

k There is no separate meat/meat alternate component in the SBP. Beginning July 1, 2013 (SY2013-2014), schools may substitute 1 oz. eq. of meat/meat alternate for 1 oz. eq. of grains after the minimum daily grains requirement is met.

l Fluid milk must be low fat (1 percent milk fat or less, unflavored) or fat-free (unflavored or flavored).

m The average daily amount of calories for a 5-day school week must be within the range (at least the minimum and no more than the maximum values).

n Discretionary sources of calories (solid fats and added sugars) may be added to the meal pattern if within the specifications for calories, saturated fat, trans fat and sodium. Foods of minimal national value and fluid milk with fat content greater than 1 percent milk fat are not allowed.

o In the SBP, calories and trans fat specifications take effect beginning July 1, 2013 (SY2013-2014)

p Final sodium specifications are to be reached by Sy2022-2023 or July 1, 2022. Intermediate sodium specification are established for SY 2014-2015 and 2017-2018. See required intermediate specifications in 210.10(f)(3) for lunches and 210.8(f)(3).

Source: IOM, 2008

Table 11
HHFKA 2010
Lunch Meal Pattern

	Grades K-5[a]	Grades 6-8[a]	Grades 9-12[a]
Amount of Food Per Week[b] (Minimum per Day)			
Fruits (cups)[cd]	2 ½ (1/2)	2 ½ (1/2)	5 (1)
Vegetables (cups)[cd]	3 3/4 (3/4)	3 3/4 (3/4)	5 (1)
Dark green [f]	1/2	1/2	1/2
Red/orange [f]	3/4	3/4	1 1/4
Beans/peas (legumes) [f]	1/2	1/2	1/2
Starchy [f]	1/2	1/2	1/2
Other [fg]	1/2	1/2	3/4
Additional Vegetables to Reach Total[h]	1	1	1 1/2
Grains (oz eq)[i]	8 (1)	8 (1)	10 (2)
Meats/Meat Alternatives (oz eq)	8	9	10
Fluid Milk (cups)[l]	5 (1)	5 (1)	5 (1)
Other Specifications: Daily Amount Based on the Average for a 5-Day Week			
Min-Max Calories (kcal)[mno]	550-650	600-700	750-850
Saturated fat (% of total calories)[no]	<10	<10	<10
Sodium (mg)[np] Target 1, 2014-2015	≤1230mg	≤1360mg	≤1420mg
Target 2, 2017-2018	≤935mg	≤1035mg	≤1080mg
Final Target, 2022-2023	≤640mg	≤710mg	≤740mg
Trans fat[np]: Nutrition label or manufacturer must indicate zero grams of trans fat per serving			

a In the SBP, the above age-grade groups are required beginning July 1, 2013 (SY 2013-2014). In SY 2012-2013 only, schools may continue to use the meal pattern for grades K-12 (see 220.23)

b Food items included in each food group and subgroup and amount equivalents. Minimum creditable serving is 1/8 cup

c One quarter-cup of dried fruit counts as ½ cup of fruit; 1 cup of leafy greens counts as ½ cup of vegetables. No more than half of the fruit or vegetable offerings may be in the form of juice. All juice must be 100% full-strength

d For breakfast, vegetables may be substituted for fruits, but the first two cups per week of any such substitution must be from the dark green, red/orange, beans and peas(legumes) or "Other vegetables" subgroups as defined in 210.10(c)(2)(ii).

e The fruit quantity requirement for the SBP (5 cups/week and a minimum of 1 cup/day) is effective July 1, 2014 (SY 2014-2015).

f Larger amounts of these vegetables may be served.

g This category consists of "Other vegetables" and defined in 210.10(c)(2)(ii)(E). For the purposes of the NSLP, "Other vegetables" requirement may be met with any additional amounts form the dark green, red/orange, and beans/peas (legumes) vegetable subgroups and defined in 210.10(c)(2)(iii).

h Any vegetable subgroup may be offered to meet the total weekly vegetable requirement

i At least half the grains offered must be whole grain-rich in the NSLP beginning July 1, 2012 (SY2012-2013), and in the SBP beginning July 1, 2013 (SY2013-2014). All grains must be whole grain-rich in both the NSLP and the SBP beginning July 1, 2014 (SY2014-2015).

j In the SBP, the grain ranges must be offered beginning July 1, 2013 (SY2013-2014).

k There is no separate meat/meat alternate component in the SBP. Beginning July 1, 2013 (SY2013-2014), schools may substitute 1 oz. eq. of meat/meat alternate for 1 oz. eq. of grains after the minimum daily grains requirement is met.

l Fluid milk must be low fat (1 percent milk fat or less, unflavored) or fat-free (unflavored or flavored).

m The average daily amount of calories for a 5-day school week must be within the range (at least the minimum and no more than the maximum values).

n Discretionary sources of calories (solid fats and added sugars) may be added to the meal pattern if within the specifications for calories, saturated fat, trans fat and sodium. Foods of minimal national value and fluid milk with fat content greater than 1 percent milk fat are not allowed.

o In the SBP, calories and trans fat specifications take effect beginning July 1, 2013 (SY2013-2014)

p Final sodium specifications are to be reached by Sy2022-2023 or July 1, 2022. Intermediate sodium specification are established for SY 2014-2015 and 2017-2018. See required intermediate specifications in 210.10(f)(3) for lunches and 210.8(f)(3).

Source: IOM, 2008

CHAPTER THREE: METHODS

Sampling Method

A convenient Central Florida school district was contacted via an email request for permission to survey their students. No particular characteristics or statistics regarding the student population of this school district differentiated its students from other Florida school districts. After submitting a research request packet to school district officials, approval to distribute an online, confidential survey to four of the sixteen district high schools was granted, pending principal approval. Principals at each of the designated high schools were individually contacted by the primary investigator, and all four agreed to student involvement. The final step in determining the sample population required teachers from the four high schools to commit to disseminating and collecting informed consents from students. All of the teachers that agreed to distribute and collect informed consents on behalf of the research team are certified instructors through the Florida Department of Education (FDOE) and teach various subject areas such as Health Opportunities through Physical Education (HOPE), math, science, social studies, and business academy classes. A few of the teachers also serve as coaches for their high school's interscholastic sports teams. No community coaches were involved in the study.

Participants

In total, 308 high school students were surveyed. The survey was conducted from January to April of 2018. Inclusion criteria included the following:

- High school age male or female students in grades 9-12 for the 2017 – 2018 school year
- Students attended one of the four selected high schools in the Central Florida school district

- Students returned a signed informed consent

Exclusion criteria included the following:

- Any student who did not return an informed consent
- Any student who turned in an informed consent without a parent/guardian's signature

Instrument

An online questionnaire to assess students' self-reported energy intake habits and energy expenditure amounts through sports team participation and physical activity was developed. Three distinct sections of the questionnaire addressed energy intake habits, energy expenditure, and students' demographic information. The first question of the survey informed students of the purpose of the study, ensured confidentiality, and that the survey was voluntary in nature. The next 12 questions addressed typical dietary habits. The goal was to investigate students' consumption of school breakfasts or lunches or both, participation in the free or reduced school lunch program, as well as eating times, meals, and frequencies, nutritional influences, food groups consumed, and hydration habits. Researchers planned to use answers from dietary habits questions to report differences in consumption rates of SBP and NSLP meals between athletes and non-athletes and to report any possible difference in the number of athletes and non-athletes who participate in the free and reduced lunch program through the USDA. Students indicated days of the week they consumed breakfast and lunch and whether they consumed school meals or meals prepared at home. Two open-ended questions allowed students to explain dietary choices at breakfast and at lunchtime. One closed-ended response question asked students if they participated in the free or reduced lunch program. Students were asked to rank order influential

nutrition sources and to indicate daily sources and amounts of hydration through a matrix table using 1 cup as the unit of measurement.

Researchers formulated the next section of five questions around sports participation and physical activity amounts. Three questions probed students about what club and interscholastic sport/s they participated in, and the frequency and duration of sport practices and exercise sessions. Students were also asked to rank their perceived exertion during practices. One question probed what kinds of physical activity students participate in during leisure time and approximate amounts. Two questions regarding physical education class were built to mimic the Physical Activity Questionnaire for Adolescents (PAQ-A) developed by Kowalski, Crocker, and Donen (2004) in the form of a seven-day recall instrument (p. 11). The survey ended with six demographic questions.

Skip logics were built into both sections of the survey in order to jump students forward to subsequent questions that applied to them; therefore, students were able to skip survey questions that did not apply to them. Qualtrics was used to create the survey instrument and to generate two methods to access the survey, one via a Quick Response (QR) code and another via a web address. Both access methods were copied and pasted on to the survey flier.

Procedures

The study received approval from the University of Central Florida Institute Review Board (see Appendix A), the Central Florida school district, as well as high school principals and teachers. Informed consents were delivered to all the teachers at the four participating high schools. Teachers were required to obtain signed informed consents from parents before students were given instructions and information on how to participate in the study. Signed informed consents were collected after a week and stored in a locked filing cabinet in the office of the

primary investigator. Study fliers were then given to those students who returned a signed informed consent. Once study fliers were distributed, students had access to the survey by using the QR code provided on the flier or by typing in the web address provided. Both links were generated by Qualtrics.

Once the survey was accessed, students were required to input the subject number from their study flier and answer the first question of the online survey which asked them to agree to participate in the survey. Students who clicked on "I agree and wish to continue participating in the survey" were allowed to continue taking the survey. Students who clicked on "I disagree and wish to end my participation in this survey" were immediately exited to the end of the survey and thanked for their time. The data from the survey was collected through Qualtrics.

Statistical Analysis

Statistical analysis of the data collected in Qualtrics was calculated using Statistics Package for the Social Sciences (SPSS). To better understand the population of respondents to the survey, descriptive statistics were generated. Frequencies were calculated for participation in high school interscholastic athletics and consumption of the federal reimbursable meals through the SBP and the NSLP. Respondents who answered "yes" to Qualtrics question 22 (Q22) regarding high school athletic participation were tabulated and labeled as "athlete." Respondents who answered "no" were labeled "non-athlete." Crosstabs compared the difference in breakfast and lunch consumption between athletes and non-athletes. A Pearson's Chi Square test (p=.05) was conducted to determine if differences between athlete and non-athlete SBP and NSLP consumption were statistically significant. A Pearson's Chi Square test (p=.05) was also used to determine if there was a statistically significant difference between the number of athletes and non-athletes who participate in the free or reduced cost lunch program through the USDA.

A Mann Whitney with an alpha level was set a priori at .05 and analyzed possible significant differences in the amount of physical activity athletes and non-athletes acquire during leisure time, as well as determining possible statistical differences in the mean when comparing total number of hours spent in physical activity between athletic and non-athletic populations. In order to do this, total time spent in physical activity for each group of respondents was established. Athlete's total minutes of physical activity was a combination of Qualtrics questions Q46 & Q47 which reported total volume of interscholastic sports practice plus Qualtrics question Q55 regarding physical activity acquired during leisure time in one week. Non-athlete's total physical activity minutes came solely from Q55 as non-athletes do not participate in interscholastic sports team practice. All statistical results were verified using SAS 9.4.

CHAPTER FOUR: RESULTS

Of the six hundred students who were provided informed consents, three hundred and eight high school male (n= 131, 16.03 ± 1.34 years, 174.62 ± 22.92 cm, and 73.36 ± 17.44 kg) and female (n= 177, 16.05 ± 1.37 years, 164.06 ± 7.29 cm, and 60.87 ± 14.15 kg) students returned signed informed consents and completed the survey with the necessary requirements to be included in the statistical analysis and final data reporting. A greater percentage of the respondents were female 56.5% as opposed to male 41.9%. Regarding ethnicity, 59.4% of the respondents were Caucasian/White, 20.5% were African American/Black, with smaller percentages representing Hispanic, Asian, Latino, Pacific Islander, Alaskan Native, and 'other' ethnicities. One hundred and seventy-two respondents (56%) identified as interscholastic athletes because they reported submitting a physical to their high school's athletic department and participate on a high school sports team. One hundred and thirty-six respondents (44%) identified as non-athletes because they did not submit a physical to their high school's athletic department and did not participate on a high school sports team.

Differences in SBP and NSLP Consumption

Analysis of the Pearson's Chi Square test (p=.05) revealed no significant difference in SBP consumption rates between athletes and non-athletes (p=.202). Additionally, Pearson's Chi Square test (p=.05) revealed no statistical difference in NSLP consumption rates between athletes and non-athletes (p=.240). Forty-two athletes (24.4%) and twenty-five non-athletes (18.4%) reported consuming the school provided breakfast. One hundred and thirty athletes (75.6%) and one hundred and eleven non-athletes (81.6%) reported not consuming the school

provided breakfast. Figure 1 reports frequencies regarding athlete and non-athlete consumption of the reimbursable SBP school breakfast.

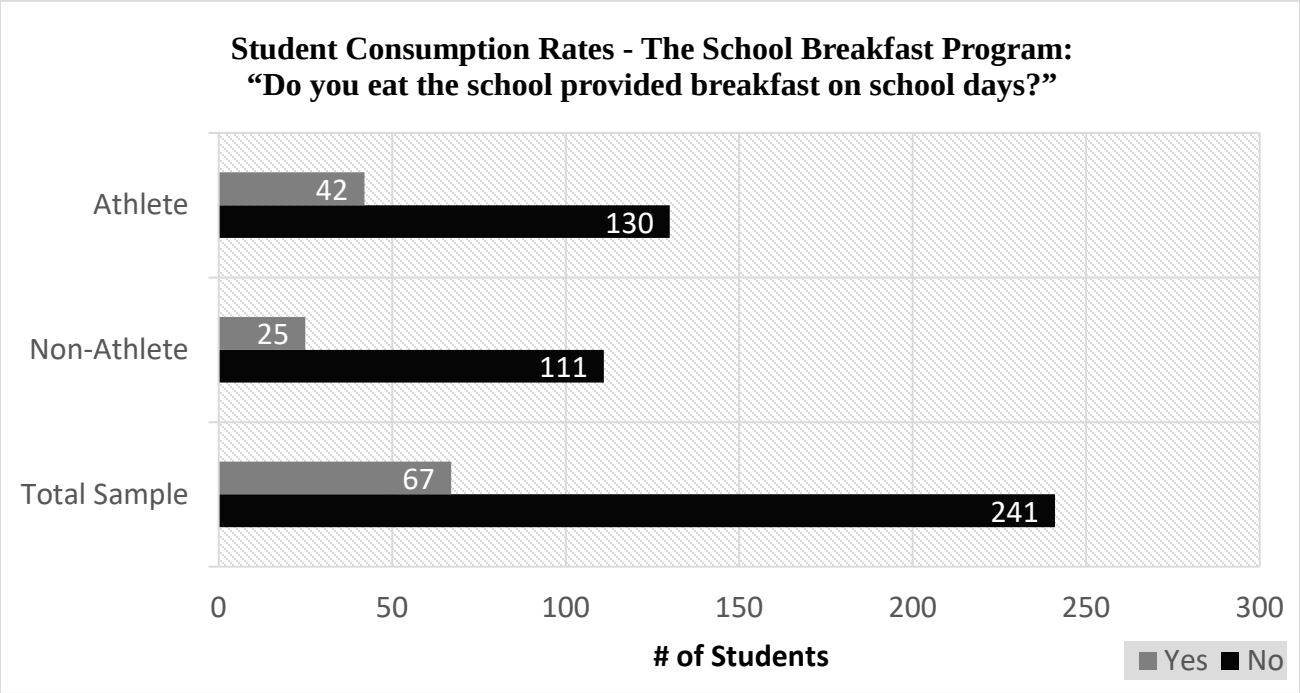

Figure 1: Students and School Breakfast Consumption Rates

Ninety athletes (52.3%) and sixty-two non-athletes (45.6%) reported consuming the school provided lunch. Eighty-two athletes (47.7%) and seventy-four non-athletes (54.4%) reported not consuming school lunch. Figure 2 report frequencies regarding athlete and non-athlete consumption of the reimbursable NSLP school lunch.

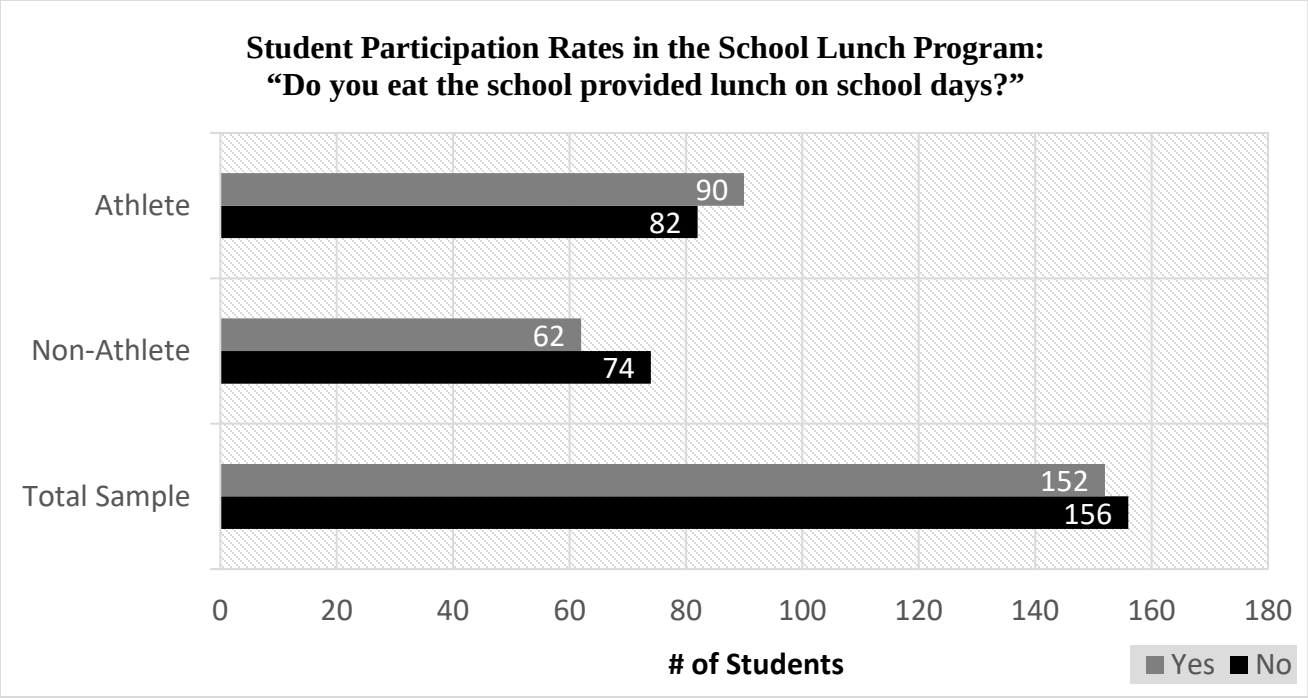

Figure 2: Students and School Lunch Consumption Rates

This demonstrates that students within the Central Florida School District who participated in the survey consume school breakfast and school lunch no differently as athlete or non-athlete.

Differences in Participation in the Free/Reduced Lunch Program

A Pearson's Chi Square test (p=.05) determined there is no significant difference in participation rates in the free and reduced lunch program from athlete to non-athlete (p=.233). Crosstabs in SPSS revealed thirty-seven athletes (21.5%) participate in the free lunch program, thirteen athletes (7.5%) participate in the reduced lunch program, and one hundred and twenty-two athletes (71%) reported zero participation in the free or reduced lunch program. Of the non-athlete population, forty (29.4%) participate in the free lunch program, seven (5.1%) participate in the reduced lunch program, and eighty-nine non-athletes (65.4%) reported zero participation in the free or reduced lunch program.

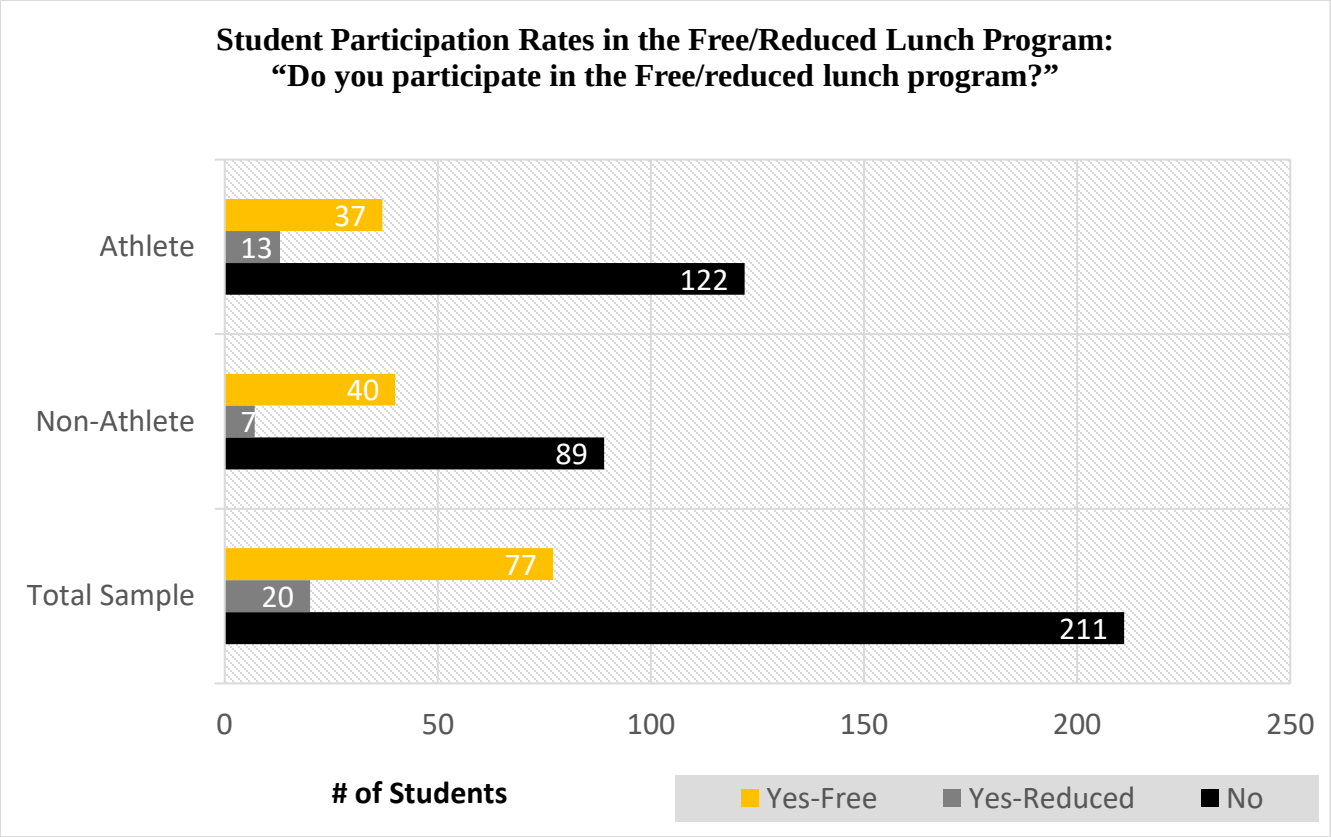

Figure 3: Student Athletes and Non-Athletes and Lunch Options

These results demonstrate similar participation rates in the free and reduced lunch program between student athletes and non-athletes who took the survey. Additionally, these results suggest generally similar socioeconomic status of student athlete and non-athlete populations within the participating school district.

Differences in the Mean Amount of Leisure Time Physical Activity

A Mann Whitney U test (p=.05) determined there is no significant difference regarding average time spent in physical activity during leisure time between athletes and non-athletes (p=.924). The average number of minutes of leisure time physical activity in a week for athletes was calculated as 277.2 minutes (4.62 hours) and 304.8 minutes (5.08 hours) for non-athletes.

This demonstrates that athletes and non-athletes spend about the same number of hours in physical activity during leisure time.

Average Number of Total Hours of Acquired Physical Activity

Results of the Mann Whitney demonstrated a significant statistical difference (p=.01) in the average number of total hours spent in physical activity between athletes and non-athletes. The average number of total hours spent in physical activity for athletes was 780.6 minutes (13.01 hours) due to the combination of leisure time spent in physical activity plus hours spent in sports practice. Because non-athletes do not accumulate hours in sports practice, the number of hours non-athletes acquire during their free time, 304.8 minutes (5.08 hours) is also the average total hours spent in physical activity for non-athletes.

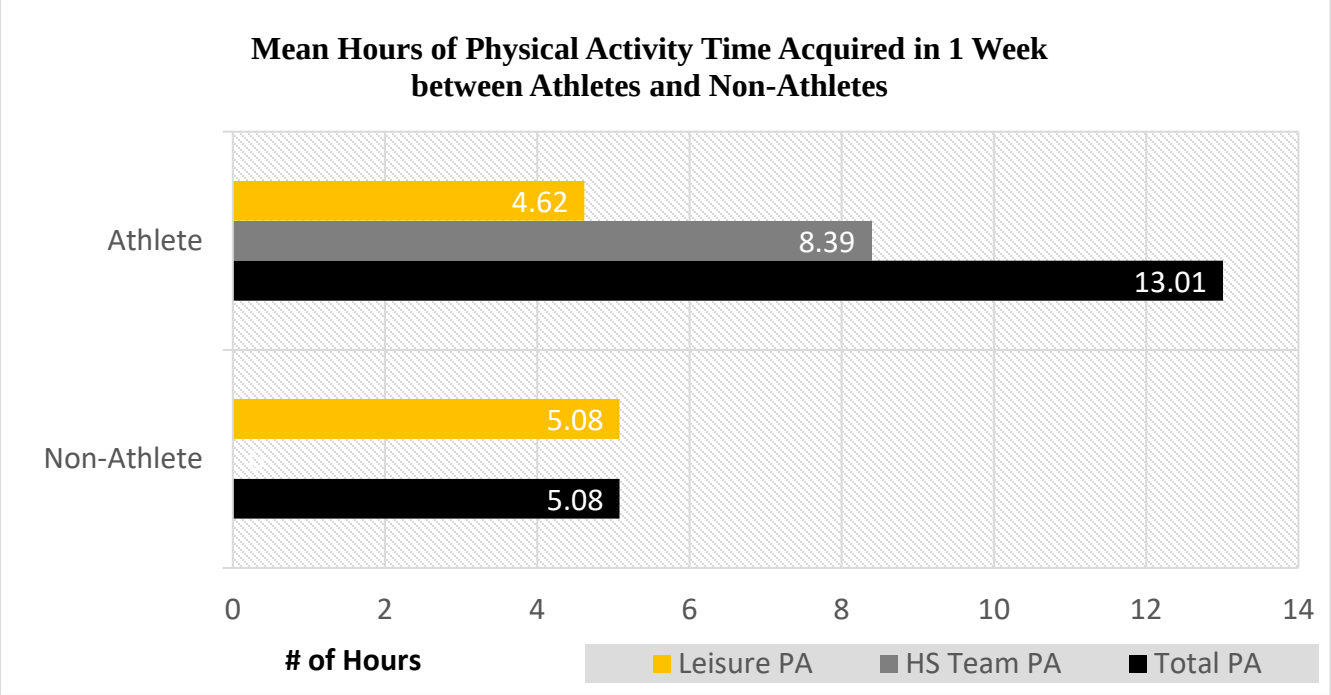

Figure 4: Student Physical Activity Histogram

These results indicate that of the students who participated in the study, students who participate on their high school's interscholastic sports teams acquire more than double the average amount of time spent in physical activity and are on average more physically active than students who do not participate in interscholastic sports through their high school.

CHAPTER FIVE: DISCUSSION

Despite the growing number of student athletes, federal institutions overlook and inadequately plan school meals to provide enough energy and nutrition to meet the energy demands required by these physically active students. Therefore, the main purpose of this study was to investigate the number of high school student athletes vs. non-athletes who regularly consume school meals. Additionally, the current study investigated the percentage of athletes and non-athletes who purchased free or reduced-price lunches, suggesting that populations of athletes would especially benefit from nutritional, energy-dense foods. Finally, a secondary aim of this study was to compare the number of hours per week high school athletes participate in physical activity compared to non-athletes in order to determine whether there is further evidence to support the need for more energy-dense meal options for athlete populations. The results of this study demonstrate that students who participate on their high school's athletic teams consume SBP and NSLP meals in the same manner as their non-athlete counterparts. More importantly, this shows that federal breakfasts and lunches are important meals for athletic students during the school day. This clearly exhibits a need for meals to be equally appropriate for student athletes as well as for overweight or obese students. The results of the study also reveal that both groups of students equally participate in the free/reduced lunch program, and approximately 30% of the students surveyed reported purchasing meals with the assistance of the free/reduced lunch program. Additionally, this study demonstrates that students who participate in interscholastic sports through their various high school athletic teams acquire more time in physical activity than students who are not on high school sports teams. These results suggest that additional

research is needed to establish meals policies that are appropriate for athletic students who require alternatives to what is currently offered through the federal meals programs.

Student participation in the SBP Breakfast and NSLP Lunch Programs

Review of data indicates that high school athletes and non-athletes consume federal school meals in approximately the same manner. Although few studies have examined school meals programs in a population of athletes, findings from those studies are similar with regard to the percentage of athletes who consume school meals (Manore, Patton-Lopez, Meng, & Wong, 2017; Croll et al., 2007; Cupisti, D'Alessandro, Castrogiovanni, Barale, & Morelli, 2002; Savoca et al., 2011). For example, Manore et al. (2017) discovered that 41% of student athletes regularly participate in School Lunch Programs. Savoca et al. (2011) summarized that high school athletes used the school cafeteria to purchase school lunches more than non-athletes. Overall, there were considerably less students who reported participating in the SBP than the NSLP.

Interestingly, when analyzing student consumption of SBP and NSLP, raw data indicates that athletes consume more school breakfasts and lunches than non-athletes do. Forty–two athletes versus twenty-five non-athletes reported eating the school breakfast. Ninety athletes versus sixty-two non-athletes reported eating school lunches. This may be due to several factors related to the increased caloric need associated with physical activity and requires further research to understand why student athletes would consume more school meals than non-athletes. While these differences highlight opportunities for future research, statistical analysis of the data revealed no significant difference in participation of school meals from athlete to non-athlete populations, indicating that school meals need to be appropriate for students who are sedentary, moderately and vigorously physically active.

Athlete vs. Non-athlete Participation in the Free/Reduced Lunch Program

Analyzing athlete and non-athlete participation in the free/reduced lunch program was of particular importance to establish if consumption of school meals occurred based on financial need. Students who qualify for the free or reduced lunch program are approved based on family income and size, or through participation in the Supplemental Nutrition Assistance Program (SNAP) or Temporary Assistance for Needy Families (TANF) government assistance programs. Results of the study showed that a majority of students within the participating Central Florida school district reported no participation in the free/reduced lunch program. Two hundred and eleven students (68.51%) said they do not utilize the free/reduced lunch program to purchase school lunch. Twenty students (6.49%) reported participating in the reduced lunch program that allows them to purchase a school lunch for $0.40/day. Seventy-seven students (25%) reported participation in the free lunch program.

When analyzing the raw data between athlete participation and non-athlete participation, there was more opportunity for athletes to report greater participation in the free/reduced lunch program simply because more students in the sample reported as student athlete and because more athletes reported consuming school lunches. Even though slightly more total athletes (50 students) over non-athletes (47 students) reported participation in the free or reduced lunch programs, statistical analysis revealed no significant difference in participation of the free/reduced lunch program from athlete to non-athlete populations. This indicates that neither population of students within the participating Central Florida school district displayed a greater

need for financial assistance over the other, and that consumption of school meals by either population was not dependent on reduced cost.

Average Hours Spent in Physical Activity

Results regarding free time physical activity revealed that athletes and non-athletes acquire on average, similar amounts of physical activity during their free time (see Figure 6). This result may be due to the fact that non-athletes have opportunities for activities after school and on weekends that high school athletes may not due to practice and game schedules. Although the current study cannot confirm this explanation, it is reasonable to suggest that non-athletes may have more freedom in their schedules to participate in physical activity through a variety of modalities of their own choosing. However, according to the average practice volume reported by the athletic population in this study, athletes inarguably acquire more overall physical activity time in one week due to leisure time physical activity *plus* physical activity acquired during sports team practice. On average, athletes in the current study participate in approximately 8.39 hours of practice in one week with their high school sports team. These findings are similar to a study conducted by Jayanthi, LaBella, Fischer, Pasulka, and Dugas (2015) that reported 11.2 $\pm$ 2.6 hours of PA acquired in one week. For the current study, when leisure time physical activity was added to high school sports participation, it was revealed that athletes participate in approximately 13 hours per week in physical activity, thus exceeding the national recommendation of 60 minutes of activity on most days of the week. These results suggest that not only do athletes have increased amounts of physical activity, they also have increased energy intake requirements due to increased physical activity, thus providing support for the need for schools to offer more nutritious, energy dense foods for this population.

Summary of Significant Findings and Implications for Public Policy and Practice

The results of this study present the first data confirming a population of high school student athletes who depend on federal school meals as a sufficient source of their daily energy intake requirements during school hours. Additionally, this study identifies the existence of a sub-population of students whose biological energy needs merit careful planning and attention regarding school meals to support academic excellence and athletic performance. While professionals working for the IOM and USDA have acknowledged this need through statements printed in federal documents and specifically state physically active students may need more than what is provided for them in school meals, this discussion ceases without further explanation or resolution (IOM School Building Blocks, 2008, p. 71; USDA, 2016b, p. 4096).

New and improved research to inform policies and improve school meals will be paramount as most of the existing research tools and data currently reports on policy regarding meals that were planned, created and consumed before 2010. Improved research with objective measures that identifies who is eating school meals and how much physical activity students acquire will be valuable to all stakeholders involved. Subsequently, policy makers who look for non-traditional ways to provide appropriate fuel for students may discover the most beneficial solutions. Research that explores expanding the times cafeterias offer foods, offering additional meals for active students, or the creation of cafeteria technology that tracks student's energy expenditure, can all be options that lead to ground-braking solutions.

Additionally, updates to credentialing and cafeteria operations may be necessary to create improved school meals for different populations of students. Current qualifications for food services administrative positions vary from district to district and often times don't require the

employment of a licensed or Registered Dietitian (RD). Individuals who earn a RD degree have acquired the minimum standards in education and training regarding food and diet. Policy changes that require school districts to employ one if not several RDs may positively impact the development of school meals. Furthermore, updating cafeteria operations could make school food offerings more appealing and available to student athletes. For example, school breakfast and lunches are generally offered at two set times during the school day with most cafeterias closing after lunchtime operations. Student athletes who wish to manage energy levels in preparation for afternoon practice or evening games may have reduced access to foods due to limited time between end of school day and interscholastic participation. If athletes cannot afford to bring their own foods, these scheduling constraints may limit the ability of athletes to leave campus and get meals.

Finally, nutritional education should be implemented in schools, especially for student athletes who may be unaware of the energy requirements needed to meet outgoing energy demands. By understanding how nutritional intake can improve performance, athletes may be more willing to consume foods that are nutritious and that meet the energy demands of their active lifestyle.

Strengths and Limitations of the Study

There are several strengths of the current study. This study had a relatively large sample of participants (n=308), with a substantial number of ethnically diverse athletes and non-athletes. Thus, results from this study may have better generalizability to other areas in the U.S. Additionally, compared to other studies, the response rate for this sample was high. However, several limitations must be mentioned as well. All data was assessed via self-report

questionnaires, which can be subject to participant bias. Additionally, this was a cross-sectional study, and therefore, no causality can be inferred. Furthermore, due to avoidance of participant burden, there was limited objective information gathered on physical activity, and no measures were administered to examine daily nutritional intake. It is possible that student athletes are returning home and consuming nutritional foods to match their high energy demands, and therefore, future studies need to investigate daily intake in order to confirm or refute such postulations.

Recommendations for Future Research

Future research should reassess the PAL coefficients used for establishing the calorie zones of meals for the grade-specific age groups based on the data from Troiano et al. in 2003-2004. While the study was the first of its kind to gather nationally representative data on physical activity using accelerometers, it was the sole study used by the USDA to determine the PAL coefficients based on a sample of 1,181 adolescents between the ages of 12-19. Furthermore, this study's population was used to describe the physical activity habits of all American school children, and no follow up study was reported. Moreover, since the gold standard is yet to be determined when assessing physical activity, the development of new objective measures of physical activity would be of great value in any attempts by the USDA and the IOM to develop calorie zones based on energy expenditure (Kowalski, Crocker, and Donen, 2004, p. 2).

Also, future research utilizing dietary recall tools would serve several purposes. Food logs could help re-evaluate the appropriateness of current law established in 2007 which requires federal breakfasts to provide one-fourth of a student's RDA and lunches to provide one-third of a student's RDA (SNDA-III, 2007). Dietary recalls would also provide an opportunity to evaluate

effects of nutrient timing for student athletes in relation to consuming school meals, and whether there is compensation of nutrition at home to enhance nutritional intake to meet energy demands of the athlete. Further research to determine actual consumption of food would be critical as there is evidence suggesting that although some schools are providing nutrient-sufficient meals, there is a disconnect regarding the energy content of the meals versus the *actual* energy intake of the students. Evidence exists that nearly 30 – 40% of school meals may be wasted in the general student population, however, future research should focus on food waste among school athletes to better determine their actual nutritional intake. Finally, further investigation is warranted to better understand nutritional intake in athletes receiving free/reduced lunch to determine whether there is an additional need to promote greater nutritional consumption during school due to lack of food availability at home.

Lastly, future studies that apply more appropriate methods to describe the health of the national student population, such as body composition analyses, may present far more useful data in improving meals served in school cafeterias. A primary assessment used to describe the general health of students is Body Mass Index (BMI). It should be noted that a when the subjects' BMI from this study's population was calculated and compared to that of the national averages for overweight and obesity rates, athletes as a group had a lower average BMI than non-athletes. However, while athletes in this study have, on average, what is considered a better BMI than non-athletes, the measurement is not appropriate for use in athletic populations and not an accurate measurement of overall health. The BMI equation does not differentiate between the presence of lean muscle mass or fat mass. The ratio of these two tissue types are important markers of human health and potential performance and have different effects on the human metabolism. While we can state that student athletes in the sample population have lower

average BMIs, we are not able to quantify accurate body composition. Furthermore, while BMI is commonly used in epidemiological studies to describe the general health status of large populations, body composition assessments such as Dual-Energy X-ray Absorptiometry (DEXA), hydrostatic weighing, and air displacement plethysmography that differentiate between the presence of lean mass and fat mass, are considered far more appropriate assessments with athletic populations. Despite the nearly 8 million student athletes in American high schools, the USDA continues to use epidemiological research and BMI statistics to guide federal policy and guidelines regarding school meals. Future studies that apply more appropriate methods to determine the body composition of the national student population may present far more useful data in determining the overall health of school aged children and in improving meals served in school cafeterias.

Conclusion

The significance of a single nutritious, well balanced meal should not be minimized. The USDA first embodied this belief as exemplified by their actions in 1946 to implement the first national school lunch program in American schools, and even more so when the institution implemented a second national school meals program again in 1975. Currently, American schools are seeing large increases in high school adolescents participating in school sports which demonstrates a significant population of students who have energy intake needs that matches energy expenditure that occurs in training and competition. With the recent changes to school meals, it is important that these initial adjustments are the first of several imminent initiatives to make meals more appropriate for diverse adolescent populations, including student athletes. Future reform that addresses the energy intake needs of a diverse student population can provide

for the needs of physically active students and impact childhood obesity rates. Federal institutions cannot become stagnant in their quest to provide students, active or not, with the best meals possible if they truly wish to develop first-rate students, academically and athletically. Furthermore, if current research emphasizes nutritional individualization and differentiation for all persons with consideration towards energy consumption and energy expenditure, this must be the next evolution in school meals.

APPENDIX A:
IRB APPROVAL LETTER 1

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Alison Mary Redd** and Co-PI: **Mike J. Redd**

Date: **December 20, 2017**

Dear Researcher:

On 12/20/2017 the IRB approved the following human participant research until 12/19/2018 inclusive:

Type of Review:	UCF Initial Review Submission Form Expedited Review
Project Title:	Exploring the self-reported dietary habits and physical activity between athletes and non-athletes in four Central Florida public high schools
Investigator:	Alison Mary Redd
IRB Number:	SBE-17-13492
Funding Agency:	
Grant Title:	
Research ID:	NA

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 12/19/2018, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

This letter is signed by:

Signature applied by Gillian Morien on 12/20/2017 08:45:54 AM EST

Designated Reviewer

APPENDIX B:
IRB APPROVAL LETTER 2

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Alison Mary Redd** and Co-PI: **Mike J. Redd**

Date: **March 20, 2018**

Dear Researcher:

On 03/20/2018 the IRB approved the following modifications to human participant research until 12/19/2018 inclusive:

Type of Review:	IRB Addendum and Modification Request Form Expedited Review
Modification Type:	Updated study sample size
Project Title:	Exploring the self-reported dietary habits and physical activity between athletes and non-athletes in four Central Florida public high schools.
Investigator:	Alison Mary Redd
IRB Number:	SBE-17-13492
Funding Agency:	
Grant Title:	
Research ID:	NA

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 12/19/2018, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

This letter is signed by:

Signature applied by Gillian Morien on 03/20/2018 09:27:31 AM EDT

Designated Reviewer

APPENDIX C:
CENTRAL FLORIDA SCHOOL DISTRICT APPROVAL LETTER

[redacted] [redacted]

October 16, 2017

To: **Mrs. Alison Redd**
[redacted]

Dr. Anne Valdes
University of Central Florida
College of Education and Human Performance
12494 University Blvd.
Orlando, FL 32816-1250

From: [redacted]
Office of Accountability, Testing, and Evaluation

Project: **Energy Expenditure & Nutrition of Student Athletes**

Dear Mrs. Redd and Dr. Valdes,

Thank you for your application to conduct research in the [redacted]. This letter is official verification that your application has been accepted and PROVISIONALLY approved through the Office of Accountability, Testing, & Evaluation. **However, approval from this office does not obligate principals or teachers of the schools you have selected to participate in the proposed research.** The following guidelines must be followed:

- Individual school principals [redacted] must approve the scope of research before any research activity is conducted. chool. Principals are under no obligation to grant complete/partial permission to conduct research within their school.
- Survey participation of teachers and or students is voluntary and will not require written consent.
- Schools WILL NOT publicize any part of this research on school websites, or Facebook.
- Schools WILL NOT email students regarding this research.
- Schools MAY distribute **RESEARCHER PROVIDED** fliers and information to teachers that contains the appropriate web links to all needed documentation and surveys.
- Teachers May distribute **RESEARCHER PROVIDED** fliers to students.
- Teachers WILL NOT print or collect research information for the researcher. Researcher will collect all required data from all volunteers independently.

This document MUST be attached to ALL correspondence in its entirety AND presented during face-to-face meetings and reviewed prior to any research.

Continued on next page…

[redacted]

Provide the following stakeholders with an abstract of your findings to the following Athletic and Food Services Managers:

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted] District Physical Education resource teacher

Provide this office with a completed copy of your research to include all chapters.

[redacted] has the right to terminate research at any time.

Sincerely,

[redacted]

Office of Accountability, Testing, and Evaluation

[redacted]

APPENDIX D:
INFORMED CONSENT

Exploring the self-reported dietary habits and physical activity between athletes and non-athletes in four Central Florida public high schools

Informed Consent

Principal Investigator:	Alison M. Redd, Doctoral Candidate
Additional Investigator:	Michael J. Redd, Doctoral Candidate
Faculty Advisor:	Anna Valdes, Ed.D, Lecturer College of Education and Human Performance
Investigational Site(s):	[redacted] Public High Schools

How to Return this Consent Form: If you give consent for your child to participate in the research, please sign and have your student return to their instructor/coach.

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being asked to allow your child to take part in a research study which will include about 600 high school students from [redacted] Your child is being invited to take part in this research study because he or she is a high school student within [redacted]

The persons doing this research is Alison Redd, Ed.D doctoral candidate, and Michael J. Redd, doctoral candidate, with the College of Education and Human Performance at the University of Central Florida. Because these researchers are doctoral candidates, they are being guided by Dr. Anna Valdes, a UCF faculty advisor in the College of Education and Human Performance

What you should know about a research study:

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should allow your child to take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you or your child.
- Feel free to ask all the questions you want before you decide.

The purpose of this research study is to understand how much physical activity high school students obtain and as well as understand dietary habits.

What your child will be asked to do in the study: Your child will be asked to participate in an online confidential survey that is approximately 24 questions regarding dietary habits and physical activity amounts. Your child does not have to answer every question or complete every task. You or your child will not lose any benefits if your child skips questions or tasks. Your child will not lose any course credit or suffer negative impact on grades based on their participation.

Location: Students will be asked to take the online survey on a computer in the setting of their choosing.

Time required: We expect that your child will be in this research study for no longer than 10 minutes

Risks: There are no expected risks for taking part in this study.

Benefits: There are no anticipated benefits for taking part in this study

Confidentiality: We will limit your personal data collected in this study. Efforts will be made to limit your child's personal information to people who have a need to review this information. We cannot promise complete secrecy. Organizations that may inspect and copy your information include the IRB and other representatives of UCF.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt you talk to Alison Redd, Ed.D doctoral candidate (Email: [redacted]) or Dr. Anna Valdes, Lecturer, in the College of Education and Human Performance at UCF (Email: [redacted])

IRB contact about you and your child's rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Withdrawing from the study: You may decide not to continue in the research study at any time without it being held against you.

Your signature below indicates your permission for the child named below to take part in this research.

DO NOT SIGN THIS FORM AFTER THE IRB EXPIRATION DATE BELOW

Name of participant

Signature of parent or guardian

Date

- ❑ Parent
- ❑ Guardian (See note below)

Printed name of parent or guardian

Note on permission by guardians: An individual may provide permission for a child only if that individual can provide a written document indicating that he or she is legally authorized to consent to the child's general medical care. Attach the documentation to the signed document.

APPENDIX E:
PARTICIPANT SURVEY ACCESS

University of Central Florida

Participant Survey Access:

http://ucf.qualtrics.com/jfe/form/SV_e4JUro9ZRfAcezz

OR

Scan the QR Code:

Your Subject Number: _____

Thank you for agreeing to take the confidential online survey. You are granted access to this survey because you have returned a signed consent form to your high school teacher/coach. We expect you will be in this study for no longer than 10 minutes.

Directions:

- Access the survey
- Enter your subject number (**REQUIRED**)
- Answer all questions to the best of your ability

For assistance please contact Alison Redd, Doctoral Candidate, at [redacted] or by email at [redacted]

APPENDIX F:
SURVEY QUESTIONS

Dissertation Study

Q1 Please type the subject number provided to you by your teacher/coach: _____

Q53 Purpose of the Study: You are being asked to participate in a survey designed to explore the dietary habits and physical activity of high school adolescents. You have received this link because you submitted an informed consent signed by your parent or guardian. Time required: The survey is approximately 24 questions. We expect that this survey will last approximately 10 minutes. Answer all questions to the best of your ability. Risks: There are no reasonably foreseeable risks or benefits involved in taking part in this study. Confidentiality: We will limit your personal data collected in this study. Efforts will be made to limit your personal information to people who have a need to review this information. We cannot promise complete secrecy. Organizations that may inspect and copy your information include the IRB and other representatives of UCF. Questions about the Research: If you have any questions or concerns regarding this research, please contact Alison Redd, M.S. or Anna Valdes, Ed.D. or, College of Education and Human Performance at alisonmredd@knights.ucf.edu or anna.valdes@ucf.edu.

Please select one of the following choices:

O I agree and wish to continue participating in the survey (2)

O I disagree and wish to end my participation in this survey (3)

Skip To: End of Survey If Purpose of the Study: You are being asked to participate in a survey designed to explore the diet... = I disagree and wish to end my participation in this survey

Q2 What days of the week do you eat breakfast? Please select the days:

- ☐ Monday (1)
- ☐ Tuesday (2)
- ☐ Wednesday (3)
- ☐ Thursday (4)
- ☐ Friday (5)
- ☐ Saturday (6)
- ☐ Sunday (7)
- ☐ I do not eat breakfast (8)

Q3 Do you eat the school provided breakfast on school days?

- O Yes (1)
- O No (2)

Skip To: Q4 If Do you eat the school provided breakfast on school days? = Yes

---

Q5 Please explain your choice in not consuming school breakfast:

_____

Skip To: Q6 If Please explain your choice in not consuming school breakfast: Is Not Empty

---

Q4 How many days a week do you consume school breakfast?

- O 1 (1)
- O 2 (2)
- O 3 (3)
- O 4 (4)
- O 5 (5)

Q6 Of the following choices, which option would influence you the most to eat breakfast offered at school more often?

- O healthier options (1)
- O reduced price (2)
- O changing how the cafeteria prepares the food (cooking, baking from scratch, etc) (3)
- O additional times to purchase foods (in between classes, afternoons, after school hours, etc) (4)
- O Other: (5) _____

Q7 What days of the week do you eat lunch? Please select the days:

- ☐ Monday (1)
- ☐ Tuesday (2)
- ☐ Wednesday (3)
- ☐ Thursday (4)
- ☐ Friday (5)
- ☐ Saturday (6)
- ☐ Sunday (7)
- ☐ I do not eat lunch (8)

Q45 Do you participate in the free or reduced lunch program at your high school? (Select one)

- O Yes - free lunch program (1)
- O Yes - reduced lunch program (2)
- O No (3)

Q8 Do you eat the school provided lunch on school days?

- O Yes (1)
- O No (2)

Skip To: Q10 If Do you eat the school provided lunch on school days? = Yes

Q9 Please explain your choice in not consuming school lunches:

_____

Skip To: Q11 If Please explain your choice in not consuming school lunches: Is Not Empty

Q10 How many days a week do you consume the school-provided lunch?

O 0 (6)

O 1 (1)

O 2 (2)

O 3 (3)

O 4 (4)

O 5 (5)

Q11 Of the following choices, which option would influence you the most to eat lunch offered at school more often?

O healthier options (1)

O reduced price (2)

O changing how the cafeteria prepares food (cooking, baking from scratch, etc) (3)

O additional times to purchase foods (in between classes, afternoons, after school hours, etc) (4)

O other: (5) _____

Q13 How many times to you consume snacks in a normal school day?

- O 0 (7)
- O 1 (1)
- O 2 (2)
- O 3 (3)
- O 4 (4)
- O 5 (5)
- O More than 5 times in a day (6)

Q14 Please mark below all the times you eat during a normal school day:

- [ ] breakfast (1)
- [ ] mid morning snack (2)
- [ ] lunch (3)
- [ ] afternoon snack (4)
- [ ] snack before practice/exercise (5)
- [ ] snack after practice/exercise (6)
- [ ] dinner (7)
- [ ] late night snack (8)
- [ ] other: (9) _____

Q15 Select the meal that is your biggest meal during a normal school day:

O breakfast (1)

O mid morning snack (2)

O lunch (3)

O afternoon snack (4)

O snack before practice/exercise (5)

O snack before practice/ exercise (6)

O dinner (7)

O late night snack (8)

Q16 In your opinion, do you:

- O eat too little food (1)
- O eat just the right amount of food (2)
- O eat too much food (3)

Q17 Think about what you normally eat in one day. Which of the following foods do you consume on a normal daily basis? (select all that applies)

- ☐ fruits (1)
- ☐ vegetables (2)
- ☐ processed foods (frozen foods, microwaveable meals, tv dinners, etc) (3)
- ☐ protein (read meat, chicken, fish, eggs, etc) (4)
- ☐ fast food (drive thru items, restaraunts, take out, etc) (5)
- ☐ carbohydrates (potatoes, breads, pastas, etc) (6)
- ☐ dairy products (milk, cheese, yogurt, etc) (7)
- ☐ sweets (desserts, sugary items, candy, etc) (8)
- ☐ meals delivered to your door (online meal kits) (9)
- ☐ other: (10) _____

Q18 Think about what you normally drink in one school day. Which of the following drinks do you consume regularly? Please select the bubble to the right to indicate how many cups you consume in a normal school day.

	None (1)	1 cup (2)	2 cups (3)	3 cups (4)	4 cups (5)	5 cups (6)	+ 6 cups (7)
water (1)	O	O	O	O	O	O	O
gatorade/powerade (2)	O	O	O	O	O	O	O
energy drink (3)	O	O	O	O	O	O	O
coffee (4)	O	O	O	O	O	O	O
tea (5)	O	O	O	O	O	O	O
soda (6)	O	O	O	O	O	O	O
diet soda (7)	O	O	O	O	O	O	O
juice (8)	O	O	O	O	O	O	O
milk / chocolate milk (9)	O	O	O	O	O	O	O
protein shake (10)	O	O	O	O	O	O	O
other: (11)	O	O	O	O	O	O	O

Q20 Where do you get a majority of your information in regards to nutrition and healthy eating? Slide your choices up or down so that the list is in order of **most influential** to **least influential**:

_____ parent (1)
_____ friend (2)
_____ coach (3)
_____ teacher (4)
_____ significant other (5)
_____ sibling (6)
_____ tv/social media/magazines/internet (7)
_____ other (8)

Q22 Do you participate in high school athletics through your high school's athletic department where you are required to complete a physical in order to participate?

O Yes (1)

O No (2)

Skip To: Q48 If Do you participate in high school athletics through your high school's athletic department where... = No

---

Q26 What type of athletics/sports are you involved with through your high school athletics programs? Select all that apply:

- [ ] football (1)
- [ ] basketball (2)
- [ ] softball (3)
- [ ] soccer (4)
- [ ] baseball (5)
- [ ] golf (6)
- [ ] tennis (7)
- [ ] lacrosse (8)
- [ ] rowing or crew (9)
- [ ] swim/dive team (10)
- [ ] cross country/running (11)
- [ ] bowling (12)
- [ ] volleyball (13)
- [ ] track and field - distance events (14)
- [ ] track and field - sprint events (15)
- [ ] track and field - field events (16)
- [ ] weightlifting (17)

☐ cheer (19)

☐ dance team (20)

☐ other (21) _____

Q46 How many total practices do you participate in over the course of one week? Please provide a number IE: 1,2,3, etc.

_____

Q47 Approximately how long does a typical practice last?

O 30-45 minutes (1)

O 1 hour (2)

O 1 hour 30 minutes (3)

O 2 hours (4)

O 2 hours 30 minutes (5)

O 3 hours (6)

O 3 hours 30 minutes (7)

O 4 hours (8)

O 4 hours 30 minutes (9)

O 5 hours (10)

O + 5 hours (11)

Q34 Rate the intensity of your typical workouts based on the following scale:

O 1 - Light activity, easy to breathe and carry on a conversation (1)

O 2 - Moderate activity, breathing heavily, can hold short conversation, becoming noticeably more challenging (2)

O 3 - Vigorous activity, borderline uncomfortable, short of breath, can still speak a sentence (3)

O 4 - Very hard activity, very difficult to maintain exercise intensity, can barely breathe and speak a few words (4)

O 5 - Maximum effort activity, feels almost impossible to keep going, completely out of breath, unable to talk, cannot maintain for more than a short time (5)

Q48 Do you participate in organized team or individual sports outside of high school athletics? (For example: competitive or club sports such as travel softball, baseball, basketball, soccer, lacrosse, football, swim team, volleyball, etc)

O Yes (1)

O No (2)

Skip To: Q30 If Do you participate in organized team or individual sports outside of high school athletics? (For... = No

---

Q49 What type of organized team or individual sports do you participate in outside of high school athletics? Select all that apply:

- [ ] football (1)
- [ ] basketball (2)
- [ ] softball (3)
- [ ] soccer (4)
- [ ] baseball (5)
- [ ] golf (6)
- [ ] tennis (7)
- [ ] lacrosse (8)
- [ ] rowing / crew (9)
- [ ] swim/dive team (10)
- [ ] cross country/running (11)
- [ ] bowling (12)
- [ ] volleyball (13)
- [ ] track and field - distance events (14)
- [ ] track and field - sprint events (15)
- [ ] track and field - field events (16)
- [ ] weightlifting (17)

☐ cheer (18)

☐ dance team (19)

☐ Other: (20) _____

Q50 How many total practices do you participate in over the course of one week? Please provide a number IE: 1,2,3, etc.

_____

Q51 Approximately how long does a typical practice last?

O 30-45 minutes (1)

O 1 hour (2)

O 1 hour 30 minutes (3)

O 2 hours (4)

O 2 hours 30 minutes (5)

O 3 hours (6)

O 3 hours 30 minutes (7)

O 4 hours (8)

O 4 hours 30 minutes (9)

O 5 hours (10)

O + 5 hours (11)

Q52 Rate the intensity of your typical workouts based on the following scale:

O 1 - Light activity, easy to breathe and carry on a conversation (1)

O 2 - Moderate activity, breathing heavily, can hold short conversation, becoming noticeably more challenging (2)

O 3 - Vigorous activity, borderline uncomfortable, short of breath, can still speak a sentence (3)

O 4 - Very hard activity, very difficult to maintain exercise intensity, can barely breathe and speak a few words (4)

O 5 - Maximum effort activity, feels almost impossible to keep going, completely out of breath, unable to talk, cannot maintain for more than a short time (5)

Q30 What type of physical activities are you involved in during your free time? Select all that apply:

☐ I don't participate in physical activity or exercise in my free time (6)

☐ Recreational sports participation - local sports leagues, casual pick up games, etc (2)

☐ Classes or lessons in activities like karate, ballet, tennis, boxing, yoga, aerobics, Tai Chi, Zumba, etc. (3)

☐ I work out on my own (go for a run, ride my bike, go to the skate park, do Crossfit, go to a gym, etc) (5)

☐ Other: (4) _____

Skip To: Q40 If What type of physical activities are you involved in during your free time? Select all that apply: = I don't participate in physical activity or exercise in my free time

---

Q55 About how many hours a week do you spend doing physical activity in your free time?

- O Less than 1 hour (12)
- O 1 hour (1)
- O 2 hours (2)
- O 3 hours (3)
- O 4 hours (4)
- O 5 hours (5)
- O 6 hours (6)
- O 7 hours (7)
- O 8 hours (8)
- O 9 hours (9)
- O 10 hours (10)
- O +10 hours (11)

Q40 Are you currently enrolled in physical education (PE) or HOPE class at your high school?

- O Yes (1)
- O No (2)

Skip To: Q46 If Are you currently enrolled in physical education (PE) or HOPE class at your high school? = No

Q42 In the last 7 days during your **physical education (PE) / HOPE class**, how often were you very active (playing hard, running, jumping, throwing) ? (Check one only)

O Hardly ever (1)

O Sometimes (2)

O Quite often (3)

O Always (4)

Q46 Were you sick, or did anything prevent you from doing your normal physical activities in the last 7 days? (check one)

O Yes (1)

O No (2)

Skip To: Q50 If Were you sick, or did anything prevent you from doing your normal physical activities in the last... = No

---

Q48 What prevented you from doing your normal physical activities?
Please type your answer in the box provided.

_____

Q50 Thank you for your time in answering questions related to your dietary habits and physical activity amounts.

Please take a moment to answer the following questions about yourself.

What zip code do you primarily reside in?

_____

Q44 What is your age?

_____

Q52 What is your height? Please answer in feet and inches.
(For example: 5 ft 7 inches, or 5'7", etc.)
If you aren't sure please make your best guess:

_____

Q54 How much do you weigh in pounds (lbs)? Please round to the nearest whole number.
If you aren't sure please make your best guess:

_____

Q56 Select the ethnicity that most defines you:

O Asian (1)

O African American / Black (2)

O Caucasian / White (3)

O Hispanic (4)

O Latino (5)

O Pacific islander (6)

O Alaskan native (7)

O Other (8) _____

Q58 Please select your gender:

- O Male (1)
- O Female (2)
- O Other (3)

End of Block: Default Question Block

REFERENCES

American Academy of Pediatrics. (2014). *Energy out: Daily physical activity recommendations.* Retrieved from https://www.healthychildren.org/English/healthy-living/fitness/Pages/Energy-Out-Daily-Physical-Activity-Recommendations.aspx

American College of Sports Medicine. (2013). Select issues for nutrition and the athlete: Team physician consensus statement. *Medicine & Science in Sports & Exercise, 45*(12), 2378-2386. doi:10.1249/MSS.0000000000000174

American College of Sports Medicine. (2015). *Physical activity in children and adolescents* [PDF file]. Retrieved from https://www.acsm.org/docs/default-source/brochures/physical-activity-in-children-and-adolescents.pdf

American Heart Association. (2016). *Recommendations for physical activity in children.* Retrieved from http://www.heart.org/HEARTORG/HealthyLiving/HealthyKids/ActivitiesforKids/The-AHAs-Recommendations-for-Physical-Activity-in-Children_UCM_304053_Article.jsp#.WtT73YjwaUk

Bayli, I., Way, R., & Higgs, C. (2013). *Long-term athlete development*. Champaign, IL: Human Kinetics.

Bhattacharya, J., & Currie, J. (2001). Youths at nutritional risk: Malnourished or misnourished? In J. Gruber (Ed.), *Risky behavior among youths* (pp. 483-522). Chicago, IL: University of Chicago Press.

Burghardt, J., Devaney, B., & Gordon, A. R. (1995). School nutrition dietary assessment study. *American Journal of Clinical Nutrition, 61*(Suppl. 1), 252S-257S. doi:10.1093/ajcn/61.1.252S

Center for Disease Control and Prevention. (2008). *Youth physical activity guidelines*. Retrieved from https://www.cdc.gov/healthyschools/physicalactivity/guidelines.htm

Center for Disease Control and Prevention. (2011). Physical activity levels of high school students – United States, 2010. *Morbidity and Mortality Weekly Report, 60*(23), 773-774.

Center for Disease Control and Prevention. (2015). *National health and nutrition examination survey 2005-2010.* Retrieved from https://wwwn.cdc.gov/nchs/nhanes/Default.aspx

Center for Disease Control and Prevention. (2017). *Childhood obesity facts*. Retrieved from https://www.cdc.gov/healthyschools/obesity/facts.htm

Croll, J. K., Neumark-Sztainer, D., Story, M., Wall, M., Perry, C., & Harnack, L. (2006). Adolescents involved in weight-related and power team sports have better eating patterns and nutrient intakes than non-sport-involved adolescents. *Journal of the American Dietetic Association, 106*(5), 709-717. doi: 10.1016/j.jada.2006.02.010

Cupisti, A., D'Alessandro, C., Castrogiovanni, S., Barale, A., & Morelli, E. (2002). Nutrition knowledge and dietary composition in Italian adolescent female athletes and non-athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 12*(2), 207-219.

Desbrow, B., McCormack, J., Burke, L., Cox, G., Fallon, K., Hislop, M., …Leveritt, M. (2014). Sports Dieticians Australia position statement: Sport nutrition for the adolescent athlete. *International Journal of Sport Nutrition and Exercise Metabolism, 24*, 570-584.

Florida Department of Education. (2017). *Florida Educational Equity Act* [PDF file]. Retrieved from http://eagendatoc.brevardschools.org/06-13-

2017%20School%20Board%20Meeting%20on%20Tuesday,%20June%2013,%202017/ADBB2032-5113-443F-9B41-0156FCA4440C.pdf

Fryar, C. D., Carroll, M. D., & Ogden, C. L. (2014). *Prevalence of overweight and obesity among children and adolescents: United States, 1963-1965 through 2011-2012*. Atlanta, GA: National Center for Health Statistics.

Fukuda, D. H., Kendall, K. L., & Hetrick, R. P., & Stout, J. R. (2013). Nutritional strategies to optimize youth development. In R.S. Lloyd & J. L. Oliver (Eds.), *Strength and conditioning for young athletes: Science and application* (pp. 185-199). Philadelphia, PA: Routledge.

Gidding, S. S., Dennison, B. A., Birch, L. L., Daniels, S. R., Gilman, M. W., Lichtenstein, A. H., … Van Horn, L. (2005). Dietary recommendations for children and adolescents: A guide for practitioners. *Pediatrics, 117*(2), 544-559. doi: 10.1542/peds.2005-2374

Gleason, P. M., & Suitor, C. W. (2003). Eating at school: How the national school lunch program affects children's diets. *American Journal of Agricultural Economics, 85*(4), 1047-1061. https://doi.org/10.1111/1467-8276.00507

Hoch, A. Z., Goossen, K., & Kretschmer, T. (2008). Nutritional requirements of the child and teenage athlete. *Physical Medicine and Rehabilitation Clinics, 19*(2), 373-398. doi: 10.1016/j.pmr.2007.12.001

Institute of Medicine. (2005). *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids*. Washington, DC: National Academies Press.

Institute of Medicine. (2008). *School meals: Building blocks for health children*. Washington, DC: National Academies Press.

Jayanthi, N. A., LaBella, C. R., Fischer, D., Pasulka, J., & Dugas, L. R. (2015). Sports-specialized intensive training and the risk of injury in young athletes: A clinical case-control study. *The American Journal of Sports Medicine, 43*(4), 794-801. doi: 10.1177/0363546514567298

Johnston, L. D., Delva, J., & O'Malley, P. M. (2007). Sports participation and physical education in American secondary schools: Current levels and racial/ethnic and socioeconomic disparities. *American Journal of Preventative Medicine, 33*(Suppl. 4), S195-S208. doi: 10.1016/j.amepre.2007.07.015

Juzwiak, C., Paschoal, V., & Lopez, F. (2000). Nutrition and physical activity. *Journal de Pediatria, 76*(Suppl. 3), S349-S358. Retrieved from http://www.jped.com.br/conteudo/00-76-S349/ing.pdf

Kann, L., McManus, T., Harris, W. A., Shanklin, S. L., Flint, K. H., Hawkins, J., … Zaza, S. (2016, June 10). Youth risk behavior surveillance – United States, 2015. *Morbidity and Mortality Weekly Report (MMWR) Surveillance Summaries, 65*(6), 1-174. doi: http://dx.doi.org/10.15585/mmwr.ss6506a1

Kowalski, K., Crocker, P., & Donen, R. (2004). *The physical activity questionnaire for older children (PAQ-C) and adolescents (PAQ-A) manual*. Saskatoon, Canada: University of Saskatchewan.

Macedonia, M., & Dunford, M. (2009). *The athlete's guide to making weight.* Champaign, IL: Human Kinetics.

Manore, M. M., Patton-Lopez, M. M., Meng, Y., & Wong, S. S. (2017). Sport nutrition knowledge, behaviors and beliefs of high school soccer players. *Nutrients, 9*(4), 350. doi: 10.3390/nu9040350

Meyer, F., O'Connor, H., & Shirreffs, S. M. (2007). Nutrition for the young athlete. *Journal of Sports Sciences, 25*(Suppl. 1), S73-S82. doi: 10.1080/02640410701607338

Meyers, A. F., Sampson, A. E., Weitzman, M., Rogers, B. L., & Kayne, H. (1989). School breakfast program and school performance. *American Journal of Diseases of Children, 143*(10), 1234-1239.

National Center for Education Statistics. (2018). *Back to school statistics*. Retrieved from https://nces.ed.gov/fastfacts/display.asp?id=372

National Collegiate Athletic Association. (2013). *Eating frequency for the student-athlete* [PDF file]. Retrieved from http://www.mdunitedfc.org/_files/Eating%20Frequency%20Fact%20Sheet_0.pdf

National Collegiate Athletic Association. (2014). *Energy availability* [PDF file]. Retrieved from https://www.ncaa.org/sites/default/files/Energy%20Availability%20Fact%20Sheet%20WEB.pdf

National Federation of State High School Associations. (2018a). *Mission statement.* Retrieved from https://www.nfhs.org/who-we-are/missionstatement

National Federation of State High School Associations. (2018b). *2016-2017 athletics participation summary* [PDF file]. Retrieved from http://www.nfhs.org/ParticipationStatistics/PDF/2016-17_Participation_Survey_Results.pdf

Ogden, C. L., Carroll, M. D., Fryar, C. D., & Flegal, K. M. (2015). *Prevalence of obesity among adults and youth: United States, 2011–2014*. NCHS data brief, no 219. Hyattsville, MD: National Center for Health Statistics.

Rogol, A. D., Clark, P. A., & Roemmich, J. N. (2000). Growth and pubertal development in children and adolescents: Effects of diet and physical activity. *The American Journal of Clinical Nutrition, 72*(Suppl. 2), 521S-528S. doi: 10.1093/ajcn/72.2.521S

Rogol, A. D., Roemmich, J. N., & Clark, P.A. (2002). Growth at puberty. *Journal of Adolescent Health, 31*(6), 192-200. https://doi.org/10.1016/S1054-139X(02)00485-8

Petrie, H., Stover, E. A., & Horswill, C. A. (2004). Concerns for the child and adolescent competitor. *Nutrition*, *20*(7/8), 620-631. doi: 10.1016/j.nut.2004.04.002

Savoca, M. R., Marine, T. L., Morton, T. B., Johnson, L. T., Bell, N. M., Aronson, R. E., & Wallace, D. C. (2011). Meal patterns and food choices of young African-American men: Understanding eating within the context of daily life. *Journal of the American Dietetic Association, 111*(9), 1335-1342. doi: 10.1016/j.jada.2011.06.006

Shomaker, L. B., Tanofsky-Kraff, M., Savastano, D. M., Kolinsky, M., Colombo, K. M., Wolkoff, L. E., … Yanovski, J. A. (2010). Puberty and observed energy intake: Boy, can they eat! *American Journal of Clinical Nutrition*, *92*(1), 123-129. doi: 10.3945/ajcn.2010.29383

Thomas, D. T., Erdman, K. A., & Burke, L. M. (2016). Academy of Nutrition and Dietetics, Dieticians of Canada, and American College of Sports Medicine joint position statement: Nutrition and athletic performance. *Medicine & Science in Sports & Exercise*, *48*(3), 543-568. doi:10.1249/MSS.0000000000000852

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the Unites States measured by accelerometer. *Medicine & Science in Sports and Exercise*, *40*(1), 181-188. doi: 10.1249/mss.0b013e31815a51b3

U. S. Department of Agriculture Food Nutrition Services. (2007). *School nutrition dietary assessment study III* [PDF file]. Retrieved from https://fns-prod.azureedge.net/sites/default/files/SNDAIII-Vol1.pdf

U. S. Department of Agriculture Food and Nutrition Services. (2012). *School nutrition dietary assessment study IV 2012* [PDF file]. Retrieved from https://fns-prod.azureedge.net/sites/default/files/SNDA-IV_Vol1Pt1_0.pdf

U. S. Department of Agriculture, & U.S. Department of Health and Human Services. (2010). *Dietary guidelines for Americans 2010* [PDF file]. Retrieved from https://health.gov/dietaryguidelines/dga2010/dietaryguidelines2010.pdf

U.S. Department of Agriculture. (2016a). *National school lunch program*. Retrieved from https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program.aspx

U.S. Department of Agriculture. (2016b). Nutrition standards in the national school lunch and school breakfast program. *Federal Register, 77*(17), 4088-4167. Retrieved from https://www.gpo.gov/fdsys/pkg/FR-2012-01-26/pdf/2012-1010.pdf

U.S. Department of Health and Human Services. (2008). *Physical activity guidelines advisory committee report*. Washington, DC: U.S. Department of Health and Human Services.

Vermeersch, J., Hanes, S., & Gale, S. (1984). The national evaluation of school nutrition programs: Programs impact on anthropometric measures. *American Journal of Clinical Nutrition 40*(Suppl. 2), 414-424. doi: 10.1093/ajcn/40.2.414

Whitney, E., & Rolfes, S. R. (2013). *Understanding nutrition* (14th ed.). Stamford, CT: Cengage Learning.

World Health Organization. (2018). *Global strategy on diet, physical activity and health*. Retrieved from http://www.who.int/dietphysicalactivity/factsheet_young_people/en/