

8-16-2016

Association of Body Weight with Athletic Success and the Occurrence of Female Athlete Triad in Cross Country Athletes

Lindsey Hinken

Western Kentucky University, lindsey.hinken301@topper.wku.edu

Follow this and additional works at: http://digitalcommons.wku.edu/stu_hon_theses

 Part of the [Dietetics and Clinical Nutrition Commons](#), [Other Public Health Commons](#), and the [Sports Sciences Commons](#)

Recommended Citation

Hinken, Lindsey, "Association of Body Weight with Athletic Success and the Occurrence of Female Athlete Triad in Cross Country Athletes" (2016). *Honors College Capstone Experience/Thesis Projects*. Paper 609.
http://digitalcommons.wku.edu/stu_hon_theses/609

This Thesis is brought to you for free and open access by TopSCHOLAR®. It has been accepted for inclusion in Honors College Capstone Experience/Thesis Projects by an authorized administrator of TopSCHOLAR®. For more information, please contact topscholar@wku.edu.

ASSOCIATION OF BODY WEIGHT WITH ATHLETIC SUCCESS AND
THE OCCURRENCE OF FEMALE ATHLETE TRIAD IN CROSS COUNTRY
ATHLETES

A Capstone Experience/Thesis Project

Presented in Partial Fulfillment of the Requirements for

the Degree Bachelor of Science with

Honors College Graduate Distinction at Western Kentucky University

By:

Lindsey E Hinken

Western Kentucky University
2016

CE/T Committee:

Dr. Margaret Cook-Newell, Advisor

Dr. Karen Mason

Dr. Keri Esslinger

Approved by:

Advisor

Department of Family and Consumer Sciences

Copyright by
Lindsey E. Hinken
2016

ABSTRACT

Young adult females who participate in endurance sports are at risk of developing Female Athlete Triad (FAT). The high prevalence of FAT among collegiate athletes and its potentially lifelong consequences substantiate the importance of relevant research. The objective of the present study is to identify the risk of FAT among the Western Kentucky University women's cross country team, based on the presence or absence of the three FAT components, and to investigate the perceptions of those determined to be 'at-risk.' It was hypothesized that a preponderance of the WKU women's cross country team would be considered 'at risk' for developing FAT, and that a relationship would be seen between the manifestation of the three FAT components and athletes' perceptions regarding thinness and improved athletic performance. Analysis of participants' food records and questionnaire responses supported these hypotheses. All participants displayed at least one FAT component, and a majority associated low body weight with athletic success. Outcomes suggest that manifestation of FAT correlates with athletes' beliefs regarding thinness and performance, i.e., low body weight leads to improved performance.

Keywords: Female Athlete Triad, Cross Country, Endurance Athletes, Collegiate Athletes

ACKNOWLEDGEMENTS

Many people helped make this Capstone Experience/ Thesis project possible. Primarily, I would like to thank my advisor, Dr. Margaret Cook-Newell, for her continuous support since we began working together two years ago. She has provided invaluable help from the inception of this project idea to its completion. I would also like to thank the other two members of my committee, Dr. Karen Mason and Dr. Keri Esslinger, for their suggestions and evaluation of my work. Lastly, I would like to thank my friends and family for encouraging me to reach my aspirations throughout my college career.

I am grateful to have been a part of the WKU Honors College for the last four years. It has provided me with a challenging academic environment that has demanded high levels of dedication and commitment. The opportunity to complete a thesis at the undergraduate level has been a unique experience that will leave me better prepared to pursue my future endeavors as a graduate student.

VITA

September 16, 1994.....Born- Dayton, Ohio
2008-2012.....St. Henry District High School
2012-2016.....Honors College at Western Kentucky University
2012-2016.....WKU President’s List
2012-2016.....WKU Honors College Award of Excellence Scholar
2012-2016.....WKU Cross Country/ Track & Field Team
2012-2014.....Sunbelt Conference Commissioner’s All Academic List
2013-2016.....Chi Alpha Sigma National College Athlete Honor Society
2015.....KIIS Greece Summer Study Abroad
2015-2016.....WKU Clinical and Applied Research Group (Psychology)
2015.....USTFCCCA NCAA Division I All Academic Honors
2015.....Conference USA Cross Country All-Academic Team
2016.....Poster presentation at the KAND Annual Conference
2016.....WKU Female Scholar Athlete of the Year

FIELDS OF STUDY

Major Field: Biology

Minor Fields: Nutrition & Psychology

TABLE OF CONTENTS

	<u>Page</u>
Abstract.....	ii
Acknowledgements.....	iii
Vita.....	iv
List of Figures.....	vi
Introduction.....	1
Method.....	6
Results.....	9
Discussion.....	16
Conclusion.....	20
References.....	22

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
Table 1.....	2
Table 2.....	7
Graph 1.....	10
Graph 2.....	10
Graph 3.....	11
Graph 4.....	12
Graph 5.....	13
Graph 6.....	14
Graph 7.....	15
Graph 8.....	16

Introduction

Association of Body Weight with Athletic Success and the Occurrence of Female Athlete Triad in Cross Country Athletes

Female Athlete Triad (FAT) is a syndrome of interrelated conditions existing on a continuum of severity (Blake, 2015). The conditions encompass inadequate caloric intake, amenorrhea, and low bone mineral density (BMD). These conditions often occur simultaneously, i.e., the manifestation of one is likely due to the presence of another. The precipitating factor is caloric deficit, often resulting in amenorrhea and low BMD. As of 2013, estimates revealed that all three components of FAT affect up to 16% of athletes, and the presence of two of the three components affect up to 60% of athletes in particular sports (Barrack, Ackerman, & Gibbs). Women who participate in collegiate endurance sports constitute a population that is highly susceptible to developing this disorder. Due to its pervasive presence and severe immediate and long-term consequences, it is clear that the development of effective prevention and early intervention and treatment strategies are of utmost importance.

A variety of research has been conducted on Female Athlete Triad. Some of the most widespread themes include the three FAT components, the disorder's prevalence, risk factors, long-term consequences, and treatment, and the effectiveness of nutrition education relative to prevention and treatment efforts. Table 1 summarizes sources that discuss one or more of these research subjects.

Table 1: Review of the Literature

Author	Risk factors and causes	Prevalence	Prevention	Nutrition education	Treatment	FAT components: a.) Energy balance b.) Bone health c.) Amenorrhea d.) Endothelial dysfunction	Long term consequences
Kransdorf	✓				✓	✓ energy balance	
Thompson	✓	✓				✓ energy balance, bone health, amenorrhea	
Raymond-Barker	✓	✓	✓	✓ (of athletes)	✓	✓ energy balance/nutrition	
Marquez			✓		✓	✓ energy balance, bone health, amenorrhea, endothelial dysfunction	✓ (decreased performance, low BMD)
Lassiter			✓	✓ (of coaches)	✓		
Laframboise					✓	✓ energy balance, bone health, amenorrhea, endothelial dysfunction	
Donaldson	✓		✓			✓ energy balance, amenorrhea	
Clairmont					✓	✓ energy balance/nutrition	
Barrack		✓	✓	✓ (of athletes)		✓ energy balance, bone health, amenorrhea, endothelial dysfunction	✓ (lowered BMD that may not be recovered)
Zeigler				✓ (of athletes)	✓	✓ energy balance, bone health, amenorrhea	✓ (lowered BMD that may not be recovered)
Jayed						✓ energy balance, bone health, amenorrhea, endothelial dysfunction	✓ (cardiovascular complications, injuries)
Sangenis	✓	✓	✓		✓	✓ energy balance, bone health, amenorrhea	✓ (bone health)

Among the sources reviewed for the present study, low energy intake was the most prominently addressed FAT component, likely because it is the initiating symptom of the disorder. In the International Olympic Committee’s (IOC) *Position Stand on the*

Female Athlete Triad, low energy availability is defined as “an energy intake inadequate to meet energy expenditure as well as other physiological needs” (2005, p. 2). Inadequate energy intake can be a result of a clinical eating disorder, subclinical disordered eating behaviors, such as calorie restriction, food avoidance, fasting, etc., or excessive exercise. Athletes may engage in these behaviors with hopes of becoming- or staying- lean for competitive advantages (Raymond-Barker, Petroczi, & Quested, 2007). When less than 30kcal/kg/day is consumed, menstrual function and bone mass are affected (Marquez & Molinero, 2013). Therefore, low energy availability often leads to the other two components of the Triad: amenorrhea and low bone mineral density.

The IOC’s *Position Stand on the Female Athlete Triad* defines amenorrhea as the “persistent absence of menstrual cycles” because of hormonal disruptions that result from negative energy balance (2005, p. 16). Lack of menstruation is related to low estrogen levels and which may result in low BMD. Due to estrogen’s ability to enhance calcium absorption and bone formation and remodeling, amenorrhea is detrimental to bone health.

Poor nutrition and amenorrhea can individually destroy bone integrity, and the effects are magnified when these conditions coincide. Low BMD is often diagnosed as osteoporosis, or osteopenia in less severe cases. The IOC’s *Position Stand on the Female Athlete Triad* defines osteoporosis as a “degenerative disease of the skeleton usually associated with elderly post-menopausal women” (2005, p. 21). It is medically classified as a geriatric disease, which is why such alarm is raised by its appearance among young females. Under this condition, bone resorption exceeds bone formation, and structural deterioration can occur, which increases skeletal fragility and the risk of musculoskeletal injuries among athletes, particularly stress fractures.

Current research reveals a higher rate of FAT among athletes than non-athletes, especially those that participate in thin-build, aesthetic, or endurance sports (Thompson, 2007; Raymond-Barker et al., 2007; Barrack et al., 2013). Among athletes, the prevalence of disordered eating ranged from 18.2%-35.4%, menstrual dysfunction ranged from 18.8%-54%, and low BMD ranged from 13%-21.8%; these occurred significantly more often in endurance runners than non-runners (Barrack et al., 2013).

A variety of risk factors contribute to the development of FAT. These can be categorized into “non-sport related” and “athlete specific” factors (IOC, 2005). “Non-sport related factors” include dieting/restrictive eating and social pressure; “athlete specific factors” include the belief that decreasing body weight or fat will improve performance, the overlap between eating disorder symptoms and traits of “good athletes”, and competitive thinness, in which athletes make unhealthy body comparisons between themselves, competitors, and/or teammates, and strive to gain a competitive advantage through attaining the leanest physique. Other risk factors include young participation in competitive sports and personality traits such as high self-motivation, compulsiveness, competitiveness, perfectionism, persistence, high expectations, and independence (Thompson, 2007; Kransdorf et al., 2013).

Female Athlete Triad has immediate and long-term physiological repercussions. In the presence of FAT, athletic performance is likely to decline due to increased injury susceptibility, muscle loss, fatigue, anemia, fluid and electrolyte imbalances, depleted oxygen stores, gastrointestinal issues, and depression (Jayed et al., 2013; Zeigler, n.d). Long-term consequences may be even more serious. If amenorrhea occurs during adolescence, it is possible that peak bone mass will not be reached, which can lead to an

increase in skeletal fragility (IOC, 2005). Some studies have shown that even when menses resumes, low bone mass may not be fully recovered (Barrack et al., 2013; Zeigler, n.d). Additionally, amenorrhea may result in infertility after a prolonged absence of progesterone (IOC, 2005).

Female Athlete Triad becomes increasingly difficult to treat as it progresses; therefore, early intervention is critical (Lassiter & Watt, 2007). Patients should work with a “team of experts” (Zeigler) including a sports physician, psychologist, and dietitian (Kransdorf et al., 2013), and coaches and family members should be included in the treatment plan to support the athlete (Marquez & Molinero, 2013). First and foremost, adequate caloric intake must be established. Typical eating disorder treatment methods, such as psychotherapy, nutritional counseling, and sometimes pharmacotherapy, are usually employed (IOC, 2005). Energy balance should be restored through reducing exercise and increasing caloric intake, which may naturally resolve amenorrhea and improve BMD (Kransdorf et al., 2013, Marquez & Molinero, 2013, Laframboise et al., 2013, Clairmont, 2000). If amenorrhea still occurs after malnutrition subsides, oral contraceptives are sometimes used to induce menstruation. Athletes may initially resist treatment, but are more likely to comply after learning about the detriments of FAT on athletic performance and future health (Raymond-Barker et al., 2007).

Because treatment can be difficult, athletic programs, coaches, and athletes themselves should strive to prevent the initial occurrence of Female Athlete Triad. Establishing proper nutrition is critical (IOC, 2005; Raymond-Barker et al., 2007). If athletes can avoid inadequate caloric intake, they are also likely to avoid amenorrhea and low BMD. Before every season, athletes should undergo screenings that assess menstrual

status, nutritional intake, body weight and composition, blood hormone levels, and injury history. Despite their obvious importance in helping to prevent Female Athlete Triad, there is a severe deficit and inadequacy of Pre-Participation Exams, PPEs, as evidenced by a study of 74% of NCAA Division I universities by Barrack et al. (2013). Although all of the participating universities mandated PPEs for incoming athletes, only 32% of the participating universities required them for returning athletes.

Education can be an important step for preventing Female Athlete Triad. Studies indicate that many female athletes are unaware of FAT and the relationship between amenorrhea and bone loss (Barrack et al., 2013). Coaches also appear to be uninformed and/or feel uncomfortable discussing the issue with their athletes (Lassiter & Watt, 2007). Education programs and interventions appear promising, as they have been associated with improved dietary habits and psychological states (Barrack et al., 2013). However, some research indicates that nutritional education is not effective in changing pathological eating behavior (Raymond Barker et al., 2013). Some athletes continue engaging in unhealthy nutritional practices, even after they are made aware of the potential consequences. This indicates that education should not be the sole source of treatment or prevention efforts.

Methods

Participants

The population of interest for this study included American female collegiate cross country runners. Women who competed during the 2015 season for the Western Kentucky University female cross country team were used as a convenience sample. There were a total of ten participants. All participants were American

college students between 18 and 22 years old. Nine participants were Caucasian; one was African American. Participants' BMIs ranged from 17.7 to 22.7 kg/m². Table 2 provides a summary of participant demographics.

Table 2										
Participant Demographics/History										
Participant #	1	2	3	4	5	6	7	8	9	10
Age	19	22	19	19	20	20	21	21	21	18
BMI	22.7	19.1	20.0	20.7	17.7	19.4	23.3	18.6	N/A	18.8
Diagnosis of Eating Disorder	Yes	No	No	No	Yes	No	No	Yes	No	No

Materials

Survey. All participants completed a survey to provide researchers with necessary data to investigate the research question. The intent of the survey was to collect demographic information, anthropometric measurements, and assess the athletes' attitudes, perceptions, and behaviors regarding a variety of topics such as food consumption; body weight, image, and composition; exercise amount and motivation; the relationship between thinness and athletic success; the influence of others; and extraneous stressors and coping ability. The Pre-Participation Examination questions recommended by the Female Athlete Triad Coalition (n.d) and the Female Athlete Screening Tool questionnaire (McNulty, 2001) are two different pre-existing sets of questions, which have been validated as effective Female Athlete Triad risk assessments in previous studies. These questionnaires

provide self-reported measures of common eating disorder characteristics and symptoms. These screening tools can indicate if one is ‘at-risk’ for developing an eating disorder. The researcher created an original 53-item survey for this specific study. It included demographics, anthropometrics, and a compilation of questions pooled from the two aforementioned questionnaires. The survey questions were either open-ended (i.e. “How do you think your weight affects your performance?”) or restricted, which utilized either a dichotomous (yes/no) or a six point Likert-scale from (1) Never/strongly disagree to (6) Always/ strongly agree.

USDA SuperTracker. This online tool generates caloric, macronutrient, and micronutrient Dietary Reference Intake (DRI) recommendations based on gender, age, height, weight, and activity level. Participants in the present study utilized this program to keep a three-day food record and compare their actual intake to their individualized DRI. (<https://supertracker.usda.gov/>)

Procedure

WKU IRB approval was obtained to conduct a study on the occurrence of Female Athlete Triad among WKU female cross country athletes. Prior to the study, participants signed a consent form. They were then asked to complete a three-day food log. All participants collectively met with the researcher at a designated time and location. During this meeting, the researcher guided participants through the process of entering their food log into the online USDA SuperTracker (n.d.), and the participants completed the survey outlined above. Afterwards, a debriefing handout was distributed in case any individuals were interested in seeking out additional resources concerning Female Athlete Triad.

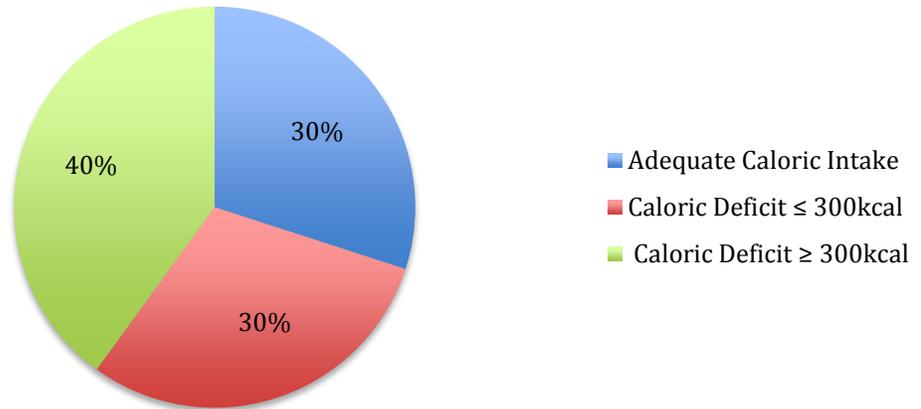
The researcher analyzed the data to determine participants’ risk level of developing

FAT and the extent to which they associated thinness with athletic success. To assess participants' risk of FAT, the investigator operationally defined the three components. Caloric intake was assessed using USDA SuperTracker (n.d.) to compare average caloric intake to recommendations. Failure to meet DRI indicated inadequate caloric intake. Self-reported lack of monthly menstruation at the time of the study was used as the diagnostic criteria for amenorrhea. Dietary calcium intake, which was based on USDA SuperTracker nutrient reports, and self-reported history of stress fractures were used to estimate BMD. Failure to meet the calcium DRI and/or the occurrence of a stress fracture indicated low BMD. Risk level for developing FAT was determined using the following protocol: Participants that showed zero, one, two, or three of the components were considered at 'No Risk', 'Low Risk', 'Moderate Risk', or 'High Risk', respectively.

Results

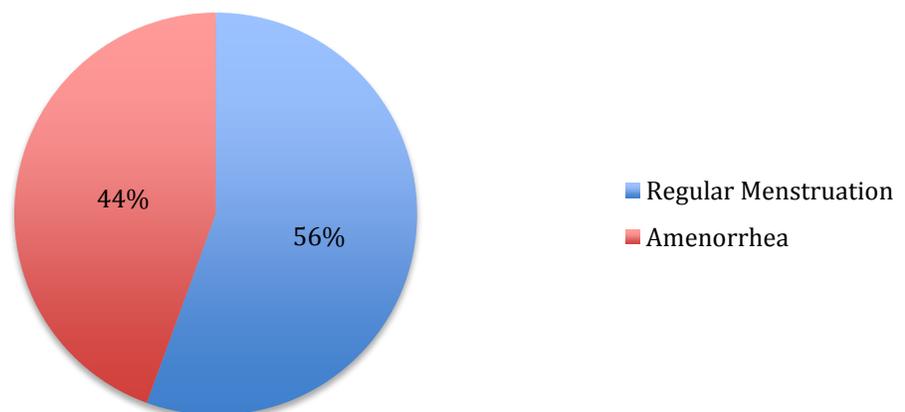
In order to identify the prevalence of the three Female Athlete Triad components, and therefore the risk of developing FAT, among the WKU women's cross country team, caloric intake, menstrual status, and BMD were assessed. Participants' reported intakes of energy and nutrients were compared to their Dietary Reference Intake (DRI). Results showed that 70% (7/10) of participants consumed fewer calories than recommended. Further analysis revealed that a preponderance (4/7) of these participants fell within a 300 calorie deficit daily. Graph 1 is a depiction of Average Daily Caloric Intake results.

Graph 1
Average Daily Caloric Intake



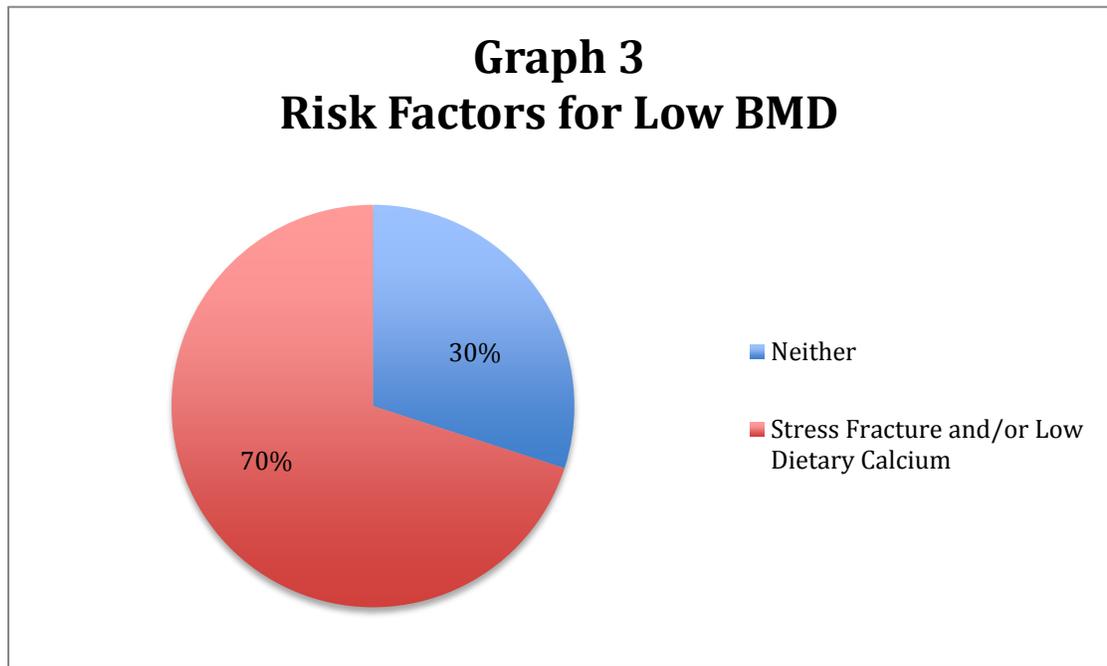
Ninety percent (9/10) of the participants responded to the survey question that addressed amenorrhea. Irregular or absent menstrual cycles over the past year were reported by 44% (4/9). Graph 2 is a display of participants' Menstrual Status.

Graph 2
Menstrual Status



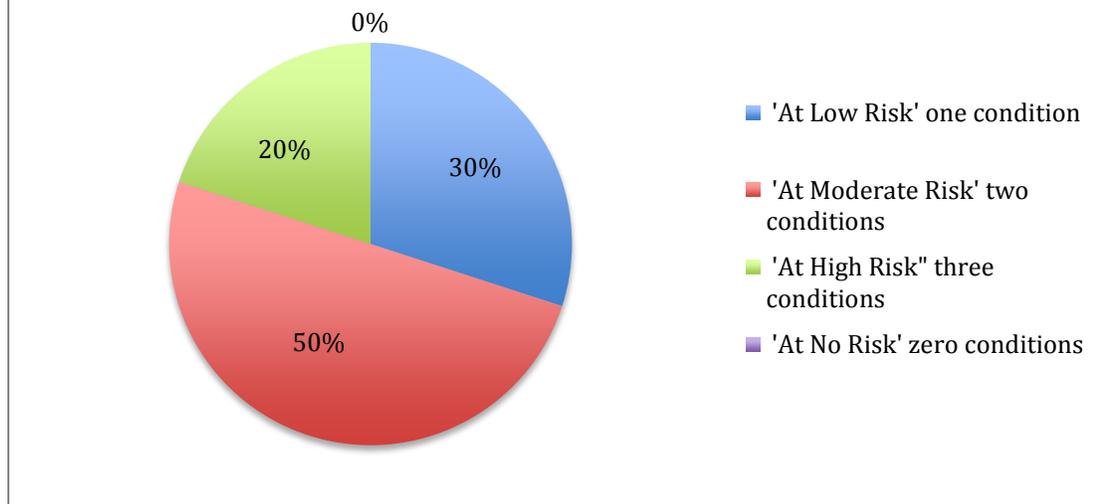
Using calcium intake and stress fracture history to estimate BMD, 70% (7/10) of

the participants were determined to be at risk of low BMD. More specifically, 86% (6/7) did not meet the calcium DRI and 43% (3/7) reported history of a stress fracture. Graph 3 illustrates the risk factors for BMD- low dietary calcium and/or stress fractures- as reported by participants.



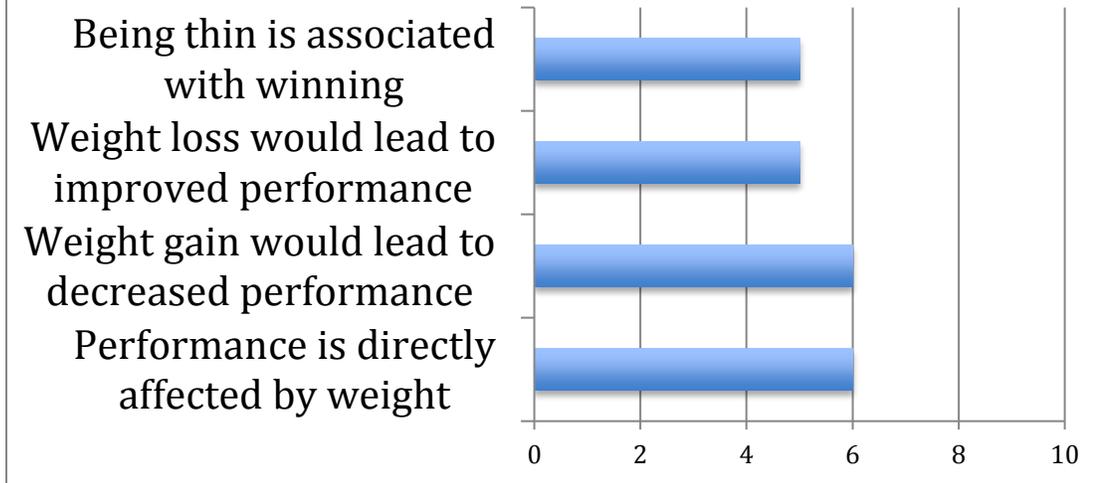
One or more of the components of Female Athlete Triad were displayed by 100% (10/10) of the participants. According to the 'At-Risk' continuum defined above, 100% (10/10) of participants were 'At Low Risk' at minimum. Three athletes, or 30% (3/10) were 'At Low Risk', 50% (5/10) were 'At Moderate Risk', and 20% (2/10) were 'At High Risk' of developing FAT, based on the operational definitions used in this study. Graph 4 presents the distribution of participants' Risk of Developing Female Athlete Triad.

Graph 4
Risk of Developing FAT



To address the second purpose of this study, the researcher investigated the perceptions of those who are at risk of developing Female Athlete Triad. Since the aforementioned results indicates 100% (10/10) of the participants are minimally 'At Low Risk' survey responses from all participants were analyzed in order to study their perceptions. Graph 5 depicts the Association of Low Body Weight with Athletic Success. Sixty percent (6/10) of the participants believe that their performance is directly affected by their weight. Sixty percent (6/10) worry that their performance would decrease if they gained weight. Fifty percent (5/10) believe their performance would improve if they lost weight. Fifty percent (5/10) believe that being thin is associated with winning. These results indicate that a preponderance of the sample on hand, all of who were previously determined to be 'At Risk' for developing Female Athlete Triad, associate low body weight with athletic success.

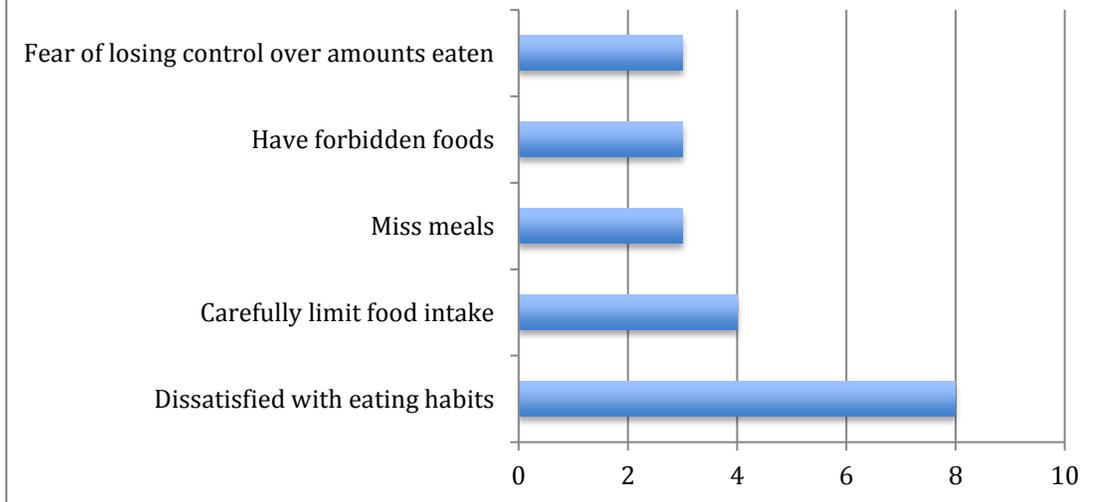
Graph 5
Association of Low Body Weight with Athletic Success



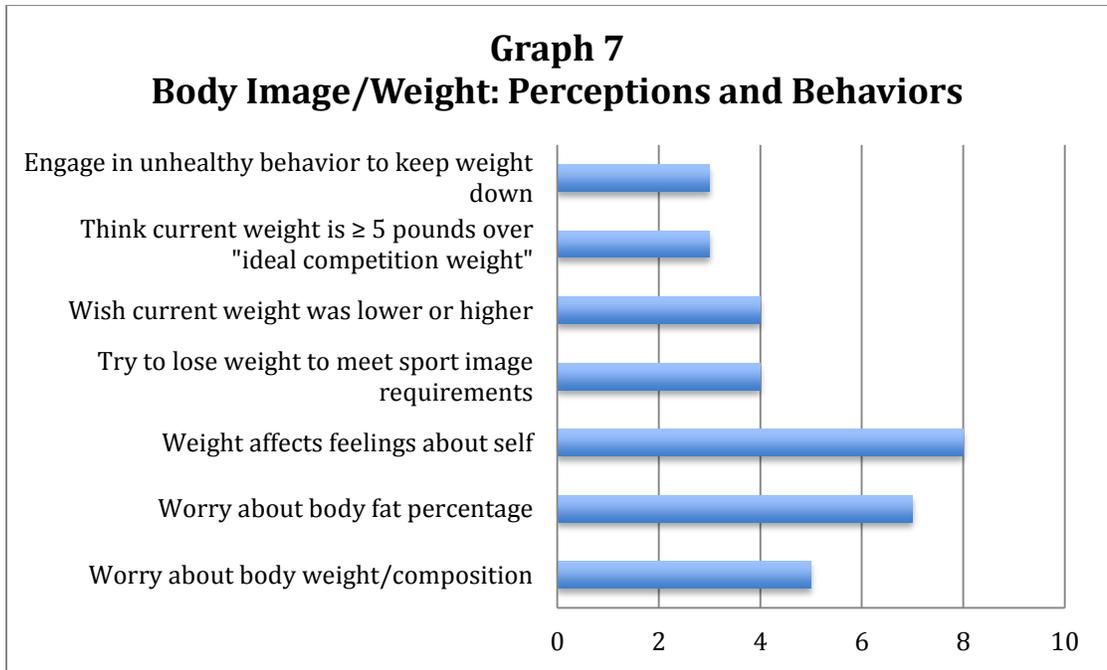
Further dissection of survey questions and responses provided additional insight into participants' beliefs, attitudes, and behaviors surrounding the following topics: food consumption; body weight, image, and composition; exercise amount and motivation; the influence of others; and extraneous stressors and coping ability.

Participant responses to key food questions revealed that 80% (8/10) are dissatisfied with their current eating habits, 40% (4/10) carefully limit their food intake, 30% (3/10) miss meals, 30% (3/10) have forbidden foods, and 30% (3/10) fear that they have lost control over how much they eat. Graph 6 displays perceptions and behaviors regarding food.

Graph 6 Food: Perceptions and Behaviors



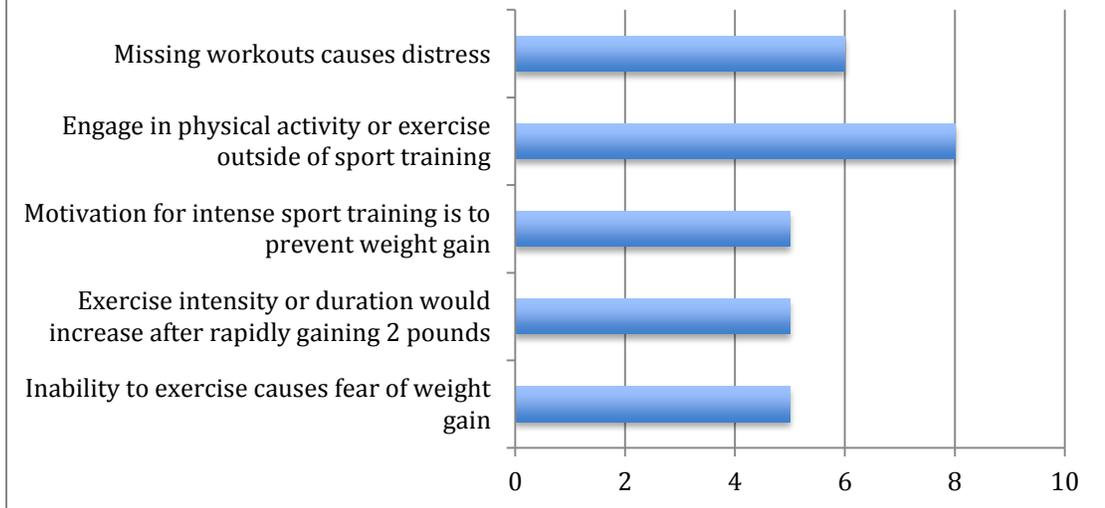
An overwhelming majority of the women surveyed, 80% (8/10), reported that body weight affects how they feel about themselves, and 70% (7/10) reported that body fat percentage is something they worry about. Fifty percent of participants (5/10) reported weight and/or body composition as a source of worry. Forty percent (4/10) try to lose weight to meet image or appearance requirements for their sport. Forty percent (4/10) wish their weight was either more or less than it was at the time of data collection. Thirty percent (3/10) believed their body weight was five or more pounds over their “ideal competition weight”. Thirty percent (3/10) reported having done things to keep their weight down that they would consider unhealthy. Graph 7 illustrates participants’ perception and behaviors regarding body weight and image.



Responses to exercise questions provided information pertaining to factors such as activity frequency, intensity, and motivation. Assessment of all five primary questions regarding exercise revealed that a preponderance of those at risk for developing Female Athlete Triad (ranging from 50-80%) exhibit at least one disconcerting exercise attitude or behavior that could potentially be a contributing risk factor for developing FAT. Results showed that 60% (6/10) of the participants were distressed if they missed a workout; 80% (8/10) engaged in physical activity or exercise in addition to training for their sport; 50% (5/10) reported that they trained intensely for their sport in order to prevent weight gain; 50% (5/10) stated that they would worry about gaining weight if they were unable to exercise; and 50% (5/10) said that they would train longer or harder in response to a sudden two pound weight gain. Graph 8 shows key exercise perceptions and behaviors.

Graph 8

Exercise: Perceptions and Behaviors



Two survey questions addressed the opinions of others about the athletes' eating habits and body weight, image, and composition. It was found that 50% (5/10) of participants have been called "fat" by a coach, judge, or family member. Additionally, 70% (7/10) said they have received suggestions to change their eating habits and/or lose weight, even though all participants have a "healthy" BMI.

Responses to survey questions concerning stress levels revealed that 100% (10/10) of participants feel stressed outside of their sport. Of these, 30% (3/10) felt that they were unable to cope with this stress. Of the three participants who reported an inability to successfully handle their stress, one was 'At High Risk', one was 'At Moderate Risk', and one was 'At Low Risk' of developing Female Athlete Triad.

Discussion

The purpose of this study was twofold. The primary objective was to identify the risk of Female Athlete Triad among the Western Kentucky University women's cross country team. The presence or absence of each of the three conditions of Female Athlete

Triad was assessed for each individual based on the aforementioned criteria. Each individual's risk of developing FAT was determined from the number of components they exhibited. It was hypothesized that a preponderance of the WKU women's cross country team would be considered 'at risk' of developing Female Athlete Triad, and results confirmed this hypothesis. Each individual displayed symptoms of one or more of the FAT components and, consequently, was at least at 'Low Risk' of developing FAT.

The second objective of the study was to investigate 'at risk' participants' perceptions, related to food, exercise, and body image, with particular emphasis on the extent to which they associate low body weight with athletic success. It was hypothesized that there would be a correlation between the manifestation of the FAT components and athletes' perceptions regarding thinness and athletic success. This hypothesis was rejected, as the sample size used in this study was insufficient to support a statistically significant correlation. However, the results suggest that a relationship between these two factors does exist. Survey responses indicated that a majority of the participants perceived a relationship between thinness and athletic success.

The results from this study contribute to the existing body of Female Athlete Triad research. They are consistent with and help further substantiate the current literature. In accordance with previous studies, the present research indicates that Female Athlete Triad is a widespread condition among collegiate endurance athletes. In addition, this study highlights the relation between the occurrence of FAT and athletes' perception of the relatedness between low body weight and athletic success. This study does not allow one to conclude that this perception causes FAT; however, it does suggest that this perception is one of the many contributing factors that likely increase one's susceptibility

to developing FAT.

Some potential limitations to this study lie in the way that the three FAT components were operationally defined. Each participant's caloric adequacy was based off of her individual DRI that was calculated through SuperTracker. The DRI calculated through SuperTracker provide a rough estimate of nutrient needs, but may vary from actual requirements. Self-reported menstruation history is a reliable preliminary judge of amenorrhea. However, official diagnoses often rely on blood level testing of FSH, LH, TSH, prolactin, and/or estrogen, to reveal hormone dysfunction. Finally, estimations of BMD were based on the adequacy of participants' calcium intake and their history of stress fractures. Evidence suggests that these indirect measures are associated with bone health and are convenient to collect (Thompson, 2007). However, a DXA scan would be more accurate and could reveal true BMD. In the absence of monetary and temporal constraints, perhaps it would have been possible to acquire more accurate measurements of caloric adequacy, amenorrhea, and BMD. However, under the circumstances of the present study, alternative methods were not feasible.

This study is somewhat limited by the sample that was used. Results are based off of a female cross country team at one NCAA Division I university. It would be interesting to collect data from other universities around the country to see how results compare. A larger sample would increase the validity of this study by more accurately reflecting the population of interest, all female cross country runners at American colleges and universities.

There are several implications from this study. Collegiate cross country athletes are a population vulnerable to developing Female Athlete Triad. Once one FAT

component manifests, the other two are often quick to follow. Female Athlete Triad grows increasingly difficult to reverse with time. Therefore, prevention is ultimately the best treatment, and should be emphasized at the collegiate level through education and pre-participation physical exams. This would better ensure that athletes are able to safely compete without jeopardizing their short and long-term health.

This study also reveals that the association between thinness and athletic success is very prevalent among those at risk of FAT. It is concerning to see the pervasiveness of this association because it is inaccurate. In actuality, low body weight, due to inadequate caloric consumption, will likely lead to an athletic performance decline as well as compromised long-term health.

Lack of awareness and the influence of others are two factors that contribute to this common misperception and the risk of developing FAT. Despite thinking they were consuming enough calories, 70% of the participants did not meet their caloric recommendation; the majority of these women averaged a substantial caloric deficit of 300 calories per day. As Table 2 shows, none of the participants were considered “overweight” based on BMI. In fact, of the nine participants who provided height and weight data, 78% (7/9) have a BMI under 21 kg/m². Nevertheless, up to 70% have been told to change their eating habits and/or lose weight. This indicates that healthy athletes are receiving unwarranted advice that may cause detrimental physical and mental effects. This exemplifies the importance of educating athletes, parents, and coaches about the risk factors and consequences of FAT. This condition currently affects many athletes, but could likely be reduced simply by providing relevant information to broaden awareness.

Another important take-away from this study is the overwhelming majority of

female athletes who reported that their body weight affects their self-concept and that they worry about body weight, body composition, and/or body fat percentage. Perhaps this is indicative of the tremendous pressure on athletes to meet the thin ideal that is imposed by sociocultural norms. Within the athletic realm, athletic talent should take precedence over aesthetics. However, in reality, this rarely happens. A misdirected emphasis on body image can result in undue stress, body dissatisfaction, and/or the development of internalizing symptoms among athletes who feel unable to meet societal expectations.

One final implication of this study stems from the fact that all participants reported feeling stressed. Forced to balance school, sport, and social responsibilities, many collegiate student athletes are faced with a significant amount of stress. Sometimes disordered eating habits can arise as a coping mechanism for excessive stress. Inability to manage stress may make one more susceptible to unhealthy eating and exercise habits, and increase their risk of developing Female Athlete Triad. Therefore, it is possible that the incorporation of healthy stress management skills will be an important part of future FAT prevention, education, and treatment efforts.

Conclusion

The results of this study supported the research hypothesis that a preponderance of the WKU women's cross country team was considered 'at risk' of Female Athlete Triad. The second hypothesis regarding the correlation between the manifestation of the three components of Female Athlete Triad and athletes' perceptions regarding thinness and improved athletic performance was not supported. Nevertheless, the data indicate a relationship between these two factors. However, the small sample size was insufficient

to test for a statistically significant correlation. All participants showed signs of one or more of the three components and were determined to be at least at 'Low Risk' of FAT. This supports previous research showing that female collegiate cross country runners constitute a population that is highly susceptible to Female Athlete Triad. A preponderance of athletes (50-60%) associated thinness with athletic success. In reality, this is an erroneous assumption that may cause both athletic performance and long-term health to suffer. Therefore, it is critical to change the unhealthy idealization of thinness that many athletes hold. Since FAT treatment can be difficult, prevention of initial occurrence is imperative. Efforts should be directed to increase awareness of FAT and to educate athletes, parents, and coaches about the nutritional needs of active young women in order to promote their lifelong health and wellbeing.

REFERENCES

- Barrack, M. T., Ackerman, K. E., Gibbs, J.C. (2013). Update on the female athlete triad. *Current Reviews in Musculoskeletal Medicine*, 6(2), 195-204.
- Blake, J. S. (2015). *Nutrition & You: MyPlate Edition*. San Francisco: Pearson Benjamin Cummings.
- Clairmont, M. A. (2000). Female Athlete Triad: Challenges in nutrition practice. *Healthy Weight Journal*, 14(4), 52.
- Female Athlete Triad Coalition. (n.d). Retrieved from <http://www.femaleathletetriad.org>
- International Olympic Committee Medical Commission Working Group Women in Sport (2005). Medical commission position stand on the Female Athlete Triad, 1-46. Retrieved from http://www.olympic.org/documents/reports/en/en_report_917.pdf
- Jayed, A., Tebben, P. J., Fisher, P. R., Lteif, A. N. (2013). Female Athlete Triad and its components: Toward improved screening and management. *Mayo Clinic Proceedings*, 88(9):996-1009.
- Kransdorf, L. N., Vegunta, S., & Files, J. A. (2013). Everything in moderation: What the Female Athlete Triad teaches us about energy balance. *Journal Of Women's Health (15409996)*, 22(9), 790-792. doi:10.1089/jwh.2013.4515
- Laframboise, M. A., Borody, C., & Stern, P. (2013). The Female Athlete Triad: A case series and narrative overview. *Journal Of The Canadian Chiropractic Association*, 57(4), 316-326.

- Lassiter, J. W., & Watt, C. A. (2007). Student coaches' knowledge, attitudes, skills, and behaviors regarding the Female Athlete Triad. *Physical Educator*, 64(3), 142-151.
- Márquez, S., & Molinero, O. (2013). Energy availability, menstrual dysfunction and bone health in sports; An overview of the Female Athlete Triad. *Nutrición Hospitalaria*, 28(4), 1010-1017. doi:10.3305/nh.2013.28.4.6542.
- McNulty, K.Y., Adams, C. H., Anderson, J.M., & Affenito, S.G. (2001). Development and validation of a screening tool to identify eating disorders in female athletes. *Journal of the American Dietetic Association*, 101(8), 886-892.
- Raymond-Barker, P., Petroczi, A., & Quested, E. (2007). Assessment of nutritional knowledge in female athletes susceptible to the Female Athlete Triad syndrome. *Journal Of Occupational Medicine And Toxicology (London, England)*, 210.
- SuperTracker: My Foods. My Fitness. My Health. (n.d.). Retrieved from <https://supertracker.usda.gov/>
- Thompson, S. (2007). Characteristics of the female athletic triad in collegiate cross-country runners. *Journal Of American College Health*, 56(2), 129-136.
- Zeigler, T. (n.d). The Female Athlete Triad. Retrieved from http://www.sportsmd.com/SportsMD_Articles/cid/12/id/367/n/the_female_athlete_triad.aspx#sthash.kgtGk7VT.K81ixjfH.dpbs