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A condition unique to female athletes is the Female Athlete Triad, which can present as: (1) low energy availability (EA) or energy deficiency, to clinical eating disorders; (2) subclinical menstrual dysfunction or deficiencies to functional hypothalamic amenorrhea; and (3) low bone mineral density (BMD) or osteopenia to frank osteoporosis (De Souza et al., 2014; Javed et al., 2013; Loucks, Stachenfeld, & DiPietro, 2006; Nattiv et al., 2007). The likelihood of athletes presenting the full Triad simultaneously is only 1-16%, but the percentages of presenting with one (16-60%) or more (3-27%) of the components are considerably greater (De Souza, Koltun, Etter, & Southmayd, 2017; Gibbs, Williams, & De Souza, 2013).

Current research regarding high school coaches has found only 2-14% of responding coaches could name all three components of the Female Athlete Triad (Triad) – low energy availability, low bone mineral density, and menstrual dysfunction (Brown et al., 2014; Mukherjee et al., 2016; Pantano, 2017; Troy et al., 2006). At present time, few studies investigating the reasons for this lack of Triad knowledge have been published. My primary objective was to identify Triad knowledge levels in NC high school coaches of female athletes, along with secondary objectives of identifying if Triad knowledge levels were associated with the gender or formal training of the coach.

The survey used in this study was the exact same survey used for a previous study of collegiate coaches (Frideres, 2016). The questions were input into an online survey format using Qualtrics software. Participants were recruited via an email which included

an anonymous link to the survey. Responses were collected from 137 current North Carolina high school coaches of female athletes, 96 of whom completed every knowledge question - 62 males (65%) and 34 females (35%).

Twenty-five percent of the 137 responding coaches correctly identified the three components of the Triad, and of the 96 who completed all questions, the average score was 67% correct. Female coaches (72% correct) scored significantly higher than male coaches (64% correct) on the entire survey ($p < .0005$). Respondents who identified as having Kinesiology-related degrees ($N = 36$) scored slightly better on the total survey (69% correct) than those with other subject area degrees (66% correct), but the difference was not significant ($p = .258$).

There has been a significant amount of research done on the Female Athlete Triad in general, and enough done specifically on the Triad knowledge of coaches at various levels to know that overall education is lacking (Brown et al., 2014; Frideres et al., 2016; Mukherjee et al., 2016; Pantano, 2006; Pantano, 2017; Troy et al., 2006). Since only 25% of the coaches in this survey could correctly answer the question that asked them to identify the three components of the Triad, it would be beneficial for Triad-specific professional development to be presented to coaches of female athletes on a yearly basis. The Triad should similarly be included as part of the curriculum during the formal training of any discipline where graduates will have contact with adolescent female athletes as part of their profession. School-level policies need to be put in place to help identify athletes who are at risk for the Triad, and stakeholders need to be given the knowledge, skills, and resources to ensure those at-risk athletes get the help they need.

NORTH CAROLINA HIGH SCHOOL COACHES' KNOWLEDGE
OF THE FEMALE ATHLETE TRIAD

by

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APPROVAL PAGE

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CHAPTER I

PROJECT OVERVIEW

The Female Athlete Triad is currently defined as low energy availability (EA), either with or without disordered eating; menstrual dysfunction or deficiencies; and low bone mineral density (BMD) (De Souza et al., 2014; Loucks, Stachenfeld, & DiPietro, 2006; Nattiv et al., 2007). All women are at risk of developing the Triad should they experience a substantial enough caloric deficit over an extended period of time (Nattiv, Agostini, Drinkwater, & Yeager, 1994; West, 1998; Wheatley, Khan, Székely, Naughton, & Petróczi, 2012). However, females engaged in competitive athletics, primarily sports that place a competitive value on a lean build or emphasize aesthetics – e.g. gymnastics, ballet, distance running, figure skating, swimming, dance, and diving – are at the greatest risk (Javed et al., 2013; Nattiv et al., 2007; Pantano, 2006; Reinking & Alexander, 2005; Torstveit & Sundgot-Borgen, 2005a; Troy, Hoch, & Stavrakos, 2006).

Research has repeatedly shown that the best approach to prevention of the Triad is through the utilization of a well-educated multidisciplinary team of relevant stakeholders around the athlete (DeSouza et al., 2014; Nattiv et al., 2007; Frideres, Mottinger, & Palao, 2016; Stickler, Hoogenboom, & Smith, 2015; Waldrop, 2005; West, 1998; Wheatley et al., 2012). As members of that multidisciplinary team, coaches play an important role in prevention of the Triad and in the physical and psychological development of their athletes (Heffner, Ogles, Gold, Marsden, & Johnson, 2003). Yet

many coaches are grossly under- or misinformed when it comes to the Triad, and this in turn puts their athletes at risk for developing the Triad and thereby reducing their chances of living healthy and active lives (Frideres et al., 2016; Kroshus, Sherman, Thompson, Sossin, & Austin, 2014; Pantano, 2006).

The knowledge of coaches who work with female athletes, although often inadequate or inaccurate, varies according to the level of sport, gender of the coach, formal training, and by sport coached (Frideres et al., 2016; Kroshus et al., 2014; Pantano, 2006). Research done with high school coaches has showed that only 2%-14% of coaches can correctly identify all three Triad components (Brown et al., 2014; Mukherjee et al., 2016; Pantano, 2017; Troy et al., 2006). Those results even allowed coaches to choose the older definition of the clinical endpoints, and identification scores were still very low. Kroshus et al. (2014) undertook a study of high school coaches that did not specifically investigate the coaches' level of knowledge, but they did find significant differences between male and female coaches with respect to knowledge of specific components of the Triad.

Frideres et al. (2016) examined the level of education of collegiate coaches and found differences in knowledge between coaches based on their formal education level (bachelor's vs. master's), but did not analyze responses by the content of the held degree. They also looked at Triad-specific training and found that coaches who had received specific training scored significantly higher than those who did not receive any similar training (Frideres et al., 2016). There have been no studies published to date

which have examined the pre-service education and training background of high school coaches.

In conclusion, the literature reviewed in this section demonstrates the critical need to evaluate current Triad knowledge of high school coaches of female athletes to determine if these coaches are sufficiently educated to positively influence their athletes through Triad education.

Based on the literature, I propose three specific aims for this study: **Specific Aim #1: *Identify the current Triad knowledge level of North Carolina high school coaches of female athletes.*** The working hypothesis, based on review of the literature, was that fewer than 10% of responding coaches would be able to correctly identify all three Triad components. **Specific Aim #2: *Determine the effect of the coach's gender on Triad knowledge.*** The working hypothesis, based on review of the literature, was that on average, female high school coaches of female athletes would demonstrate significantly higher levels of knowledge about the Triad compared to male coaches of female athletes. **Specific Aim #3: *Determine the effect of the coach's formal education on Triad knowledge.*** The working hypothesis, based on review of the literature, was that on average, high school coaches who have had some combination of formal training in a kinesiology-related field or Triad-specific professional development would demonstrate significantly higher levels of knowledge about the Triad than those with no previous kinesiology or Triad-specific education.

Methods

Participants

Participants were 137 current high school coaches of female athletes in the state of North Carolina. Demographic information on the responding coaches was collected including: age, gender, years of experience coaching female athletes, sport(s) coached, current job title, and level of formal education including major subject studied.

Measures

The survey utilized established measures of knowledge of the triad – including components, prevention, and long-term health implications; and demographic information (age, gender, years of experience coaching females, formal training, sport coached, and current occupation). The survey used for this project was the exact survey used for a study of college coaches by Frideres et al. (2016). Permission was provided via email from the authors to use this survey with appropriate credit given and references cited.

Procedures

Survey questions (see Appendix) were entered into an online survey using Qualtrics survey software. Data collection from the participating coaches did not begin until after approval was granted from the Institutional Review Board at the University of North Carolina at Greensboro. Participants were recruited through email contact with the administration of individual school districts and when that did not generate enough participants, email contact was made with the state coaches association directors.

Four weeks into participant solicitation through school districts' central administration, it became apparent this was not yielding enough participants in the time frame allotted to complete this project; only one district had agreed, three declined and the rest never responded. I then began soliciting participants through the directors of the state coaching associations; this yielded immediate results. All of the responding directors, four out of the six contacted, agreed to send out the anonymous survey link to their membership databases. The directors also sent follow-up messages the week before the survey closed (December 11-15). The one school district whose Superintendent consented to survey dissemination had a designated appointee send the survey link to their coaches. All participants were informed that their participation in the survey was voluntary and completely anonymous.

Data Analysis

Descriptive statistics were used to analyze the survey answers and the demographic information about the respondents. To test normality of the data, the Kolmogorov-Smirnov test was used. Significance differences were tested with independent samples t-tests for mean differences, with the Levene's Test used to determine equality of variance, and the Fisher's Exact Test. The Fisher's Exact Test was used to test for significance of association as it is the standard test when the data is categorical and in a 2x2 table.

General Triad knowledge, the focus of Specific Aim #1, was assessed by the percent of correct answers chosen by respondents on the survey, much like a traditional exam. In addition to overall knowledge, responses to the question which asked

respondents to identify the three components of the Triad were also evaluated. Descriptive statistics were used to calculate how many coaches correctly answered that specific question. A Fisher's Exact Test measured the association between respondent's confidence level and correctness of their answer. To evaluate Specific Aims #2 and #3, an independent sample t-test, with the alpha level set at .05, was conducted to compare differences in mean scores on the survey between male and female coaches, and between respondents with formal kinesiology or Triad training and those without such formal training. All statistical analysis was performed using SPSS software.

Results

One hundred thirty-seven high school coaches, 94 males (69%) and 43 females (31%), responded to the female athlete triad knowledge survey. The responding coaches ranged in age from 23 years old to 67 years old, represented twelve different sports, their coaching experience ranged from 1 year to 46 years for all coaching; and 1 year to 40 years for coaching female athletes. The education level of the subjects is described in Table 1. Thirty-six of the 137 respondents (26%) indicated majoring in a Kinesiology-related field (e.g. physical education, health, kinesiology, exercise science).

Specific Aim #1: Identify the current Triad knowledge level of North Carolina high school coaches of female athletes

Every respondent (n = 137) did not answer every question, but all 137 in the sample did answer the first question regarding identification of the three Triad components. Regarding the component identification question, 34 of 137 respondents 25% answered correctly with a 95% confidence interval of [17%, 32%]. The data (Table

2) also showed evidence that those who responded with confidence in their answer to this question (choosing a 3 or 4 on the confidence scale) were more likely to get the correct answer (Fisher's Exact test; $p = .006$) than those who were less confident in their answer (1 or 2 on the confidence scale).

Ninety-six respondents, 62 males (65%), 34 females (35%), completed every knowledge question on the survey and were therefore able to have a total score calculated. The average score was 67% correct with a 95% confidence interval of [65%, 69%].

Specific Aim #2: Determine the effect of the coach's gender on Triad knowledge

A one-tailed independent samples t-test showed that women (72% correct) scored significantly higher than men (64% correct) on the entire survey ($p < .0005$). Additionally, a higher percentage of women (33%) than men (21%) answered the component identification question correctly, but according to a Fisher's Exact test that difference was not statistically significant ($p = .201$).

Specific Aim #3: Determine the effect of the coach's formal education on Triad knowledge

Respondents who identified as having Kinesiology-related degrees scored slightly better on the total survey (69% correct) than those with other subject area degrees (66% correct), but according to a two-tailed independent samples t-test the difference was not significant ($p = .258$). However, a Fisher's Exact Test showed that having a Kinesiology-related degree (39% answered correctly) did result in significantly better performance on

the first question regarding identification of the three Triad components ($p = .022$) than those with other subject area degrees (20% answered correctly).

Discussion

There has been a significant amount of research done on the Female Athlete Triad in general, and enough done specifically on the Triad knowledge of coaches at various levels to know that overall education is lacking (Brown et al., 2014; Frideres et al., 2016; Mukherjee et al., 2016; Pantano, 2006; Pantano, 2017; Troy et al., 2006). Since only 25% of the coaches in this survey could correctly answer the question that asked them to identify the three components of the Triad, it would be beneficial for Triad-specific professional development to be presented to coaches of female athletes on a yearly basis. The Triad should similarly be included as part of the curriculum during the formal training of any discipline where graduates will have contact with adolescent female athletes as part of their profession. The data in this survey also showed that respondents were overly confident of their answers on the questions dealing with menstrual dysfunction; their percentage of correct answers was considerably lower than the percentage of respondents with high levels of confidence in their answers. The opposite was true with the energy availability and bone density questions; the percentage of respondents who were highly confident in their answers was lower than the percentage of correct answers. More needs to be done at the administration level of high schools to equip school staff with the information needed to help its female athletes. Policies need to be put in place to help identify athletes who are at risk for the Triad, and stakeholders

need to be given the knowledge, skills, and resources to ensure those at-risk athletes get the help they need.

CHAPTER II

DISSEMINATION

This project involved an anonymous online survey of North Carolina high school coaches of female athletes. The primary purpose of this project was to determine the current knowledge levels of the responding coaches about the Female Athlete Triad. Further purposes included investigating any possible differences in knowledge levels between male and female coaches, and between coaches with Kinesiology-related degrees and coaches who do not have Kinesiology-related degrees. A confidence scale was also provided after each question to allow respondents to select how confident they were with their answers. The targeted audience for the results from this project include district-level decision and policy makers and the coaches themselves. The results can be used to lobby for the inclusion of Triad-related questions in yearly pre-participation exams (PPEs) and to lobby for additional professional development for all stakeholders involved with high school athletics.

Adolescence is a critical time of physical, social, and emotional development for female athletes. Yet many of those who work most closely with this population are under-informed with respect to the inherent health needs and considerations of young female athletes. One study found that less than half of physicians, physical therapists, athletics trainers, and only 8% of coaches who work with adolescent girls were able to

identify all three components of the highest profile of all conditions specific to females – the Female Athlete Triad (Troy et al., 2006).

The Female Athlete Triad (Triad) is a syndrome of three interrelated health issues that has been officially recognized for over 20 years (Kroshus et al., 2015). The original definition included the clinical endpoints of disordered eating, amenorrhea, and osteoporosis, but has since been broadened to reflect more of a continuum than specific points (Otis et al., 1997; Yeager, Agostini, Nattiv, & Drinkwater, 1993). Research has repeatedly shown that the best approach to prevention of the Triad is through the utilization of a well-educated, multidisciplinary team of relevant stakeholders – e.g. coaches, athletes and their families, school nurses, athletic trainers, registered dietitians, physical therapists – around the athlete (DeSouza et al., 2014; Nattiv et al., 2007; Frideres et al., 2016; Stickler et al., 2015; Waldrop, 2005; West, 1998; Wheatley et al., 2012).

Since coaches are integral members of the multidisciplinary team needed to help athletes avoid the Triad, and very influential in the physical and psychological development of their athletes, their importance is paramount (Heffner et al., 2003). Studies have shown the knowledge of coaches who work with female athletes, although often inadequate or inaccurate, varies according to the level of sport, gender of the coach, formal training, and by sport coached (Frideres et al., 2016; Kroshus et al., 2014; Pantano, 2006). In the little research that has been conducted on high school coaches, even simple knowledge of the three components of the Triad ranges from 2%-14% (Brown et al., 2014; Mukherjee et al., 2016; Pantano, 2017; Troy et al., 2006). This project is potentially highly significant because its successful completion can be expected

to provide the foundation upon which to build a Triad-specific professional development program. Such a program will ultimately assist female athletes in leading healthy and active lives through the education of coaches and other members of the multidisciplinary team at the high school level. A well-educated multidisciplinary team will be better prepared to transmit Triad knowledge to the athletes and the athletes' families, thereby increasing knowledge and concurrently reducing the probability of Triad-related diagnoses over time.

Approach

Specific Aim #1: *Identify the current Triad knowledge level of North Carolina high school coaches of female athletes.* The working hypothesis, based on review of the literature, was that fewer than 10% of responding coaches would be able to correctly identify all three Triad components.

Specific Aim #2: *Determine the effect of the coach's gender on Triad knowledge.* The working hypothesis, based on review of the literature, was that on average, female high school coaches of female athletes would demonstrate significantly higher levels of knowledge about the Triad compared to male coaches of female athletes.

Specific Aim #3: *Determine the effect of the coach's formal education on Triad knowledge.* The working hypothesis, based on review of the literature, was that on average, high school coaches who have had some combination of formal training in a kinesiology-related field or Triad-specific professional development would demonstrate significantly higher levels of knowledge about the Triad than those with no previous kinesiology or Triad-specific education.

Methods

Participants

Participants were 137 current high school coaches of female athletes in the state of North Carolina. The coaches were initially recruited via contact with the administration of individual school districts, and then through contact with directors of state coaching associations when recruitment through the school districts did not result in a sufficient sample of coaches. Demographic information on the responding coaches was collected including: age, gender, years of experience coaching female athletes, sport(s) coached, current job title, and level of formal education including major subject studied.

Measures

The survey utilized established measures of knowledge of the triad – including components, prevention, and long-term health implications; and demographic information (age, gender, years of experience coaching females, formal training, sport coached, and current occupation). The survey used for this project was the exact survey used for a study of college coaches by Frideres et al. (2016). This survey was piloted for content validity with a panel of nine experts, Division II college coaches who did not participate in the actual study, all holding terminal degrees with a minimum of five years of direct experience with the Triad. The instrument was tested for reliability (using an intra-class correlation coefficient) with a sample of 12 coaches, and for concurrent validity (using a one-factor ANOVA) with 45 college coaches from an endurance sport and 63 coaches from sports that do not emphasize weight control (Frideres, Mottinger, & Palao, 2015; Frideres et al., 2016). It was deemed unnecessary to pilot the survey with

high school coaches since validity, reliability, and readability had already been tested and established with coaches who presumably have relatively similar educational levels as high school coaches and often are working with athletes of approximately the same age. Permission was provided via email from the authors to use this survey with appropriate credit given and references cited.

Procedures

Survey questions (see Appendix) were entered into an online survey using Qualtrics survey software. Data collection from the participating coaches did not begin until after approval was granted from the Institutional Review Board at the University of North Carolina at Greensboro. Participants were recruited through email contact with the administration of individual school districts and when that did not generate enough participants, email contact was made with the state coaches association directors.

Targeted school districts were selected randomly from all the public-school districts in North Carolina. A minimum of six school districts from each classification – rural, urban, and suburban – were selected in an attempt to elicit responses from each type of school district for broader generalization of results. Districts that did not approve the study were replaced by another randomly selected district from the same classification when possible. When it was not possible to select another district from the same classification, another district was chosen at random from all remaining districts not previously selected.

Four weeks into participant solicitation through school districts' central administration, it became apparent this was not yielding enough participants in the time

frame allotted to complete this project; only one district had agreed, three declined and the rest never responded. I then began soliciting participants through the directors of the state coaching associations; this yielded immediate results. All of the responding directors, four out of the six contacted, agreed to push out the anonymous survey link to their membership databases. The directors also sent follow-up messages the week before the survey closed (December 11-15). The one school district whose Superintendent consented to survey dissemination had a designated appointee send the survey link to their coaches. All participants were informed that their participation in the survey was voluntary and completely anonymous.

Potential participants were also given the option to participate in a drawing for one of two \$100 Amazon gift cards. Upon completion of the survey, respondents were directed to another survey where they could enter their email if they wished to be entered into the drawing. The two winning email addresses were drawn under the observation of an unrelated third party on Saturday December 16th. The winners were notified by email from both Amazon and the author on December 19th.

Data Analysis

Descriptive statistics were used to analyze the survey answers and the demographic information about the respondents. To test normality of the data, the Kolmogorov-Smirnov test was used. Significance differences were tested with independent samples t-tests for mean differences, with the Levene's Test used to determine equality of variance, and the Fisher's Exact Test. The Fisher's Exact Test was

used to test for significance of association as it is the standard test when the data is categorical and in a 2x2 table.

General Triad knowledge, the focus of Specific Aim #1, was assessed by the percent of correct answers chosen by respondents on the survey, much like a traditional exam. In addition to overall knowledge, responses to the question which asked respondents to identify the three components of the Triad were also evaluated. Descriptive statistics were used to calculate how many coaches correctly answered that specific question. A Fisher's Exact Test measured the association between respondent's confidence level and correctness of their answer. To evaluate Specific Aims #2 and #3, an independent sample t-test, with the alpha level set at .05, was conducted to compare differences in mean scores on the survey between male and female coaches, and between respondents with formal kinesiology or Triad training and those without such formal training.

Multiple choice questions were scored by whether or not the respondent selected the correct answer. For multiple answer questions, if the respondent chose a correct option it was scored correct, if they did not choose a correct option it was scored incorrect. Likewise, if a respondent chose an incorrect option it was scored incorrect, but if they did not choose an incorrect option it was scored correct. The true/false questions also included an option for 'don't know'. When respondents chose that option, it was scored as incorrect for the purpose of data analysis. Confidence scores that were used for analysis purposes were recoded to indicate 'low' confidence (responses of 1 or 2 recoded

to 0) or ‘high’ confidence (responses of 3 or 4 recoded to 1). All statistical analysis was performed using SPSS software.

Results

One hundred thirty-seven high school coaches, 94 males (69%) and 43 females (31%), responded to the female athlete triad knowledge survey. The responding coaches ranged in age from 23 years old to 67 years old, represented twelve different sports (Figure 1), their coaching experience ranged from 1 year to 46 years for all coaching; and 1 year to 40 years for coaching female athletes. The education level of the subjects is described in Table 1. Thirty-six of the 137 respondents (26%) indicated majoring in a Kinesiology-related field (e.g. physical education, health, kinesiology, exercise science).

Figure 1. Number of Coaches for Each Sport Represented.

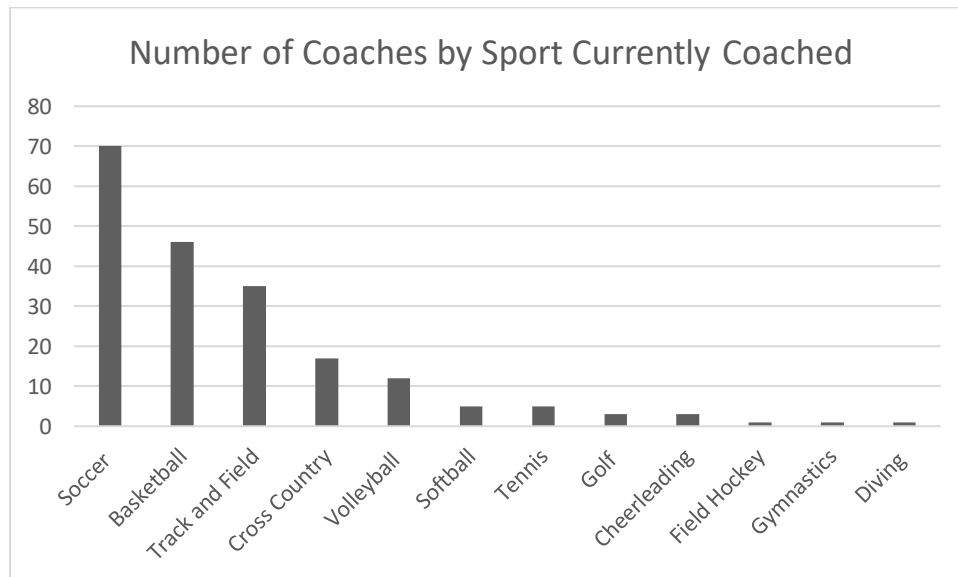


Table 1. Description of the Education Level of Responding Coaches.

Highest degree completed	Frequency	Percent
High school diploma/GED	6	4.4
Associate's Degree	6	4.4
Bachelor's Degree	76	55.5
Master's Degree	47	34.3
Doctoral Degree	2	1.5
Total	137	100.0

Specific Aim #1: *Identify the current Triad knowledge level of North Carolina high school coaches of female athletes*

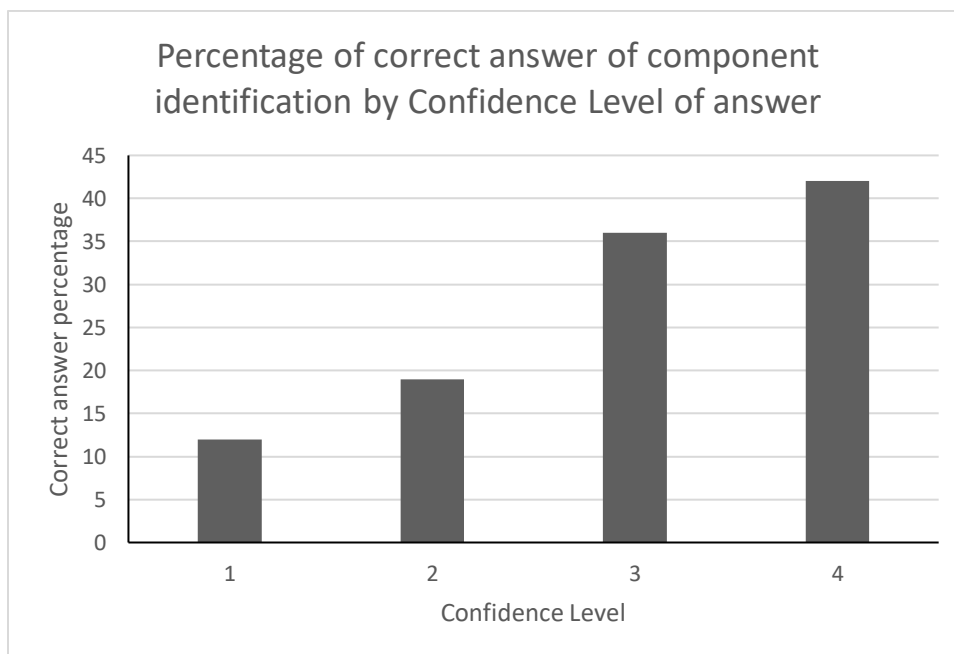
Every respondent (n = 137) did not answer every question, but all 137 in the sample did answer the first question regarding identification of the three Triad components. Regarding the component identification question, 34 of 137 respondents 25% answered correctly with a 95% confidence interval of [17%, 32%]. The data (Table 2) also showed evidence that those who responded with confidence in their answer to this question (choosing a 3 or 4 on the confidence scale) were more likely to get the correct answer (Fisher's Exact test; p = .006) than those who were less confident in their answer (1 or 2 on the confidence scale).

Ninety-six respondents, 62 males (65%), 34 females (35%), completed every knowledge question on the survey and were therefore able to have a total score calculated. The average score was 67% correct with a 95% confidence interval of [65%, 69%].

Table 2. Crosstabulation of Answers for the Three Components of the Triad and Confidence Levels.

			Confidence level: 0=low, 1=high		Total
			0	1	
The three components of the Female Athlete Triad are: Value of 0 = wrong answer chosen	0	Count	67	36	103
		Percent	65.0%	35.0%	100.0%
	Amenorrhea, Disordered eating, Osteoporosis	Count	13	21	34
		Percent	38.2%	61.8%	100.0%
Total		Count	80	57	137
		Percent	58.4%	41.6%	100.0%

Figure 2. Percentage of Correct Answer on Component Identification Question by Confidence Level of Answer.



Specific Aim #2: *Determine the effect of the coach's gender on Triad knowledge*

A one-tailed independent samples t-test showed that women (72% correct) scored significantly higher than men (64% correct) on the entire survey ($p < .0005$).

Additionally, a higher percentage of women (33%) than men (21%) answered the component identification question correctly, but according to a Fisher's Exact test that difference was not statistically significant ($p = .201$).

Specific Aim #3: *Determine the effect of the coach's formal education on Triad knowledge*

Respondents who identified as having Kinesiology-related degrees ($N=36$) scored slightly better on the total survey (69% correct) than those with other subject area degrees (66% correct), but according to a two-tailed independent samples t-test the difference was not significant ($p = .258$). However, a Fisher's Exact Test showed that having a Kinesiology-related degree (39% answered correctly) did result in significantly better performance on the first question regarding identification of the three Triad components ($p = .022$) than those with other subject area degrees (20% answered correctly).

Other Findings

Fifty-seven percent (76 of 134) correctly indicated that females of any age can suffer from the Triad, and 82% (108 of 131) indicated that consequences of the Triad can affect a female for the rest of her life. Also, 46% (51 of 110) indicated that an athlete that suffers from the Triad will not necessarily have a sudden, apparent decrease in sport performance. Sixty-two percent (68 of 110) incorrectly believe that for health reasons, an athlete with a confirmed case of the Triad must stop competing immediately.

Specifically regarding menstrual dysfunction, 65% (74 of 114) correctly indicated that amenorrhea involves the absence of three or more consecutive menstrual cycles, and 39% (45 of 115) believe oligomenorrhea is not a major health concern as long as the athlete is menstruating in the off season. Only 27% of responding coaches (30 of 111) indicated that it is not an invasion of the athlete's privacy for the coaching staff to ask if her menstrual cycles are regular. Female coaches were significantly less likely (Fisher's Exact Test; $p < .0005$) to think that asking athletes about the regularity of their menstrual cycles was an invasion of privacy. Overall, a one-tailed independent samples t-test showed that female coaches correctly answered the questions regarding menstrual dysfunction significantly more often than male coaches ($p = .033$).

Twenty-six percent (30 of 114) indicated eating disorders are caused exclusively by psychological problems. Only 51% (57 of 112) indicated that giving the athlete a range of acceptable weights or body fat compositions will help her feel less pressure related to weight control. Seventy-three percent of respondents (80 of 109) correctly indicated that when confronted about disordered eating or Triad concerns, the athlete will typically not be relieved and desire help, but 100% (114 of 114) acknowledged that eating disorders can be fatal.

Regarding bone mineral density, 61% (69 of 114) recognized that osteopenia, like osteoporosis, is directly affected by nutrition. The survey responses showed a high level of certainty with 92% (104 of 113) of coaches indicating that repeated stress fractures should serve as a warning with regards to low bone mineral density, but 47% of coaches

(52 of 111) incorrectly indicated that college-age athletes who suffer from low bone density can generally recuperate all bone loss later in life.

Only 10% (11 of 109) of respondents' athletic departments currently have a policy in place that specifies what to do when it is *suspected* that an athlete suffers from one or more aspects of the Triad. Additionally, only 8% (9 of 108) have a policy in place that specifies what to do with a *confirmed* case of an athlete with one or more aspects of the Triad. Fourteen percent (15 of 109) of coaches personally provide their athletes some sort of information or educational programming about the Triad, while the athletic departments provide this information 8% (9 of 109) of the time.

Only 10% (11 of 109) of respondents' athletic departments currently have a policy in place that specifies what to do when it is *suspected* that an athlete suffers from one or more aspects of the Triad. Additionally, only 8% (9 of 108) have a policy in place that specifies what to do with a *confirmed* case of an athlete with one or more aspects of the Triad. Fourteen percent (15 of 109) of coaches personally provide their athletes some sort of information or educational programming about the Triad, and athletic departments provide this information 8% (9 of 109) of the time.

Discussion

The purpose of this study was to investigate the current knowledge levels of North Carolina high school coaches related to the Female Athlete Triad and to explore whether gender or formal education impacted knowledge levels. It is critical that coaches possess knowledge and awareness of the Triad so they are able to educate their athletes about the importance of proper nutrition on the athlete's performance and long-term

health. Coaches and athletes both need to be aware of the signs and symptoms of the Triad to aid in early detection and referral for medical or psychological treatment if necessary (Mukherjee et al., 2016).

The main findings of this study were twofold, and better than expected. Overall Triad knowledge was relatively high (mean of 67% correct) given that only 25% of responding coaches could correctly identify all three Triad components. However, that 25% was higher than previous studies done with high school coaches which had ranged from 2%-14% (Brown et al., 2014; Mukherjee et al., 2016; Pantano, 2017; Troy et al., 2006). To add perspective, a score of 67% correct out of 100% does represent a passing score in North Carolina high schools, but with a letter grade equivalent of a D (North Carolina State Board of Education, 2015). So, this could be viewed as the coaches' collective knowledge in this study not being very good. Also, targeted coaches were notified about the subject matter of the survey prior to deciding whether or not they wanted to participate. It is possible that some coaches did not even attempt the survey given their lack of knowledge about the Triad. Therefore, the results could be biased toward coaches who had previous knowledge or familiarity. That possible bias may indicate even less knowledge than what appears. Nevertheless, these findings resulted in the higher percentage of correct answers in this study versus others. It is also interesting to note that, percentagewise, respondents who were more confident in their answers got the question right more than those who were less confident with their choice. This implies that the responding coaches who were less confident in their answer, those who more likely just took a guess, rarely guessed correctly. Most often, the coaches that got it

right knew they were right, and the ones who got it wrong were unsure of their answer. Therefore, numerous coaches were largely self-aware of their Triad knowledge, at least with respect to naming the specific components.

The secondary purposes of this study were to determine if the sex of the coach or the formal education of the coach impacted overall Triad knowledge. The results of this study showed that women ($M = 72\%$ correct) scored significantly higher than men ($M = 64\%$ correct) on the entire survey ($p < .0005$). Although that was the expected outcome, other research that has tested the same theory has found no significant difference in Triad knowledge between male and female coaches (Mukherjee et al., 2016; Pantano, 2017). The female coaches did answer the component identification question correctly more often and were also more confident in their answers than male coaches, but the differences were not statistically significant. The fact that females scored better than males on the survey could be attributed to the fact that males are generally less knowledgeable about health issues that are more often associated with females, such as menstruation and eating disorders.

With regards to the formal education of the coach, coaches whose degree was in a kinesiology-related field did score better ($M = 69\%$ correct) on the overall survey than coaches with degrees in other subjects or no degree at all ($M = 66\%$ correct). These findings were not statistically significant ($p = .258$). This could be due to the difference in the two sample sizes. Only 26 coaches earned kinesiology-related degrees, compared to 70 with other degrees. A sample size of 30 is generally accepted as the minimum to assume normality, so it is possible the smaller sample size in this study was not normally

distributed and skewed the average lower. Had these samples been more even, the kinesiology-degree coaches may have scored enough higher. The rationale behind theorizing that a difference exists was based on the concept that coaches would have been more likely to encounter information within their required coursework on the Triad than coaches with other degrees, and this study supports that rationale. To the best of this author's knowledge, there has been no other research done on high school coaches that compared the type of degree held by the coach with Triad knowledge. Research on college coaches has showed that coaches with graduate degrees were able to identify the components of the Triad more effectively than coaches with bachelor's degrees (Frideres et al., 2016). However, that research did not factor in the subject matter of those degrees, just the level of highest degree completed.

An interesting finding in this study, outside of the planned aims, dealt with issues regarding the menstruation status of the female athletes. Past research has indicated that from 54% to 90% of coaches, regardless of gender, report feeling comfortable discussing menstrual status with their athletes, but a much smaller percentage (2% - 30%) actually do ask those questions (Brown et al., 2014; Pantano 2017; Troy et al., 2006). The findings in this study could highlight one possible reason for this discrepancy – 73% of responding coaches felt it was an invasion of an athlete's privacy to ask if her menstrual cycles are regular. However, female coaches were significantly less likely to have this perception than male coaches ($p < .0005$). This belief may act as a roadblock to coaches, even those who understand the importance of this information. They may be uncomfortable discussing it with their athletes.

The data also showed some other interesting relationships between confidence of answers and correctness of answers. Table 3 shows the relationship between percentages of coaches who were highly confident in their answers (confidence level of 3 or 4 selected for at least 80% of the questions in that block) and percentages of coaches who got at least 80% of the questions in that block correct.

Table 3. Percentages of Correct^a Scores and Confidence^b Scores for Three Blocks of Questions

	Menstrual ^c Questions	Menstrual Confidence	EA ^d Questions	EA Confidence	BMD ^e Questions	BMD Confidence
Male	17%	47%	67%	62%	68%	63%
Female	35%	46%	84%	60%	76%	37%
Kines Degree	33%	44%	82%	65%	83%	46%
Non- Kines Degree	19%	48%	70%	60%	65%	58%
^a These percentages represent coaches who correctly answered at least 80% of the questions in that block. ^b These percentages represent coaches who indicated they were highly confident in their answers by selecting either a 3 or 4 confidence level. ^c There were five questions that dealt specifically with menstrual dysfunction. ^d There were 10 questions that dealt with energy availability. ^e There were 5 questions that dealt with bone mineral density.						

Regarding the questions dealing with menstrual dysfunction, the percentage of coaches who were highly confident in their answers was higher than the percentage of coaches who were correct at least 80% of the time. However, the opposite was true for the energy availability and bone mineral density blocks of questions. This indicates that many of the responding coaches were either not as confident in their level of knowledge as they should have been or thought they knew more than they did. Either way, the data suggest

these coaches did not have a good command of their own Triad knowledge and would benefit from continuing Triad education.

This study was designed to replicate the Frideres et al. (2106) study of college coaches. One difference in this study was how the subjects were recruited. The survey was sent to coaches of one participating school district and to coaches who were members of the state associations of basketball, soccer, track/cross country, and cheerleading - the organizations that responded to the participant recruitment email. Therefore, coaches of those sports are represented in this study with much more frequency than coaches of other sports; with the exception of volleyball, which is likely due to coaches coaching both volleyball and one of the four sports that responded. The two sports most represented in this study, soccer and basketball, are not considered sports with a high risk of Triad incidence (Frideres, 2016; Rust, 2002). A sample of coaches with greater representation from high-risk sports such as volleyball, gymnastics, swimming/diving, and cross country may have yielded different results. Future studies should attempt to draw more of a random sample of coaches across a wider range of sports than was accomplished with this study.

Conclusion

There has been a significant amount of research done on the Female Athlete Triad in general, and enough done specifically on the Triad knowledge of coaches at various levels to know that overall education is lacking (Brown et al., 2014; Frideres et al., 2016; Mukherjee et al., 2016; Pantano, 2006; Pantano, 2017; Troy et al., 2006). Since only 25% of the coaches in this survey could correctly answer the question that asked them to

identify the three components of the Triad, it would be beneficial for Triad-specific professional development to be presented to coaches of female athletes on a yearly basis. The Triad should similarly be included as part of the curriculum during the formal training of any discipline where graduates will have contact with adolescent female athletes as part of their profession. The fact that this survey showed that coaches with kinesiology backgrounds did not score significantly better than those with other degrees, further illuminates the need for Triad information to be included in all kinesiology-related education programs. This information should also be included as a component of the National Federation of State High School Associations coaching courses required of all North Carolina high school coaches; perhaps renewed yearly similar to concussion protocol requirements.

More needs to be done at the administration level of high schools to equip school staff with the information needed to help its female athletes. Policies need to be put in place to help identify athletes who are at risk for the Triad, and stakeholders need to be given the knowledge, skills, and resources to ensure those at-risk athletes get the help they need. Increasing awareness and education of all the stakeholders will help to normalize and destigmatize conversations about the Triad, facilitate educating the athletes, and provide them with the support, resources, and assistance required.

CHAPTER III

ACTION PLAN

The first step is to get the information in front of the people who would benefit most from seeing the results, especially those for whom the sample in the study may represent. I will take advantage of presentation opportunities, first locally in the state of North Carolina, such as the annual North Carolina Alliance for Athletics, Health, Physical Education, Recreation, Dance, and Sport Management convention, Physical Education Leadership Training, or any of the individual coaching association meetings. This would be an ideal way to disseminate the findings to those who helped generate the data.

The next step is to take the findings to a broader audience, targeting presentations at the regional or national level, such as the North Carolina Coaches Association annual coaches' clinic, the national Society of Health and Physical Educators America convention, the North American Coach Development Summit, the Southern District Conference, or the national Physical Education Teacher Education & Health Education Teacher Education conference. It may also be worth considering presentations to associations of athletic trainers, sport physical therapists, or school nurses.

Ultimately, the goal is to go beyond presenting data findings at conferences, to presenting the findings to policymakers at individual school districts and coaching certification organizations such as the National Federation of State High School

Associations. All interscholastic coaches in the state of North Carolina are already encouraged, and at some districts required, to take a concussion in sports course.

Presentation of these findings could help lobby for the inclusion of a Triad course, even if it is initially offered as an elective.

It is necessary to develop a Power Point presentation to effectively disseminate the findings of this study. The presentation will begin with the most current definition of the Triad and some relevant background information, including previous similar research to establish relationship and a point of reference for the current study. Slides will include data and graphs that represent the current study methods, participant demographics, data analysis, and main findings - notably the data relevant to the three aims of the study. Data will be included concerning the responses to the questions about each component which will illustrate the various levels of understanding of each component. Showing this data in a concise and easily understandable manner will ensure the audience comprehends the data and its significance. Other interesting findings will be included such as the association between confidence levels and correct answers, the significant differences between male and female coaches on certain questions or certain subjects, and athletic program data from the responding coaches. The presentation will end with a slide indicating where audience members can go online for more information regarding the Triad, similar to the information at the end of the online survey.

Such a presentation could then serve as a catalyst to push for a policy requiring Triad-related professional development for all coaches of female athletes, initially at the district level, then ultimately statewide. This presentation would be offered to central

office administration, boards of education, athletic directors, school nurses, school administration, and coaches.

Beyond just presenting educational information to school districts, it would be beneficial to lobby to include questions relating to the Triad on pre-participation exams (PPEs). It may be beneficial to present study findings and recommendations to interested school boards, as these boards possess the authority to assist in enacting this recommendation. Examples of PPEs that already include questions designed to assess Triad-related signs and symptoms could be included as part of this presentation. This would help team physicians, private practicing family physicians and pediatricians, and school nurses to notice some of the warning signs and give them data for use in referring the athlete to the necessary professionals. This early intervention will help the athlete before presentation of more serious components of the Triad. This may also help initiate, or ease, conversational talking points between the athletes and the relevant stakeholders about topics that may typically be sensitive or difficult to broach. Although this study did not specifically ask about pre-participation exams, the results of the questions regarding athletic department policies show there is very little currently done at the administrative level aimed specifically at the Triad. If school districts can establish a setting where athletes, coaches, and administrators are in concert with assessing and discussing Triad-related health issues, it may relieve the historical stigma behind discussing matters of healthy menstruation and eating.

The following information will be used as takeaway data for a handout which can be distributed to anyone interested in the Triad:

The Female Athlete Triad

The three components of the Triad are low energy availability (EA), menstrual dysfunction, and low bone mineral density (BMD).



ARE YOU AT RISK FOR FEMALE ATHLETE TRIAD?



female athletes who train vigorously — especially those who overtrain



women who practice sports regularly for fun, especially sports that have an aesthetic component (like dancing, ballet, figure skating or gymnastics)



women who practice exercises or sports that are tied to fitting within a weight class (e.g. tae kwon do, judo or wrestling)



women with eating disorders like anorexia or bulimia



women who are "chronic dieters" or "yo-yo dieters" who eat a low-calorie diet



women who have compounding psychological disorders like anxiety, depression or obsessive compulsive disorder (OCD)



women with other hormonal issues like PCOS, adrenal fatigue or chronic fatigue

Dr. Axe
FOOD • MEDICINE

For more information on the Triad visit:

<http://www.femaleathletetriad.org> – Home page of the Female Athlete Triad Coalition

<https://www.acsm.org/docs/brochures/the-female-athlete-triad.pdf> - Informational brochure from the American College of Sports Medicine

<https://www.acog.org/Resources-And-Publications/Committee-Opinions/Committee-on-Adolescent-Health-Care/Female-Athlete-Triad> - Position statement from the American Congress of Obstetricians and Gynecologists

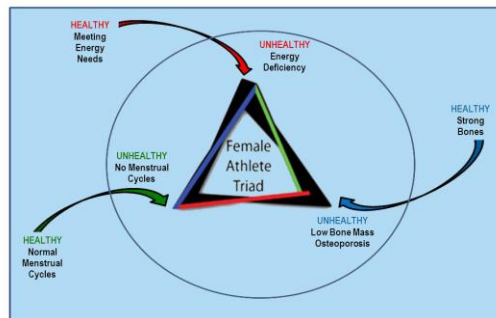
By the numbers . . .

Component Prevalence in female athletes:

At least one component – 16%-60%

Two components – 3%-27%

All three components – 1%-16%



NORTH CAROLINA COACHES' KNOWLEDGE:

Recent research targeting North Carolina High School coaches of female athletes found:

* Only 25% of coaches could correctly identify all three components

* Average score of 67% correct on the full survey, equivalent letter grade of D

* Female coaches scored significantly better on the full survey and were more likely to be able to correctly identify the three components

* Coaches with a formal Kinesiology-related education scored better on the full survey and were significantly more able to identify the three components than coaches with formal education in other subjects not related to Kinesiology

* Average score on questions blocks:

Menstrual – 53%

EA - 80%

BMD - 78%

OTHER INTERESTING FINDINGS:

* Only 14% of coaches provide their athletes with Triad-related information

* Responding coaches overestimated their knowledge of menstrual dysfunction, but underestimated their knowledge of EA and BMD

* There is much uncertainty surrounding Triad knowledge

* Only 8-10% of respondents' athletic departments have policies in place to deal with the Triad

* More needs to be done at the policy/administrative level

* Percentagewise, respondents who were more confident in their answer to the component ID question got the question correct more than those who were less confident in their answer

* Coaches were self-aware about their ability to define the Triad

REFERENCES

- Bailey, D. A., Martin, A. D., McKay, H. A., Whiting, S., & Mirwald, R. (2000). Calcium Accretion in Girls and Boys During Puberty: A Longitudinal Analysis. *Journal of Bone and Mineral Research*, *15*(11), 2245–2250.
- Brown, K. N., Wengreen, H. J., & Beals, K. A. (2014). Knowledge of the Female Athlete Triad, and Prevalence of Triad Risk Factors among Female High School Athletes and their Coaches. *Journal of Pediatric and Adolescent Gynecology*, *27*(5), 278–282.1
- Compston, J. E., McConachie, C., Stott, C., Hannon, R. A., Kaptoge, S., DeBiram, I., ... Jaffa, A. (2006). Changes in bone mineral density, body composition and biochemical markers of bone turnover during weight gain in adolescents with severe anorexia nervosa: a 1-year prospective study. *Osteoporosis International*, *17*(1), 77–84.
- De Souza, M. J., Nattiv, A., Joy, E., Misra, M., Williams, N. I., Mallinson, R. J., ... Expert Panel. (2014). 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. *British Journal of Sports Medicine*, *48*(4), 289–289.

- Frideres, J. E., Mottinger, S. G., & Palao, J. M. (2015). Design, validation, and reliability of survey to measure female athlete triad knowledge among coaches. *Motriz: Revista de Educacao Física*, *21*(2), 148–157.
- Frideres J. E., Mottinger S. G., & Palao J. M. (2016). Collegiate coaches' knowledge of the female athlete triad in relation to sport type. *The Journal of Sports Medicine and Physical Fitness*, *56*(3), 287–294.
- Gibbs J. C., Williams N. I., & De Souza M. J. (2013). Prevalence of individual and combined components of the female athlete triad. *Medicine and Science in Sports and Exercise*, *45*(5), 985–996.
- Harel, Z., Gold, M., Cromer, B., Bruner, A., Stager, M., Bachrach, L., ... Bone, H. (2007). Bone Mineral Density in Postmenarchal Adolescent Girls in the United States: Associated Biopsychosocial Variables and Bone Turnover Markers. *Journal of Adolescent Health*, *40*(1), 44–53.
- Heffner, J. L., Ogles, B. M., Gold, E., Marsden, K., & Johnson, M. (2003). Nutrition and Eating in Female College Athletes: A Survey of Coaches. *Eating Disorders*, *11*(3), 209–220.
- Javed, A., Tebben, P. J., Fischer, P. R., & Lteif, A. N. (2013). Female Athlete Triad and Its Components: Toward Improved Screening and Management. *Mayo Clinic Proceedings*, *88*(9), 996–1009.
- Kroshus, E., Fischer, A. N., & Nichols, J. F. (2015). Assessing the Awareness and Behaviors of U.S. High School Nurses With Respect to the Female Athlete Triad. *The Journal of School Nursing*, *31*(4), 272–279.

- Kroshus E., Sherman R. T., Thompson R. A., Sossin K., & Austin S. B. (2014). Gender differences in high school coaches' knowledge, attitudes, and communication about the female athlete triad. *Eating Disorders*, 22(3), 193–208.
- Loucks A. B., Stachenfeld N. S., & DiPietro L. (2006). The female athlete triad: do female athletes need to take special care to avoid low energy availability? *Medicine and Science in Sports and Exercise*, 38(10), 1694–1700.
- McKay, H., Liu, D., Egeli, D., Boyd, S., & Burrows, M. (2011). Physical activity positively predicts bone architecture and bone strength in adolescent males and females. *Acta Paediatrica*, 100(1), 97–101.
- Mukherjee S., Chand V., Wong X. X., Choong P. P., Lau V. S. M., Wang S. C. L., ... Ng K. W. (2016). Perceptions, awareness and knowledge of the Female Athlete Triad amongst coaches – Are we meeting the expectations for athlete safety? *International Journal of Sports Science and Coaching*, 11(4), 545–551.
- Nattiv A., Agostini R., Drinkwater B., & Yeager K. K. (1994). The female athlete triad. The inter-relatedness of disordered eating, amenorrhea, and osteoporosis. *Clinics in Sports Medicine*, 13(2), 405–418.
- Nattiv A., Loucks A. B., Manore M. M., Sanborn C. F., Sundgot-Borgen J., Warren M. P., & American College of Sports Medicine. (2007). American College of Sports Medicine position stand. The female athlete triad. *Medicine and Science in Sports and Exercise*, 39(10), 1867–1882.
- Nazem, T. G., & Ackerman, K. E. (2012). The Female Athlete Triad. *Sports Health*, 4(4), 302–311.

- North Carolina State Board of Education. (2015). *January Newsletter*. Retrieved from <https://stateboard.ncpublicschools.gov/sbe-newsletter/2015-newsletter/01newsletter.pdf/view>.
- Otis CL, Drinkwater B, Johnson M, Loucks A, & Wilmore J. (1997). American College of Sports Medicine position stand. The Female Athlete Triad. *Medicine and Science in Sports and Exercise*, 29(5).
- Pantano K. J. (2006). Current knowledge, perceptions, and interventions used by collegiate coaches in the US. Regarding the prevention and treatment of the female athlete triad. *North American Journal of Sports Physical Therapy: NAJSPT*, 1(4), 195–207.
- Pantano K. J. (2017). Knowledge, Attitude, and Skill of High School Coaches with Regard to the Female Athlete Triad. *Journal of Pediatric and Adolescent Gynecology*, 30(5), 540–545.
- Rauh, M. J., Nichols, J. F., & Barrack, M. T. (2010). Relationships Among Injury and Disordered Eating, Menstrual Dysfunction, and Low Bone Mineral Density in High School Athletes: A Prospective Study. *Journal of Athletic Training*, 45(3), 243–252.
- Reinking, M. F., & Alexander, L. E. (2005). Prevalence of Disordered-Eating Behaviors in Undergraduate Female Collegiate Athletes and Nonathletes. *Journal of Athletic Training*, 40(1), 47–51.

- Stickler, L., Hoogenboom, B. J., & Smith, L. (2015). The Female Athlete Triad - What Every Physical Therapist Should Know. *International Journal of Sports Physical Therapy*, 10(4), 563–571.
- Soyka L. A, Fairfield W. P., & Klibanski A. (2000). Clinical review 117: Hormonal determinants and disorders of peak bone mass in children. *The Journal of Clinical Endocrinology and Metabolism*, 85(11), 3951–3963.
- Torstveit, M. K., & Sundgot-Borgen, J. (2005). Participation in leanness sports but not training volume is associated with menstrual dysfunction: A national survey of 1276 elite athletes and controls. *British Journal of Sports Medicine*, 39(3), 141–147.
- Torstveit, M. K., & Sundgot-Borgen, J. (2005). The female athlete Triad: Are elite athletes at increased risk? *Medicine and Science in Sports and Exercise*, 37(2), 184–190.
- Troy K., Hoch A. Z., & Stavrakos J. E. (2006). Awareness and comfort in treating the Female Athlete Triad: are we failing our athletes? *WMJ: Official Publication of the State Medical Society of Wisconsin*, 105(7), 21–24.
- Waldrop, J. (2005). Early identification and interventions for female athlete triad. *Journal of Pediatric Health Care*, 19(4), 213–220.
- West R. V. (1998). The female athlete. The triad of disordered eating, amenorrhea and osteoporosis. *Sports Medicine (Auckland, N.Z.)*, 26(2), 63–71.

Wheatley, S., Khan, S., Székely, A. D., Naughton, D. P., & Petróczi, A. (2012).

Expanding the Female Athlete Triad concept to address a public health issue.

Performance Enhancement & Health, 1(1), 10–27.

Yeager K. K., Agostini R., Nattiv A., & Drinkwater B. (1993). The female athlete triad:

disordered eating, amenorrhea, osteoporosis. *Medicine and Science in Sports and*

Exercise, 25(7), 775–777.

Yurth E. F. (1995). Female athlete triad. *The Western Journal of Medicine, 162*(2), 149–

150.

APPENDIX A

SURVEY INSTRUMENT QUESTIONNAIRE TO MEASURE COACHES' FEMALE ATHLETE TRIAD KNOWLEDGE

Please answer the following demographic and experiential questions. Unless otherwise noted, please choose one answer per question.

1. Current age: _____
2. Sex:
 - Female
 - Male
3. Ethnic group:
 - African-American
 - Asian
 - Caucasian
 - Hispanic
 - Native American
 - Other
4. Highest degree completed:
 - High school diploma / GED
 - Associate's Degree
 - Bachelor's Degree Major area of study: _____ Year: _____

Master's Degree Major area of study: _____ Year: _____

Doctoral Degree Major area of study: _____ Year: _____

5. Sport(s) currently coaching at this level. Indicate the sport by checking the box then type the number of years* coaching this sport (if appropriate, choose more than one):

*Please enter years in a numerical format.

Cross country _____ Field hockey _____ Soccer _____ Volleyball _____

Basketball _____ Bowling _____ Fencing _____ Ice hockey _____

Rifle _____ Skiing _____ Waterpolo _____ Rowing _____

Track & field _____ Golf _____ Lacrosse _____ Softball _____

Tennis _____ Swimming _____ Diving _____ Gymnastics _____

Wrestling _____ Football _____ Baseball _____ Other _____

If you coach track and field, please also mark which trial(s):

Sprints _____ Jumps _____ Throws _____

Hurdles _____ Multi-events _____ Walk _____

Middle & long distance (800 m and above) _____

6. Current position:

Head coach

Assistant coach

Graduate assistant

Student (undergraduate) coach

7. Number of years coaching at this level (including this year)? _____

8. Sports coached in your lifetime (please check all that apply)?

- Cross country _____ Field hockey _____ Soccer _____ Volleyball _____
- Basketball _____ Bowling _____ Fencing _____ Ice hockey _____
- Rifle _____ Skiing _____ Waterpolo _____ Rowing _____
- Track & field _____ Golf _____ Lacrosse _____ Softball _____
- Tennis _____ Swimming _____ Diving _____ Gymnastics _____
- Wrestling _____ Football _____ Baseball _____ Other _____

If you have coached track and field, please also mark which trial(s):

- Sprints _____ Jumps _____ Throws _____
- Hurdles _____ Multi-events _____ Walk _____
- Middle & long distance (800 m and above) _____

9. Total number of years you have coached (regardless of level, sport, & gender of athletes) : _____

10. Total number of years you have coached female athletes: _____

11. Number of coaches in your current program (including yourself):

	Full time	Partial time
Head coach	_____	_____
Assistant coach	_____	_____
Graduate assistant	_____	_____
Student (undergraduate) coach	_____	_____

Knowledge of the triad

Please complete the following statements. Next to the answer please indicate the level of confidence you have in its correctness using the following scale:

1 = Not at all confident

2 = Somewhat confident

3 = Confident

4 = Completely sure

Example: There are__ days in a week. **Seven** Confidence 1 2 3 4

12. The three components of the Female Athlete Triad are:

- disordered eating, anemia, osteoporosis
- anemia, 44menorrea, disordered eating
- amenorrea, disordered eating, osteoporosis
- amenorrea, osteoporosis, anemia

Confidence 1 2 3 4

13. Those who can suffer from the triad are:

- young adult female athletes who have started to menstruate
- any physically active female

adolescent female athletes

Confidence 1 2 3 4

14. Consequences of the triad can affect a female:

while she is still competing

as long as she remains physically active

for the rest of her life

Confidence 1 2 3 4

15. Signs and symptoms of the triad can include (choose all that apply):

dizziness stress fracture depression

hyperactivity

fatigue low bone mineral density mealtime anxiety weight

gain

irritability sore throat abdominal pain knuckle

scars

dry hair & skin hypertension tachycardia (high resting heart
rate)

amenorrhea (lack of menstruation)

Confidence 1 2 3 4

16. Risk factors of the triad include (choose all that apply):

perfectionism resilient

chronic dieting training outside of scheduled practices

low self-esteem participation in strength training

competitive nature feeling pressure to lose weight to improve performance

Confidence 1 2 3 4

Please choose one answer (true, false, or don't know) for the following questions.

Indicate the level of confidence you have in your answer's correctness when answering true or false. Leave the confidence level blank when answering don't know.

1 = Not at all confident

2 = Somewhat confident

3 = Confident

4 = Completely sure

Example There are 25 hours in a day.

True / **False** / Don't know Confidence 1 2 3 4

17. Anorexia nervosa is characterized by the failure to maintain a normal weight for a person's age and height and an intense fear of gaining weight. **True** / False / Don't know
Confidence 1 2 3 4

18. Individuals with bulimia nervosa can be almost any weight and often experience body image disturbance. **True** / False / Don't know
Confidence 1 2 3 4
19. Amenorrhea involves the absence of three or more consecutive menstrual cycles. **True** / False / Don't know
Confidence 1 2 3 4
20. Oligomenorrhea (six or fewer menstrual cycles per year) is not a major health concern as long as the athlete is menstruating in the off-season. True / **False** / Don't know
Confidence 1 2 3 4
21. Osteoporosis is characterized by low bone mineral density which affects overall bone health. **True** / False / Don't know
Confidence 1 2 3 4
22. Osteopenia (lesser degree of bone loss than in osteoporosis), like osteoporosis, is directly affected by nutrition. **True** / False / Don't know
Confidence 1 2 3 4
23. Eating disorders can be fatal. **True** / False / Don't know
Confidence 1 2 3 4
24. Menstrual dysfunction in a college athlete generally has no bearing later in her adult life. True / **False** / Don't know
Confidence 1 2 3 4
25. Because of the impact of running on bone density, bone loss does not occur in many light-weight athletes. True / **False** / Don't know
Confidence 1 2 3 4
26. Repeated stress fractures should serve as a warning with regards to low bone mineral density. **True** / False / Don't know
Confidence 1 2 3 4

27. Eating disorders are caused exclusively by psychological problems. True / **False** / Don't know
Confidence 1 2 3 4
28. If weight is a concern for the health of an athlete or for avoiding injury, giving the athlete a range of acceptable weights or body fat compositions will help her to feel less pressure related to weight control. **True** / False / Don't know
Confidence 1 2 3 4
29. Adequate levels of training and nutrition may cause some female athletes to stop menstruating. True / **False** / Don't know
Confidence 1 2 3 4
30. College-aged athletes who suffer from low bone density can generally recuperate all bone loss later in life. True / **False** / Don't know
Confidence 1 2 3 4
31. An athlete that suffers from the triad will have a sudden, apparent decrease in sport performance. True / **False** / Don't know
Confidence 1 2 3 4
32. As a coach, stressing an ideal weight helps an athlete understand how she can perform best in her sport. True / **False** / Don't know
Confidence 1 2 3 4
33. Joking comments made by others about one's weight can trigger disordered eating patterns in susceptible athletes. **True** / False / Don't know
Confidence 1 2 3 4

34. Once an athlete has a confirmed case of one of the three components of the triad, screening for the other two components should follow. **True** / False / Don't know
Confidence 1 2 3 4
35. It is an invasion of the athlete's privacy for the coaching staff to ask if her menstrual cycles are regular. True / **False** / Don't know
Confidence 1 2 3 4
36. A coach's influence on the athlete extends to the behaviors and beliefs of the coach regarding weight issues. **True** / False / Don't know
Confidence 1 2 3 4
37. Prevention of the triad involves emphasizing to athletes the amount of macro- and micronutrients that they need to compete as opposed to the foods they should avoid. **True** / False / Don't know
Confidence 1 2 3 4
38. An efficient and easy way for medical staff to screen for the triad involves using menstrual health history and nutritional history questionnaires. **True** / False / Don't know
Confidence 1 2 3 4
39. The coaching staff member or the athletic trainer with the best relationship with the athlete is the person who should intervene when a case of the triad is suspected. **True** / False / Don't know
Confidence 1 2 3 4

40. For health reasons, an athlete with a confirmed case of True / **False** / Don't know
the female athlete triad must stop competing immediately. Confidence 1 2 3 4
41. When confronted about disordered eating or triad concerns, typically the athlete will be relieved and desire help. True / **False** / Don't know
Confidence 1 2 3 4
42. The intervention team should minimally involve a **True** / False / Don't know
medical physician, dietician, and a psychiatrist or psychologist. Confidence 1 2 3 4

Finally, please complete the following questions about your program, choosing one answer unless otherwise noted.

43. The athletic department currently has a policy in place that Yes / No / Don't know
specifies what to do when we *suspect* that an athlete suffers
from one or more aspects of the female athlete triad
44. The athletic department currently has a policy in place that Yes / No / Don't know
specifies what to do with a *confirmed* case of an athlete
with one or more aspects of the female athlete triad.

45. The athletic department provides educational programming for the athletes about the female athlete triad. Yes / No / Don't know
46. As a coach, I personally provide information for the athletes about the female athlete triad. Yes / No
47. Although I do not personally speak to the athletes about it, I do provide educational programming about the female athlete triad for them. Yes / No
48. I have received training on the subject of the Female Athlete Triad as a collective entity. Yes / No
49. I have received training on at least one of the components of the Triad. Yes / No
- If so, which component(s)?
 - Amenorrhea
 - Disordered eating
 - Osteoporosis

For more information regarding the Female Athlete Triad visit:

<http://www.femaleathletetriad.org> – Home page of the Female Athlete Triad Coalition

<https://www.acsm.org/docs/brochures/the-female-athlete-triad.pdf> - Informational

brochure from the American College of Sports Medicine

[https://www.acog.org/Resources-And-Publications/Committee-Opinions/Committee-on-](https://www.acog.org/Resources-And-Publications/Committee-Opinions/Committee-on-Adolescent-Health-Care/Female-Athlete-Triad)

[Adolescent-Health-Care/Female-Athlete-Triad](https://www.acog.org/Resources-And-Publications/Committee-Opinions/Committee-on-Adolescent-Health-Care/Female-Athlete-Triad) - Position statement from the American

Congress of Obstetricians and Gynecologists

APPENDIX B

TABLES

Table 4. One-Sample T-Test Establishing Percentage of Correct Answers on Component Identification Question.

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
The three components of the Female Athlete Triad are:	6.700	136	.000	.248	.17	.32

Table 5. Crosstabulation of Answers for the Three Components of the Triad and Confidence Levels.

			Confidence level: 0=low, 1=high		Total
			0	1	
The three components of the Female Athlete Triad are:	Incorrect answer	Count	67	36	103
		Percent	65.0%	35.0%	100.0%
	Amenorrhea, Disordered eating, Osteoporosis	Count	13	21	34
		Percent	38.2%	61.8%	100.0%
Total		Count	80	57	137
		Percent	58.4%	41.6%	100.0%

Table 6. Chi-Square Tests for Crosstabulation of Answers for the Three Components of the Triad and Confidence Levels.

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.564 ^a	1	.006		
Continuity Correction ^b	6.501	1	.011		
Likelihood Ratio	7.497	1	.006		
Fisher's Exact Test				.009	.006
Linear-by-Linear Association	7.509	1	.006		
N of Valid Cases	137				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.15.

b. Computed only for a 2x2 table

Table 7. Average Overall Score on the Survey Broken Down Between Male and Female.

	Sex:	N	Mean	Std. Deviation	Std. Error Mean
% Correct	Male	62	64.0596	10.59333	1.34535
	Female	34	71.5316	7.48066	1.28292

Table 8. Independent Samples T-Test for Mean Differences Between Scores of Males and Females on the Full Survey.

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
% Correct	Equal variances assumed	4.427	.038	-3.641	94	.000	-7.47198	2.05209
	Equal variances not assumed			-4.019	87.949	.000	-7.47198	1.85900

Table 9. Number and Percentage of Correct Answer Chosen on Component Identification Question Broken Down by Male and Female.

	Sex:	N	Mean	Std. Deviation	Std. Error Mean
The three components of the Female Athlete Triad are:	Male	94	.21	.411	.042
	Female	43	.33	.474	.072

Table 10. Independent Samples T-Test for Mean Differences Between Scores of Males and Females on the Component Identification Question.

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
The three components of the Female Athlete Triad are:	Equal variances assumed	6.811	.010	-1.419	135	.158	-.113	.080
	Equal variances not assumed			-1.346	72.060	.183	-.113	.084

Table 11. Overall Average Score on the Survey Broken Down by Major Area of Study for Highest Degree Completed.

	Major area of study for highest degree completed (value of 1 = kinesiology-related degree):	N	Mean	Std. Deviation	Std. Error Mean
% Correct	0	70	65.9838	10.34423	1.23637
	1	26	68.6502	9.79791	1.92153

Table 12. Independent Samples T-Test for Mean Differences Between Scores of Coaches With Kinesiology-Related Degrees and Those With Other Degrees on the Full Survey.

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
PrntCorrect	Equal variances assumed	.730	.395	-1.138	94	.258	-2.66639	2.34302
	Equal variances not assumed			-1.167	47.063	.249	-2.66639	2.28493

Table 13. Crosstabulation of Major Area of Study for Highest Degree Completed and Answer on the Component Identification Question.

			The three components of the Female Athlete Triad are:		Total
			Incorrect answer	Amenorrhea, Disordered eating, Osteoporosis	
Major area of study for highest degree completed:	Non-kines.	Count	81	20	101
		Percent	80.2%	19.8%	100.0%
	Kines.	Count	22	14	36
		Percent	61.1%	38.9%	100.0%
Total		Count	103	34	137
		Percent	75.2%	24.8%	100.0%

Table 14. Chi-Square Tests for Crosstabulation of Answers for the Three Components of the Triad and Major Area of Study for Highest Degree Completed.

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.182 ^a	1	.023		
Continuity Correction ^b	4.210	1	.040		
Likelihood Ratio	4.890	1	.027		
Fisher's Exact Test				.041	.022
Linear-by-Linear Association	5.144	1	.023		
N of Valid Cases	137				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.93.

b. Computed only for a 2x2 table

Table 15. The Frequency of Athletic Departments That Currently Have a Policy in Place That Specifies What to Do When They Suspect That an Athlete Suffers from One or More Aspects of the Female Athlete Triad.

		Frequency	Valid Percent
Answer	No/Don't Know	98	89.9
	Yes	11	10.1
	Total	109	100.0
Missing	System	28	
Total		137	

Table 16. The Frequency of Athletic Departments That Currently Have a Policy in Place That Specifies What to Do with a Confirmed Case of an Athlete with One or More Aspects of the Female Athlete Triad.

		Frequency	Valid Percent
Valid	No/Don't Know	99	91.7
	Yes	9	8.3
	Total	108	100.0
Missing	System	29	
Total		137	

Table 17. The Frequency of Athletic Departments That Provide Educational Programming for the Athletes About the Female Athlete Triad.

		Frequency	Valid Percent
Valid	No/Don't Know	100	91.7
	Yes	9	8.3
	Total	109	100.0
Missing	System	28	
Total		137	

Table 18. Frequency of Coaches Who Indicated They Personally Provide Information for the Athletes About the Female Athlete Triad.

		Frequency	Valid Percent
Valid	No/Don't Know	94	86.2
	Yes	15	13.8
	Total	109	100.0
Missing	System	28	
Total		137	

Table 19. Frequency of Responses to the Statement - Although I Do Not Personally Speak to the Athletes About It, I Do Provide Educational Programming About the Female Athlete Triad for Them.

		Frequency	Valid Percent
Valid	No/Don't Know	94	86.2
	Yes	15	13.8
	Total	109	100.0
Missing	System	28	
Total		137	

Table 20. Frequency of Cumulative Scores for Questions About Coaches' Current Programs and Their Policies Regarding the Triad.

		Frequency	Valid Percent
Valid	.00	78	72.2
	1.00	17	15.7
	2.00	3	2.8
	3.00	6	5.6
	4.00	2	1.9
	5.00	2	1.9
	Total	108	100.0
Missing	System	29	
Total		137	