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OVERALL DIET QUALITY OF COLLEGIATE ATHLETES

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OVERALL DIET QUALITY OF COLLEGIATE ATHLETES

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
College of Agriculture
at the University of Kentucky

By

Amanda Nicole Ireland

Lexington, Kentucky

Director: Kelly Webber, PhD, MPH, RD, LD, Assistant Professor of Dietetics and
Human Nutrition

Lexington, Kentucky

2013

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ABSTRACT OF THESIS

OVERALL DIET QUALITY OF COLLEGIATE ATHLETES

Athletes appear healthy according to weight for height and body fat standards. Though athletes appear to be healthy, little is known about their diets. Research states there is a connection between athletic performance and nutrition. The objective of this study was to determine the diet quality of 138 collegiate athletes. Data were collected in a laboratory. Demographics were collected via survey. Anthropometrics were assessed using a free standing stadiometer and the BodPod® for body fat assessment. Block 2005 Food Frequency Questionnaire© was used to assess diets. The Healthy Eating Index (HEI) 2005 was used to calculate diet quality scores. The average BMI was 23.2 (2.3) kg/m² and the average body fat was 17.8 % (6.5). The average HEI score was 51.2 (8.8). Higher HEI scores were correlated with higher body fat percentage in this sample. Diets were adequate in: calcium, iron, and vitamin C. Diets were inadequate in: fiber, fruits and vegetables intakes. The athletes had excessive intakes of sodium and total percent fats. These findings demonstrate the need for nutrition education for collegiate athletes.

KEYWORDS: Diet quality, collegiate athletes, Healthy Eating Index 2005, Block 2005 Food Frequency Questionnaire, Nutrition knowledge

Amanda Nicole Ireland

July 5, 2013

OVERALL DIET QUALITY OF COLLEGIATE ATHLETES

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CHAPTER ONE

Collegiate athletes are an inspiration for many younger athletes and should be an influence on how to perform efficiently at the position that is being played. Today, collegiate athletes are considered to be some of the healthiest people based on their body weight composition and should have an ideal body appearance. Collegiate athletes are required to fit a specific body appearance for their position and the sport in which they participate. Collegiate athletes may be pressured by their coaches and strength staff to fit a specific body size because of performance expectations and the comparison with other competitors. Despite appearances, collegiate athletes' overall performances may be hindered by nutritional deficiencies.

Problem Statement

Poor dietary habits can lead an athlete to be underweight during his/her athletic career and lead to being obese post-athletic career. Other post-athletic health problems that may be of concern include type 2 diabetes mellitus, coronary heart disease, increased risk of certain cancers, and osteoporosis. Most athletes do not worry about the potential future of diseases during their collegiate years. Instead, they are focused on their athletic performance and what the coaches expect from them.

It is known that the diet of an athlete can have an effect on his/her overall performance (Bronci, 2011). Athletes, who have healthy and balanced diets, can perform better due to having adequate nutrient stores built up in their body. When those stores are maximized in the body, the body will utilize them as needed during physical activity. In poor quality diets, these nutrient stores will not be replenished to their maximized state. With these minimal stores, the body cannot perform to its full potential.

Athletes receive most of their nutrition knowledge from the coaching staff, strength and conditioning staff, and athletic training staff; however, it is questionable how accurate the information is (Torres-McGehee, Pritchett, Zippel, Minton, Cellamare, Sibiliala, 2012). These athletic professionals may have some general knowledge of nutrition; however, these are not nutrition professionals. The staff of the institution who may offer nutrition information to athletes may or may not have a strong understanding about nutrition. A registered dietitian can give the athlete the most accurate information on which food options are best to reach his/her goal. Registered dietitians can offer nutrition counseling and presentations, develop meal plans for the athlete, and work closely with the food service program at the college to check the nutritional status of the meals that are offered.

Purpose

The purpose of this study is to assess the diet and body composition of collegiate athletes. This study will compare and contrast the diets of collegiate athletes by sport, and gender. The objective of this study is to determine the nutritional quality of the diet of 138 collegiate athletes.

Research Questions:

1. What are the dietary excesses and deficiencies found among the athletes?
2. Is there a relationship between body fat percentage and diet quality in the collegiate athletes in this study?
3. Is there a difference between the diet quality of male and female athletes in this study?

Hypotheses

1. Athletes will have excesses and deficiencies in their diet similar to those found in the general population.
2. There is a negative correlation between body fat and diet quality in athletes.
3. Females will report higher diet quality than males.

Justification

According to a joint position paper written by the American Dietetic Association, Dietitians of Canada, and American College of Sports Medicine, it was reported that for someone who is physically active, cares about athletic performance, and strives for good recovery from these physical performances, proper nutrition is crucial (JCSM, 2009). An athlete's overall performance could improve if the athlete receives proper nutrition education. This research study will evaluate the current dietary intake of collegiate athletes.

Assumptions

The participants in this study are a small representation of collegiate athletes. It is assumed that athletes care about their overall performance and have the desire to perform to their fullest potential. It is believed that the results from a food frequency questionnaire are an accurate representation of the diet of the athletes that participated in the study. It is believed they answered accurately to the best of their ability.

CHAPTER TWO: Literature Review

The overall diet for athletes could significantly affect their performance. Many people offer nutrition advice to collegiate athletes. However, it is unclear if the information that is being received is completely accurate. Although these athletes receive nutrition education, some athletes ignore what is being taught or do not know how to effectively apply the diet to their everyday life. There are certain macronutrient and micronutrient requirements that can play a significant role in athletic performance.

Diet Quality

Diet quality is determined by the food choices that are made. A diet high in quality consists of but not limited to whole grains, lean meats, fresh fruits and vegetables and low-fat milk consumption. Diet quality is also based on frequency of these food items. Those who are more conscious of their food choice are more aware of what types of foods offer more nutrients and may be fewer calories. Some components that can affect the diet quality are: vitamins, minerals, fiber, whole grains, healthy fats, and fruits and vegetables (“Diet quality and nutrition”, 2013). Those who are less concerned about the foods they are consuming, generally choose foods that are high in fat, sugar, and sodium. These diets are low in nutrient density. When a diet has poor quality, the concern for chronic health conditions rises. Some of these conditions are obesity, type 2 diabetes mellitus, and cardiovascular disease.

The Healthy Eating Index of 2005 (HEI-2005), created by the USDA, is a measure of diet quality in conformance to Federal dietary guidance (Guenther, Reedy, & Krebs-Smith, 2008). It is a standardized tool that can be used in nutrition monitoring, interventions, and research. The standards for this measurement were created using a

density approach (expressed as amount per 1,000 calories). The components of the HEI-2005 are: total fruit (including 100% juice), whole fruit (not juice), total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, meat and beans, oils, saturated fats, sodium, and calories from solid fats, alcoholic beverages, and added sugars. To determine the standards for scoring, intervals must be determined that will move through the number of points allotted for that component. The scores for each component, are then added together to determine the overall score. This determines the overall diet quality score. One of the strengths of the HEI-2005 are assessing diets on a 1,000 calorie basis to be able to evaluate diet quality per a standard diet quantity. Other strengths are evaluating energy-dense, nutrient-poor food consumption, as well as evaluating American diets that are furthest from the recommendations (Guenther et al., 2008). Some limitations of the HEI-2005 are that it does not assess the diet of those who are younger than 2 years of age, it does not assess the diet of those whose dietary patterns are different from the American typical diet, and it does not delineate specific fats: oils, total fats, cholesterol, and *trans* fats. When evaluating participants about their average diet, a questionnaire is one method of gathering the appropriate data. Participants can be honest about their food choices, especially when the questionnaire covers many different food options that are not generally mentioned when discussing food patterns with a participant.

The Block 2005 Food Frequency Questionnaire was developed using large surveys, such as the National Health and Nutrition Examination Survey (NHANES) to examine food groups and physical activities. This questionnaire was designed to estimate usual intake of a wide variety food groups (“Assessment and analysis,” 2013).

This self-administered diet history food frequency questionnaire was tested and found to be valid and reliable by a study that contained 11,658 adult participants in the Second National Health and Nutrition Examination Survey (NHANES II) for a self-administered diet history questionnaire (Block, Hartman, Dresser, Carroll, Gannon, & Gardener, 1986). This study evaluated the total caloric intake of the participants and seventeen nutrients. Based on this questionnaire, composition values were determined by how frequent these foods were consumed. When nutrient information was collected on the survey, this food list combined with appropriate portion sizes was used to determine amount of nutrients. This study showed correlations of $r > 0.70$. These results are those found nationally.

Nutrition Knowledge of an Athlete

Athletes receive their nutrition knowledge from many different sources. Some of these sources are the athletes themselves, coaches, strength and conditioning specialists and athletic trainers (Torres-McGehee et al., 2012). In a study by Torres-McGehee et al., 2012, each of these groups was evaluated on basic nutrition knowledge. Individuals were examined on how much nutrition knowledge they had to determine their confidence levels with nutrition. There were 579 participants that consisted of 185 athletes, 131 coaches, 192 athletic trainers, and 71 strength and conditioning coaches in the study. The participants were asked to answer questions on basic nutrition knowledge, supplements and their relationship to performance, weight management, and hydration. To have adequate nutrition knowledge, the participants needed to score at least a 75% in all domains (with the highest possible score being 100%). This study found that the participants had an average score of 68.5% in all domains. Strength and conditioning

specialists had the highest nutrition knowledge with 83.1%, athletic trainers with 71.4%, coaches had 35.9%, and athletes having only a 9%. Registered dietitians were the main resources reportedly used by the coaches', strength and conditioning coaches', athletic trainers' nutrition knowledge. It was concluded that athletic trainers and strength and conditioning specialists offer the most adequate nutrition knowledge of all the surveyed personnel for an athlete. The study suggested that the coaches and support staff receive the most nutritional education and as they are around the athletes often, they may set a good example. In addition, they may develop nutrition programs for these athletes. There is little research available because this is a relatively new and growing area. The small amount of research that has been done in this field has had very small participant numbers.

If an athlete receives nutrition education, it depends on the athlete to apply the knowledge to his/her actual diet. In a study that consisted of collegiate, female swimmers, it was concluded that although the athletes have the nutrition knowledge for an adequate diet, the recommended dietary allowance (RDA) for all three macronutrients (fat, carbohydrates, protein) was not met (Hoogenboom, Morris, Morris, & Schaefer, 2009). This study consisted of eighty-five female collegiate swimmers from six Michigan Universities that were asked to complete a nutrition knowledge questionnaire and a 24-hour recall survey. The purpose of this study was to determine the nutrition knowledge of these swimmers and to assess if they effectively apply this knowledge to their everyday diet. A limitation of this study was that the participants had difficulty remembering their intake for the 24-hour recall and a rough estimate of the portion sizes. Although 71.75% of the participants chose the correct answers on the nutritional knowledge questionnaire,

from the 24-hour recall, 95.9% of the participants did not meet the recommended dietary allowance (RDA) for all three macronutrients. This study confirms that though some athletes receive some nutrition education, their diet does not represent such knowledge.

Some athletes do not believe that nutrition can play a role in performance. These athletes believe that training and practice are all that is needed for optimal performance. A group of Division I NCAA athletes (328), were asked to complete a nutrition knowledge questionnaire during their yearly physicals. This questionnaire was used to determine if the nutrition knowledge from a registered dietitian is beneficial to the athletes and if the athletes were actually applying the education to their lifestyles. This questionnaire was used to evaluate their knowledge of specific nutrients and their roles on the body and performance effects (Rosenbloom, Jonnalagadda, & Skinner, 2002). Results from this study showed that 63% of men and 54% of women knew that carbohydrates and fat were the main energy sources for activity. Out of all the participants, 74% of men and 75% of women knew that consuming excess carbohydrates will make them gain weight. About half of these athletes were aware that high-fat meals should not be consumed between 2-3 hours before an event. The majority of the participants of this study believe that consuming sugary foods and drinks prior to an event will adversely affect performance. A little less than half of the athletes that participated in the study believe that protein is the main energy source for the muscle. Approximately 34% of the women and 35% of the men believe that protein supplements are necessary. It was concluded from these results that athletes could benefit from more information about the role of protein as an energy source as well as for improving muscle mass. Most of these participants knew that dehydration has an effect on performance.

Limitations are that this sample represents a small sample of the Division I NCAA and cannot be generalized for all collegiate athletes. Despite this limitation, this study adequately demonstrates that athletes would benefit from in depth education on how foods affect the body.

Male versus Female Athletes

Most male and female athletes are aware that they must consume adequate calories to meet the needs required for the body to produce enough energy to avoid altering performance. A study that evaluated “Personal Food Systems of Male Collegiate Football Players: A grounded Theory Investigation” proposed a theoretical model explaining the personal food choice processes of collegiate football players (Long, Perry, Unruh, Lewis, & Stanek-Krogstrand, 2011). This study had fifteen football players that were purposefully sampled. This group represented the different positions, years of athletic eligibility, and ethnic backgrounds. These athletes were asked predetermined, open-ended questions. They were asked about their process on making food choices. The findings were verified by research members, an external audit, and a nutrition specialist. The results from this study indicated that time and peer-influences were important factors for the athletes. With the stresses from both academics and athletics, these athletes were limited on time which influenced their food choices. An important priority for these athletes was hydration. The athletes first choice of food were foods high in protein because they thought their bodies needed protein to remain healthy. A limitation in this study would be the focus group style of face-to-face interview. There is a possibility that the athletes provided the interviewer what they thought the interviewer wanted to hear. In addition responses may be been influenced by other participants’ responses.

The female athlete's diet is a concern to many health professionals because there are so many health risks that can be issues for women after their athletic career. Some of the concerns that female athletes should be aware of are higher risks of arthritis, problems with child-bearing, and obesity after their athletic career. A study of fifty-two NCAA Division I female collegiate athletes compared the dietary intake and eating habits to the current guidelines for sports nutrition of female athletes (Shriver, Betts, & Wollenberg, 2012). The study lasted from January 2009 to May 2010. Dietary intake was collected for a total of three days. This may not be long enough duration to receive the most adequate results depending on how much physical activity was performed for these days, if it was a day the athlete had a competition, and variations of intake due to seasonal availability of foods. The athletes completed anthropometric measurements and dietary assessment using a 3-day food record, a 24-hour recall and the Nutrition Questionnaire that was previously used for the Combined Events Athlete Department (CEAD) project for the USA athletes for Track and Field. Results from this study were that these female athletes were not meeting their recommendations on calories and carbohydrates. For athletes, the recommended amount of carbohydrates are 6 to 10g/kg body weight per day (Rodriguez, DiMarco, & Langley, 2009). Carbohydrates are needed to aid in training performance, however, 75% of the participants failed to meet these requirements. Most of the participants were not consuming a regular breakfast. Many of these female athletes did not monitor or meet their hydration needs. This study concluded that nutrition interventions are needed to improve the overall diet in female collegiate athletes. Limitations of this study were a small sample size, time and commitment, and knowledge

of nutrition. These results cannot be generalized to all female collegiate athletes. A larger sample size and a random selection of athlete participants should be studied.

Macronutrient Recommendation

Macronutrients are important when considering athletic performance and the health of the athlete after his/her career. Athletes consume macronutrients (proteins, carbohydrates, and fat) throughout their day, however, it is important to determine if these athletes are consuming adequate amount of these nutrients to meet the demand of the body.

According to the position paper developed by American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance, the overall physical activity and athleticism of an athlete can be amplified by nutrition (Rodriguez et al., 2009). Consuming adequate energy intake is important for an athlete whether his/her sport is high-intensity and/or long in duration. Caloric intakes are based on individual basis using an individual's height, weight, and physical activity demands for the athlete. When an athlete consumes adequate caloric intakes, this will help maintain body weight and distinguish training effects. If proper caloric intake is not met, athletes may see a decreased amount of lean muscle mass and bone density. Female athletes may suffer from the Female Athlete Triad, which is when there is an energy deficit, osteoporosis, and cessation of menstrual cycles.

From the position statement, carbohydrate recommendations for an athlete range from 6-10g/kg body weight per day (Rodriguez et al., 2009). An athlete requires carbohydrates in the body because carbohydrates help maintain blood sugar levels and help replace glycogen stores. The amount that is needed is calculated on an individual

basis. Some of the criteria that contribute to the determination of the needed amount are total energy expenditure, sport, gender, and environment (Rodriguez et al., 2009). With these recommendations, many athletes do not meet their recommended amount of carbohydrates in their diet.

Protein needs are easily met through the diet. Most athletes do not require supplementation for protein or amino acids. Protein recommendations for endurance and strength-training athletes range from 1.2-1.7 g/kg, which is greater than the average adult needs of 0.8g/kg daily (Rodriguez et al., 2009). It has been determined that protein and amino acids are needed to produce and maintain muscle mass in the body (Phillips, 2012). With the knowledge of benefits of protein and muscle health, athletes try to consume enough protein to ensure adequate muscle health, however, most athletes consume more than the recommended intake of protein on a regular basis without trying.

Athletes should consume a diet with adequate amount of fat on a regular basis. If the amount of fat is too high or too low in the diet, it can hinder athletic performance. Fat intake should be 20%-35% of total calories. Fat is important in the diet because it provides a source of fat-soluble vitamins, essential fatty acids, and is a good source of energy (Rodriguez et al., 2009). Foods that contain fat should be chosen in moderation with more healthy fats rather than the unhealthy fats. Healthier fats contain monounsaturated fatty acids and polyunsaturated fatty acids.

Micronutrients and Athletic Performance

Calcium.

Calcium is an important mineral for athletes to have in their diet. Calcium helps promote bone health, maintenance of calcium blood levels, regulate muscle contraction,

nerve conduction, and normal blood clotting (Rodriguez et al., 2009). If an athlete is deficient in calcium, they are at a higher risk of suffering from bone fractures and/or low bone-mineral density. If an athlete's diet does not show sources of calcium, supplementation of 1500 mg daily may be recommended. Because of major health concerns for calcium supplements, it is encouraged that dietary sources of calcium are consumed (Maughan, 1999). Adequate amount of calcium in the diet is important when discussing diet quality as calcium ensures bone health.

Iron.

Iron is used to aid in blood cell formation and enzymes involved in energy production. Red blood cells (which carry oxygen around the body) are particularly essential for endurance athletes (Rodriguez et al., 2009). This helps promote oxygen flow through the body, nervous system function, behavioral system, and immune system. Iron requirements for endurance athletes (distance runners) are increased by approximately 70%. The Recommended Dietary Allowances for all other athletes are: women 18mg and men 8mg. Adequate amount of iron can be used to enhance athletic performance by lengthen the duration of physical activity by providing more oxygen through the body. With low iron levels, red blood cells are not capable of carrying the amount of oxygen throughout the body that is demanded during physical activity.

Vitamin C.

The recommendation for vitamin C intake for males is 90mg per day and 75mg per day for females. If the diet is adequate in vitamin C containing food, then supplementation is not necessary. There has not been a proven effect of vitamin C as an ergogenic aid for athletes (Rodriguez et al., 2009). For an athlete who does not consume

adequate amounts of vitamin C, athletic performance may be hindered from oxidative stress on the muscles and other cells leading to lipid peroxidation.

Sodium.

Sodium is a crucial electrolyte and mineral that is required by every person, especially athletes. Athletes with high sweat rates (endurance athletes) and those who are in certain environmental areas can require a higher amount. The Tolerable Upper Intake Level is 2.3g/day (Rodriguez et al., 2009). However, most athletes reach this level without supplementation. Sodium is found naturally in many food items, added to many foods for preservatives and flavor and in sport beverages. According to research, beverages that contain electrolytes (specifically sodium and potassium) can help maintain fluid balance and can benefit performance (Rodriguez et al., 2009). These electrolytes and fluids help with sweat replacement when nutrients and fluids are lost. Muscle cramps and muscle fatigue are often associated with hyponatremia. Sodium also helps retain fluids. An athlete with too much fluid retention can be damaging to the joints.

Fiber.

Though there is no research for specific fiber needs for athletes, it is important to consider the fiber requirements for this age group. Collegiate athletes typically range from ages 18-23 years old. The recommended intake for dietary fiber for this age group is 25 grams for females and 38 grams for males (“Position of the American Dietetic Association: Health Implications of Dietary Fiber,” 2008). Dietary fiber has been shown to provide many health benefits throughout the lifecycle. Adequate dietary intake can benefit many different body systems throughout life. Some of these are: aiding in cardiovascular health, gastrointestinal function and the immune system as well as

preventing stroke, type 2 diabetes mellitus, and obesity, (Anderson, Baird, Davis, Ferreri, Knudtson, Koraym, & Williams, 2009). Fiber can be helpful for constipation and diarrhea (“Position of the American Dietetic Association: Health Implications of Dietary Fiber,” 2008). It is important for an athlete to have regular bowel movements during performance times because it will help keep the athlete comfortable during athletic performance.

In review, literature states that the Healthy Eating Index 2005 accurately evaluates diet quality (Guenther, Reedy, Krebs-Smith, & Reeve, 2008). Using the information gathered from the Block 2005 Food Frequency Questionnaire as well as the Healthy Eating Index 2005 jointly, one can accurately assess the diet and its quality in the selected participants. Athletes gain nutrition knowledge from a variety of sources, some of which are not reliable. Registered dietitians may significantly help improve athletic performance by offering accurate education about macronutrients and micronutrients, and how vital these are throughout the body. Athletes that apply this education to their everyday lifestyle might see a significant improvement in their performance.

CHAPTER THREE: Methodology

Study Design

This was a cross-sectional study and data were collected between September 2010 and January 2012 on collegiate athletes who volunteered for this study. The study received approval from IRB prior to the start of this study. All data were taken from the first measurement of an individual athlete which had more than one assessment during that time period. The athletes' height and weight were measured and his/her body composition was determined using the BodPod®. The BodPod® is a tool to measure body composition using air displacement plethysmography. The athlete's demographics were also collected by questionnaire at this initial meeting. The athletes were asked to complete a Block 2005 Food Frequency Questionnaire to be used to evaluate their diet. The diet quality score was calculated using the Block 2005 Food Frequency Questionnaire© and the Healthy Eating Index 2005.

Participants

There were a total of 138 participating collegiate athletes in this study. There were both male and female participants for the study. There were 15 African American participants. All participants were 18 years of age and over and were on the active roster for a collegiate sports team.

Food Frequency Questionnaire

The Block 2005 Food Frequency Questionnaire© was used to assess the athletes' diets. The questionnaire contains questions on over 100 foods and includes portion size and frequency of consumption. The scale for frequency was: never, a few times a year, once per month, 2-3 times per month, once per week, 2 times per week, 3-4 times per

week, 5-6 times per week, and every day. The questionnaire was analyzed by the Nutrition Quest Company and results were returned to the research team. SPSS statistical analysis software was used to analyze the data.

The Healthy Eating Index 2005 Point System

The results of the food frequency questionnaire were used to determine the diet quality of the athletes. The Healthy Eating Index (HEI) 2005 was used as the measurement of diet quality. This measure of diet quality assesses diet quality that conforms to federal dietary guidance and recommendations. The components on the HEI 2005 index and the scoring standards are shown in Appendix I (Guenther, Krebs-Smith, Reedy, Britten, Juan, Lino, Carlson, Hiza & Basiotis, 2005). These standards are expressed per 1,000 calories.

The scores for each of the twelve components of the HEI-2005 were determined by the maximum and minimum standard score represented as on a designated point system. Ten components were expressed on a “per 1,000 Calorie” basis. Two components were based on a “percentage of energy” score. These points were added together to determine the overall diet quality score based on these twelve components.

Scores for each of the 12 categories were calculated as follows:

First, the total Calories consumed by each participant were divided by 1000. This variable will be called “calorie factor” throughout the remaining equations.

For the total fruit (that includes 100% juice) calculation, the total fruit in cups was divided by “calorie factor” to give the number of cups of fruit consumed per 1000 Calories. This amount of fruit was then translated into points on a scale of 0-5 per the

scoring system of the HEI 2005. Any amount ≥ 0.8 cup equivalents per 1000 Calories was given a score of 5. Consumption of 0.4 cup equivalents was given a score of 2.5.

Table 3.1 HEI Point Distribution for Total Fruits

Points	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	0.0
Amount Consumed (cups)	≥ 0.80	0.72	0.64	0.56	0.48	0.40	0.32	0.24	0.16	0.08	0.00

To calculate whole fruit (excluding juice), the total solid fruit in cups was divided by “calorie factor” to give the number of cups of whole fruit consumed per 1000 Calories. The amount of solid fruit was then translated into points on a scale of 0-5 per the scoring system of the HEI 2005. Any amount ≥ 0.4 cup equivalents per 1000 Calories was given a score of 5. Consumption of 0.2 cups equivalent received a score of 2.5 points.

Table 3.2 HEI Point Distribution for Whole Fruits

Points	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	0.0
Amount Consumed (cups)	≥ 0.40	0.36	0.32	0.28	0.24	0.20	0.16	0.12	0.08	0.04	0.00

For the calculation for total vegetables, the total vegetables in cups was divided by “calorie factor” to give the number of cups of vegetables consumed per 1000 Calories. The amount of vegetables consumed was then translated into points on a scale of 0-5 per

the scoring system of the HEI 2005. Any amount ≥ 1.1 cup equivalents per 1000 Calories was given a score of 5. Consumption of 0.55 cups equivalents received a point of 2.5.

Table 3.3 HEI Point Distribution for Total Vegetables

Points	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	0.0
Amount Consumed (cups)	≥ 1.1	0.99	0.88	0.77	0.66	0.55	0.44	0.33	0.22	0.11	0.00

The total of dark green and orange vegetables, as well as legumes, was calculated as the sum total of the three variables that was reported in cups and was then divided by “calorie factor”. The amount of cups from the sum of these variables was translated into points on a scaled of 0-5 points per the scoring system of HEI 2005. Any amount above 0.40 cup equivalent per 1,000 Calories received a score of 5.0. Consumption of 0.2 cups received 2.5 points.

Table 3.4 HEI Point Distribution for Dark Green and Orange Vegetables, and Legumes

Points	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	0.0
Amount Consumed (cups)	≥ 0.40	0.36	0.32	0.28	0.24	0.20	0.16	0.12	0.08	0.04	0.00

Total grains were calculated by the total amount of grains reported in ounces divided by “calorie factor”. The amount of total grains consumed was translated in a points scale from 0-5 points per the scoring system of HEI 2005. Any amount that was greater than 3.0 ounces equivalent per 1,000 Calories received a score of 5.0. Consumption of 1.5 ounces received 2.5 points.

Table 3.5 HEI Point Distribution for Total Grains

Points	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	0.0
Amount Consumed (ounces)	≥3.0	2.70	2.40	2.10	1.80	1.50	1.20	0.90	0.60	0.30	0.00

Whole grains were calculated using the number of whole grains reported in ounces divided by “calorie factor” to get whole grains in ounces. Whole grains score was based on a 0-5 point scaled that was determined by the scoring system by HEI 2005. Any ounces equivalent greater than 1.5 per 1,000 Calories received a score of 5.0. Points of 2.5 were given if consumption of 0.75 ounces were given 2.5 points.

Table 3.6 HEI Point Distribution for Whole Grains

Points	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	0.0
Amount Consumed (ounces)	≥1.5	1.35	1.20	1.05	0.90	0.75	0.60	0.45	0.30	0.15	0.00

The total amount of milk in cups was determined by using the milk reported in cups and dividing by “calorie factor”. The amount of milk in cups consumed was translated into a point system from 0-10 according to the scoring system standards by HEI 2005. Any amount above 1.3 equivalent cups per 1,000 Calories received a score of 10.

Table 3.7 HEI Point Distribution for Amount of Milk

Points	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0	0.0
Amount Consumed (cups)	≥1.3	1.17	1.04	0.91	0.78	0.65	0.52	0.39	0.26	0.13	0.00

For the component score for meat, the sum of ounces for meat, fish and poultry was divided by “calorie factor”. The amount of meat, fish and poultry consumed was translated into a score between 0-10 points based on HEI 2005. Any amount above 2.5 ounce equivalent per 1,000 Calories received a score of 10.

Table 3.8 HEI Point Distribution for Sum of Ounces of Meat, Fish, and Poultry

Points	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0	0.0
Amount Consumed (ounces)	≥2.5	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00

Discretionary fats and oils in grams were calculated fats and oils reported and divided by “calorie factor”. Discretionary fats and oils in grams per 1,000 Calories were

translated in a 0-10 point system per the HEI 2005 standards. Any score greater than 12 grams received a score of 10.

Table 3.9 HEI Point Distribution for Discretionary Fats and Oils

Points	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0	0.0
Amount Consumed (grams)	≥12.00	10.80	9.60	8.40	7.20	6.00	4.80	3.60	2.40	1.20	0.00

Sodium was calculated by taking sodium in grams and divide by “calorie factor”.

The sodium score was determined by HEI 2005 standards and was on a scale from 0-10 points. Any amount above 0.7 grams per 1,000 Calories received a score of 10.

Table 3.10 HEI Point Distribution for Sodium

Points	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0	0.0
Amount Consumed (grams)	≥0.7	0.63	0.56	0.49	0.42	0.35	0.28	0.21	0.14	0.07	0.00

Saturated fats were calculated by the total saturated fat grams consumed multiplied by 9 Calories per gram, and then the Calories from saturated fats was divided by the total number of Calories consumed. The amount of saturated fats that was consumed was translated to a 0-10 point system according to HEI 2005 standards. Any score less than 7% per 100 Calories received a score of 10.

Table 3.11 HEI Point Distribution for Saturated Fats

Points	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0	0.0
Amount Consumed (% of energy)	≤7%	7.80	8.60	9.40	10.2	11.00	11.80	12.6	13.4	14.2	≥15.0

To calculate the total calories from solid fat, alcohol, and added sugar (SoFAS), the researchers used discretionary fat in grams that was consumed and multiplied that amount by 9 Calories fat to get Calories of fat. The percentage of Calories that came from alcohol was multiplied by total Calorie intake. This indicated the total Calories of alcohol. Added sugars, in teaspoon equivalents, were multiplied by 16 Calories per teaspoon of sugar to get Calories of sugar. All three, Calories of sugar, Calories of alcohol, and Calories of fat are added together to get the total number of SoFAS that is then divided by the total Calories overall to get the percentage of energy. The percentage of SoFAS consumed per 1,000 Calories was translated into a point system based on 1,000 Calories. This point system was a 0-20 point system determined by the HEI 2005 standards. Any score less than 20%, received a score of 20.

Table 3.12 HEI Point Distribution for SoFAS

Points	20.0	18.0	16.0	14.0	12.0	10.0	8.0	6.0	4.0	2.0	0.0
Amount Consumed (% of energy)	≤20%	23%	26%	29%	32%	35%	38%	42%	45%	48%	≥50%

The overall diet quality score was determined by adding up the points for each of the above 12 components.

CHAPTER FOUR: Results

There were a total of 138 participants in the study. There were 48 male and 90 female athletes participating in the study. The average age of all the participants was 19.4 years old. Of the total participants, 10.9% were African American. There were five sports represented in this study: swim/dive, soccer, basketball, volleyball, and gymnastics. There were five different academic class levels represented in this study. Those in their first year of school made up 42.8% of the study. Out of all the participants, 28.3% were in their second year of school and 18.8% were in their third year of school. Participants in their fourth year of school were 9.4% and in the fifth year was 0.7%.

The mean body mass index for all of the participants was 23.2 (2.3) kg/m². The male participants had a mean body mass index of 23.6 (2.4) kg/m². The female had a mean body mass index of 22.9 (2.2) kg/m² (P=0.07). All of the participants had an average body fat of 17.8 (6.5%). The male participants had a body fat of 11.1(3.9%), females were 24.1 (4.5%) (P<0.001). All of the participants had an average total Calories of 2476.2 (SD 1742.9). The female participants' mean of total Calories was 1866.9 (SD 976.8). The mean of total Calories for the male participants was 3615.8 (SD 2238.4; P<0.001).

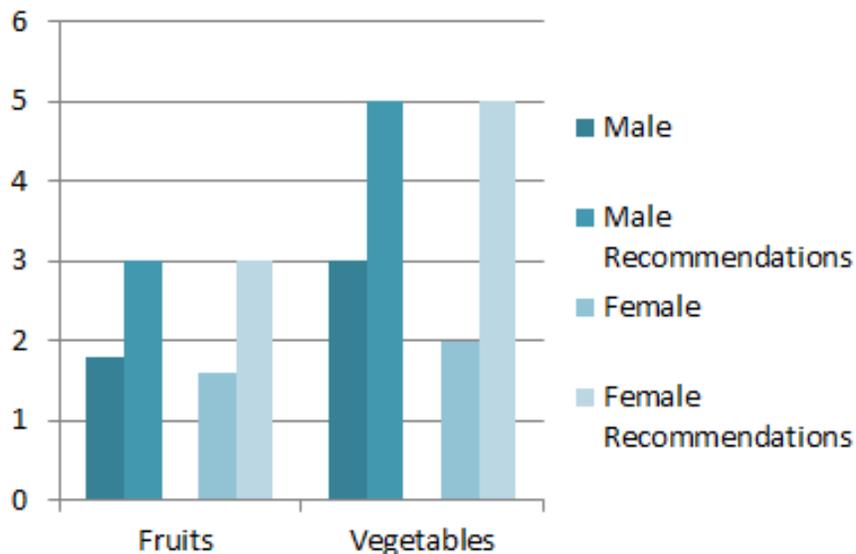
The average HEI score overall for all of the participants was 51.2 (SD: 8.8). The male average HEI score was 47.7 (SD: 7.9). The overall HEI score for females was 53.1 (SD: 8.6) (p<0.001). All of the participants consumed 1.7 (SD: 1.2) cups of fruit on average. The average amount of fruit consumed by the male participants was 1.8 (SD: 1.1) cups. The female participants consumed an average of 1.6 (SD: 1.2) cups of fruit (P=0.40). The amount of vegetables that was consumed by all the participants was 2.4

(SD: 1.2) cups. The males consumed 3.1 (SD: 2.4) cups and the females consumed 2.0 (SD: 1.6) cups total vegetables (P=0.003). The dietary fiber averaged 20.5 (SD: 14.2) grams. The females consumed 16.9 (SD: 9.8) grams and the males consumed 27.3 (SD: 18.4; P<0.001). The Calories from solid fats, alcoholic beverages, and added sugars (SoFAS) that were consumed by the group as a whole was 1231.3 (SD: 907) Calories. The Calories from SoFAS that were consumed by males were an average of 1844.6 (SD: 1174.1). The females had 900.6 (SD: 468.2) of SoFAS that contributed to their Calorie intake(P<0.001).

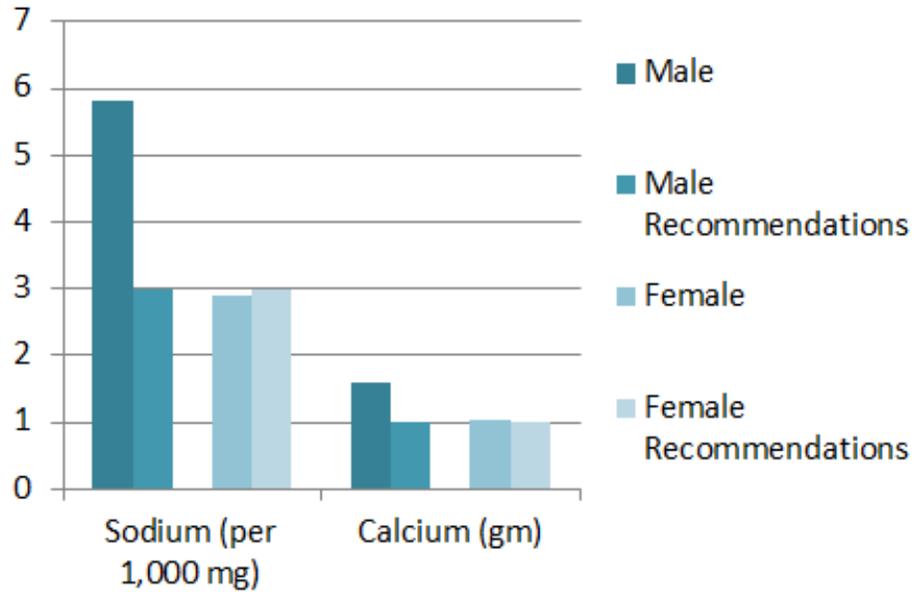
Sodium consumption for all the participants was 3893.7 (SD: 3001.1) milligrams. The male participants consumed 5803.2 (SD: 3996.5) milligrams. The females had an average consumption of sodium of 2875.3 (SD: 1553.6) milligrams (P<0.001).

There is a negative correlation between diet score and percent body fat ($r = -0.481$; $P < 0.001$), as no correlation between BMI and diet score, $r = 0.031$; $P = 0.722$.

Figure 4.1 Male and Female Recommendations compared to Intake of Fruits and Vegetables



Figures 4.2 Male and Female Recommendations compared to Intake of Sodium and Calcium



Figures 4.3 Male and Female Recommendations compared to Intake of Fiber

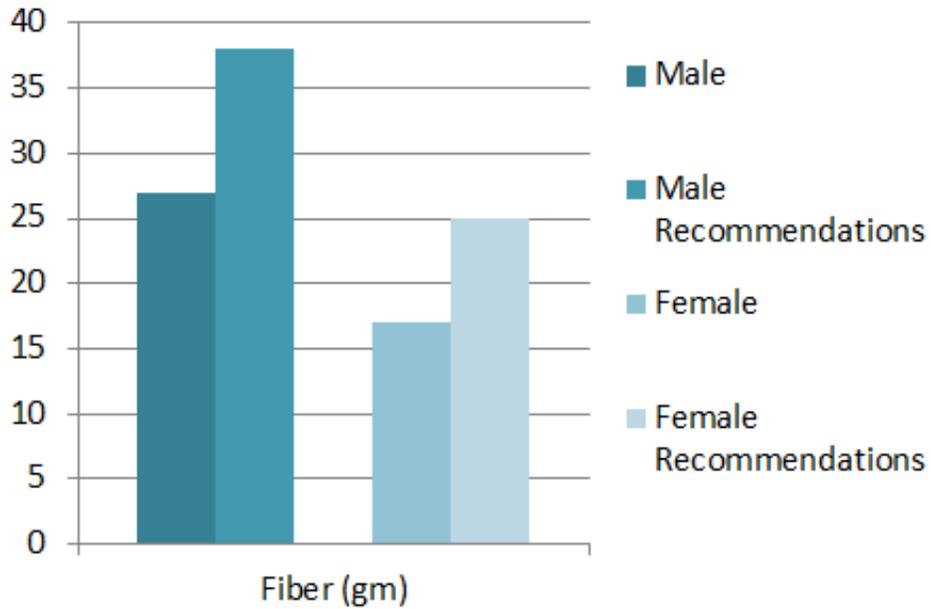


Figure 4.4 Male and Female Recommendations compared to Intake of Vitamin C and Iron

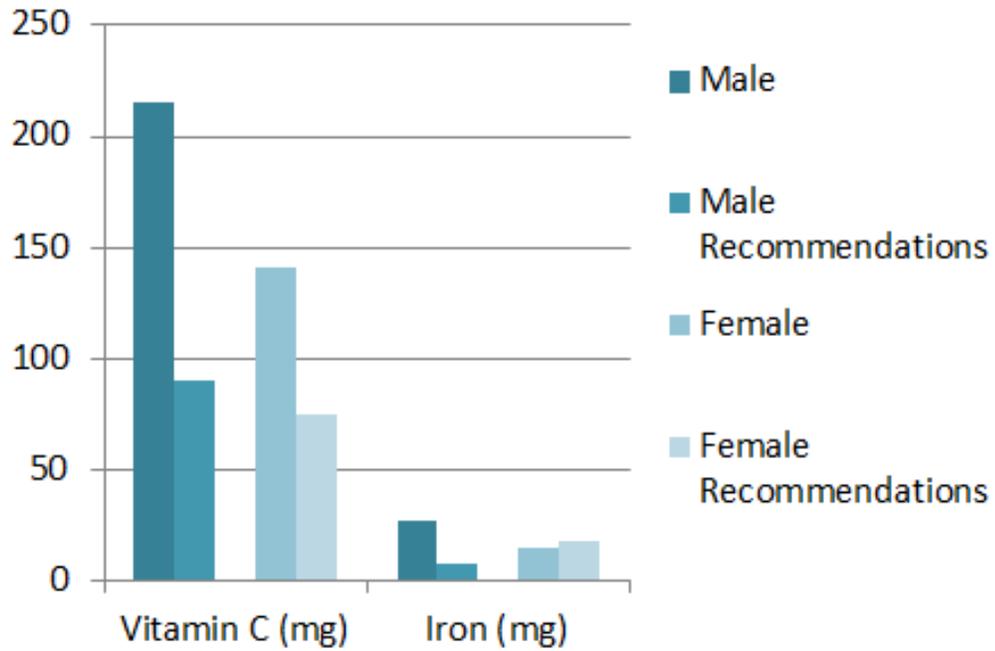
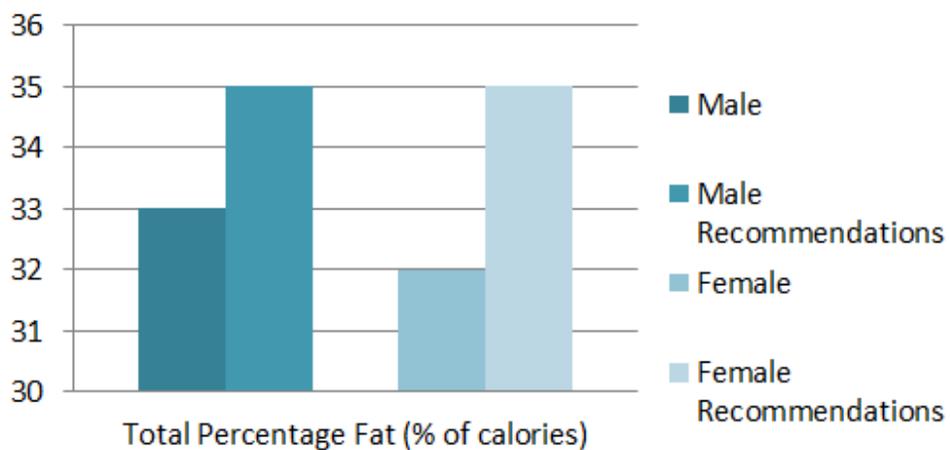


Figure 4.5 Male and Female Recommendations compared to Intake of Total Percent Fat



CHAPTER FIVE: Discussion

The purpose of this study was to assess and compare the diet quality between male and female collegiate athletes in the sample. These results were compared to diet recommendations for the age and gender of these athletes. The average age of these participants were 19.4 (\pm 1.2) years. Out of all the participants, 65% were female athletes. The average diet quality score was 51 (SD: 8.75). Based on these findings, athletes do not have a high diet quality score.

Athletes' knowledge concerning nutrition and their diets, generally, do not come from a registered dietitian, however, they receive basic knowledge from various positions surrounding athletics. This research demonstrates that athletes could benefit from additional education from dietitians. Dietitians can offer more accurate information as well as being more individualized for the athlete and specific sport. With continuous education on nutrition, athletes may be more accepting to the changes needed in their diet to affect their athletic performance.

Based on these findings from this study, there are some nutrients that athletes are consuming in excess, others are consumed in adequate amounts, and still others are deficient in the athletes' diets. These variations in consumption may affect the overall performance for an athlete. Iron was found to be an excess in males but deficient in females. This could be related to the higher consumption of meat products in male athletes. Both male and female athletes consumed an excess of sodium. This could be a result of the types of foods consumed as well as sport beverages which are often high in sodium. Based on the recommended intake for both calcium and vitamin C, both males and females receive an excess of these nutrients. Calcium consumption can be associated

with the amounts of dairy products consumed. Vitamin C was determined based on the fruits and vegetables consumed. The percent fat consumed was in excess for both male and female athletes. Based on the literature and this study, this may be due to athletes choosing high fat foods rather than leaner food items.

These athletes also had deficiencies in some areas of their intakes. Some of these deficiencies were in fruit and vegetable consumption as well as fiber. Fiber may be less due to the lack of fruit and vegetable consumption. Both fruits and vegetables contain amounts of fiber. If athletes do not consume appropriate amount of fruits and vegetables, their fiber intake will be less. Based on research, some athletes do not receive adequate nutrition education and may not be aware of all the benefits of consuming fruits and vegetables.

The HEI diet quality score gives a good representation of the diet of an athlete. With nutrition education, athletes will improve their diet and performance that is affected by the diet as well as start lifelong diet trends that will be beneficial after their athletic career. Based on the results from this study, there is a strong positive correlation between the HEI score and percent body fat. This means that the athletes who have a leaner body mass, have a lower HEI diet score. This is a good indication that just because athletes may have a BMI in a healthy range and are physically active, athletes are unaware or do not demonstrate a healthy lifestyle based on their diet intake. A diet education intervention from a registered dietitian may be appropriate for collegiate athletes.

Limitations

The limitations of this study include a small sample size, therefore this may not be a good representation of other athletes. Some of the answers that were reported on the

food frequency questionnaire may not be completely accurate for some of the individuals of the study. Another limitation is that the researchers did not assess if athletes were currently in or out of season; this could influence some of their dietary choices depending on their current physical activity state. The research also did not attempt to assess current levels of physical activity. The results for the specific nutrient intakes was based on entire diet reports from the FFQ, however, HEI score was based on a “per 1,000 Calories” score.

CHAPTER SIX: Conclusion

Based on this study and the related research to this study, it is clear that though athletes appear to be very healthy, they may not know how to choose appropriate food items. A dietary intervention is appropriate for athletes to help them achieve their highest athletic ability and may improve their overall performance. It will be most beneficial for athletes to receive this nutrition information from registered dietitians because this is the area in which they are educated and can give the most accurate information to these athletes.

APPENDECES

Appendix I: Healthy Eating Index 2005

Component	Maximum Points	Standard for Maximum Score	Standard for minimum score of zero
Total Fruit (includes 100% juice)	5	≥ 0.8 cups equiv. per 1,000 Calorie	No Fruit
Whole Fruit (not juice)	5	≥ 0.4 cups equiv. per 1,000 Calorie	No Whole Fruit
Total Vegetables	5	≥ 1.1 cups equiv. per 1,000 Calorie	No Vegetables
Dark Green and Orange Vegetables and Legumes	5	≥ 0.4 cups equiv. per 1,000 Calorie	No Dark Green or Orange Vegetables or Legumes
Total Grains	5	≥ 3.0 cups equiv. per 1,000 Calorie	No Grains
Whole Grains	5	≥ 1.5 cups equiv. per 1,000 Calorie	No Whole Grains
Milk	10	≥ 1.3 cups equiv. per 1,000 Calorie	No Milk
Meat and beans	10	≥ 2.5 oz equiv. per 1,000 Calorie	No Meat or Beans
Oils	10	≥ 12 grams equiv. per 1,000 Calorie	No Oil
Saturated Fat	10	$\leq 7\%$ of energy	$\geq 15\%$ of energy
Sodium	10	≥ 0.7 grams equiv. per 1,000 Calorie	≥ 2.0 grams of 1,000 Calorie
Calories from Solid Fats, Alcoholic beverages, and added sugars (SoFAS)	20	$\leq 20\%$ of energy	$\geq 50\%$ of energy

Appendix II: Definition of Terms

1. Diet Quality: is the food choices that are made on a regular basis. An example of food items are: whole grains, lean meats, fresh fruits and vegetables and low-fat milk consumption.
2. Collegiate Athletes: People who perform in sports during their college career
3. Healthy Eating Index 2005: a point system that was developed to determine a diet's quality that evaluates twelve different components based on the federal guidelines
4. Block 2005 Food Frequency Questionnaire©: a questionnaire that evaluates different food groups and physical activity
5. Nutrition Knowledge: the amount of information from education and experiences about nutrition that one knows

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VITA

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