UNIVERSITY OF WISCONSIN-LA CROSSE

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NUTRIENT INTAKE IN FEMALE COLLEGIATE TRACK AND FIELD ATHLETES

A Manuscript Style Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Masters Clinical Exercise Physiology

Marni J Benson

College of Science and Health
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NUTRIENT INTAKE OF FEMALE COLLEGIATE

TRACK AND FIELD ATHLETES

By Marni J Benson

We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Masters Clinical Exercise Physiology

The candidate has completed the oral defense of the thesis.

Rebecca Battista, Ph.D.	6-5-09
Thesis Committee Chairperson	Date
Kris Greany, Ph.D.	6/05/09
Thesis Committee Member	Date
Dennis Kline, MS	6/5/09
Thesis Committee Member	Date

Thesis accepted

Vijendra K. Agarwal, Ph.D.	7/1/09
Associate Vice Chancellor for Academic Affairs	Date

ABSTRACT

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The purpose of this study was first, to determine if Division III female track and field athletes met the nutrient recommendations and second, to identify barriers the athletes faced trying to receive adequate nutrient intake. Twenty-six females were tested once during their competitive season for an interview and basic background information. The testing session included discussion of a twenty-four hour eating behavior journal (EBJ), eating habits, physical activity record, and background questionnaire. An ANOVA was used to determine any differences that occurred in nutrients between events. Frequencies of participants meeting the nutritional requirements were used to determine if athletes fell above or below recommendations. Frequency tests were also conducted on the questionnaire to determine barriers to healthy eating. The dietary intake of Division III female track and field athletes was found insufficient for an active athletic population. Frequencies revealed that being rushed during meal time was the main encountered barrier.

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INTRODUCTION

It is well accepted that both athletic performance and recovery from strenuous exercise can be enhanced by optimal nutrition (1,2). Competitive athletes require sufficient energy to achieve and maintain energy balance which is important for maintenance of lean tissue, immune function, and optimal performance (3). Nonetheless, while nutrient intake is important to all athletes, many barriers may exist for collegiate athletes. These barriers include, but are not limited to money and convenience. As a result, the college athlete may not be able to consume the recommended macronutrients or micronutrients which may lead to alterations to performance or potential injuries. Consequently, gaining knowledge about collegiate athletes eating habits and dietary intake may be important.

Recent studies have found that collegiate athletes are not meeting the basic nutritional recommendations for adults, let alone for athletes (3,4). Deuster et al., (1986) observed three day dietary intakes on a group of female runners training for the 1984 Olympics. The results showed the mean intakes were above the RDA for women in nutrients such as calcium, magnesium and iron while other macronutrients and minerals were well below recommendations for their level of activity (5). However, it is important to note overall, the caloric intakes were found to be relatively low.

Similar findings were described by Clark et al., (2003) in Division I female soccer players. This study compared the athletes' pre- and post-season dietary intakes using 3-day food records in order to determine if they were meeting minimum energy requirements during training and competition, and to establish what dietary components needed to be addressed in nutritional counseling. The overall results showed that the athletes met their caloric intake requirements based on their activity level pre and post season, but failed to meet the specific nutrient requirements. One of the nutrients not sufficiently met was carbohydrates, which play a critical role in training and recovery from training. Carbohydrates help maintain blood-glucose levels and replace muscle glycogen needed to maintain desired intensity levels (1,6). Therefore, observing specific nutrients in addition to caloric intake is important (3).

Nutrients are critical to the athlete. Each nutrient has specific responsibilities if the appropriate intake is met. Carbohydrates, protein, and lipids are the three macronutrients. They provide energy to maintain the body's functions during rest and physical activity (6-8). Micronutrients include the vitamins and minerals and while they may not directly supply the energy to the body, they do have a number of important roles. For example, they assist in energy production, hemoglobin synthesis, bone health, immune function, protection of body tissues, and building and repairing muscle tissue after exercises (1).

A lack in certain nutrients suggests athletes may not be making wise nutritional choices. For example, athletes may consume more nutrient dense foods in order to obtain adequate carbohydrates, protein, and micronutrients (1). This means college athletes need to be smart about their food choices. Examples of nutrient dense foods include fruits, vegetables, and whole grains. These foods provide a substantial amount of vitamins and minerals while containing relatively few calories. Vitamins and minerals that are found to be important to health and in an athletic population, performance, include calcium, vitamin D, iron, and fiber. All in all, having the right combination of these nutrients would be critical to an athlete.

Even though college athletes may be knowledgeable about the macronutrients and micronutrients requirements and understand that diet affects athletic performance, they still may not eat an adequate diet (4). Even after scoring high on a nutritional quiz showing these athletes were knowledgeable in nutrition Rash et al., (2008) still found that knowledge of proper nutrient intake predicted less than one percent of actual dietary intake. In addition, nutrition attitude measured by the athletes' responses to five statements of belief that healthy eating is related to sports performance was high. However, their positive attitudes towards healthy eating were only 5% predictive of dietary intake. Nonetheless, results of this study suggest there is a disconnection in college athletes between knowing and practicing good nutrition.

Knowing what an athlete has consumed is one way to learn more about their typical eating habits. Diet recalls, diet histories, and food frequency questionnaires are some of the most common methods to determine nutrient intake. A dietary recall occurs over 24 hour period and requires the subject to recall everything they ate or drank the previous day. The diet history method is similar to the recall but observes intake over a period of three or seven consecutive days instead of just the previous 24-hours. Each of these methods require accurate recording and good communication skills from the subject and, when necessary, the interviewer. Food frequency questionnaires look at the frequency of consumption of a pre-determined food and beverage list. This method provides information concerning whether or not individuals consume adequate amounts of the required food groups. Typically, this method is only used in large scale studies.

The method used will likely depend on the question at hand, however it is important to note, regardless of the method used, there are limitations to each.

The American Dietetic Association, Dieticians of Canada, and American College of Sports Medicines' position statement suggests that physical activity, athletic performance, and recovery are all enhanced by optimal nutrition. This would include all athletes. However, the majority of studies that relate nutritional intake to performance typically only include NCAA Division I athletes, single gender subjects, or choose sports where body image is poor, such as gymnastics or wrestling. While it may be that NCAA Division I athletes have a more demanding schedule than NCAA Division III, the same problem may exist in terms of proper nutrition for training. In Division III, class schedules are not made around training sessions resulting in practices being scheduled at many different times of the day. This may result in athletes having to eat breakfast and/or dinner at various times of the day depending on practice time and availability of the cafeteria. In addition, funding is a major difference between the two levels. Training tables and supplements provided during practice (e.g. Gatorade, Power bars) are not provided to Division III athletes, requiring athletes to really consider what to consume after practice.

Overall, nutrition and athletic performance are related (1). While consuming the recommended amounts of macronutrients and micronutrients are important, acquiring them may be more difficult in certain populations such as collegiate athletics. Competition, limited financial resources, and being away from home all are contributors to this challenge. Nutritional issues that collegiate athletes face can lead to inadequate eating habits resulting in decreased performance and even overall health issues (7).

Therefore, the purpose of this study was first, determine if Division III female track and field athletes met the nutrient recommendations and second, to identify barriers the athletes faced trying to consume adequate nutrient intake.

METHODS

Participants

Twenty-six athletes from a midwestern NCAA Division III collegiate female track and field team were recruited for this study. This was a sample of convenience and was a good representation of competitive Division III female track and field team as the team won their third straight indoor conference championships and placed second at both the indoor and outdoor nationals this year (2008/09). Participants were recruited during both the indoor and outdoor season.

Participants were tested once during their competitive season for an interview and basic background information. Testing sessions were coordinated with the coaching staff to establish the hard workout days for each event in which we had participants (e.g. sprinters, distance runners, jumpers). All participants provided written informed consent prior to any testing. Approval was provided by the University of Wisconsin-La Crosse Institutional Review Board prior to the initiation of data collection.

Procedures

Participants attended one session at the University of Wisconsin-La Crosse Human Performance Lab during their competitive indoor or outdoor season. These sessions took place following their events' hard practice of the week. Each testing session consisted of discussing a dietary record, eating habits, physical activity record, background questionnaire, and height and weight measurements. The individual sessions lasted about 10 minutes per participant.

The day prior to their session, the participants were asked to complete a dietary record using an Eating Behavior Journal. An example was provided of a completed

Eating Behavior Journal to help illustrate how detailed they needed to be in their individual journals. Copies of these journals are located in Appendix B. This record included the athletes' consumption of all foods, beverages, and supplements 24 hours prior to their scheduled session. The following day at the lab visit, the principle investigator interviewed the participants concerning information recorded in their Journal. The interview was used in order to ensure accurate and appropriate information. Food models were used and specific brands, portion sizes, and food content, were clarified at this time

During the second portion of the testing session, the athlete's barriers were assessed by asking questions in regards to her eating habits, also listed in their journal. The first question asked, was if they lived on or off campus, and if it was with family (e.g. parents) in order to understand the extent of their food options. The next several of questions addressed where they typically ate each of their meals, if money limited their options available, and if any were eaten in a rushed manner. If indicated that at least one meal was rushed they were then asked to explain the reasoning, at the time of the interview. Looking at the day they made all their recordings, on a scale 1 to 5, (1- absolutely unhealthy, and 5- extremely healthy) each athlete was asked to rank how healthy they thought their food/beverage choices. They also were asked to rank the difficulty of practice, on a scale 0 to 10, (0-rest, and 10-maximal). A copy of the questionnaire is located in the Appendix C.

The final question asked which event(s) the athlete regularly competes. From this information we grouped sprinters as runners competing in the 55, 200, 300, 400, 600, 800 meter dashes, 55m hurdles, 4x200m or 4x400m relay, distance runners as competing in the mile, 3000m and 5000m runs, or distance medley relay, and jumpers as competing in long or triple, high jump, and pole vault. To determine what category the athletes who competed in the pentathalon belonged in, the investigator asked the coach which one of the events was the athlete's strongest.

In order to determine activity levels and estimate energy expenditure, athletes filled out activity records (Appendix D). These records were to include any activity performed in or outside of practice. We requested the athletes record the specific activity, duration of the activity (minutes), and the level of intensity. Intensity was reported as easy (light workout), medium (breaking a sweat), or hard (heavy workout). A completed activity record was given to each athlete in order to provide them with an example in completing the journal adequately. The specification about the activity level assisted in accurately looking at proper nutrient recommendations using the ESHA Food Processor®.

Height and weight were both taken at the testing session. Height was measured in inches, while weight was measured to the closest pound on a beam scale. These numbers were later entered into the ESHA Food Processor® to develop individualized nutrient recommendations for each athlete.

A food consumption analysis using an ESHA Food Processor® program was performed and utilized individuals' activity levels to provide a specified breakdown of all that they had consumed. Entering the participants' entire dietary intake from the Journal into the ESHA Food Processor® program enabled an estimation of the nutritional intake of each athlete. Using the athlete's height, weight (lbs), and activity level, an estimation of energy intake versus energy expenditure was provided. Outcomes included relative and absolute amounts and percent recommended of all desired variables. The specific activity level of the athletes in the ESHA Food Processor® program was termed “very active”. This label corresponds to individuals who are full-time athletes, unskilled laborers, some agricultural laborers (especially “peasant” farming), military on active duty, some miners and steel workers as defined by the ESHA Food Processor program. The label of “very active,” relates to an activity factor of 1.9 in the following energy expenditure equation:

REE (resting energy expenditure) x AF (activity factor) = Energy Expenditure.

This activity level was determined based on the athlete’s reported activities. The ranking for activity level remained unchanged for each athlete due to the limited activity rating scale within the food processor program.

Statistical Analysis

An ANOVA ($P < 0.05$) was used to determine any differences that may have occurred in physical characteristics and nutrients between the different events. To determine if the nutrient recommendations were met, a simple frequency test was used to determine participants who fell above or below the recommended values. Carbohydrates, protein, fat, fiber, iron, calcium, and vitamin D were the nutrients measured. Lastly, frequency tests were also conducted on the survey to determine barriers to healthy eating.

RESULTS

Of the 26 subjects assessed, eight were sprinters, ten were distance runners, and eight were jumpers (mean age = 20.12 ± 1.24 years). Additional descriptives, including the athletes' height, weight, and body mass index, are presented in Table 1.

Overall, these athletes did not meet their dietary intake recommendations. More specifically, they did not meet the caloric recommendations for 'very active' individuals, or any of the macronutrients and micronutrients observed. Carbohydrates were the most common macronutrient for which athletes were deficient (26.9%), while protein was the closest in meeting the recommended intake (96.1%). The breakdown of each of these nutrients is presented in Table 3. When comparisons were made between events, no significant differences were found.

The most common barrier to eating healthy was lack of time. In fact, throughout their day of recording more than half (53.8%) of the athletes were rushed for one or more of their meals. It was reported that breakfast was the meal most often rushed (26.9%) with the primary reason being class. In addition, breakfast was most commonly eaten off campus (61.5%) and eaten alone (73.1%). Over half (57.7%) of the athletes also ate supper off campus following practice, and reported eating with friends (76.9%). A complete breakdown of each meal is presented in Tables 4-6.

Table 1: Descriptives including age, height, weight, and BMI of the 26 participants observed.

	Total	Age (years)	Height(cm)	Weight(kg)	BMI
Total	26	20.12 ± 1.24	168.03 ± 7.65	62.30 ± 7.08	22.01 ± 2.03
Sprinters	8	20.25 ± 1.17	165.74 ± 5.38	62.40 ± 6.19	22.66 ± 2.14
Distance	10	19.70 ± 1.49	166.62 ± 6.14	59.11 ± 4.57	21.28 ± 1.85
Jumpers	8	20.50 ± 0.93	172.08 ± 10.21	66.20 ± 9.05	22.28 ± 2.11

Table 2: Caloric intake reported on Eating Behavior Journals by 26 female track and field athletes versus the athletic population recommendations.

N=26	N	Intake Kcal/kg	met recommendations (37-41 kcal/kg)	Not met	
				Over	Under
Total	26	39.1 ± 16.4	5 (19.2%)	8 (30.8%)	13 (50%)
Sprinters	8	38.1 ± 10.6	1 (12.5%)	3 (37.5%)	4 (50%)
Distance	10	40.2 ± 18.1	3 (30%)	3 (30%)	4 (40%)
Jumpers	8	38.8 ± 20.6	1 (12.5%)	2 (25%)	5 (62.5%)

Table 3: Nutrient intake reported on Eating Behavior Journals by 26 female track and field athletes versus the athletic population recommendations.

Met Recommendations	Total (n=26)	Sprinters (n=8)	Distance (n=10)	Jumpers (n=8)
Carbohydrates	7 (26.9%)	2 (25%)	4 (40%)	1 (12.5%)
Carb/kg	5.7 ± 2.4	5.8 ± 1.9	5.9 ± 2.7	5.4 ± 2.8
Protein	25 (96.1%)	8 (100%)	9 (90%)	8 (100%)
Protein/kg	1.6 ± 0.7	1.7 ±0.6	1.6 ± 0.9	1.4 ± 0.5
Fat	9 (34.6%)	2 (25%)	4 (40%)	3 (37.5%)
Fat/kg	1.2 ± 0.7	1.1 ± 0.5	1.2 ± 0.7	1.4 ± 0.9
Fiber	8 (30.8%)	3 (37.5%)	4 (40%)	1 (12.5%)
Calcium	18 (69.2%)	5 (62.5%)	6 (60%)	7 (87.5%)
Iron	12 (46.1%)	3 (37.5%)	5 (50%)	4 (50%)
Vitamin D	12 (46.2%)	3 (37.5%)	4 (40%)	5 (62.5%)

Table 4: Results each meal's characteristics obtained via questionnaire for all track and field participants.

Breakfast	**Location**		**Rushed**	
	On	**Off**	**Yes**	**No**
Totals	10(38.5%)	16(61.5%)	7(26.9%)	19(73.1%)
Sprinters	4(50%)	4(50%)	1(12.5%)	7(87.5%)
Distance	5(50%)	5(50%)	3(30%)	7(70%)
Jumpers	1(12.5%)	7(87.5%)	3(37.5%)	5(62.5%)
Lunch				
Totals	17(65.4%)	9(34.6%)	5(19.2%)	21(80.8%)
Sprinters	6(75%)	2(25%)	2(25%)	6(75%)
Distance	7(70%)	3(30%)	3(30%)	7(70%)
Jumpers	4(50%)	4(50%)	-	8(100%)
Supper				
Totals	11(42.3%)	15(57.7%)	2(7.7%)	24(92.4%)
Sprinters	4(50%)	4(50%)	1(12.5%)	6(75%)
Distance	5(50%)	5(50%)	-	10(100%)
Jumpers	2(25%)	6(75%)	1(12.5%)	7(87.5%)

Table 5: Reason for being rushed at meals obtained via questionnaire of all track and field participants.

	Reason Rushed			
Breakfast	**Class**	**Practice**	**Homework**	**Meeting**
Totals	7(100%)	-	-	-
Sprinters	1(100%)	-	-	-
Distance	3(100%)	-	-	-
Jumpers	3(100%)	-	-	-
Lunch				
Totals	2(40%)	2(40%)	1(20%)	-
Sprinters	-	1(50%)	1(50%)	-
Distance	2(66.7%)	1(33.3%)	-	-
Jumpers	-	-	-	-
Supper				
Totals	-	1(50%)	-	1(50%)
Sprinters	-	1(100%)	-	-
Distance	-	-	-	-
Jumpers	-	-	-	1(100%)

Table 6: Social situation at each meal obtained via the questionnaire of all track and field participants.

	Social Situation			
Breakfast	**Friends**	**Class**	**Alone**	**Work**
Totals	6(23.1%)	1(3.8%)	19(73.1%)	-
Sprinters	3(37.5%)	-	5(62.5%)	-
Distance	3(30%)	1(10%)	6(60%)	-
Jumpers	-	-	8(100%)	-
Lunch				
Totals	8(30.8%)	-	18(69.2%)	-
Sprinters	1(12.5%)	-	7(87.5%)	-
Distance	5(50%)	-	5(50%)	-
Jumpers	2(25%)	-	6(75%)	-
Supper				
Totals	20(76.9%)	-	5(19.2%)	1(3.8%)
Sprinters	7(87.5%)	-	1(12.5%)	-
Distance	8(80%)	-	2(20%)	-
Jumpers	5(62.5%)	-	2(25%)	1(12.5%)

Table 7: Athletes' perception of how healthy their food and beverage choices and rating of difficulty of practice on the day of reporting.

	Health Scale	**Practice Rating**
Total	3.7 ± 0.6	5.3 ± 1.7
Sprinters	4.0 ± 0.5	4.8 ± 1.8
Distance	3.7 ± 0.7	6.0 ± 1.7
Jumpers	3.5 ± 0.5	5.0 ± 1.7

DISCUSSION

Overall, our results for one day showed that Division III female track and field athletes are not meeting the nutrient recommendations for an athletic population. In addition, it seems as if the biggest barrier concerning eating a healthy meal was being rushed during a meal.

Our results showed all track and field athletes did not consume the adequate recommendations for caloric intake for an average female, and even more importantly for an active female athlete. The recommended caloric intake of 37-41kcal/kg was only met by 19.2% of the athletes and 50% of the remaining subjects were under the recommendations, while the remaining 30.8% were over. More specifically, the two macronutrient intakes not met were carbohydrates and fats. These two macronutrients are important in that they provide energy for the body's functions during both activity and rest (6-8). Not meeting the recommended energy intake will lead to fat and lean tissue mass being used by the body for fuel resulting in the loss of overall strength, and often lead to inadequate intake of the micronutrients (1). Other studies have shown similar results to ours. Clark et al., (2003) found Division I soccer players were not meeting adequate intake of calories, carbohydrates, and fats while meeting the protein recommendations while Kabasakalis et al., (2007) found top-level swimmers not consuming the recommended carbohydrate levels and having high fat intakes. Even with adequate intake of protein, the athletes overall are not meeting all the specific recommendations to enhance their performance.

Even with the athletes not meeting their recommendations, overall they perceived they were eating healthy. In fact, they reported their food/beverage choices a 3.7 ± 0.6, on a scale 1 to 5, (1- absolutely unhealthy, and 5- extremely healthy). Zawila et al., (2003) observed female cross-country runners and found that those runners who had been more educated in nutrition scored higher on a nutrition quiz. There were also strong positive correlations with confidence that optimal nutrition has a positive affect on athletic performance (10). This suggests to help athletes understand a healthy diet and its' importance on performance proper guidance and education should be encouraged. Quatromoni (2008) explains that athletes will participate in a multidisciplinary wellness program if one is provided to help face the demands of sports and college lifestyles and such programs have been shown to be effective. This multidisciplinary wellness program was set up to help the athletes face the demands of sports and college lifestyle. Nonetheless, there was a poor connection between our athletes eating healthy and perceiving that they are eating appropriately. Perhaps more counseling or education on the topic should be encouraged at the Division III level.

It is important to further understand the barriers to eating adequate caloric and/or nutrient intakes. Over half of our athletes reported being rushed during at least one of their meals. Breakfast was the meal most often rushed because of class. Those who were rushed had a higher caloric intake of 2606.19 (43.36kcal/kg) than those who were not rushed (2125.21, 34.20kcal/kg) throughout the day. Neither one of these groups fit into the recommended range of 37-41 kcal/kg. Waking up earlier or preparing breakfast the night before would help these athletes to avoid being rushed in the morning and allow for an adequate breakfast. Eating a sufficient breakfast is especially important if the previous day's practice was hard in order to replace the expended energy stores.

One of the limitations of this study was the small number of athletes observed. A larger sample would have possibly shown a greater difference between the athletes involved in the different events. However, a more important limitation may have been the type of dietary recall method used in this study.

There are numerous advantages and disadvantages of each method used to determine nutrient intake. The main advantage of a 24-hour recall is that it can be conducted using a single short interview as well as include a large number of subjects (11). However, one limitation to using this type of recall is it only observes intake over one 24 hour period. As a result, selecting the day to perform the recall is a critical component. When working with athletes, this limitation may be even more important. For example, different days during training (e.g. hard versus easy days) or even a rest day may vary their diet and be reflected in their caloric intake. While longer dietary histories (e.g. three or seven days) provide consecutive days of recording they have been found to be of little use for athletes because of the daily changes in their training (11). In addition, the longer the histories require increased dependence on the subject's memory and compliance. All in all, determining the appropriate method to obtaining nutrient intakes depends on the question being addressed and the inherent limitations to the overall results.

The wide range of rankings of the difficulty of practice is also a limitation needing to be addressed. Even when the athletes did their recordings on a "hard" practice day their rankings ranged from 2-8 (5.3 ± 1.7) on a 10 point scale. Foster et al., (2001) found that there were relevant differences between coach's' and athletes' ratings of the intensity of practices. For practice sessions intended by the coaches to be relatively hard, the athletes rated them significantly less than coaches intended, while they rated intended easier practices as harder on the scale (12). The difference between a light and hard practice would influence greatly what the athlete consumed that day in order to replace expended energy.

Labeling the athletes' activity level as "very active" influences the calculated level of energy expenditure by Mets. Expenditure then effects the recommendations for each nutrient. Having more distinct definitions between "active" and "very active" could alter the recommendations and result in more athletes receiving adequate intake. Perhaps the "very active" recommendations are too extreme leading numerous studies to suggest that athletes are not consuming proper nutrition.

Overall, our results suggest the dietary intake of Division III female track and field athletes was insufficient for an active athletic population. The main barrier encountered by half of these athletes was being rushed during meal time. This indicates there are other underlying factors or barriers needing to be further examined to determine what causes these athletes to consume inadequate diets. Future research should look at the dietary practices over a longer time period ultimately allowing for the possibility for underlying barriers to emerge. Considering the population observed, weekday consumption may change in reference to the date of weekly competition or practice intensity while weekend dietary intake could also be included. And finally, all collegiate levels of athletes should be observed as each division has its challenges to eating healthy.

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APPENDIX A

INFORMED CONSENT

Protocol Title: Nutrient Intake in Female Collegiate Track and Field Athletes

Principle Investigator: Marni Benson
620 11th St. N #1
La Crosse, WI 54601
(701) 361-1799
Emergency Contact: Marni Benson
(701) 361-1799

- **Purpose and Procedure**
  - The purpose of this study is to determine if track and field athletes are meeting the recommended energy and nutrient intakes necessary for training and performance.
  - My participation will involve attending a 15 minute session scheduled with the principle investigator. During the entire day prior to the session, I will record what foods and beverages I consumed and when I had them, on a handout provided to me. In addition, I will record all activities, including what I did at practice in that same time period.
  - At the scheduled testing session I will discuss my 24-hour dietary and activity recordings. The investigator will ask me questions about what I wrote in order to gain more reliable information. Food models and prompt questions will be used to gain this information.
  - Height and weight will be collected to individualize my estimated nutrition requirements.
  - The total time requirement is approximately one 15 minute session.
  - Testing will take place in room 225 Mitchell, Human Performance Lab.
- **Potential Risks**
  - There are no potential risks for me participating in this study.
- **Rights and Confidentiality**
  - My participation is voluntary.
  - I can withdraw from the study at any time for any reason without penalty.
  - The results of this study may be published in scientific literature or presented at professional meetings using grouped data only.
  - All information will be kept confidential through the use of number codes. My data will not be linked with personally identifiable information.
- **Possible Benefits**
  - At the end of the study I will learn my energy and nutrient intake from the testing session. From this information, it can be determined if more education concerning nutrition and performance is necessary.

Questions regarding study procedures may be directed to Marni Benson (701-361-1799), the principal investigator, or the study advisor Rebecca Battista, Ph.D., Department of Exercise and Sport Science, UW-L (608-785-8182). Questions regarding the protection of human subjects may be addressed to the UW-La Crosse Institutional Review Board for the Protection of Human Subjects, (608-785-8124 or irb@uwlax.edu).

Participant ________________________________ Date______________

Researcher_________________________________ Date______________

APPENDIX B

EATING BEHAVIOR JOURNAL

Eating Behavior Journal

Time Eaten	**Location** (dining hall, home, restaurant)	**Foods and Beverages Consumed** Amounts/Description *very specific*	**Degree of Hunger** 0=not hungry 1=hungry 2=very hungry	**Social Situation** (alone, friends, or teammates)

Eating Behavior Journal

Time Eaten	**Location** (dining hall, home, restaurant)	**Foods and Beverages Consumed** Amounts/Description *very specific*	**Degree of Hunger** 0=not hungry 1=hungry 2=very hungry	**Social Situation** (alone, friends, or teammates)
7:15	Home	Milk 8oz	1	alone
		Whole wheat toast, 1 slice, Sara Lee		
		Reduced fat peanut butter, 1 tsp		
		Med banana		
8:00	REC	Water, 12 oz	0	alone
9:30	Class	Strawberry Yogurt, Yoplait Light, 1 individual container	1	classmates
		Water 12 oz		
		1 Quaker Chocolate Chip granola bar		
11:30	Home	Turkey-4 thin slices	2	roommate
		Mustard-1 tbsp		
		Lettuce-1/2 c, ice burg		
		Tomatoes- 3 slices		
		Diet coke-1 can		
		Bbq chips- sm bag, baked		
		Baby carrots- 6		
2:00	class	Water, 12 oz	2	classmates
		Apple-med		
		Double stuffed oreos-3		
6:00	Home	Cheerios honey nut-1½ C	1	alone
		Skim milk-2 C		
7:30	Home	water	8 oz.	

APPENDIX C

QUESTIONNAIRE

Name: ________________________________ Date: __________
Please check the most appropriate box.

1. Where do you currently live?
   _____ Dorms _____ Off Campus _____ With family (e.g, parents)

2. Thinking of a typical week, where do you usually eat meals?
   a. Breakfast
      _____ On _____ Off campus
   b. Lunch
      _____ On _____ Off campus
   c. Dinner
      _____ On _____ Off campus

3. Considering today, were any of your meals eaten in a rush today (e.g., did you have limited time to eat)?
   a. Breakfast
      _____ yes _____ no
   b. Lunch
      _____ yes _____ no
   c. Dinner
      _____ yes _____ no

If your meals were hurried, check all the boxes that apply as to why you ate fast.
_____ practice time _____dining hall hours _____ hungry

_____ meet with study group _____ class

_____ other (please explain):

4. For any of your meals today, did you eat out (e.g., off campus dining, Burger King, Subway, etc)
   _____Yes _____ No

If yes, was the food choice made by amount of money you had available to you?
   _____ Yes _____ No

5. On a scale of 1 to 5, how healthy did you feel your food/beverage choices were today?
   1-absolutely unhealthy

2-unhealthy
3-moderately healthy
4-healthy
5-extremely healthy

6. Please circle the event(s) you regularly compete in?

55 dash	mile	Shot put	4x200 Relay
200 dash	3000 run	High Jump	4x400 Relay
300 dash	5000 run	Long Jump	Distance Medley Relay
400 dash	55 Hurdles	Triple Jump	
600 dash	Pentathalon	20-lb weight	
800 dash		Pole vault	

7. Considering only your practice today, if you had to tell your roommate how hard it was OVERALL, what would you choose (please circle the most appropriate answer)?

0-rest
1-very easy
2-easy
3-moderate
4-sort of hard
5-hard
6-
7-very hard
8-very,very hard
9-nearly maximal
10-maximal

8. How long, in minutes, did you practice today?

APPENDIX D

PHYSICAL ACTIVITY RECORD

Name:

Day of Activity:

Activity	Duration (min)	Intensity

Intensity
Easy = This is a light workout
Medium = You are breaking a sweat
Hard = Heavy Intensity

Name:

Day of Activity:

Activity	Duration (min)	Intensity
walked to class	15	easy
warm-up jog	5	easy
elliptical	45	medium
lifted	10	medium
sprints	10	hard
stretched	5	easy
walked home	20	easy

Intensity
Easy = This is a light workout
Medium = You are breaking a sweat
Hard = Heavy Intensity

APPENDIX E

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Introduction

Competitive athletes require sufficient energy to achieve and maintain energy balance. It is well accepted that both athletic performance and recovery from strenuous exercise can be enhanced by optimal nutrition (1,2). However, it is also relatively well known that athletes, specifically college athletes do not consume the recommended macro and micronutrients critical to training and performance. Therefore it is important to further understand any barriers collegiate athletes face when it comes to eating healthy.

Macronutrients

Carbohydrates, protein, and lipids are the three macronutrients. They provide energy to maintain the body's functions during rest and physical activity (3-5). Acceptable macronutrient distribution ranges (AMDRs) are set for each of these nutrients to suggest a role in chronic disease and ensure sufficient intakes of other essential nutrients, such as fiber (5,6).The AMDRs for carbohydrates, protein, and lipids are 45-65%, 10-35%, and 20-35% respectively. Athlete's requirements are considered to be in the same ranges with the general population (5).

Carbohydrates are the primary energy fuel for the body, especially during intense physical activity (4). It plays a critical role in training and recovery helping to maintain blood-glucose levels and replace muscle glycogen needed to maintain desired intensity levels (1,4). The AMDR has the lower percentage at 45% because below that would not allow for the AI (adequate intake) of fiber to be met, and the 65% of carbohydrates still allows for an adequate amount of protein and lipids (5). The exact percent of caloric intake needed for each athlete depends upon gender and the amount of physical activity

(1). Carbohydrates play a crucial role during recovery and in maintaining desired intensity levels in training (1,4).

The association of fiber with lowering blood cholesterol and the risk of heart disease, and maintaining blood glucose has led to a new DRI report of dietary recommendations (5). The adequate intake includes both dietary and functional fiber. Dietary fiber is nondigestible carbohydrates and lignin that are in plants while functional fiber is isolated, nondigestible carbohydrates that have been shown to have beneficial physiological effects in humans (5,6). The primary physiological effects include reducing of blood glucose levels, and normalization of cholesterol levels. The AI is 38g/d and 25g/d for men and women respectively, based on a 14g per 1000 kcal diet (5).

Protein supplies the body with energy, plays a role in tissue structure, and aids in metabolic, transport, and hormonal systems (4). Protein is the macronutrient that many researchers debate about in terms of the recommended amounts for athletes. Some believe athletes need a greater amount than the general population while others believe AMDR of 10-35% is sufficient. The AMDR allows for sufficient nitrogen and amino acids needed for protein synthesis, but can be found harmful if consumed in excess adding strain on the liver and kidneys (4,5).

Lipids are the largest nutrient store of potential energy for the body's biological work, and assists in absorption on vitamins (4,5). The AMDR is set at 20-35%, and is the same for both the general and athletic population (5). It has been found that there is no benefit for a diet of less than 15% (1). Horvath et al. examined the effects of different fat intake levels of endurance runners of both sexes. Low (17%), medium (31%), and high (44%) fat menus were adjusted with the carbohydrate intakes to meet the RDAs of other nutrients (2). The runners placed on the low fat diet were not able to meet any of the RDAs or required amount of caloric intake. Those on the medium and high fat diets met or even exceeded the recommendations. Increasing dietary fat increases energy consumption (2). Fat is important in diets of athletes because it not only provides energy but essential fatty acids (1).

Micronutrients

Micronutrients may not directly supply the energy to the body but they have a number of important roles. Energy production, hemoglobin synthesis, bone health, immune function, protection of body tissues, and building and repairing muscle tissue after exercises are the primary roles (1).

Dietary reference intakes are used for the recommendations for micronutrients. The recommended daily allowances (RDA) meet the needs of 97.5% of a specific group (7). The research is limited but it is suggested that exercise does not increase the need for vitamins, and eating a balanced diet should provide the adequate amount (1,8).

Three of the main micronutrients when relating to physical activity are iron, calcium, and vitamin D. Iron combines with hemoglobin to transport oxygen in the blood, and also combines with myoglobin to aid in oxygen storage and transport in the muscle cell aiding in the energy production needed for exercise (1,4). When determining the adequate amount for an individual age, gender, diet, drug use, and level of activity all have to be taken into consideration (4,7). Vegetarian diets and women menstruating are special considerations. In general, regular physical activity does not create insufficient iron reserves (4). However, if not eating the recommended amount athletes are at an increase risk of iron deficiency anemia.

A few of calcium's roles are aiding in muscle action, blood clotting, nerve transmission, activation of enzymes, and synthesis of vitamin D (4). Calcium is the most frequent mineral deficiency, and most often seen in women (8). Osteoporosis is one of the components of the female athlete triad. Bone density closely relates to the number of menstruation cycles which if reduced can remove estrogen's protective effect on bones (4). Sufficient calcium intake may not directly enhance performance but exercise does help build bone mass and strength. Calcium and vitamin D both play a role in optimal bone health.

Vitamin D plays an important role in bone health and prevention of autoimmune and chronic diseases (9). Vitamin D increases calcium absorption promoting growth and maintenance of bones (4). This vitamin is received through sunlight and dairy sources. Currently there is not an increased recommendation from the general population for athletes, but is thought to have positive affects on health and performance such as decreasing the risk of stress fractures (9). Although not much research has been done on vitamin D it is well recognized for its beneficial roles on bone health, immunity, and inflammation and likely to affect an athlete's overall health and ability to train..

Athletes Dietary Intakes

Challenges are faced when college athletes try to achieve the recommended amounts of a nutritional diet. These barriers include, but are not limited to money and convenience. Poor eating habits can lead to insufficient energy intake, and injuries, while in the complete opposite direction of consuming too many calories can result in high body fat percentages and overweight (3). Past studies have shown both of these extremes in athletes. Collegiate athletes are not consuming adequate nutritional diets is the bottom line to both of these extremes.

Quatromoni, 2008 suggested that college athletes need nutrition services to help effectively face the rigorous demands of their sports and college lifestyles. This program had a multidisciplinary wellness team made up of physicians, athletic trainers, strength and conditioning coaches, academic counselors, sport psychologists, and sport dieticians that was designed to provide screening, referrals, assessment, diagnosis, treatment, and educational programming for collegiate athletes. Quatromoni observed this program while collegiate athletes with nutritional risks were treated. The nutrition consultations provided by a registered dietician provided counseling using many strategies including cognitive behavioral therapy, self-monitoring journals, readiness to change, and goal setting. The main goal was to ensure nutritional adequacy for athletic performance and build self-efficiency for healthful relationships with food and body image. The common challenges reported for consuming adequate diets by these athletes were dieting, dissatisfaction with body image, weight gain in off season, stress management, pressures of the sports environment, adjustment to college life, and academic pressures (3). After a year of using the established program the number of athletes served was doubled, eighty-two percent of them being women (3). This observation of the multidisciplinary wellness program illustrates that if nutrition services are provided athletes will participate and have been shown to be effective. Having the status of a Division I school this wellness program is able to meet the financial needs required to effectively maintain and offer its services.

Athletes themselves believe that nutrition plays a role in their performances. Zawila et al., 2003 and Rash et al, 2008 compared the relationships between nutritional knowledge, and nutrition-related attitude in cross-country runners and track athletes. Zawila et al. observed female cross-country runners and found that those runners who had been more educated in nutrition scored higher and correlated strongly with confidence that optimal nutrition has a positive affect on athletic performance (8).

To further understand barriers to receiving adequate nutrition, Rash et al., 2008 compared knowledge and attitude of both genders on a track team to their actual dietary patterns. After scoring high on a nutritional quiz showing these athletes were knowledgeable in nutrition it was determined that knowledge of proper nutrient intake predicted less than one percent of actual dietary intake (10). In addition, nutrition attitude measured by the athletes' responses to five statements of belief that healthy eating is related to sports performance was high. However, their positive attitudes towards healthy eating were only 5% predictive of dietary intake. Nonetheless, results of this study suggest there is a disconnection in college athletes between knowing about and practicing good nutrition.

The majority of all these athletes showed positive beliefs on the relationship between nutrition and athletic performance using the Likert scale (8,10). The true-false questions on nutrition knowledge varied in results, each showing different strong and weak areas, but overall had a good basic understanding of nutrition. Zawila et al., (2003) reported the athletes' knowledge as strong on functional foods, iron, and hydration while Rash et al., (2008) saw carbohydrates as the strongest topic. Both these studies showed the athletes' nutritional knowledge weakest on vitamins and minerals.

Strict diets that are sometimes adopted by competitive athletes do not always allow the required nutrients to be consumed while putting their bodies in danger. Extreme caloric intake restrictions for example can often lead to excessive fatigue, compromised immunity, or menstrual dysfunction. Dissatisfaction of body weight or body composition is a common challenge to these athletes with chronic dieting (3). This is what ultimately leads to macro- and/or micronutrient deficiencies making the athlete more prone to injury or disease.

In other cases, athletes may be consuming the correct caloric intake, but are still not receiving optimal nutrition. Clark et al., (2003) observed Division I soccer players during a competitive season. It was determined that the players were meeting the recommended caloric intake during both pre- and post-season even with their change in activity level taken into consideration. However, the authors did point out that the athletes were still not meeting the specific nutrient guidelines (11). In fact, it was noted that protein and fat intake met the recommendations, but carbohydrates fell short. Carbohydrates have the critical role of fueling the body, especially during high intensity activities (4). A similar result was found in top-level swimmers of both genders (12). The low carbohydrate consumption was thought to prevent the athletes from training as hard, and the majority of the fat was saturated (12). Carbohydrates help maintain blood-glucose levels and replace muscle glycogen needed to maintain intensity levels desired (1,4). Athletes should be encouraged to eat nutrient-dense diets, getting adequate amounts of carbohydrates, protein, and fat.

Many studies have shown collegiate athletes are not receiving adequate nutrition. There are a number of barriers among this population to meet the recommendations.

However, knowledge of good nutrition has been found to not be one of them. Eating on campus in cafeterias offers both healthy and unhealthy options. Knowing what to look for and being aware of healthier choices that offer the best nutrition is important. Nutrition counseling has shown to be an effective tool for overcoming these barriers.

Dietary Records

Knowing what an athlete has consumed is one way to learn their typical eating habits. Diet recalls, diet histories, and food frequency questionnaires are some of the most common methods to determine if athletes are receiving adequate nutrition. For dietary recalls the subject is asked to record everything they ate or drank for a specific time, usually 24 hours. Diet histories look at longer time periods, typically three or seven consecutive days, attempting to construct a typical eating pattern. Each of these methods require accurate recording from the subject and good communication skills from both the subject and, when necessary, the interviewer. To complete a food frequency questionnaire subjects looks at a list of foods with options to indicate how often each item is eaten.

Each of these methods has a number of advantages along with disadvantages. Minimal subject burden and the ability to study a large number of subjects are the two largest advantages of 24 hour recalls (13). The disadvantages of this method include the high dependence on memory, and estimation of proportions (13). In addition, the authors note that the days of recording must be chosen carefully to represent the different kinds of day in the athletic populations' lifestyle, and obtaining as much information as possible about their lifestyle and physical activity is crucial (2001).

It is important to look at both the advantages and disadvantages when choosing which method to use look at subjects' typical eating habits. Populations participating in different sporting events may vary in benefiting from one type of dietary measurement over another.

Summary

To achieve and maintain energy balance competitive athletes require sufficient energy. It is known performance and recovery is enhanced from proper nutrition and that college athletes often do not meet the nutrient recommendations important. It is critical fully understand and identify the barriers they commonly face.

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