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**The Impact of an Educational Module on Female Collegiate Athlete Knowledge Regarding
the Female Athlete Triad**

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NURS 797W: Honors Thesis

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May 14, 2021

Abstract

The Female Athlete Triad was defined in women's sport as early as 1992, by the American College of Sports Medicine (ACSM). The guidelines regarding the Triad emphasize the importance of education in the prevention of the disorder. However, there is little research supporting if this education is occurring and if it is effective. A quantitative, quasi-experimental study was conducted at the University of New Hampshire. Twenty-five female collegiate athletes participated in a pre-test, educational intervention, and post-test to determine baseline knowledge and if there was any improvement in knowledge after education. Percent changes in scores from pre-test and post-test were analyzed as well as a two-tailed t-test. Results showed an increase in correct answers in all categories of knowledge. In knowledge regarding Female Athlete Triad risk factors, the change in scores was statistically significant ($p= 0.0253$).

Background

Female Athlete Triad

In June of 1992, the American College of Sports Medicine (ACSM) recognized a growing problem of interconnected disorders occurring in women's sports. A two-day workshop was convened to discuss this topic and develop parameters for prevention, screening, treatment, education, etc. The disorder was labeled as the Female Athlete Triad and defined as three components consisting of disordered eating, amenorrhea, and osteoporosis (Nattiv et al, 1994). It was also decided that research would continue to develop consistent guidelines.

The statement was revisited by the ACSM in 1997, the new guidelines continued to endorse the same components of the Triad but also outlined that "physically active girls and women should be educated about proper nutrition, safe training practices and the warning signs of the Triad" (Otis et al., 1997). As research continued, in 2007, the ACSM updated its position again. The updated guideline featured a new definition for Female Athlete Triad classification which included (1) low energy availability, (2) menstrual dysfunction, and (3) bone density as the interrelated components for diagnosis (Nattiv et al., 2007). This change in definition broadened the range of clinical manifestations for the Triad. Again, it was endorsed that education of athletes should be done for prompt intervention and prevention (Nattiv et al, 2007).

Energy Availability

Energy availability is the balance between caloric intake and calories burned (Daily & Stumbo, 2018). The result can range from optimal energy availability to low energy availability and be present with or without an eating disorder (Nattiv et al., 2007). When there is a negative balance between these components it results in energy deficiency. This can be a result of restricted caloric intake or excessive energy expenditure. This imbalance may not be intentional.

Reasons for low energy availability other than an eating disorder can include inadequate knowledge regarding appropriate nutrition, lack of time to prepare meals, financial strain, or physiological reasons such as loss of appetite from a training session (Wasserfurth et al., 2020). However, an eating disorder can still be a root cause.

Prevention of energy deficiency is aimed at educating athletes on their nutritional needs. These needs will be dependent on activity level and vary based on the individual athlete. Furthermore, athletes should be screened for eating disorders or disordered eating to receive early intervention. In a study of elite athletes, it was found that 30% experienced an eating disorder compared to the general population where there was only a prevalence of 5.5% (Mehta et al., 2020). Furthermore, 46.7% of those in sports that emphasize leanness such as track and gymnastics reported disordered eating (Mehta et al., 2020). These athletes can be referred to clinical specialists to ensure their caloric needs are being met and they can stay engaged in their sport safely.

Menstrual Function

Menstrual function varies from eumenorrhea to amenorrhea (Nattiv et al., 2007). The standard regular menstruation pattern is every 28 days. Meanwhile, oligomenorrhea is menstruation that occurs at intervals greater than 35 days or fewer than nine menstrual cycles in a year (Nattiv et al., 2007). Lastly, amenorrhea is classified as the absence of menstruation by the age of 15 or absence of menstrual cycle for three months (Nattiv et al., 2007). These irregularities begin to occur when there is low energy availability. The body must conserve energy, so it suppresses reproductive function to do so (Daily & Stumbo, 2018). Since athletes may be experiencing low energy availability it may also lead to menstrual dysfunction.

Studies have shown that secondary amenorrhea prevalence was as high as 69% in dancers and 65% in long-distance runners (Mehta et al., 2020). These athletes may be unaware that menstrual irregularity is an indication of compromised health or that it is resulting from low energy availability. If education is provided on this topic athletes can report menstrual irregularity and take steps to correct it before it has an impact on bone density.

Bone Mineral Density

Bone mineral density (BMD) can range from optimal bone health to osteoporosis (Nattiv et al, 2007). Osteoporosis is defined as “a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture” (Manolagas, 2020). This diagnosis is made through the use of a bone density scan. This component is also influenced by the other two components of the Triad. .

Menstrual dysfunction can lead to estrogen deficiency. Estrogen has a key role in the maintenance of bone mass density. It highly influences calcium absorption, bone formation, and bone remodeling (Nattiv et al, 2007). Meanwhile, low energy availability can result in inadequate intake of nutrients that influence bone density. These are components such as calcium and vitamin D that are required for bone health. As bone density decreases the risk of fracture and osteoporosis increases. Lost bone mass density is especially problematic because peak bone mass is achieved by the third decade of life (Nattiv et al, 2007). Therefore, prevention of lost bone mass is important for life-long health.

Risk Factors

Simply being a woman in sport puts individuals at risk for the triad (Daily & Stumbo, 2018). Other risk factors for the Triad include early age of sports specialization, abuse, dieting, sports with endurance, aesthetic or weight class components, and emphasize/reward for leanness

(Weiss Kelly & Hecht, 2016). Sports that are commonly found in this category include gymnastics, figure skating, distance running, dance, and wrestling. However, this does not mean that those engaged in other sports may not be at risk. At the University of New Hampshire, there are students competing at the collegiate level in these sports. Current data doesn't provide the exact prevalence of FAT, but it does report that fifteen to 62% of female college athletes have disordered eating which is a component of the triad (Hobart & Smucker, 2000). These symptoms may be irreversible, so prevention and early recognition are important (Loveless, 2017).

Literature Review

While there is an emphasis on the need for Triad education there seems to be a gap in research as to if this education is occurring and if it is effective. A review of the literature revealed only one study, completed at Kent State University, that specifically looked at the Female Collegiate Athlete's knowledge regarding the topic and if an educational intervention improved this knowledge. Within this study, only 14% of participants could identify all three components of the Triad (Rennolds, 2015). To combat this lack of knowledge it must be evaluated if an educational intervention would be successful in increasing knowledge regarding FAT. After the implementation of an educational intervention, the Kent State study found that the number of participants that could identify all three components of the Triad increased to 35% (Rennolds, 2015). Other articles focused on high school athletes, coaches, and athletic trainers. While these individuals are still a part of the larger picture it is still important to recognize the need to empower the individual athlete regarding their health.

Research Questions

To address this gap in research this study aims to evaluate:

1. Female collegiate athlete baseline knowledge of the Female Athlete Triad
2. Address if an educational module will improve female collegiate athlete knowledge regarding the Female Athlete Triad.

Methods

Study Design

A 24 question Qualtrics survey was created that was comprised of a pre-test, educational intervention, and post-test (Appendix A). The pre and post-test were identical to evaluate if knowledge improved after viewing a 9-minute recorded PowerPoint lecture in which information about the Triad components, risk factors, and signs/symptoms were presented (Appendix B). The survey, as well as the educational PowerPoint were adapted from the Kent State University study (Rennolds, 2015).

Sample

Participants were included only if they were current female collegiate athletes participating in an NCAA-sponsored sport. They were recruited by email through UNH's athletic department.

Data Analysis

The questions within the survey were categorized based on what type of Female Athlete Triad knowledge was assessed such as risk factors, signs, and symptoms, etc. Each participant's answers were labeled as correct or incorrect. For each question, it was then determined what percent of respondents identified the correct answer. This was done separately for the pre and post-test. The percent change in correct answers was then recorded.

Once the percent change was determined the scores were further analyzed for statistical significance. Correct answers were categorized numerically with the number 1 and incorrect

answers were given a 0. The average was then found as well as the standard deviation. These values along with sample size were then plugged into an online t-test calculator to examine statistical significance. Results were considered significant if the p-value was less than 0.05.

Results

Sample

Twenty-seven participants completed the pre-test while twenty-five also completed the post-test. Several of the participants had partial answers stopping once they got through the demographic section. These answers were not factored into the results. All of the answers recorded were from current female collegiate athletes competing on an NCAA-sponsored team. The survey was designed to end if these criteria were not met.

Triad Awareness

It was found that 70.4% of survey participants had previously heard of the female athlete triad. Furthermore, at the time of the pre-test 74.1% of participants were able to correctly identify all three components of the Triad.

Table 1: Percent Change in Scores

	Pre- Test (n=27) N (%)	Post-Test (n=25) N (%)	% Change
Aware of Female Athlete Triad	19 (70.4%)	-	-
Q1. Correctly Identified 3 Triad Components	20 (74.1%)	22 (88%)	13.9%
Q2. Correctly Identified Criteria for Diagnosis	20 (74.1%)	22 (88%)	13.9%
Q3. Correctly Identified Energy Availability Definition	26 (96.3%)	25 (100%)	3.7%
Q4. Correctly Identified Relationship Between Triad Components	21 (77.8%)	24 (96%)	18.2%
Q5. Correctly Identified Risk Factors of the Triad	18 (66.7%)	23 (92%)	25.3%

Q6. Correctly Identified Optimal Energy State for Competition	24 (88.9%)	24 (96%)	7.1%
Q7. Correctly identified “normal” menstrual pattern	20 (74.1%)	23 (92%)	17.9%

Each category of question had an increase in the percent correct answers after the educational module was viewed. The largest increase in correct answers was seen in Question 5 which assessed if the participant “Correctly Identified Risk Factors of the Triad”. The pretest percent correct was 66.7% and post-test was 92% for a percent change of 25.3%. These percent changes indicated that knowledge had improved from pre-test to post-test.

Table 2: Two Tailed T-Test

	Question 1		Question 2		Question 3		Question 4	
	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
Average	0.7047	0.88	0.7047	0.88	0.9629	1	0.7777	0.96
STD	0.4465	0.3317	0.4465	0.3316	0.1924	0	0.4236	0.2
P-value	0.1167		0.1166		0.3400		0.558	

	Question 5		Question 6		Question 7	
	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
Average	0.6666	0.92	0.8888	0.96	0.7407	0.92
STD	0.4803	0.2768	0.3202	0.2	0.4465	0.2768
P-value	0.0253		0.3454		0.0909	

To detect for statistical significance a two-tailed t-test was completed. Question five regarding Female Athlete Triad risk factors was found to be statistically significant with a p-value of 0.0253. The rest of the results did not produce statistical significance.

Participants Perceived Best Resource for Education

Within the post-test, a question was also included in which participants were asked to rank from best to worst what they perceived to be the best resource to receive information regarding the Female Athlete Triad from. The best resource was labeled as a physician and the worst being the internet.

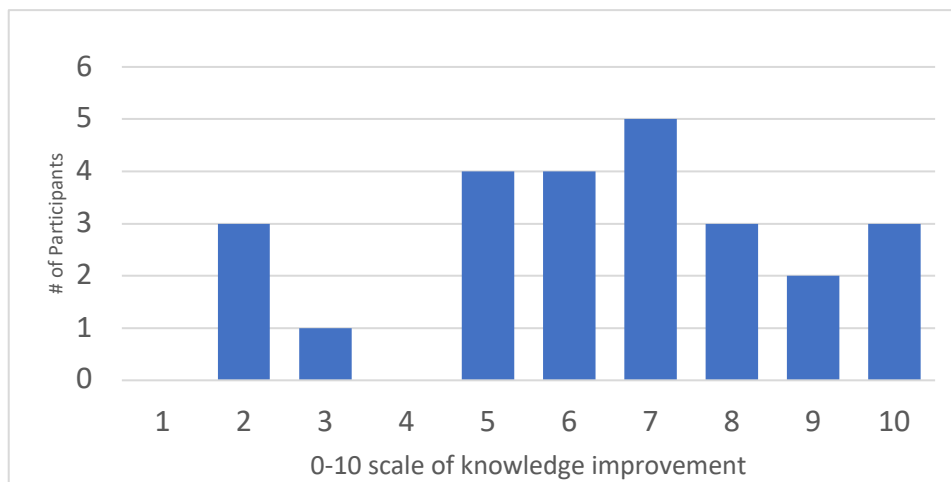
Table 3: Participant Ranking Best Resource for Education

1.	Physician
2.	Athletic Trainer
3.	Dietician/Nutritionist
4.	Coach
5.	Parents
6.	Teammates
7.	Internet

Perceived Improvement in FAT Knowledge

Lastly, after the post-test participants were asked to record on a scale of 0-10 how much they felt their knowledge had improved. Zero was quantified as not at all and ten being immensely. The average recorded response to this question was seven indicating that a majority of respondents felt as if their knowledge had improved through the educational intervention.

Table 4: Perceived Improvement in FAT Knowledge



Discussion

Overall, the results of the study saw an improvement in female collegiate athlete knowledge regarding the Female Athlete Triad after the implementation of an educational module. This was reflected in the percent change from the pre-test and post-test scores. In addition, participants expressed that they felt as though their knowledge had improved as a result of the intervention.

Regarding Triad awareness, this study found that 74% of respondents were previously aware of the Female Athlete Triad. This result was far higher than the 14% that were aware of the Triad in the Kent State study (Rennolds, 2015). This previous awareness may be a result of the sample's demographic. Although the survey was available to all female athletes through the university's field house a majority of participants were a part of the cross country team. The cross country team has previously discussed this topic within the context of their training, so awareness was higher.

Limitations

The study results did show that there was an increase in scores however, many of the changes were not found to be statistically significant. The reasons for this outcome may be due

to a small sample size that consisted of a group predominately familiar with the Female Athlete Triad. In addition, the survey was completed at the participant's connivance at home. This could result in participants not completely viewing the educational module or looking up answers to the questions.

Implications

The results of this study should support an initiative to integrate Female Athlete Triad education into the curriculum of all female athletes. The results also support that athletes would prefer that they receive education from a physician, athletic trainer, and/or a dietician. At the University of New Hampshire, these professionals can be found in the athletic department. At the beginning of each season, athletes have meetings with these professionals to be cleared to compete. This education could be incorporated into these meetings to ensure that athletes feel empowered to recognize and prevent the Triad.

Further research should be aimed at examining the most beneficial form of education. Due to COVID-19, for this study, a pre-recorded lecture was used because it was easy to distribute. In the future, it should be evaluated if an in-person lecture, interactive module, handouts, or other media would help improve knowledge by a larger margin.

In addition, this study can be adapted to evaluate the knowledge of other stakeholders such as coaches, parents, and athletic trainers. This education should be introduced to athletes at the high school level in order to prevent complications later in an athlete's career. Early intervention is a key component of Female Athlete Triad prevention so integrating this knowledge early can be beneficial to developing athletes.

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Appendix A: Qualtrics Survey
Exclusion Questions

Please select your gender

- Male
- Female
- Other
- Prefer Not to Say

Do you participate in a NCAA sponsored sport?

- Yes
- No

Knowledge Questions

Have you ever heard of the Female Athlete Triad?

- Yes
- No

Which of the following conditions are included in the interrelated conditions of the Female Athlete Triad? (Select all that apply)

- Energy deficiency
- Heart arrhythmia
- Menstrual dysfunction
- Polycystic ovary syndrome
- Premenstrual syndrome
- Low bone density

An athlete needs to have all components of the Female Athlete Triad for diagnosis.

- True
- False

Energy availability is the balance between:

- caloric intake and energy burned
- caloric intake and amount of sleep
- amount of sleep and energy burned

Bone density is directly impacted by menstrual dysfunction and energy deficiency.

- True
- False

For the following, indicate if the statement is true or false.

- All females who are physically active are at risk for development of the Female Athlete Triad.
- Energy deficiency is the optimal state of caloric intake for improve athletic performance
- Amenorrhea is regular menstruation every 28 days.
- The Female Athlete Triad only affects athletes' health while they are participating in sports.
- Participation in sport(s) that require endurance is considered a risk factor for developing Female Athlete Triad.
- Participation in a sport where emphasis is placed on having a low body weight and a lean physique (i.e. figure skating, ballet, gymnastics) may be a risk factor for developing Female Athlete Triad.
- Female athletes should not train competitively in order to decrease risk of developing the Female Athlete Triad

Please list possible signs/symptoms of the Female Athlete Triad.

What are possible long term complications of the Female Athlete Triad?

Rank the following in order of best to worst resource for student-athletes, regarding Female Athlete Triad support.

- _____ Internet
- _____ Parents
- _____ Athletic Trainer
- _____ Teammates
- _____ Mental Health Practitioner
- _____ Physician
- _____ Coach
- _____ Dietician/Nutritionist

Appendix B: Educational Module

The Female Athlete Triad

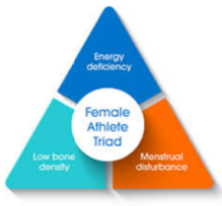
Educational Intervention
By: Cayla Barretto, SN

1

What is it?


There are three main components:

1. energy deficiency
2. low bone density
3. menstrual dysfunction



2

Energy Deficiency



Characteristics


- Restricting caloric intake
- Excessive energy expenditure
- Burning more calories than consumed

How can this be prevented?

- Insufficient energy available for body functions
- Caloric intake - calories burned = available energy

3

Menstrual Dysfunction



Characteristics


- Eumenorrhea**
 - Regular menstruation approximately every 28 days
- Oligomenorrhea**
 - Menstruation every 35 days or fewer than nine menstrual cycles in 1 year
- Amenorrhea**
 - Delay to start of menstrual cycle
 - Absence of menstrual cycle - 3 months

This may be caused by energy deficiency & leads to low bone density

Why does this occur?

4

Low Bone Density



Characteristics

- Menstrual Dysfunction**
 - Estrogen deficiency
 - Loss of bone calcium
- Energy deficiency**
 - Prolonged caloric deficit
 - Deficiency in vitamins necessary for bone health
 - Protein, Vit D, Calcium

Diagnosed via bone density scans

5

Risk Factors

- Sports with endurance, aesthetic or weight focus
- Being a member of sports
- Fatigue of sports participation
- Sports with injuries & need for surgery
- Illness
- Injury

How is an athlete's risk assessed?

6

Signs & Symptoms

Other than physical examination shows no abnormalities. The only findings may include bradycardia or low BUN. The athlete's attitude toward eating and seeing physicians may be more indicative of an issue.



- lanugo
- hair loss
- dry skin
- brittle hair & nails
- bradycardia
- irregular/absent menstrual cycle
- cold hands/feet
- decreased bone density

7

Long Term Implications

- increased risk of osteoporosis & fracture
- poor mental health
- Time off from sport & increased healing time

8

Where to seek help?

Resources Available on Campus

- Coaches
- Athletic Trainers
- Dietician
- Parents
- Physician
- Mental Health Practitioner



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UNH Specific Resources

Psychological & Counseling Services (PACS)
 M-F 8a to 5p call **(603)-862-2090** to schedule an appt
 There is also an after hours emergency crisis line

Director of Sports Nutrition
 Marcia Nelson
marcia.nelson@unh.edu



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