The Triad Trial: Online Education for Coaches on the Prevention of the Female Athlete Triad

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THE TRIAD TRIAL: ONLINE EDUCATION FOR COACHES ON THE PREVENTION OF THE
FEMALE ATHLETE TRIAD

by

Megan Jane Ostler

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Nutrition and Food Sciences

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Logan, Utah

2014
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ABSTRACT

The Triad Trial:

Online Education for Coaches on The Prevention of The Female Athlete Triad

by

Megan Jane Ostler, Master of Science

Utah State University, 2014

Major Professor: Dr. Heidi Wengreen
Department: Nutrition, Dietetics, and Food Science

The female athlete triad (triad) includes decreased energy availability, menstrual dysfunction, and decreased bone mineral density. The triad is a common problem among female athletes and negatively affects performance and health. The purpose of this study was to develop an online educational resource aimed at educating coaches about the triad. The online resource included a website, blog, and Facebook page, under that title The Triad Trial, which targeted coaches of female athletes 13 to 18 years of age. Resources were evaluated by panels of experts, coaches, and athletes, then made available to the public (www.thetriadtrial.com). Coaches were contacted by email or social media and encouraged to visit the site and complete a survey. Traffic to the website was monitored for the 8 weeks that the survey was open. During the 8-week period there were 756 unique visits to the website and 89 participants who completed the survey. Of people who took the survey, 82% had never heard of the triad and 75% said the website helped change their opinion about
the seriousness of the triad. Of respondents, 92% reported learning something new, and 82% said they plan to use at least 1 resource or tool provided by the website.

This study indicates that online education for coaches may be an effective way to reach and educate coaches of female athletes about the triad. More research on outcomes among athletes is needed.

(89 pages)
PUBLIC ABSTRACT

The Triad Trial:

Online Education for Coaches on The Prevention of The Female Athlete Triad

Megan Jane Ostler

High school coaches play a huge role in establishing a healthy environment for their athletes and often students. The coach-athlete relationship has proven to be a strong and useful bond in prevention of adverse behaviors of athletes or in prevention of health problems such as concussions. The female athlete triad (triad) is a common health problem among female athletes. Many high school coaches are unaware of the triad or the serious health and performance consequences for their athletes. The triad is a syndrome marked by 3 interrelated adverse effects: decreased energy availability, menstrual dysfunction, and decreased bone mineral density.

The purpose of this study was to develop an online educational resource aimed at educating coaches about the triad. After the online education materials were created and reviewed by small panel groups, the materials were launched online and available to the public with the aim to target high school coaches. We collected online surveys from 90 participants including coaches and parents of high school female athletes and found a lack of knowledge, but eagerness to learn and help with self reported improvements in knowledge, attitudes, and confidence in preventing the triad. By educating coaches and providing the tools for prevention, we hypothesize that coaches can play a large role in the prevention of the triad among high school athletes and help to keep our student athletes healthy and performing well in school and sports.
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Megan Jane Ostler
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ABSTRACT

BACKGROUND: As research about the female athlete triad (triad) increases, so does the need for prevention education. The purpose of this study is to develop an online educational resource aimed at educating coaches about the triad.

METHODS: The project includes a formal assessment of this resource in addition to an evaluation of changes in coaches’ knowledge, attitudes and behavior regarding the triad after visiting this online resource. The online resource includes, a website, blog, and Facebook page under the title The Triad Trial.

RESULTS: After coaches have been exposed to the online education material, they will be invited to complete a survey regarding their changes in attitude, knowledge, and behavior. Only surveys completed by coaches of female athletes between the ages of 13-18 years will be assessed. Information about traffic to the online resources will also be captured and assessed.

CONCLUSIONS: We hypothesize that online education may be an effective way to reach and educate coaches on the prevention of the triad. More research on outcomes among athletes is needed.

PROBLEM STATEMENT

The female athlete triad is the interrelationship between decreased energy availability, menstrual dysfunction, and decreased bone mineral density.\(^1\) It is a medical condition that affects athletes worldwide and has serious implications.\(^2\) This syndrome can lead to premature bone loss, problems with fertility, musculoskeletal injuries, and psychological distress related to disordered eating.\(^1\) As research about the triad increases, so does the call for prevention education for coaches.\(^1\)-\(^8\) Coaches play a crucial role in the prevention of the female athlete triad. Coaches can positively impact athletes by educating and encouraging them to adopt healthy patterns of behavior, recognizing risky behaviors,
and making proper referrals when needed, but knowledge and understanding of the triad is required.\textsuperscript{8}

Online Education provides the means to educated coaches regardless of location. It has been well documented that online learning can be effective, satisfying, and more economically feasible than traditional face-to-face learning.\textsuperscript{9} Online and open educational resources would allow coaches to learn at their own pace and provide them with useful, free tools. However, the coaches must be self-motivated to learn and utilize the tools online. The purpose of this study is to develop online education material to educate coaches on the female athlete triad, evaluate the education material and assess if educating coaches online will,\textsuperscript{1} increase their awareness and knowledge of female athlete triad,\textsuperscript{2} improve their confidence in recognizing and preventing female athlete triad, and\textsuperscript{8} improve their confidence in educating athletes using the tools provided.

**BACKGROUND AND LITERATURE REVIEW**

**The Female Athlete Triad**

In the last 4 decades female participation in high school sports has dramatically increased from 7\% in 1972 to 41\% in 2009.\textsuperscript{1} This increase is thought to be due to the Title IX passed by congress in 1972, which prohibited the exclusion or discrimination of any educational program or activity that receives federal funding.\textsuperscript{1} Because of this act female participation in sports increased in federally funded schools.

This increase in female participation of sports has been overall positive since research has proven that those who are physically active tend to live healthier and longer lives.\textsuperscript{10} However there may be an increased risk of triad symptoms for women who are driven to excel in sports.\textsuperscript{10} In 1992, the American College of Sports Medicine (ACSM) identified this as an association of disordered eating, amenorrhea, and osteoporosis among
female athletes, which was recognized as the female athlete triad. The position statement put out by the ACSM states that the Triad is a health concern for active women and girls driven to excel in sports which involves 3 distinct and interrelated conditions: disordered eating, amenorrhea (irregular or absent menstrual periods), and osteoporosis (low bone mass and micro architectural deterioration).

These 3 corners of the triad physiologically and psychologically contribute to the development of the other triad symptoms. The pressures to perform well and maintain a lean physique can result in a high level of training and low energy availability from not eating enough for training load. Low energy availability can lead to an alteration in the endocrine function ultimately leading to amenorrhea (loss of menstrual cycles). The effects of amenorrhea on the hypothalamus and pituitary leads to a decreased production of oestrogen, which plays a role in bone mineral density. Decreased oestrogen leads to decreased bone mineral density and ultimately, increased risk from osteoporosis and injury.

Decreased Energy Availability

Originally, the first component of the triad was thought to be disordered eating or the practice of unhealthy weight management methods that included purging (self-induced vomiting), food restriction, or use of appetite suppressants, diet pills, laxatives, or diuretics. However, recent studies have shown that many athletes may have decreased energy availability without disordered eating. Therefore, some athletes may have decreased energy availability because of disordered eating practices while others may simply be unaware of the calories needed for their training level. In response to these new findings, the ASCM position changed in 2007 to decreased energy availability with or without disordered eating. Energy availability is dietary energy intake minus exercise
energy expenditure. It is the amount of dietary energy remaining after exercise for other bodily functions.\textsuperscript{10}

Energy availability is a prevalent symptom among female athletes either intentionally or unintentionally. One study on the female athlete triad in high school students found that 54\% of female athletes had low energy availability without disordered eating.\textsuperscript{12} When tested, none of these athletes had an increased risk of disordered eating.\textsuperscript{12} This along with other studies have show that athletes may not be aware that they are energy deficit due to a lack of knowledge in nutrition requirements and the lack of increased appetite with exercise.\textsuperscript{13}

In experimental trials, dieting or food restriction increased hunger, but the same energy deficit from exercise did not increase energy.\textsuperscript{13} This lack of a strong biological signal to increase intake related to exercise creates a challenge for athletes to maintain energy balance without nutrition education and appropriate tools.

Another challenge to maintain energy balance is that exercise may suppress hunger. Many studies have also shown that hunger can be suppressant by high intensity bouts of exercise.\textsuperscript{14} A study showed that 2 bouts of exercise (50min at 70\% VO$_2$ max) in a single day did not increase food intake within 36 hours.\textsuperscript{15} Another study of athletes training 40 weeks for a marathon had a 20\% increase in energy expenditure but no increase in energy intake.\textsuperscript{13} In a review by Louchks, women reported having to force themselves to eat beyond appetite to compensate for exercise energy expenditures.\textsuperscript{13} Appetite can not be relied upon to ensure adequate energy intake and athletes need to be educated and eat by discipline to ensure energy balance.\textsuperscript{13}

The consequences of having decreased energy intake, and thus availability, are poor performance and increased risk for the other components of the triad. Low energy
availability affects reproductive hormones and can lead to altered menstruation.\textsuperscript{16}

Researchers have suggested that the lower end of energy needs for women are 30kcal/kg free fat mass/day and that intakes below this level may suppress reproductive function.\textsuperscript{17}

Decreased intake and menstrual irregularities can put athletes at 2-4 times greater risk for stress fractures and muscular-skeletal injury than eumenorrheic (normally menstruating) athletes with adequate intake.\textsuperscript{1,10}

\textbf{Amenorrhea}

An unbalanced diet, inadequate caloric intake, or excessive training may lead to menstrual abnormalities in females.\textsuperscript{10} This is especially prevalent among athletes.\textsuperscript{1} There is a range of menstrual irregularities among females. The first sign or onset is oligomenorrhea, which is defined as greater than 35 days between menstrual cycles.\textsuperscript{1} The next stop in the disease progression of menstrual irregularities is Amenorrhea or the lack on menstrual cycles. The 2 types of amenorrhea are primary amenorrhea, which refers to a delay in menarche after the age of 15 years. Secondary amenorrhea is seen in females that after started menstruating and refers to the lack of menstruation for 3 consecutive months.\textsuperscript{1} It is important to note that before attributing menstrual irregularities to the female athlete triad it is important to rule out other causes such as pregnancy, problems with reproductive organs or thyroid disease.\textsuperscript{10} Any female that hasn’t started menstruating by age 15 or 16 years, has menstrual cycles at intervals greater than 35 days, or have missed 3 consecutive menstrual cycles should be evaluated by a physician.\textsuperscript{10}

When decreased energy availability is the cause behind amenorrhea, it is classified as functional hypothalamic amenorrhea. In this types of amenorrhea, ovarian function decreases due to low luteinizing hormone (LH), which is suppressed if the availability of oxidizing metabolic fuels is low.\textsuperscript{18} Previously this decrease in LH was thought to be
associated with low body fat; however, current research indicates that it is caused by decreased energy availability.\textsuperscript{11} Research has shown that LH production can be disrupted in as little as 5 days when energy availability is decreased by more than a third.\textsuperscript{10} This provides evidence that the cessation of menstruation may be an energy conservation strategy.

The prevalence of menstrual irregularities varies between studies. The prevalence of secondary amenorrhea and oligomenorrhea has been estimated to be around 2-5% among the general population.\textsuperscript{6} Among exercising females, the prevalence is thought to be around 20%. Among sports that emphasize a lean physique such as running and dancing this has been reported to be as high as 44% among ballet dancers and 51% among endurance runners.\textsuperscript{1} Oligomenorrhea increases risk for infertility, decreased bone mineral density, impaired endothelium-dependent arterial vasodilation, impaired skeletal muscle oxidation metabolism, and elevated low-density lipoprotein cholesterol.\textsuperscript{10,19}

**Osteoporosis**

The last component of the triad is Osteoporosis. Both menstrual irregularities and decreased energy availability lead to decreased bone mineralization and eventually osteoporosis. Osteoporosis is associated with reduction in bone mass, without alteration of bone tissue mineralization.\textsuperscript{11} It is diagnosed when bone mineral density is more than 2.5 standard deviations below the average for a young adult.\textsuperscript{11} Osteopenia is a bone mineral density that is 1-2.5 standard deviations below the average and can evolve to osteoporosis.\textsuperscript{11} Osteoporosis and osteopenia increase the risk for stress fractures in athletes and can lead to more serious injuries.\textsuperscript{11}

In a clinical trial, exercising women with an energy intake below 30 kcal/kg/free fat mass/day started to have increased bone resorption and decreased bone formation after
just 5 days.\textsuperscript{10} This decreased energy availability leads to menstrual irregularities as discussed previous. The low estrogen and other hormonal changes that occur when menstrual cycles are irregular or absent can lead to osteoporosis.\textsuperscript{10} This is especially true for young athletes. According to the ASCM, a 20-year-old athlete with amenorrhea during critical teenage growth periods may have bone mass typical of a 70-year-old female.\textsuperscript{10} This can result in a 3 fold risk of stress fractures.\textsuperscript{6} Athletes with menstrual irregularities and decreased bone mass can improve their bone mineral density with adequate nutrition, weight bearing exercise, and treatment of menstrual irregularities.\textsuperscript{11} It is important to educate athletes and coaches on the importance of maintaining bone health because even with treatment bone mineral density will never be as high as if the athlete had remained eumenorrhoeic and reversal of loss may be impossible depending on severity.\textsuperscript{11}

\textbf{Previous Studies: The Call for Coaches}

As research about the triad increases, so does the call for prevention education for coaches.\textsuperscript{1-8} Coaches play a crucial role in the prevention of the female athlete triad. Coaches can positively impact athletes by educating and encouraging them to adopt healthy patterns of behavior, recognizing risky behaviors, and making proper referrals when needed, but knowledge and understanding of the triad is required.\textsuperscript{8}

Previous studies have found that female athletes lack the nutrition related knowledge to prevent the female athlete triad.\textsuperscript{3,4} One study found adequate knowledge in only 9\% of athletes and 35.9\% of coaches.\textsuperscript{4} Because athletes receive most of their nutrition information from parents, coaches, and peers, it is important that those sources have adequate, correct information to prevent the female athlete triad.\textsuperscript{2,3}

A study found that 1/3 of exercising females still believed that irregular periods were normal and called for greater education for athletes, coaches, and parents.\textsuperscript{2} This study
also found coaches, parents, teammates, and magazines to be the top 4 sources of nutrition information in cross-country runners.\(^2\) Coaches and all individuals working with female athletes need to be educated on the triad and have “strategies to prevent, recognize, and treat the female athlete triad.”\(^6\)

**Educating Coaches**

Coach education is important in prevention of the triad due to their relationships with the athletes. Studies have shown that coaches with high level knowledge of the triad have different perceptions and behaviors than coaches with general knowledge.\(^8\) These coaches were able to recognize the signs and symptoms of the triad, understand that menstrual irregularities could lead to stress fractures, and knew when it was appropriate for women with triad history to be screened for osteoporosis.\(^8\)

Because of the irreversible damage that can occur due to the female athlete triad prevention is the best intervention. It is important that education on the triad focus treatment and prevention including nutrition information, and screening techniques.\(^8\) Other studies have found that education of coaches could lead to prevention of alcohol use, injury due to poor technique, and concussions.\(^20-22\) Applying this information to coaches, could means that education of coaches could lead to increased prevention of the female athlete triad.

**Heads Up: Concussion in High School Sports**

The "Heads Up: Concussion in High School Sports," by the Center for Disease Control and Prevention, is an example of a program that aimed to change athlete health risks by providing education to coaches. The heads-up initiative had the goal to decrease concussions in high school athlete by educating coaches about the risk and consequences of
conussions for their athletes. Coaches were provided with a toolkit that include a booklet, wallet card, video, CD-ROM, posters, clipboard sticker, parent fact sheet, and athlete fact sheets. Coaches were then surveyed by a separate study to evaluate the effects.22

Surveys were mailed to self-identified coaches that had ordered a concussion survey within 6 months of order. There were 1009 surveys mailed out and 333 eligible coaches who responded to the survey. Of coaches that responded, 90% had used at least on tool from the kit material. The most popular materials included the booklet (79%), wallet card (60%), video (59%), and athlete’s fact sheets (57%). The least used material was the CD-ROM (30%). This tool kit had great success with 82% of coaches reporting the toolkit as very or extremely useful, 67% stating they would be using the material in the future, and 34% of coaches indicating that they learned something new.22

They also reported having a change of view on the seriousness of concussions (50%). High numbers also indicated that they educated others including athletes and parents. More than 1/3 of respondents reported changing how they prevented and managed concussions. Overall the evaluation of the “Heads Up” initiative showed positive changes in participants’ knowledge, attitudes, behavior, and skills related to concussion prevention and management.22

This study illustrates the strong impact of education and provision of tools to coaches. It can lead to prevention and education of others. This can be applied to the female athlete triad. Our study, although online, will be provided a similar toolkit with education materials for coaches, and handouts for athletes and parents. It is the goal of this study to provide education and tools for coaches that can lead to increase awareness and knowledge of female athlete triad, improve coaches’ confidence in recognizing and preventing, female athlete triad, and improve confidence in educating athletes using provided tools. These
changes will be evaluated through self-reported surveys similar to the Heads-Up Study. We hypothesize that providing this information online will help with cost, time, accessibility and overall effectiveness.

**Online Learning**

In 2009, it was reported that 61% of American adults look online for health information, 30% of adults accessed social media, and about 10% of online health inquiries had a major impact on someone’s health care or the way they care for someone else. This indicates that many adults can be reached and impacted via the internet. Although there is little empirical evidence to support the use of social media in health education, experts still feel confident in recommending its use for education purposes.

Online learning popularity is increasing due to cost effectiveness, time efficiency, accessibility, use of different instructional strategies, and consistent information. Websites and blogs, along with social media not only provide a means to educate a widespread group but may also lead to increased learning. Research shows that the use of multimedia as well as high levels of interaction especially social engagement can have positive effects on learning. By fostering an interactive, multimedia online learning experience, it is possible to educate widespread groups of people effectively with decreased time and cost. This emerging field, although not well studied offers increased opportunity to connect and education efficiently. This study will assess if online and social media is an effective way to reach and educate coaches of female athletes.
SPECIFIC AIMS

1. To create online education material for coaches on the prevention of the female athlete triad.
2. Evaluate content of online provision of education materials and tools through expert and small panel review
3. Assess whether or not online education increased coaches’ confidence in recognizing, preventing, and educating on the female athlete triad.

RESEARCH DESIGN AND METHODS

The main objective of this study is to develop online education materials for coaches. This material is focused on the female athlete triad. Because this study is looking at educating coaches via online media on the female athlete triad a website, blog, and Facebook page under the title The Triad Trial have been developed. These will be used to educate the coaches and provide them with tools to use with their athletes.

The second objective is to evaluate the online education materials. This will be done first after the development of the education materials, they will be reviewed by nutrition experts for content and then reviewed by a small sample of coaches and athletes for improvements and suggestions. After the expert panel has approved the material and suggestions from small coach and athlete panel have been considered and implemented, the online education material will be launched and available to anyone via the Internet.

Coaches will be recruited through social media, email, and referrals. Coaches that have expressed interest and provided emails will be contacted via email and encouraged to spread the word via Facebook. The Facebook page developed for this study will be publicized via Facebook. It will start with Megan Ostler who created the page. She will post about the page and encourage anyone to visit and spread the word to friends who are
coaches. Although this will be available for access by any Internet user it will be aimed at coaches of females between the ages of 13-18 years. The use of the website and blog will be tracked for first time visitors, returning visitors, and total page loads which will indicated if visitors went through the pages. This information will be recorded before and after the launch to eliminate normal traffic. Our goal is to get at least 50 eligible coaches to complete the survey, and assess if publicizing on Facebook lead increased traffic to the page.

Coaches will be encouraged to go through the website, browse and download tools, and follow the blog and Facebook page which will be updated weekly with new tips, information, and tools. After coaches have been exposed to the online education material they will be encouraged to take an ending survey that will assess as changes in attitude, knowledge, and behavior. The objective of this study is to evaluate the developed education material, and see if educating coaches can lead to improvements in general knowledge, attitudes and behavior.

These improvements will be self reported via the survey, and coaches will not be followed at this time to assess actual behavior change. The survey will include 30 questions including, multiple choice, true or false, and free response. Questions are aimed to assess eligibility (coach of females between 13-18 years of age), current practices pertaining to the triad, and knowledge, behavior, and attitude changes due to the intervention.

There will be frequent reminders via social media to participate and take the survey after utilizing the website, tools, and blog. Prior to taking the survey, an online consent form will appear informing participants that participation is voluntary and they may choose to stop at any time. No identifying information will be collected through the survey and answers will remain anonymous.
STATISTICAL ANALYSES

Data collected from the survey will be examined using descriptive statistics. Rates of self-reported change in knowledge and behavior will be noted. The survey includes 7 questions regarding the demographic characteristics of the coach. Self-reported change in knowledge and behavior will be examined across demographic groups including gender, age, level of education of the coach, BMI (healthy weight vs. overweight), and geographic location (rural vs. urban). The self-reported questions designed to assess the impact of the online resources include 2 regarding changes in attitude, 6 regarding changes in knowledge, and 3 regarding changes in confidence about the female athlete triad after visiting the online resources. The survey also includes evaluative questions regarding what aspects of the website the coaches thought were especially helpful. This information will be used to assess possible improvements and popular aspects of the intervention.

Website traffic statistics will also be recorded and assessed. The use of the website and blog will be tracked for first time visitors, returning visitors, and total page loads which will indicated if visitors went through the pages. This information will be recorded before and after the launch to eliminate normal traffic. This information will be used to assess if publicizing on Facebook lead increased traffic to the page and if those users returned.

REFERENCES


ABSTRACT

BACKGROUND: The female athlete triad (triad) is the interrelationship between decreased energy availability, menstrual dysfunction, and decreased bone mineral density. The triad affects athletes worldwide and negatively impacts both performance and health. This syndrome can lead to impaired athletic performance, premature and irreversible bone loss, problems with fertility, musculoskeletal injuries, and psychological distress related to disordered eating.

METHODS: This review will summarize the current status of the triad research and current literature on online education. Also, because there is little information on coaches and the female athlete triad, this review will focus on the results of coach education in various areas.

RESULTS: It has been well documented that online learning can be effective, satisfying, and more economically feasible than traditional face-to-face learning. Studies have found that education/training of coaches could lead to prevention of a variety of negative behaviors or conditions.

CONCLUSIONS: It has been hypothesized that prevention education aimed at coaches may be an important factor in preventing the female athlete triad, however there is little research on coaches and the female athlete triad. The object of this literature review is to assess if online coach education would be an effective manner to prevent the female athlete triad.

THE CALL FOR COACHES

As research about the triad increases and evidence mounts as to the high prevalence and severe consequences, there has been an increased call for prevention education for coaches. Coaches play a crucial role in the prevention of the female athlete triad by positively impact athletes by educating and encouraging them to adopt healthy patterns of behavior, recognizing risky behaviors, and making proper referrals when needed with adequate knowledge and understanding of the triad.

However, previous studies have found that female athletes and coaches lack the nutrition related knowledge to prevent the female athlete triad. A study surveyed 131
National College Athletic Association coaches and 185 athletes randomly selected from 100 universities in the United States. The survey had a sports nutrition knowledge questionnaire, which consisted of 20 multiple-choice questions on micronutrients and macronutrients, supplements and performance, weight management and eating disorders, and hydration. A score of 75% or more was considered "adequate nutrition knowledge." Only 9% of athletes and 35.9% of coaches scored high enough to be considered to have adequate nutrition knowledge. Because athletes receive most of their nutrition information from parents, coaches, and peers, it is important that those sources have adequate, correct information to prevent the female athlete triad.

A study conducted in Australia focused on the nutrition and female athlete triad knowledge of 18 to 40 year old females participating in greater than 2 hours a day and 3 times a week of strenuous activity. Participants were recruited from sporting clubs and fitness centers. Out of the 180 women who completed the survey, 45% did not think that amenorrhea could affect bone health, 22% of those involved in lean build sports reported that they would do nothing if experiencing amenorrhea, and 35% of all respondents considered irregular menstruation normal for active women. This study also found coaches, parents, teammates, and magazines to be the top 4 sources of nutrition information in cross-country runners. Because of these results the researchers called for greater education for athletes, coaches, and parents. Coaches and all individuals working with female athletes need to be educated on the triad and have procedures to prevent, recognize, and treat the female athlete triad.

**WHY FOCUS ON COACHES?**

Coaches play a vital role in the prevention of the triad due to their relationships with the athletes. Coaches often have daily contact with athletes and are held in high regard by
their athletes. Coach education is also important due to the lack of nutrition knowledge. As previously mentioned only 36% were found to have adequate nutrition knowledge and many are still unaware of the female athlete triad.4

To assess the effect of coach education on the female athlete triad, a study surveyed 91 Division I collegiate coaches in the United States. Coaches were divided into high and low knowledge based on their ability to list the 3 components of the female athlete triad. 43% were able to correctly list the 3 components. Coaches with high-level knowledge of the triad had significantly (p-value =0.001) different perceptions and behaviors than coaches with general knowledge.8 These coaches were able to recognize the signs and symptoms of the triad, understand that menstrual irregularities could lead to stress fractures, regularly asked their athletes about their menstrual cycles, and knew when it was appropriate for women with triad history to be screened for osteoporosis.8 This indicates that educating coaches about the female athlete triad may change their behavior regarding prevention and treatment and lead to improved athlete outcomes.

It appears that when coaches are educated or exposed to prevention materials, they act differently than their non-educated counterparts based. This is further seen in a study of 254 track and field coaches from high school level to elite. Those that had been trained and certified in performance enhancing drugs reported feeling more knowledgeable and more strongly felt that the coach plays a key role in drug deterrence.10

A study, although small (10 coaches) used 3 different methods of educating coaches and provided surveys right after completion of the education modules and 3 months later to assess behavior change. This study found that formal large-scale coach education could have an impact on coaches’ learning by impacting both their practices and self-awareness. This study found that 8 out of 10 coaches change their practices, and all 10 reported
learning something new. Another study looked at alcohol prevention among athletes and found that coaches’ behavior differed based on alcohol school policies and education. Those who had attended a workshop, class, or seminar were significantly more likely to report that they teach their athletes about the harmful effects of alcohol and help their athletes to resist the pressure to use alcohol.

These studies indicate that educating coaches may cause them to change their practice and be more vocal in teaching their athletes about risky behaviors, making their opinions clear and perhaps deterring athletes from these risky behaviors. Coaches, especially high school coaches, provide a great opportunity to impact the well being of athletes. It appears, from the previous studies, that when coaches are educated, most modify their behaviors to have a positive impact on athletes.

These positive impacts on athletes are likely due to the coach-athlete relationship, which has been extensively researched and shown to be powerful. A coach has remarkable influence on the physical and psychological development of their athletes. Their main responsibility is to help their athletes perform at their maximum level and reach goals they could not attain on their own. To meet this demand coaches have 5 defined roles: teacher, organizer, competitor, learner, and friend/mentor.

As a teacher, coaches use their knowledge and skills in training on physical, technical, tactical, and mental aspects of their specific sport. Some may even teach their athletes psychological skills to help them mentally prepare and relax before competitions, control anxiety or improve self-confidence. Coaches also act as organizers, by scheduling and planning for training and competitions for a successful season. Coaches often have an outline or plan for the season to help the athletes meet their goals. As a competitor, coaches have a role during competitions such as substitutions, time-outs, and interacting with
officials. Coaches also have a role as a learner. They should be continually learning and improving their abilities to help their athletes perform well and stay healthy while training and performing.\textsuperscript{12}

The last role and potentially the most influential is that of friend and mentor. Coaches are often close with their athletes and have daily interactions. They can become positive role models and provide support and counseling to their athletes. An important finding is that successful coaches aim to improve their athlete's lives both inside and outside the sport.\textsuperscript{12} When coaches are fulfilling their roles and developing their relationships with athletes, they can have tremendous influence. This coach-athlete relationship is the foundation of coaching.\textsuperscript{13} It is vital for achievement and mastery of qualities such as leadership, determination, confidence, and self-reliance.\textsuperscript{13} This relationship is one of the most significant influences on athlete's motivation and performance.\textsuperscript{14}

As the term athlete-coach relationship suggests, there is a personal dimension of coaching that includes expanding's the coaching role to go beyond the required tasks.\textsuperscript{15} Mentoring has historically had many meanings however when it comes to coaches and athletes, researchers have defined mentoring as a trusting relationship, where the coach has an interest in the personal development of the athletes and works to fulfill their needs and in return imitation of behavior takes place.\textsuperscript{15} The following study shows the influence that this relationship can have on negative athlete behavior.

In a study looking at alcohol consumption among athletes, it was found that the athlete's perception of the coaches' approval of alcohol consumption was strongly associated with drinking behaviors. College athletes (362) were surveyed, and the survey measured drinking behaviors and frequency as well as coach measures including, coach monitoring, approval, relationship, and knowledge.\textsuperscript{16} Significant relationships were found
between coaches influence and athlete drinking ($R^2 = 0.07, p < 0.05$). Coaches’ approval and athlete drinking showed a positive relationship ($b=0.98, p < 0.05$). The coaches’ knowledge showed a trend towards significance while the monitoring variables were insignificant. There were no significant interactions involving gender. Therefore, those athletes that reported feeling that their coach disapproved of their alcohol consumption, were less likely to drink.\textsuperscript{16} This research suggests that the coach-athlete relationship is not only important for sports performance but also in decreasing risky behaviors and again suggests that coaches may exert a tremendous influence on athletes and their behaviors making them a vital part for athlete interventions and prevention of the female athlete triad.

The following studies provide additional examples of the role of the coach athlete relationship in impacts of coach education in providing positive outcomes among athletes.

**COACH EDUCATION PREVENTION PROGRAMS**

A study at the University of Washington looked at educating coaches on a cognitive-behavioral intervention that was designed to promote a motivational climate, which has been shown in previous research to decrease athlete anxiety. They trained 20 coaches of male and female athletes and then monitored the athletes over the course of a basketball season. There were a total of 145 athletes in the intervention and 69 children in the control group. Based on answers from pre and post intervention surveys, researchers found that athletes with trained coaches perceived that their coaches had more mastery on the motivational climate scale for youth sports, and showed decreased total anxiety scores from preseason to late season. In contrast, the control group athletes reported increased anxiety over the season for both genders. The difference between the groups was statistically significant for somatic anxiety ($p=0.001$), worry ($p=0.008$), concentration ($p=0.001$)
disruption, and total score ($p=0.001$). This suggests that educating coaches not only had an positive effect on their behavior and thus athletes overall anxiety, but that athletes seem to be aware of when coaches are trained or have education on a given topic. As was previously mentioned, it seems that when coaches are clear with their expectations and have knowledge on a subject it leads to positive behavior outcomes of athletes whether it be with alcohol consumptions, drug use, or decreased anxiety.

Another study conducted by Pierce et al. of the Melbourne Medical School in Australia looked at the program “Coach the Coach” which provided football coaches and club youth leaders with mental health training to help increase awareness and support of young male athletes experiencing mental health difficulty with a emphasis in depression. The researchers used a questionnaire to assess coaches’ pre and post intervention knowledge on depression. The questionnaire focused on recognizing signs, evidence supported treatment options, and confidence in responding to athlete depression. This was followed-up with focus group interviews. Coaches/leaders (36) completed the training of which only 24 completed post intervention data collection. Greater than 50% of the coaches/leaders showed increased knowledge and recognition of depression and schizophrenia in a given clinical example. Of the coaches/leaders, 66% reported increased confidence in responding to mental health difficulties seen in others.

Athletes were given an initial survey with a scenario of a young depressed person. Of the players surveyed 70% did not view depression as a sign of weakness, 60% did not feel that a depressed person could “snap out of it,” and 65% disagreed with not telling anyone. The only change seen between the surveys although not statistically significant was how players viewed depressed individuals. With the follow-up survey, 45% were less likely than with the initial to view a young depressed person as dangerous.
Although the benefits to the players were less obvious, the change in knowledge, confidence, and awareness of coaches may lead to increased future benefits to players. The positive findings in the coaches suggest that coach education may lead to changes in behavior and appropriate monitoring and treatment as needed. Further research is warranted in this subject to show if longer-term changes in behavior of coaches would lead to changes in athlete attitudes associated with mental health and depression.

Coaches and parents are important contributors to the overall body climate of athletes either positive or negative. A study wanted to influence athletes’ environments’ by changing the attitudes, beliefs, and behaviors, related to body image, of these influential adults. They hypothesized that this would create a more body friendly climate and positively effect athletes’ body image, eating attitudes, and behaviors. In this study, 62 young female gymnasts, 11 to 18 years of age, involved in a gymnastic clubs were targeted. Before the intervention, coaches, parents, and athletes perceived significant pressure to be thin, and more than half reported that having a lower body weight would help the athletes succeed. About 1/3 viewed pubescent development as a disadvantage.¹⁹

The Body Sense intervention used in this study had modest but positive effects on the participant’s perception of pressure to be thin within their club. There was no significant change in any other measures including body-esteem, self-efficacy, and EAT-26 scores, which assess risk for eating disorders. There was also no significant change with the 32 mothers’ measurements and too few fathers and coaches completed both surveys for data analysis.¹⁹ This suggests that perhaps the decreased pressure to be thin perceived by the athletes came from the intervention and not from influential adults. However because of the small sample size, it may be possible that the changes athletes perceived from coaches and parents were not captured. Other limitations included no follow-up period, incomplete
questionnaires, and an adherence to the program was not measured. So while the positive effects on perceived pressure to be thin are small, this study does warrant further investigation of climate change for athletes. Controlling for some of the limitations and including follow-ups in future studies may strengthen the effects on perceived pressure to be thin and better assess overall environmental changes that may take longer to perceive such as changes in eating behaviors and weight management.

The *Heads Up: Concussion in High School Sports*, by the Center for Disease Control and Prevention, is an example of a successful program that aimed to change health risks of athletes by providing education to coaches. The heads-up initiative had the goal to decrease concussions and increase appropriate treatment for concussions in high school athletes by educating coaches about the risk and consequences of concussions. Coaches were provided with a toolkit that include a booklet, wallet card, video, CD-ROM, posters, clipboard sticker, parent fact sheet, and athlete fact sheets. A sample of coaches was then surveyed to evaluate the effects of the educational campaign.

Surveys were mailed to self-identified coaches that had ordered a concussion survey within 6 months of the survey. There were 1009 surveys mailed out and 333 eligible coaches who responded to the survey. Of coaches that responded, 90% had used at least one tool from the kit material. Popular materials included the booklet (79%), wallet card (60%), and video (59%), and athlete’s fact sheets (57%). The least used material was the CD-ROM (30%). This tool kit had great success with 82% of coaches reporting the toolkit as very or extremely useful, 67% stating they would be using the material in the future, and 34% of coaches indicating that they learned something new.

Many of the surveyed coaches (50%) reported that the educational materials changed their view on the seriousness of concussions, 68% indicated that they educated
others including athletes and parents, and 33% of respondents reported changing how they prevented and managed concussions among their athletes. Overall the evaluation of the *Heads Up* initiative showed positive changes in high school coaches’ knowledge, attitudes, behavior, and skills related to concussion prevention and management.\textsuperscript{20}

This study illustrates the strong impact of education and provision of tools to coaches. It can lead to prevention, appropriate management of conditions and education of athletes and parents. This study also provides an example of large-scale education of coaches with over 13,000 coaches receiving the toolkit. The CDC was able to make an impact on concussion prevention and management by simply providing education materials outside of the classroom and on a large scale. This can be applied to the female athlete triad and suggests that education materials provided to coaches on a large scale could lead to the prevention, management of symptoms, and spreading of education or awareness to others such as parents and athletes.

This program and the overall prevention of concussions have been aggressively pushed lately to help avoid the detrimental effects of concussions. In an attempt to aid in this prevention movement, 33 states of the United States now require education for coaches, parents, athletes, and school personnel in the recognition, management, and prevention of concussions in youth sports.\textsuperscript{21} This provides a great example of the potential large-scale effective prevention education.

Online concussion prevention education has also been evaluated. Another study evaluated the *ACTive: Athletic Concussion Training using Interactive Video Education* program. This interactive e-learning program was used to train community coaches of athletes 10-18 years of age. In this study, 75 coaches completed a post intervention survey on concussion prevention and management, and the results showed significant differences
between the intervention and control groups for knowledge (symptoms, general p=<0.001, misconceptions p=0.003), self efficacy (p=<0.001) and behavior intentions (p=<0.001). The intervention group had increased knowledge about sports concussions, management, and prevention. They had different attitudes regarding the importance of prevention and had greater intention and self-efficacy of concussion management. Although this is a small sample size, it does suggest that online learning maybe an effective way to educate coaches on prevention of concussions and that this method warrants further investigation to assess the impact of online education the prevention of concussions or other conditions or behaviors that negatively affect athletes.

With the female athlete triad, like many other problems affecting teen athletes, prevention rather than treatment is the best strategy and coaches play a crucial role in prevention. Studies have found that education/training of coaches could lead to prevention of a variety of negative behaviors or conditions. Applying this information means that education of coaches could lead to increased prevention of the female athlete triad as well. Although there are limited studies that have focused on educating coaches, this is an emerging field with promising results.

SOCIAL MEDIA AND ONLINE LEARNING

In 2009, it was reported that 61% of American adults look online for health information, 30% of adults accessed social media, and about 10% of online health inquiries had a major impact on someone’s health care or the way they care for someone else. In 2013, 76% of low income adults were online and 96% of high income adults online. 67% of online adults use social media sites and social media is used by 20-24% of those searching for health related topics. As of 2010, Facebook is the most commonly used online social network site among adults. Among adults with a online social profile 73%
reported having a Facebook profile while only 48% reported a MySpace and only 14% reported a LinkedIn profile. Adults are using these sights to connect with old friends, make new friends, and/or connect with people with shared hobbies or interests. This indicates more and more people are online and using social media provides a means to reach and impact many adults via the Internet. Also adults are looking to connect with others who share similar interests and thus may provide a way to target a population of interest such as coaches.

The popularity of online learning is increasing due to cost effectiveness, time efficiency, accessibility, use of different instructional strategies, and consistent information. Websites and blogs, along with social media not only provide a means to educate a widespread group but may also lead to increased learning. Research shows that the use of multimedia as well as high levels of interaction especially social engagement can have positive effects on learning, and has been utilized in distance classroom settings to improve online learning at universities. Such social interactions are abundant with mediums such as Facebook and twitter and have been hypothesized to lead to increased learning and positive behavior outcomes. Although there is little empirical evidence to support the use of social media in health education, the large number of individuals utilizing social media suggests that it may be an effective way to reach and communicate with target populations. Examples of the few studies that have utilized social media are presented below.

As previously mentioned, the Internet and social media are commonly used by US adults to access health information. In a study by Mrazik, 178 coaches were surveyed to assess their knowledge and comfort with concussions. This study found the majority of coaches had a good understanding of common issue, and correctly identified return-to-play
best practices despite having received information from various formal and informal sources. The most frequent sources were newspapers, magazines, and the Internet. This study, like others, found that 1 of the first sources coaches for health inquires is the Internet and that providing information online can have a positive effect on coaches’ knowledge base.

Online media has been used in a variety of ways to disseminate health information. A study looked at the impact of website based information in assisting primary care physicians in promoting preventative care. Since most physicians only have about 1 minute per meeting to talk to patients about prevention this was thought to help provide additional information to patients and supplement the information given by their physicians. There were 167 patients of 6 primary physician offices that participated in the study. This sample was put into 2 groups, 1 with a basic website and the other with a more complex. Behavioral changes were measured at baseline, 3 months, and 6 month follow-ups. There was significant improvement in healthful eating, and physical activity in both groups. These results were seen at both follow-ups 3 and 6 months. There was no difference between the sites indicating that the complex website was not more or less impactful than the basic. This shows that website based health information can change behavior and have positive effects on patient health.

One study evaluated the use of Twitter, a popular social media application, for its effect on weight loss outcomes. It was hypothesized that being active and connecting with others trying to lose weight would increase success based on previously mentioned research on social interactions and learning. Researchers found that the use of twitter was associated with greater weight loss. Social media has been incorporated into other online
weight management programs through message boards or chat rooms and although the benefits are unclear, it may play a role in retaining and engaging participants.32

Another study looked at using web based information and social media in physical activity promotion among undergraduate females. The 134 females were divided into 2 groups, those who received the online information only, and those who also were enrolled in the Facebook group for the intervention.33 Participants received access to the intervention website with education materials and a physical activity self-monitoring tool. Those in the Facebook group received emails, website instructions, and moderator communications reminding participants to be active on the Facebook group page and provide social support related to physical activity. The results were insignificant between the groups. Both groups experienced increases in social support and physical activity over time but there were no differences in the perceived social support or activity between the groups.33 In this study the component of social media did not appear to have an impact on the outcomes of social support or increased physical activity. With mixed results between studies it is important that further research assess what aspects of social media when incorporation make it success and aid in increased social support and improved outcomes among participants.

Extension program are taking advantage of this new medium and using Facebook and the web to reach a greater audience and improve community health. The Oregon State University Extension Nutrition Program developed an example of such as extension program. There goal was to increase fruit and vegetable consumption by residents of Oregon with a specific goal to target limited income mothers with children at home. The project, called the Food Hero Project, used a variety of channels including a website, kits,
purchased media, and a monthly message package. The messages focus on meal planning, shopping, cooking, and safe storing.\(^{24}\)

Although follow-up and impact are difficult to measure with this type of interventions, the *Food Hero Project* measure progress is by tracking online presence. In between 2012 and 2013 their Facebook community grew 47% and referrals from Pinterest, a popular social sharing website, grew 98%. This information has helped them to strategize and organize their online presence to make the greatest impact.\(^{24}\)

As social media continues to prove to be an effective means to reach and educate, researchers are now focusing on best practices or what makes social media effective. A study wanted to determine effective social media use in nutrition education for low-income mothers. Small focus groups (4) with an average of 7 women were conducted, and trust appeared as the major theme throughout the focus groups. Participants wanted reliable information on updated and referenced pages, which would help them trust the information provided. They reported liking to see the words “studies show” or “research finds.” Participants also reported a need to trust the author and suggested a biography page for the authors that could help them develop some kind of rapport.\(^{34}\)

Email has also been shown to be a great way to reach people. Another study compared nutrition information provided via email and Facebook. In this study 18 health messages were delivered over a 6-week period through email or Facebook and compared to a control group. There were a total of 92 participants who completed the pre intervention survey to assess nutrition knowledge scores. Of participants, 92% completed the post intervention survey to compare knowledge gains. Both and email and Facebook group had large knowledge gains compared to the control group which showed slightly lower scores. 79% of the email group read the majority of the messages compared to only 56% of the
email group. While both were more effective than the control group with no messages in changing health knowledge, it appears that people are more inclined to read and open messages sent to their personal emails. While users of Facebook may not read each health message is appears to be as effective as email messages.\textsuperscript{35}

Although an emerging and not well-documented field, online education programs for coaches have promising results and warrant additional studies to assess the effect of using an online medium to educate coaches. An intervention using online education for coaches is the \textit{Play It Cool} program, which was designed to increased ice hockey coaches knowledge and preparation through structured online curriculum. The program consisted of 7 learning modules that focused on concepts that lead to safer player behaviors. This program was delivered to coaches of players between 9 to 15 years of age. The pilot study was introduced to 24 coaches in a focus group. Overall the results showed that the program was effective in raising awareness of hockey safety issues. The coaches reported liking the discussion board and felt that the approach was more conducive to engagement than the traditional classroom setting. The coaches also reported the content was informative and appreciated the range of content and felt that the information was helpful.\textsuperscript{36} Overall this pilot study showed positive results and warrants continued evaluation of this and similar programs to help educate coaches on preventative measures.

By fostering an interactive, multimedia online learning experience, it is possible to educate widespread groups of people effectively with decreased time and cost. This emerging field, although not well studied, offers increased opportunity to connect and education efficiently. This field has had overall positive effects and warrants increased research to assess the best practices and use of online and social media to educate coaches effectively and lead to behavior changes and ultimately improved athlete outcomes.
research indicates that online education on the female athlete triad may provide an effective way to educate coaches and lead to the prevention, awareness, and proper management of symptoms. The use of social media could allow coaches to connect with those who share similar interests and lead to the spreading of education and awareness to other parents and athletes.

REFERENCES


CHAPTER 3

THE TRIAD TRIAL: ONLINE EDUCATION FOR COACHES FOR THE PREVENTION OF THE FEMALE ATHLETE

ABSTRACT

BACKGROUND: The female athlete triad (triad) is a common problem among female athletes and negatively affects performance and health. The purpose of this study was to develop an online educational resource aimed at educating coaches about the triad.

METHODS: The online resources included a website, blog, and Facebook page, under the title The Triad Trial which targeted coaches of female athletes 13 to 18 years of age. Resources were evaluated by panels of experts, coaches, and athletes, and then made available to the public (www.thetriadtrial.com). Coaches were contacted by email or social media and encouraged to visit the site and complete a survey.

RESULTS: The survey was open for 8 weeks, during which time there were 732 unique visits to the website and 90 participants who completed the survey. Participants’ self-reported positive changes in knowledge, attitude, and behaviors related to prevention of the triad.

CONCLUSIONS: This study suggests that online education may be an effective way to reach and educate coaches on the prevention of the triad. More research on outcomes among athletes is needed.

BACKGROUND

In the last 4 decades female participation in high school sports has dramatically increased from 7% in 1972 to 41% in 2009.¹ This increase in female participation of sports has been overall positive since research has proven that those who are physically active tend to live healthier and longer lives.² However, there may be increased risk for women who are driven to excel in sports.² In 1992, the American College of Sports Medicine (ACSM) identified the association of disordered eating, amenorrhea, and osteoporosis among female athletes, which was recognized as the female athlete triad.²
Originally, the first component of the triad was thought to be disordered eating or the practice of unhealthy weight management methods that included purging (self-induced vomiting), food restriction, or use of appetite suppressants, diet pills, laxatives, or diuretics.\textsuperscript{2} However, recent studies have shown that many athletes may have decreased energy availability without disordered eating.\textsuperscript{1,3} Therefore, some athletes may have decreased energy availability because of disordered eating practices while others may simply be unaware of the calories needed for their training level.\textsuperscript{1} In response to these new findings, the ASCM position changed in 2007 to decreased energy availability with or without disordered eating.\textsuperscript{2} Energy availability is dietary energy intake minus exercise energy expenditure. It is the amount of dietary energy remaining after exercise for other bodily functions.\textsuperscript{2}

Decreased energy availability is a prevalent symptom among female athletes whether intentional or unintentional. A study on the female athlete triad in high school students found that 54\% of female athletes had low energy availability without disordered eating.\textsuperscript{3} When tested, none of these athletes had an increased risk of disordered eating based on an eating disorder examination questionnaire.\textsuperscript{3} This along with other studies have show that athletes may not be aware that they are energy deficit due to a lack of knowledge in nutrition requirements and the lack of increased appetite with exercise.\textsuperscript{4} In experimental trials, dieting or food restriction increased hunger, but the same energy deficit from exercise did not increase energy intake or hunger.\textsuperscript{4} This lack of a strong biological signal to increase intake related to exercise makes it challenging for athletes to maintain energy balance without nutrition education and appropriate tools.

Decreased energy availability leads to hormone changes and menstrual dysfunction. These hormone changes as well as inadequate energy intake lead to decreased bone
mineralization and may eventually result in fractures. These changes in bone and menstrual status have been found to start after just 5 days of inadequate energy intake defined as less than 30 calories per kilogram of fat free mass.\textsuperscript{2, 5} Depending on the degree of loss, it may be irreversible. According to the American College of Sports Medicine, a 20 year old athlete with amenorrhea during critical teenage growth periods may have bone mass typical of a 70 year old female.\textsuperscript{2} This can result in a 3 fold risk of stress fractures.\textsuperscript{6}

This interrelationship between decreased energy availability, menstrual dysfunction, and decreased bone mineral density affects athletes worldwide and has serious health and performance implications.\textsuperscript{1, 7} This syndrome can lead to premature bone loss, problems with fertility, musculoskeletal injuries, and poor performance in sports and school.\textsuperscript{1} As research about the triad increases, so does the call for prevention education for coaches.\textsuperscript{1, 2, 6-13} Previous studies have found that female athletes and coaches lacked adequate nutrition related knowledge to prevent the female athlete triad.\textsuperscript{10, 11} Because athletes receive most of their nutrition information from parents, coaches, and peers, it is important that those sources have adequate, correct information to prevent the female athlete triad.\textsuperscript{7, 10}

Coach education is important in prevention of the triad due to their relationships with the athletes. Coaches often have daily contact with athletes and are held in high regard by their athletes. Studies have shown that coaches with high level knowledge of the triad have different perceptions and behaviors than coaches with general knowledge.\textsuperscript{9} Knowledgeable coaches were able to recognize the signs and symptoms of the triad, understand that menstrual irregularities could lead to stress fractures, and knew when it was appropriate for women with triad history to be screened for osteoporosis.\textsuperscript{9}

As the term athlete-coach relationship suggests, there is a personal dimension of coaching that includes expanding the coaching role to go beyond the technical skills.\textsuperscript{14}
Coaches often develop a trusting relationship with athletes and are viewed as mentors. As a mentor, the coach has an interest in the personal development of the athletes and works to fulfill their needs and in return athletes often imitate coach behavior. This coach-athlete relationship has proven to be an effective way to change negative athlete behavior. In a study looking at alcohol consumption among athletes, it was found that the athlete’s perception of the coaches’ approval of alcohol consumption was strongly associated with drinking behaviors. That is, those athletes that reported feeling that their coach disapproved of their alcohol consumption, were less likely to drink. Coach education has also been used in the prevention of concussions, athlete anxiety, and negative body image.

Coaches, especially high school coaches, provide a great opportunity to impact the well being of athletes. Although many lack adequate nutrition knowledge, it appears, from the previous studies, that when coaches are educated, most modify their behaviors to have a positive impact on athletes. Coaches can positively impact athletes by educating and encouraging them to adopt healthy patterns of behavior, recognizing risky behaviors, and making proper referrals when needed. Educating coaches on the triad may lead to prevention of the triad and improved athlete outcomes as coaches are able to educate, monitor, and manage triad symptoms.

In 2009, it was reported that 61% of American adults look online for health information, 30% of adults accessed social media, and about 10% of online health inquiries had a major impact on someone’s health care or the way they care for someone else. In 2013 these numbers grew to 76% of low income adults online, 96% of high income adults online, and 67% of online adults use social media sites. Social media is used by 20-24% of those searching for health related topics. As of 2010, Facebook is the most commonly used
online social network site among adults.\textsuperscript{21} Social media is also being used by adults to connect with people who share their interests or hobbies as well as old and new friends.\textsuperscript{22} These statistics indicates more and more people are online and the use of social media provides a means to reach and impact many adults via the Internet. Also adults are looking to connect with others who share similar interests and thus may provide a way to target a population of interest such as coaches. Although there is little empirical evidence to support the use of social media in heath education, it is still worth researching due to the possible impact to reach large masses of individuals.

Online Education provides the means to educated coaches regardless of location. It has been well documented that online learning can be effective, satisfying, and more economically feasible than traditional face-to-face learning.\textsuperscript{22} Online and open educational resources would allow coaches to learn at their own pace and provide them with useful, free tools. Online education on the female athlete triad may provide an effective way to educate coaches and lead to the prevention, awareness, and proper management of symptoms. The use of social media could allow coaches to connect with those who share similar interests and lead to the spreading of education and awareness to others such as parents and athletes. The purpose of this study is to develop online education material to educate coaches on the female athlete triad, evaluate the education material and assess if educating coaches online will increase their awareness and knowledge of female athlete triad, improve their confidence in recognizing and preventing female athlete triad, and improve their confidence in educating athletes using the tools provided.
METHODS

Participants

This study was reviewed and approved by the institutional review board (IRB). Participants included coaches and parents of female athletes between the ages of 13-18 who took the online survey between January 17th and March 14th. Although the study was targeting high school coaches, parents who gained access through social media were also included in the results. Surveys of individuals who were not a coach or parent and over that age of 18, were not included in the data set. The majority of participants were high school coaches in the state of Utah who were contacted by email. Prior to participation, an online consent form appeared informing participants that participation was voluntary and they may choose to stop at any time (appendix A).

Instrumentation

Online instruments included the Triad Trial website, weekly blog, and Facebook page which were created by the researchers. The website provided basic information on the female athlete triad and a toolkit for coaches which included handouts on the 3 distinct conditions related to the triad a preseason athlete risk assessment, brochure for parents and basic PowerPoint for educating athletes. It also included tools for calculating energy availability and a menu sample. The blog was updated weekly with posts about sports nutrition including pre and post workout snacking, calcium, vitamin D, nutrition during injury recovery, eating on the go, protein needs for athletes, hydration, and performance aids. The Facebook page posted weekly blogs and occasional reminders to visit the website.

A mixed method was used to evaluate the online resources. First small panel groups of 5 experts, 5 coaches, and 5 athletes were asked to individually review the website and fill out a survey on the content, visual appeal, navigation, and usefulness of the website.
Second a survey was attached to the website for general use which evaluated changes in knowledge, attitudes, and behavior of coaches (appendix E). This survey was used for data collection on the effectiveness of the website and positive coach outcomes.

**Procedure**

Reviewing the literature illuminated the need for widespread coach education pertaining to female athlete triad. Because more and more Americans are online, it was determined that the education materials would be provided online to assess the response of coaches to this type of education and provision of tools. After the development of online resources, individuals from the small panel group reviews were contacted. The expert group was composed of Registered Dietitians with experience in sports nutrition, and advanced knowledge of the female athlete triad. Coaches for the small panel group were contacted via email from referrals made by college athletes. The athlete group was composed of Utah State University athletes from track and field as well as cross fit.

After small panel review modifications were made as needed, including changes in the visual structure of the website, content corrections, and addition of tools and resources. Once modifications were completed the online survey attached to the website was made active and a Facebook post was shared announcing the website. During the first week of the intervention there was little participation. Coaches registered with the Utah High School Activity Association who worked with female athletes were emailed regarding this study and the opportunity for voluntary participation. Coaches were encouraged to browse the website, download applicable tools, and follow the weekly blog.

After exposure to the online materials coaches were encouraged to take the attached survey. No identifying information was collected through the survey and answers
remained anonymous. Improvements were self reported via the survey, and coaches were not followed at this time to assess actual behavior change. The survey included 30 questions including, multiple choice, true or false, and free response that assess eligibility, previous knowledge, changes in knowledge, attitude, and practices, as well view on the overall effectiveness of the online materials. To incentivize coaches, we conducted an iPad drawing at the end of the 8-week intervention period. After completion of the anonymous survey, coaches were instructed to email a secure email used only for the purpose of the drawing. This was voluntary and only email addresses were collected and saved for the drawing.

The use of the website and blog was tracked for first time visitors, returning visitors, and total page loads. A program entitled StatCounter was embedded into the website and collected total page loads as well as “cookies” from visitors that showed first time users, and returning visitors. This allowed researchers to track trends in traffic related to Facebook posts. This information was recorded before the launch to eliminate normal traffic.

**Data Analysis**

Quantitative data from the survey was analyzed using SPSS and included descriptive statistics and analysis of variance (ANOVA) to compare the mean among groups including groups based on gender, relationship to athlete, location, sport, and previous knowledge. For ranked answers, 1 correlated to strongly agree, 2 to agree, 3 to neutral, 4 to disagree, and 5 to strongly disagree, thus the means correlated to positive responses.

**RESULTS DISCUSSION**

Website Traffic: During the 8 week intervention there was a total of 1574 page views, 732 unique visits, 624 first time visits and 108 returning visitors. While there was moderate traffic to the site and returning visitors, only 89 completed the survey. When the
website initially launched there was minimal traffic with 0-25 unique visitors per day.

When emails were sent to USHAA coaches on January 24th and 27th those numbers rose and on the 27th there were 211 unique visitors, 444 page loads. Those numbers consistently declined each week, however there were spikes in visitors with each weekly Facebook posts. These spikes increased views from 5 visitors a day to 21 on the day of Facebook posts. However like with total traffic, spikes due to Facebook posts declined with each week. This is likely due to the lack of increased traffic to the Facebook page. There was a total of 30 “likes” to the Facebook page and likely the same audience was viewing the posts each week. If the Facebook page had been shared and promoted more by “friends,” it is likely that visits to the website would not have declined with each week. While Facebook drove traffic to the page, survey results show that it did not motivate participation as much as personalized emails.

Figure 3-1 Website Traffic

![Website Traffic During Trial](https://via.placeholder.com/150)

Tracked via cookies by statcounter.com
Qualitative results came from written as well as true/false, and likert scale based questions. The first 9 questions of the survey gathered population and eligibility information including age, gender, location, sports coaches, weight, and height. This information was used to group participants for ANOVA testing. Questions 10 through 17 from the survey gathered information on past practices and experience with the female athlete triad. Questions 18 through 30 assessed attitude and behavior changes as well as overall effectiveness of the online resource.

Demographics

Table 3-1 Population Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>43</td>
<td>47.8</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>45</td>
<td>50.0</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>47</td>
<td>52.2</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>28</td>
<td>31.1</td>
<td></td>
</tr>
<tr>
<td>Role</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coach</td>
<td>43</td>
<td>47.8</td>
<td></td>
</tr>
<tr>
<td>Parent</td>
<td>3</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Coach/Parent</td>
<td>12</td>
<td>13.3</td>
<td></td>
</tr>
<tr>
<td>Coach/Athlete</td>
<td>18</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td>Coach/Parent/Athlete</td>
<td>10</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>Age of Athletes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;13 years of age</td>
<td>1</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>13-18 years of age</td>
<td>83</td>
<td>92.2</td>
<td></td>
</tr>
<tr>
<td>&gt; 18 years of age</td>
<td>1</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Sport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross Country</td>
<td>20</td>
<td>22.2</td>
<td></td>
</tr>
<tr>
<td>Track and Field</td>
<td>28</td>
<td>31.1</td>
<td></td>
</tr>
<tr>
<td>Basketball</td>
<td>23</td>
<td>25.6</td>
<td></td>
</tr>
<tr>
<td>Volleyball</td>
<td>12</td>
<td>13.3</td>
<td></td>
</tr>
<tr>
<td>Softball</td>
<td>9</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>Soccer</td>
<td>11</td>
<td>12.2</td>
<td></td>
</tr>
<tr>
<td>Dance</td>
<td>3</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Cheerleading</td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Swimming</td>
<td>7</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Tennis</td>
<td>5</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td>26.4</td>
<td></td>
</tr>
</tbody>
</table>
There were a total of 90 completed and eligible surveys. Surveys of individuals under 18 years of age were not included. Of the 90 participants 45 were male, 43 were female, and 2 didn’t specify. Only 16.7% of participants had previously heard of the female athlete triad and 19% could correctly name the 3 components of the triad. Only 75 of participants indicated the city/county in which they coached. Of those 75, 47 coached in an urban area, which was defined as a city or county with a population greater than 20,000 and determined by the Utah Department of Workforce Services. 89% heard about the website from email. 48% of participants reported themselves as a coach, 13% reported they were a coach and parent of athletes, 20% reported being a coach and athlete, and 11% reported being a coach, parent of an athlete, and an athlete themselves. This indicates that while some were parents or athletes, 92% of participants were coaches of female athletes and 92.2 % coaches females between the ages of 13-18 years of age, indicating that the majority of participants met the target population for this study. The average BMI was 26.4, and there were no coaches considered underweight (BMI<18).

**Past Experience with the Triad**

Of the respondents, 35.6% coaches reported coaching females with stress fractures in the past and 5 reported being unsure and 81.1% participants reported no previous knowledge of the female athlete triad. Normal weight coaches were more likely to have previously heard of the triad compared to overweight coaches and overweight coaches were more likely than obese coaches (p=0.026). Of the coaches, 20% agreed they had encouraged their athletes to maintain a certain weight or body shape in the past, males were more likely to agree with this answer than females (p=0.028) The majority if coaches regularly encouraged their athletes to eat more during training and encouraged pre/post workout snacking before viewing the website.
Knowledge

Of respondents, 11% of coaches agreed that missing menstrual cycles posed no risk to their female athletes and 29% were neutral indicating that 40% of the surveyed coaches were unaware of the dangers associated with missing menstrual cycles, however, urban coaches were more aware of the dangers than rural coaches (p= 0.025). More than half (54%) of respondents reported being aware, that decreased energy intake and missing menstrual cycles could affect bone status, prior to viewing the website.

When compared by sport, cross country coaches more often had heard of the female athlete triad (p=0.002), encouraged pre and post workout snacks (p= 0.037), were more aware that missing menstrual cycles were harmful to their athletes (p=0.021), and has less of a change in attitude associated with the female athlete triad, this may have been due to higher previous knowledge of the female athlete triad reported by cross country coaches. Track and field coaches had also more often heard of the triad compared with other sports.
(p=0.011) and were more aware that intake and menstruation could affect bone status (0.045).

After the intervention 95.6% strongly agreed or agreed that they now understood the importance of regular menstrual cycles, and 96.6% reported strongly agreeing or agreeing that they understood the importance of adequate energy intake and that inadequate amounts could lead to poor performance and future health risks. Most of the coaches (90%) strongly agreed or agreed that they learned something new, 7.8 were neutral and 2.2 % did not respond.

**Utilization**

Of participants, 92.2 % felt that the website gave them the tools necessary to educate their athletes on the triad, 80% have used or plan to use at least 1 of the tools provided, and 40% utilized the blog or Facebook page for new information and females were found to use the blog or Facebook post more than males (p=0.032). Surveys indicated that 63.3 have shared or plan to share this resource with a friend, 96.6% reported that they would recommend this resource to another coach, athlete, or parent, and 83.4% reported that they would likely visit this site again if left online. When asked if they liked that the resources were online, 95.6% reported liking that everything was online.

The most downloaded tool during the 8 weeks was the *Preseason Athlete Survey* with 31 downloads, followed closely by the *Energy Availability Handout* (30), *How to Assess Energy Availability* (29), and PowerPoint (29). The sample menus (27) and brochure (28) for parents were also popular. The least downloaded tools were the *Bone Health* (15) and *Amenorrhea* (20). See appendices F-K for examples of the above mentioned tools.

Information on energy availability seemed to be the most popular topic and have the most knowledge and attitude changes. It is important to note that the number of downloads
reported were for the 8 weeks only and after the intervention there was additional downloads of all the tools suggesting that coaches may have returned to download the tools later.

**Attitude Changes**

When asked if their attitude regarding the seriousness of the female athlete triad had changed, after visiting the online resources, 74.4 agreed, and 22.2 were neutral with only 1 participant disagreeing that their attitude had changed. Those who had previously heard of the triad reported less change than those with no exposure (p=0.005). The majority of participants (63%) agreed that this website made them feel more confident in talking to their athletes about menstrual cycles, 80% reported feeling more confident in talking to their athletes about adequate calorie intake, and 85.6 % now felt confident in recognizing the signs of the triad due to the website. When compared by gender, males on average reported feeling more confident in talking to there athletes about adequate calories than females (p=0.040) and there was no significant difference between groups in talking to their athletes about menstruation.
Figure 3-3 Post Intervention Changes in Participants’ Knowledge and Attitudes

<table>
<thead>
<tr>
<th>Changes in Knowledge and Attitude</th>
<th>Percentage of participants who agreed after viewing the website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand importance of menstruation</td>
<td>95.6</td>
</tr>
<tr>
<td>Understand impacts of energy intake</td>
<td>96.6</td>
</tr>
<tr>
<td>Learned something new</td>
<td>90</td>
</tr>
<tr>
<td>Change of attitude regarding seriousness</td>
<td>74</td>
</tr>
<tr>
<td>Raised confidence in addressing energy</td>
<td>80</td>
</tr>
<tr>
<td>Raised confidence in addressing menstruation</td>
<td>61.1</td>
</tr>
<tr>
<td>Confident recognizing the signs</td>
<td>85.6</td>
</tr>
</tbody>
</table>

**Suggest Resource Changes**

Some of the suggested changes that participants made for the future included, additional resources based on location such as counselors to send athletes too. Others suggested more basic handouts for athletes and calculators for energy needs. Some coaches wanted more research while others requested more simplicity with highlighted main points. Increased technology was another suggestion with videos, smart phone apps, and calculators for energy needs. Overall it would seem that the coaches are eager to learn and utilize this information, but want it to be quick, easy, and technology based. A few male coaches reported being nervous about talking to their student athletes about menstrual and asked for tips or tools with this sensitive subject.

**Participant’s Final Comments**

Participants were asked to provide any additional comments at the end of the survey. Many expressed gratitude for the resource and commented that they “enjoyed learning about the female athlete triad.” Other re-stated that they felt that the resource was helpful and needed.
Other comments include:

- “I thought it was great and would appeal to many of the teenage girls that would read this. Well done.”
- “I learned a lot about the Female Athlete Triad. I work with female athletes from 38 different countries. I have noticed the "fragility" of our Asian girls and now can talk to them about the importance of their diet and calorie input…”
- “This has made me stop and think about athletes I have coached in the past, and I never thought about building bone mass now to help with future issues.”
- “This is very interesting and the ability to access online will help educate.
- “Thanks for your time and interest in helping female athletes be more healthy.”
- “This is a great part of my coaching plan when I talk to my athletes about their health.”
- “Thanks for building this resource and reaching out to coaches. It’s very valuable and I’ll use it with my teams and in camps that I run with younger players. Even the best teams in the state aren’t talking about any of this. The default is we are busy and competitive, so we typically train, strengthen and hope our girls are ok and get through it.”
- This website is professional and very clean looking and intuitive. It was great to learn about these things more so that I can talk with my athletes about it and their parents. Really liked this site”
- “Great handouts! I plan on using some of these at my next parent/athlete meeting before we start our next training season. Thank you!!!!”
- “Thanks so much for the information. I discuss nutrition at every parent meeting and with athletes weekly during our high school season. I now have access to a pretty concise PowerPoint that is backed up by more than just "the coach" talking.”
- “I have coached athletes who have had this problem. It can be devastating and life threatening. Thanks for developing it.”
- “Thanks for the resources! I have been telling my athletes that they need to eat more for YEARS!!!! I love how you have summed this up and created easy, usable handouts. Thank you!!!!!”

LIMITATIONS

This study was a pilot for the provision of online education materials and tools for coaches focusing on the female athlete triad to assess coaches’ response. There was no control group to better assess the impact of the online education materials, and the coaches were not followed overtime to assess behavior changes. Although Facebook increased traffic to the site for a short time, it did not seem to spread beyond the contacts of the researchers. There was only a total of 30 "likes" to the page. Had the Facebook page been promoted and spread, it would have allowed greater traffic and possible participation. To
really assess the power of utilizing Facebook, it would have been helpful to pay the promotion fee to determine how much traffic Facebook can drive when being promoted outside of the researchers influence. Other limitations include the target population, of Utah coaches who may not represent the average coach from other areas.

CONCLUSIONS

The results from this study indicate that the majority of high school coaches are unaware of the female athlete triad, however they are eager to learn and improve their practices. Participants’ self-reported positive changes in knowledge, attitude, and behaviors related the prevention of the triad. This study suggests that online education may be an effective way to reach and educate coaches on the prevention of the triad. More research on outcomes among athletes is needed.

IMPLICATIONS FOR SCHOOL HEALTH

High school coaches play a huge role in establishing a healthy environment for their athletes and often students. The coach-athlete relationship has proven to be a strong and useful bond in prevention of adverse behaviors of athletes or in prevention of health problems such as concussions. Many high school coaches are unaware of the female athlete triad or the serious health and performance consequences for athletes. By educating coaches and providing the tools for prevention, we can prevent the triad among high school athletes and keep our student athletes health and at top of their game.

HUMAN SUBJECTS APPROVAL STATEMENT

This study was exempted by the institutional review board under 45 CFR Part 46.101(b) category #2. The study was approved on November 1, 2013.
REFERENCES


14. Mastroleo NR, Marzell M, Turrisi R, Borsari B. Do coaches make a difference off the


CHAPTER 4
SUMMARY AND CONCLUSIONS

The female athlete triad (triad) is a common problem among female athletes and negatively affects performance and health. Past research has measured the nutrition and triad knowledge and found it to be lacking among athletes and coaches. Based on prevention research in other fields, it appears that because of the strong bond between coaches and athletes, targeting coaches for prevention education can lead to positive outcomes with athletes.

This study aimed to develop an online educational resource that educated coaches about prevention and management of the triad. An online format was chosen for cost, and effectiveness in reaching coaches, as well as to further evaluate online education effectiveness. This pilot study targeting coaches of high school aged female athletes to assess their current knowledge and self-reported changes that occurred in knowledge, behavior, or attitude related to the online education. We thought that if coaches were receptive to online education and there appeared to be improvements, it would be worth researching further.

The results from our study indicated, like other studies, that coaches did lack adequate nutrition knowledge. Many (83%) had never heard of the female athlete triad and almost half were still unaware of the dangers of missing menstrual cycles. After viewing the education materials participants reported large gains in knowledge, confidence, and overall attitude regarding the seriousness of the intervention.

The tools provided were utilized and continued to be downloaded from the website after the 8 week intervention period. Overall coaches reported that the tools were helpful and helped them feel more confident sharing triad information. Some of the free responses
from coaches indicated that they would have liked more technology and easy tools such as calculators and apps that they could store on their phone and utilized as needed. Almost all the coaches reported that they liked that everything was online and it appears that coaches would prefer increased technology for future education.

There was also a social media component included due to the emerging research and prevalence of social media use among adults. Past studies have found mix results. This study found that although Facebook presence increased traffic with each post, it was not effective long term, however there were few likes to the Facebook page and low traffic. Perhaps with greater promotion provided by Facebook for a small fee, there would have been increased traffic and greater results evident due to the social media impact. It warrants further research to analyze how social media could best impact online education.

The coaches from this study appeared to be eager to learn and improve their practices. This study suggests that online education may be an effective way to reach and educate coaches on the prevention of the triad and warrants additional research. Future research should look at long-term changes of coaches, especially behavior changes, and the impacts that these changes have on athletes to further evaluate if coach education does lead to prevention of the female athlete triad among athletes. Prevention of the triad is vital in keeping our female athletes healthy and performing well.
APPENDIX A. LETTER OF INFORMATION

Letter of Information
The Triad Trial: Online Education for Coaches

Introduction/Purpose Professor Dr. Heidi Wengreen in the Department of Nutrition, Dietetics and Food Sciences at Utah State University is conducting research on the development of online education material to educate coaches on the female athlete triad and assess if it is effective and useful to coaches. You have been asked to take part because you are a coach of high school aged female athletes in the state of Utah.

Procedures If you agree to be in this research study, you will be asked to visit the website, browse and download tools, and follow the blog and Facebook page which will be updated weekly with new tips, information, and tools. After you have been exposed to the online education material they be encouraged to take a ending survey which will help us assess the effectiveness of this new tool.

Alternative Procedures If you choose not to participate in this research study simply exit the survey. You may still use the website and blog although we ask that you take the survey if you utilize our resources.

Risks There is minimal risk in participating in this research.

Benefits There is no financial benefit to participating. Benefits include education information and tools to help prevent the female athlete triad among your athletes.

Explanation & offer to answer questions If you need further information/explanation about this research study you may contact Megan Ostler at megan.mansell@aggiemail.usu.edu. If you have other questions or research-related problems, you may reach Professor Dr. Heidi Wengreen at (435) 797-1806 or by e-mail at Heidi.Wengreen@usu.edu

Voluntary nature of participation and right to withdraw without consequence Participation in research is entirely voluntary. You may refuse to participate or withdraw at any time without consequence.

Confidentiality Participant information will not be collected. If participants choose to comment, share, or “like” that will be visible to other facebook, blog, and website users. Use of the website and tools will be tracked only by total number.

IRB Approval Statement The Institutional Review Board (IRB) for the protection of human participants at USU has reviewed and approved this research study. If you have any pertinent questions or concerns about your rights or think the research may have harmed you, you may contact the IRB Administrator at (435) 797-0567 or email irb@usu.edu. If you have a concern or complaint about the
Letter of Information
The Triad Trial: Online Education for Coaches

research and you would like to contact someone other than the research team, you may contact the IRB Administrator to obtain information or to offer input.

Investigator Statement “I certify that the research study has been presented to the individual, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered.”

Heidi Wengreen, R.D., Ph.D.  Megan Ostler, R.D.
Principal Investigator  Student Researcher
(435-797-1806)  (801-618-6248)
(heidiwengreen@usu.edu)  (megan.mansell@aggiemail.usu.edu)
APPENDIX B. EXPERT REVIEW SURVEY

Expert Review Survey

Please rank to what degree you agree or disagree with the following statements. Please provide additional comments as necessary, especially to explain statements that you disagree with indicating things that you reviewed that need to be revised. Use the following scale:

<table>
<thead>
<tr>
<th>1=strongly agree</th>
<th>2=agree</th>
<th>3=neutral</th>
<th>4=disagree</th>
<th>5=strongly disagree</th>
</tr>
</thead>
</table>

1. The purpose of the website is clearly indicated.
   Rate Given: _____
   Comments:

2. There is adequate information about the authors
   Rate Given: _____
   Comments:

3. The source of information is adequately indicated on the content pages and tools.
   Rate Given: _____
   Comments:

4. The general appearance of the website is appealing.
   Rate Given: _____
   Comments:

5. It is easy to navigate through the website and links are clearly marked
   Rate Given: _____
   Comments:

6. The text on the site is the appropriate font, size, and color for easy ready
   Rate Given: _____
   Comments:

7. The graphics on the different pages are the appropriate size and serve a purpose
   Rate Given: _____
   Comments:

8. The reading level is appropriate for high school level coaches.
   Rate Given: _____
   Comments:

9. The content would be easily comprehended by coaches with no more than a high school education
   Rate Given: _____
   Comments:
10. The site is free of spelling and grammatical errors
   Rate Given: ____
   Comments:

11. The content is informative
   Rate Given: ____
   Comments:

12. The content is accurate.
   Rate Given: ____
   Comments:

13. I would bet that coaches would likely visit the website multiple times.
   Rate Given: ____
   Comments:

14. The site has relevant and helpful links
   Rate Given: ____
   Comments:

15. The tools (provide a definition of what these are and where to find them... just not sure how obvious these are) were helpful.
   Rate Given: ____
   Comments:

16. The tools were accurate
   Rate Given: ____
   Comments:

17. There were enough tools
   Rate Given: ____
   Comments:

18. The tools were free from spelling and grammatical errors
   Rate Given: ____
   Comments:

19. The tools were easily downloaded
   Rate Given: ____
   Comments:

20. The links were appropriate and up to date.
   Rate Given: ____
   Comments:

Please list any additional comments:
APPENDIX C. COACH REVIEW SURVEY

Coach Review Survey

Please rank to what degree you agree or disagree with the following statements. Please provide additional comments as necessary, especially to explain statements that you disagree with indicating things that you reviewed that need to be revised. Use the following scale:

<table>
<thead>
<tr>
<th></th>
<th>1=strongly agree</th>
<th>2=agree</th>
<th>3=neutral</th>
<th>4=disagree</th>
<th>5=strongly disagree</th>
</tr>
</thead>
</table>

1. The purpose of the website is clearly indicated.
   Rate Given: _____
   Comments: 

2. The general appearance of the website is appealing.
   Rate Given: _____
   Comments: 

3. It is easy to navigate through the website and links are clearly marked
   Rate Given: _____
   Comments: 

4. The text on the site is the appropriate font, size, and color for easy ready
   Rate Given: _____
   Comments: 

5. The content is informative
   Rate Given: _____
   Comments: 

6. I would likely visit the website multiple times.
   Rate Given: _____
   Comments: 

7. The site has relevant and helpful tools
   Rate Given: _____
   Comments: 

8. There were enough tools
   Rate Given: _____
   Comments: 

9. Going through the website changed my attitude on the seriousness of the Female Athlete Triad. Why?
Rate Given: ____
Comments: 

10. The website would help coaches recognize the signs of the Female Athlete Triad?
   Rate Given: ____
   Comments: 

11. This intervention gives the tools necessary to educate coaches on the Female Athlete Triad?
   Rate Given: ____
   Comments: 

12. I learn something new?
   Rate Given: ____
   Comments: 

13. I liked that the intervention and resources were online? Why?
   Rate Given: ____
   Comments: 

14. I would recommend this resource to another coach, athlete, or parent? Why?
   Rate Given: ____
   Comments: 

15. What tool was most useful?

16. Is there anything you would change?

17. Would you use an educational slideshow for teaching athletes if it was provided?

18. Would you use a brochure to educate parents if it was provided?

19. Is there anything you would add to the website or toolbox?

20. Please provide any additional comments?
APPENDIX D. ATHLETE REVIEW SURVEY

Athlete Review Survey

Please rank to what degree you agree or disagree with the following statements. Please provide additional comments as necessary, especially to explain statements that you disagree with indicating things that you reviewed that need to be revised. Use the following scale:

| 1=strongly agree | 2=agree | 3=neutral | 4=disagree | 5=strongly disagree |

1. The purpose of the website is clearly indicated.
   Rate Given: _____
   Comments: ____________________________

2. The general appearance of the website is appealing.
   Rate Given: _____
   Comments: ____________________________

3. It is easy to navigate through the website and links are clearly marked
   Rate Given: _____
   Comments: ____________________________

4. The text on the site is the appropriate font, size, and color for easy reading
   Rate Given: _____
   Comments: ____________________________

5. The content is informative
   Rate Given: _____
   Comments: ____________________________

6. I would likely visit the website multiple times.
   Rate Given: _____
   Comments: ____________________________

7. The site has relevant and helpful tools
   Rate Given: _____
   Comments: ____________________________

8. There were enough tools
   Rate Given: _____
   Comments: ____________________________

9. Going through the website changed my attitude on the seriousness of the Female Athlete Triad. Why?
10. The website would help other athletes recognize the signs of the Female Athlete Triad?
   Rate Given:____
   Comments:

11. This intervention gives the tools necessary to educate athletes on the Female Athlete Triad?
   Rate Given:____
   Comments:

12. I learned something new?
   Rate Given:____
   Comments:

13. I liked that the intervention and resources were online? Why?
   Rate Given:____
   Comments:

14. I would recommend this resource to another coach, athlete, or parent? Why?
   Rate Given:____
   Comments:

15. My coaches could have used this information?
   Rate Given:____
   Comments:

16. What tool was most useful?

17. Is there anything you would change?

18. Is there anything you would add to the website or toolbox?

19. Please provide any additional comments?
APPENDIX E. INTERVENTION SURVEY

Intervention Website Survey

The following questions were loaded in the ProProfs website and embedded into the intervention survey web page.

How did you hear about this website/blog
• Facebook
• Email
• Word of Mouth
• Online Search
• Other (Please specify)

What is your gender?
• Male
• Female

Are you 18 years of age or older?
• Yes
• No. We thank you for your interest. However, this survey is for those 18 years and older.

What is your weight?

What is your height?

Please select all that apply
• I coach female athletes
• I am a parent of a female athlete
• I am an athlete
• Other (Please specify)

If you do coach females what are the ages of your athletes
• Younger than 13
• 13-18
• Older than 18
• N/A

Where do you coach? Please specify state and county/city. If you are not a coach, skip to next question.

Which sport(s) do you coach? (Check all that apply)
• Basketball
• Cheerleading
• Cross Country
In the past, I thought missing menstrual cycles posed no risk to the health of young female athletes.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

In the past, I was aware that intake and menstrual cycles could affect bone status.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

In the past, I was aware that intake and menstrual cycles could affect bone status.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

My attitude on the seriousness of the Female Athlete Triad changed after visiting the Triad Trial website.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

I understand the importance of having regular menstrual cycles.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

I understand the importance of consuming adequate calories and am aware that decreased intake can lead to poor performance and future health risks.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
This website helped me feel confident speaking with my athletes about menstrual cycles.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

This website helped me feel more confident talking to my athletes about adequate calorie intake.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

This website helped me feel confident recognizing the signs of the Female Athlete Triad.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

This website gave me the tools necessary to educate my athlete on the Female Athlete Trial.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

I learned something new from this website.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

I have used (or plan to use) at least one of the tools provided in the tool kit.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree
This website helped me feel confident speaking with my athletes about menstrual cycles.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

This website helped me feel more confident talking to my athletes about adequate calorie intake.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

This website helped me feel confident recognizing the signs of the Female Athlete Triad.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

This website gave me the tools necessary to educate my athlete on the Female Athlete Trial.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

I learned something new from this website.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

I have used (or plan to use) at least one of the tools provided in the tool kit.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree
I utilized the blog and Facebook pages for new information and tools.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

I have shared (or plan to share) this website, blog, or Facebook page with a friend.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

I liked that the educational materials and all resources were online.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

I would recommend this resource to another coach, athlete, or parent.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

I would likely visit the website/blog multiple times if left available.
  • Strongly Agree
  • Agree
  • Neutral
  • Disagree
  • Strongly Disagree

Is there anything you would change?

Is there anything you would add to the website or toolbox?

Please list any additional comments below
Amenorrhea

Are Your Female Athletes At Risk?

Why Is Amenorrhea A Concern?
When decreased energy availability is the cause of amenorrhea it is classified as functional hypothalamic amenorrhea and can be reversed by increased energy intake. In this type of amenorrhea, ovarian function decreases due to low luteinizing hormone (LH), which is suppressed if the availability of energy is low. The low estrogen and other hormonal changes that occur when a menstrual cycle is irregular or absent can lead to osteoporosis. This decrease in bone density puts athletes at a higher risk of developing hairline fractures, stress fractures, and osteopenia, a bone-thinning condition that is thought to be a precursor to osteoporosis...

What is Amenorrhea?
Amenorrhea is the temporary or permanent loss of menstruation categorized into primary or secondary. Primary amenorrhea is when the menstrual cycle has yet to begin by age 15, whereas secondary amenorrhea is the absence of a menstrual period for more than three regular menstrual periods for a woman who has been previously menstruating.

Prevalence and Prevention
The prevalence of secondary amenorrhea has been estimated to be around 2-5% among the general population. Among exercising females the prevalence is thought to be around 20%. Among sports that emphasize a lean physique such as running and dancing this has been reported to be as high as 44% among ballet dancers and 51% among endurance runners (West, Thein-Nissenbaum).

Screen your athletes, and be aware if they have regular menstruation cycles and are at risk for amenorrhea. Educate your athletes on consuming enough calories to compensate for the rigorous workouts and the potential health effects of amenorrhea.

References:
APPENDIX G. BONE DENSITY HANDOUT

FEMALE ATHLETE TRIAD

Bone Health

The Triad

Many female athletes feel pressure to focus on achieving and maintaining a low body weight. Often, this leads to habits of disordered eating and over exercising. These behaviors can put the athlete at risk for amenorrhea and osteoporosis. A combination of all three symptoms can lead to lifetime consequences if not treated properly.

Low Bone Density

Female athletes with an inadequate energy intake can develop amenorrhea, the loss of their menstrual period. Amenorrhea causes a decreased production of hormones such as estrogen, which helps absorption of calcium as well as other bone protecting properties. Decreased absorption and intake of calcium can lead to bone loss, osteopenia, and osteoporosis. According to the American College of Sports Medicine (ACSM), a 20-year-old athlete with amenorrhea during critical teenage years may have bone mass typical of a 70-year-old female. This may not be 100% reversible with the return of normal menstrual function so prevention is the key.

Low bone density can cause possible, such as stress fractures and broken bones. Weight-bearing exercises strengthen bone density in a healthy female athlete. However, an athlete with the Triad, preforming weight-bearing activities is at greater risk for stress fractures than a healthy athlete. It is also important that athletes have adequate vitamin D and calcium intake for healthy bones. Good sources of both are: egg, low-fat yogurt, skim milk, trial mix, almonds, cottage cheese, oranges, and orange juice.

Nutrient Recommendations

The calcium requirements are 1,200 mg for adolescents and 1,000 for adult women. Recommendations are 400-600 mg of vitamin D per day.


APPENDIX H. ENERGY AVAILABILITY HANDOUT

Energy Availability

How Much Is Enough?

Eating is just as important for athletes as practice and strength. Heavy exercise and training can lead to a negative energy balance, which if unmonitored can lead to loss of a menstrual cycle and compromise bone strength. With so much daily activity, some athletes require far more calories and nutrients than the average person.

The Best Diet is a Balanced Diet

It is important that athletes get adequate fat, protein, carbohydrates, and micronutrients.

Carbohydrates: The amount sufficient to maintain muscle glycogen stores from day to day is 5 to 12 gm/kg/day (2.3 to 5.5 gm/lb.) depending on body size and intensity and duration of activity. The practice of “Carb loading” with simple sugars isn’t recommended. Fruits and some vegetables such as corn, potatoes, and peas can be great sources of carbohydrates.

Fats should make up about 25-30% of your total daily energy intake. Choose unsaturated fats (oils and fat from avocado, nuts, and fish) and avoid saturated and trans fats. Fats are important for body functions, nutrient absorption, and back-up energy. Fat should never be completely eliminated from the diet.

Protein should be consumed at, or slightly above 1.2 to 1.4 g/kg/day (0.5 to 0.6 lb.) if you’re an endurance or resistance training athlete. Overconsumption of protein is a popular trend but doesn’t have any positive effect on muscle repair or maintenance. Make sure to choose lean protein such as chicken, fish, dairy, and beans.

Micronutrients: It’s very important that you get all of the necessary vitamins and minerals, especially as an athlete. Eating a balanced diet, will help to ensure you are getting the vitamin and minerals your body needs during training. Calcium is especially important for female athletes to aid in bone strength. Good sources of calcium include dairy products, almonds, green leafy vegetables, and fortified foods.

MID WORKOUT FUEL

An energy boost provided by a simple carbohydrate can be beneficial to your performance for long distance running, stop and go sports, or other strenuous activity exceeding 1 hour. The Academy of Nutrition and Dietetics recommends consuming 0.7 g of carbohydrates per kg of body weight (usually about 30-60 g) per hour of endurance exercise.

Disordered Eating

In certain sports like track, swimming, gymnastics, dancing and figure skating, eating disorders are more common because an emphasis is placed on weight. Know that compulsive exercise — burning off more calories than you consume in a day through exercise alone — is another form of eating disorder, with dangerous side effects. If you feel the pressure by your teammates, parents, coaches or even yourself to lose weight for your sport, then you should talk to a professional. There is no reason that you should ever feel pressure to starve yourself, vomit or over-exercise.
APPENDIX I. ASSESSING ENERGY BALANCE

Calculating Energy Balance

Dietary Energy Intake – Energy Expenditure = Energy Availability

In order to know if your athletes are in positive or negative energy balance you need to know the amount of energy eaten versus burned. It can be difficult to find out exactly how much energy is burned and consumed each day. Tracking can be an easy way for any athlete to get a general idea of energy availability.

3 Day Food and Activity Log

Food Intake

- Record everything you eat and drink for 3 days including 1 weekend day and 2 weekdays.
- Make sure they represent your usual eating habits/patterns (don’t include a birthday or special occasion).
- Record each food and beverage consumed on separate lines. Separate mixed dishes as much as possible (e.g., sandwich, lasagna, stew, casserole, etc.).
- Measure beverages in liquid ounces and foods in cups, tsp., etc.
- Record food preparation; baked, boiled, fried, grilled, etc.
- List any additional information you think might be helpful.

Activity

- Record your activity on the same days that you record your food intake.
- Include all exercise/training and any significant lifestyle physical activity (e.g., riding your bike to school, walking to the store, etc).
- Also include type of exercise, length of time, distance and intensity if applicable.

Decreased Energy Availability

The term energy in nutrition is used interchangeably with calories. We use energy to emphasize the fuel that comes from food. Energy Availability is the energy from food left over after exercise that is available for body activities such as breathing, maintaining body temperature, recovering from training, having normal periods, building strong bones, etc.

Without adequate energy your body does not have the fuel for training and competing. If energy balance is negative it may lead to weight loss and then muscle loss. During training many athletes are in a negative energy balance but don’t have weight to lose. With inadequate energy the body has to choose which functions to maintain and which to decrease leading to amenorrhea, decreased bone mineral density, and increased fatigue.

MyPlate Super Tracker Instructions

Create A Profile

- Go to www.choosemyplate.gov
- Under the “Popular Topics” menu, click “Supertracker”
- Click the blue button on the right side of the screen that says “Create Your Profile”
- Under “Step 1” enter your profile name, age, gender, physical activity level, height, and weight
- Under “Step 2” enter your username, password, and email (optional)
- Under “Step 3” click “Submit”
- A box will pop up saying you are registered. Click “Ok”

Food Record

- Click on the center box titled “Food Tracker”
- Type in the first food item from your log
- Modify your search as needed to find an item that best fits the food you actually ate
- Select the most appropriate item, then choose the amount you ate from the drop down menu options
- Check the box next to the time of day you ate the food item
- Click the +Add button
- Continue to add meals, snacks and beverages listed on your food log until all foods have been entered

Exercise Record

- Click the tab at the top of the screen titled “Physical Activity Tracker”
- Enter your activity in the search box
- Click the option from the list that best describes the type of activity you performed
- Enter the time you spent doing that activity
- Enter the days you did this activity
- Continue until all have been entered

Reports

There are many reports that you can print to assess your intake. To assess your energy balance, print the Nutrient Report and Physical Activity Report. Compare your intake with energy used for activity and regular body functions. Many athletes are a few hundred calories short and could benefit from adding an extra snack each day.

Helpful Tips:

If you can’t find an item you are looking for try
- Making it plural such as tomatoes instead of tomato
- Try general terms such as potato chips instead of lays chips.

You can try searching for mixed items instead of entering each item.
- For example try chicken enchiladas instead of tortilla, chicken, cheese, et.
- If there is not a mixed item that accurately describes exactly what you ate, then enter all the individual items to get an accurate estimate.
Food Record

Name:__________________  Date:__________  Day of Week: M T W Th F Sa Su

Please record as accurately as possible all food and beverages you consume for one day.

<table>
<thead>
<tr>
<th>Time</th>
<th>Food/Beverage</th>
<th>Brand or Source</th>
<th>Type of Preparation</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00am</td>
<td>Example: Cinnamon raisin bagel</td>
<td>Lenders</td>
<td>Toasted</td>
<td>1 ea. (3oz)</td>
</tr>
</tbody>
</table>
# Activity Record

Name: ___________________  Date: __________  Day of Week: M T W Th F Sa Su

Please record the exercise/training that you do on the days that you are recording your food intake. Include any significant lifestyle activity.

<table>
<thead>
<tr>
<th>Time</th>
<th>Type of Exercise/Activity</th>
<th>Duration</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00am</td>
<td>Example: Running</td>
<td>1 hour</td>
<td>6 miles/hour</td>
</tr>
</tbody>
</table>


APPENDIX J. SAMPLE MENUS

2000 Calories

**Breakfast:** Honey Bunches of Oats cereal (2 cups), 1% milk (8 oz.), and 1 large banana

**Lunch:** Turkey sandwich (cheese, mustard, mayo, and lettuce), 2 large carrot sticks, apple, and baked potato chips (1 oz.)

**Dinner:** 2 cups spaghetti and meatballs, 1 cup broccoli, and grape juice (12 oz.)

For many training athletes this caloric level would not be adequate to meet their needs and could lead to decreased energy availability. Adding in snacks throughout the day especially before training can help ensure adequate energy intake.

2500 Calories

**Breakfast:** Honey Bunches of Oats cereal (2 cups), 1% milk (8 oz.), and 1 large banana

**Smack:** Greek Yogurt (6 oz.) and 1 granola bar

**Lunch:** Turkey sandwich (cheese, mustard, mayo, and lettuce), 2 large carrot sticks, apple, and baked potato chips (1 oz.)

**Smack:** String cheese and 3 clementines

**Dinner:** Spaghetti and meatballs (2 cups), broccoli (1 cup), and grape juice (12 oz.)

3000 Calories

**Breakfast:** Honey Bunches of Oats cereal (2 cups), 1% milk (8 oz.), and 1 large banana

**Smack:** Greek Yogurt (6oz.) and 1 granola

**Lunch:** Turkey sandwich (cheese, mustard, mayo, and lettuce), 2 large carrot sticks, apple, and baked potato chips (1 oz.)

**Smack:** String cheese, 3 clementines, triscuit thin crisps (14 crackers)

**Dinner:** 2 cups spaghetti and meatballs, 1 cup broccoli, and grape juice (12 oz.)

**Smack:** Chocolate chip mint ice cream (1 cup)
APPENDIX K. TRIAD BROCHURE

How Can I Help?

Anyone can help by spreading the word. Research has shown that many coaches, parents, and athletes are unaware of this syndrome.

Parents and coaches can help by talking about the female athlete triad with their athletes, knowing that warning signs such as increased fatigue, late or missed periods, and stress fractures.

If your athlete is showing signs of the female athlete triad try adding snacks and increased calories during training. If symptoms continue contact a doctor, some of the early warning signs are similar to other medical problems and may be unrelated to the female athlete triad.

Learn More!

To learn more about the female athlete triad or for more tools, check out our website below. There are hundreds to share, tools to assess energy availability, and more.

You can also check out the blog attached to the website for more tips on sports nutrition for your athlete.

Connect with others on our Facebook page.

Help us prevent the triad and keep female athletes healthy!

www.thetriadtrial.com

The Triad Trial
Education for Prevention
USU 2014
What is the Triad?

A syndrome that involves three related but distinct components: decreased energy availability, problems with menstruation, and decreased bone density. It is a medical condition that affects athletes worldwide and can lead to poor performance in sports and school, premature bone loss, problems with fertility later in life, and injuries including stress fractures.

What is the cause of the triad?

The female athlete triad was named for the three parts that are related. It starts with what we call decreased energy availability. Energy availability refers to the energy left over after exercise for other bodily functions including menstruation (having monthly periods), and building strong bones.

When athletes are training at high intensities for long periods of time, they use up a lot of energy. If they are not making up for the extra calories burned with diet they will start to feel tired, perform poorly, and may start to have late or missed periods.

It was previously thought that only athletes with eating disorders would not eat enough and thus have decreased energy availability. Research has now shown that high intensity training can suppress hunger and many athletes are unaware that they are not eating enough to sustain their training.

When energy is low the body may stop menstruation to conserve energy. When the body stops menstruating, there are decreased levels of hormones that would be involved with normal menstruation. These hormones also play a role in building strong bones.

Both inadequate calories and lack of menstruation can lead to weak bones and eventually injury. In fact, a 20-year-old athlete who stopped menstruating during her critical teenage years, may have the bone strength typical for a 70-year-old female and 3 times the risk for stress fractures and injury.

We build bones until about the age of 30 when we reach our peak. It is critical during teens and 20’s to have adequate nutrition and normal menstruation to build strong bones and prevent injury now and later in life.