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**THE EFFECT OF THE FEMALE ATHLETE TRIAD ON
PERFORMANCE:
BOTH PHYSIOLOGICALLY AND PSYCHOLOGICALLY**

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Introduction

The female athlete triad is a condition that is composed of an interaction of three separate disorders: low energy intake due to the presence of an eating disorder or disordered eating, menstrual dysfunction, such as, oligomenorrhea or amenorrhea, and osteoporosis. Separately, each disorder can affect performance; however, when the disorders are combined, the consequences are magnified. The female triad has a profound effect on an athlete's performance both physiologically and psychologically.

The central disorder that initiated the development of the female triad is low energy intake (e.i. low food intake or low caloric intake). Many coaches, athletes, and parents are unaware of the differences between disordered eating and an eating disorder. As defined by the National Institute of Mental Health, an eating disorder "is an illness that causes serious disturbances to your everyday diet, such as, eating extremely small amounts of food or severely overeating" (National Institute of Mental Health, 2012). The presence of an eating disorder is based on the criteria met for the Diagnostic and Statistical Manual of Mental Disorders (Weinberg and Gould, 464). The most common types of eating disorders are Anorexia Nervosa and Bulimia Nervosa. Anorexia is characterized by "refusal to maintain a minimal body weight for their particular age and height, intense fear of gaining weight or becoming fat, disturbances in how one experiences one's body weight, size, or shape, and the absence of at least three

consecutive menstrual cycles” (Weinberg and Gould, 464). Bulimia is characterized by “recurrent episodes of binge eating, a feeling of lack of self control over eating behavior during binges, engaging in regular, self-induced vomiting, use of laxative or diuretics, strict dieting or fasting, or vigorous exercise to prevent weight gain, and a minimum of two binge-eating episodes a week for at least three months (Weinberg and Gould, 465).” On the contrary, disordered eating is defined as “the entire spectrum of exaggerated eating patterns involving picking at food, pushing food around the plate, and engaging in compulsive or ritualistic eating patterns, such as, cutting food into tiny morsels or eating a very limited number of bland, low calorie foods (Weinberg and Gould, 471). Disordered eating consists of the eating problems that are not severe or serious enough to meet the criteria of DSM-IV for either anorexia or bulimia. Low energy intake due to disordered eating or eating disorders can cause menstrual dysfunction as a way for the body to conserve energy.

Menstrual dysfunction is the second characteristic of the female athlete triad. Menstrual dysfunction is a term used to describe irregular menstrual cycles. Both amenorrhea and oligomenorrhea are subcategories of menstrual dysfunction. Amenorrhea, the most severe type of menstrual dysfunction, is defined as the complete absence of the menstrual cycle. Oligomenorrhea is less severe than amenorrhea and is used to describe menstrual periods occurring at an interval greater than 35 days. Menstrual dysfunction is a result of low estrogen levels and therefore is a predisposing factor for osteoporosis.

Osteoporosis is the final disorder that comprises the female athlete triad, as well as the last disorder to occur. Osteoporosis is a “metabolic bone disorder resulting in resorption of calcium from the bone” (Hamann, 381). This resorption causes the bones to weaken and become

brittle. Osteoporosis is usually the last disorder to occur because it results from low levels of estrogen.

The female athlete triad can affect any female athlete; however, it is more prevalent among the athletes that specialize in aesthetic sports or sports that emphasize leanness, for example, ballet, gymnastics, wrestling, and cross country. Athletes who suffer from the triad generally have low self esteem and have issues about their bodies, such as, constantly pointing out flaws and not liking how their body looks. The female athlete triad is a very serious condition that leads to many health consequences. These health consequences include heart disease, kidney disease, and stress fractures. An athlete's performance is accredited to psychological and physiological well being and therefore, the triad has consequences on performance. Due to the detrimental effect the triad has on performance, it is crucial that the condition is detected early and that recovering and counseling are emphasized in the healing process.

Methods

By extensively reviewing the research and scholarship which was conducted on the female triad as a whole and each component, I will add to the scholarship by presenting information about both the physiological and psychological effects of the female athlete triad. There is an abundant amount of research done on the physical effects on the triad, but not on the psychological effects, which are just as important. I will also use the reviewed research to summarize each component of the triad, as well as make recommendations regarding prevention and counseling. It will also describe the urgency of proper treatment of the condition. Finally, I will add to the existing research is by suggesting recommendations for future studies in this field. I will propose a future research study that uses both quantitative surveys and qualitative

questions based on the answers given to select questions in the surveys. This proposed study will address the limitation of the use of quantitative surveys as a primary source of establishing if an athlete is suffering from an eating disorder. This future study will establish what variables in the athlete's life led to a development of an eating disorder.

Literature Review

The scholars who have researched the female athlete triad have addressed the condition according to the three components: eating disorders and disordered eating, menstrual dysfunction, and osteoporosis. Some scholars focus on one individual component and others focus on the combination of two or three of the components. The scholars also focus on the prevalence and incidence rates of the triad as well as the effect of the female athlete triad on performance. All three components have a distinct effect on performance. The female athlete triad is a major area for concern because when the three disorders interact, the effects of each disorder become magnified and create more severe consequences.

There are many research studies explaining the female triad and the prevalence of the condition. Scholars explain that the female athlete triad is prevalent in all sports; however, the occurrence is more common in sports that emphasize low body weight for performance and appearance. In separate studies, Monore, Kam, and Loucks (2007) and Kirchner and Cohen (2002) focus on disordered eating as the central component of the triad. Both of these sources relate low caloric intake to the decrease of endocrine and reproductive functions.

Kirchner and Cohen (2002) explained the aspects of the female triad as well as the warning signs and symptoms. They argued that the female athlete triad can have life threatening consequences and that there is a need for steps taken to prevent and treat the condition. They

explained that disordered eating is the central characteristic in the female athlete triad so the steps for prevention of the triad have to start with preventing disordered eating habits among athletes. The presence of disordered eating causes the body to conserve energy in any way possible. Hypothalamic dysfunction is one result of disordered eating because caloric intake is insufficient to maintain endocrine functions. Hypothalamic dysfunction is defined as “a problem with the region of the brain called the hypothalamus, which helps control the pituitary gland and regulate many body functions” (National Institute of Health). The pituitary gland, in turn controls the adrenal glands, ovaries, testes, and thyroid gland.” Due to the lack of energy intake, there is not enough energy available for physiological functions and exercise. Therefore, the central nervous system suppresses reproductive functions. Kirchner and Cohen (2002) also considered prevention and treatment methods. These methods include screening, physical exams, laboratory analyses, and diagnostic studies. The treatment methods that were examined were nutrition, exercise, psychotherapy and pharmacotherapy (Kirchner & Cohen, 2002).

Manore, Kam, and Loucks (2007) also argued that disordered eating is the central component in the female triad. Manore, Kam and Loucks (2007) explain that efficient energy intake is needed for physiological processes to occur. They explain that dietary energy is used for cellular maintenance, thermogenesis (the regulation of body temperature), immunity, growth, reproduction, and movement. In agreement with Kirchner and Cohen (2002), without efficient energy intake, the human body relies on other sources of energy (i.e. protein). The body’s reliance on protein causes muscle wasting and breakdown. In addition to muscle wasting, the endocrine system also starts to shut down to preserve energy. They also explain that energy deficiency reduces the body’s ability to build bone, maintain muscle, repair damaged tissue, and recover from injuries. Manore, Kam and Loucks (2007) explain that the triad may increase the

risk of cardiovascular disease, may decrease immune functions, and may increase the risk of stress fractures. The authors used previous studies conducted on animals to compare the effects of energy deficiency. The study done by Manore, Kam and Loucks (2007) had similar results to those studies done on animals (Manore, Kam & Loucks, 2007).

Both the medical article written by Kirchner and Cohen (2002) and the research study done by Manore, Kam and Loucks (2007) explore similar physiological effects the female athlete triad can have on performance. Due to the lack of calories consumed, the body relies on energy from the muscles. If the body starts to break down muscles, performance is going to diminish. The athlete will lose both muscle strength and muscle endurance. With energy deficiency, athletes also lose the ability of muscle repair. Therefore, after an injury is sustained, the athlete will have a prolonged recovery period due to energy deficiency.

Many people are unaware of how prevalent the female athlete triad is. Therefore, Beals and Manore (2002) designed a study that looked at the prevalence of eating disorders, menstrual dysfunction, and musculoskeletal injuries in collegiate athletes involved in a wide variety of sports. They divided the sports into the following categories: aesthetic, endurance, and team-anaerobic. The aesthetic sports included cheerleading, gymnastics, and diving. Endurance sports included basketball, cross-country, track, field hockey, crew, soccer, swimming, and water polo. The last category, team-anaerobic sports, included field events in track, golf, softball, tennis, and volleyball. Beals and Manore (2002) identified the prevalence of the triad in relation to the type of sport, and determined that the prevalence of eating disorders is higher in those sports that emphasize a lean body type and low weight. They also wanted to determine if there was a higher incidence of menstrual dysfunction and musculoskeletal injuries in females who suffer from eating disorders. Beals and Manore (2002) tested the hypothesis that the prevalence

of eating disorders is higher in the sports that emphasize a lean body type and low weight by using the Eating Attitude Test-26, and the Body Dissatisfaction Subscale of the Eating Disorder Inventory. The athletes were also asked if they had ever been diagnosed or treated for an eating disorder. Menstrual function was assessed by a menstrual history questionnaire that included questions relating to age of menarche, frequency and regularity of menstrual cycles, training associated changes in cycle frequency and regularity, and oral contraceptive use.

Beals and Manore (2002) found that females participating in aesthetic sports weighed less than those in other types of sports and reported a higher desire for a lower ideal body weight than other athletes. Significantly more athletes in aesthetic sports sustained musculoskeletal injuries in their college careers. Athletes in aesthetic sports also scored significantly higher for eating disorders and reported using very low calorie diets, fasting, vomiting, and using laxatives as a means of weight control. Many athletes in aesthetic sports have a high desire to be more toned and have a lower body weight. This, in turn, affects their performance because they do not feel confident in themselves and happy in their skin. However, a limitation of this study was the use of oral contraceptives by a number of subjects. Oral contraceptives regulate menstrual patterns and make it difficult to truly tell if an athlete suffers from menstrual dysfunction (Beals & Manore, 2002).

In addition to the study done with Manore (2002), Beals (2002) designed a study to look at the nutritional status, eating behaviors, and menstrual function of female adolescent volleyball players. This is a similar study to the one done with Manore (2002). Both studies look at the female triad among athletes that specialize in sports that are not of the aesthetic nature. In the study, Beals (2002) used a health/weight/dieting/menstrual history questionnaire, the Eating Disorder Inventory, and the Body Shape Questionnaire. Nutritional and energy intake levels

were determined by a three day food records and activity logs. The results suggest that athletes in aesthetic sports are not the only ones who suffer from this condition. Almost 40% of the volleyball players considered themselves overweight, having elevated scores for body dissatisfaction, 10% reported vomiting, 26% reported fasting, and 15% reported using diet pills. Many of the athletes considered themselves overweight. This study provides evidence that athletes in other sports still have issues with their bodies. It also shows that the volleyball players engage in behaviors to lower energy intake, such as fasting, vomiting, and using diet pills. This article looks at some of the characteristics of an eating disorder and emphasizes that all female athletes are at risk for developing the triad (Beals, 2002).

In addition to the scholarship focusing on the prevalence of the female triad, an extensive amount of scholarship has focused on eating disorders and disordered eating. Not only do the scholars look at the prevalence of energy deficiency, but they also look at the predisposing factors for developing the habits. These next few studies are relevant because they establish what precautionary steps need to be taken in order to prevent the behavior of low caloric intake.

Krentz and Warshburger (2011) analyzed and determined potential sport-specific related factors of eating disorders in both female and male aesthetic athletes. The methods they used to do this were disordered eating, general body dissatisfaction, and sports-related body dissatisfaction questionnaires. In addition to those standard questionnaires, they also designed questionnaires that focused on a desire to be leaner to improve sports performance and social pressure to be lean in a sports environment. Krentz and Warshburger (2011) hypothesized that sports-related variables do in fact provide additional variance in symptoms of eating disorders, especially in those athletes that specialize in aesthetic sports. They found that compared to the control group, athletes had significantly higher values for disordered eating. The results also

show that female athletes have a higher prevalence of eating disorders than male athletes. Krentz and Warshburger (2011) found that the most influential factors for the development of eating disorders were the desire to be lean in order to improve sports performance, body dissatisfaction (general unhappiness with one's body) and sports related body dissatisfaction (unhappiness with one's body as it relates to the sport in which they are involved). In addition, the sports environment was found to enhance all these feelings. Krentz and Warshburger (2011) also agree that disordered eating is the main factor in the development of the female triad because it contributes to the other two factors which are menstrual dysfunction and osteoporosis (Krentz & Warshburger, 2011). The study done by Krentz and Warshburger (2011) is important because it allows coaches, psychologists, and parents to pinpoint the factors associated with eating disorders. The results of the study also suggest that the sports environment and the pressure brought on by coaches, teammates, and parents can have a detrimental effect on the mental stability of the athlete. Social pressure was found to increase the feelings of dissatisfaction and desire to be lean that were associated with the development of eating disorders (Krentz & Warshburger, 2011).

Anshel (2004) designed a study that focused on the mental side of the female athlete triad. Anshel (2004) compared the psycho-behavioral characteristics between young ballet dancers and non-dancers that are thought to be linked to eating disorders and disordered eating in addition to examining and determining the psycho-behavioral patterns that are most likely linked to the development of eating disorders (Anshel, 2004). Anshel (2004) questioned whether or not dancers are at greater risk for developing eating disorders than non-dancers based on their scores for Drive for Thinness (DT), Bulimia, Perfectionism, and Body Dissatisfaction. Anshel (2004) used the Eating Disorder Inventory to test for DT, Bulimia, Body Dissatisfaction,

ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, and maturity fears. Results show that there was a significant difference in weight between dancers and non dancers within the same age group. Ten of the dancers were categorized as having an eating disorder, as opposed to only three non dancers. The results of the study show that “dancers have a greater drive for thinness, have higher body dissatisfaction, and are more perfectionistic than non dancers. Being at risk for an eating disorder was strongly associated with the amount of body dissatisfaction an individual had” (Anshel, 2004). Anshel (2004) found that the eating habits of dancers are not only influenced by the individuals feelings about themselves, but also by significant others (Anshel, 2004).

One of the controversies surrounding the study done by Anshel (2004) is the argument that ballet dance is not a significant source of exercise and that it is an insufficient means of burning calories. However, ballet dance is composed of aerobic and anaerobic skills. The sport focuses on fast paced movement and jumps as well as slow and controlled movements. Researchers argue that anaerobic portions ballet dance can be compared to weight lifting because they both are not significant sources of burning calories, yet they lead to the development and control of muscles. The development of muscle is the only way to speed up resting metabolism. Therefore, even though the activity of dance may not contribute the same amount of calories burned as running in a single session, ballet does lead to higher resting metabolic rate, which in turn uses more calories for basic functions of life.

As Anshel (2004), Gibbs, Williams, Schied, Toombs, and De Souza (2011), focused on drive for thinness as being a contributor to the development of the disordered eating or eating disorders. Gibbs, Williams, Schied, Toombs and De Souza (2011) investigated if a high DT score was related to behavioral changes that reflect either dietary restriction or participation of

high volumes of exercise, which would then result in a development of energy deficiency. In comparison to Anshel's (2004) argument, they argued that a high DT score may be an indication of underlying energy deficiency and found that a high DT score is in fact associated with energy deficiency in exercising women. In addition, high DT score was also found to be correlated with suppressed reproductive functions (Gibbs, Williams, Schied, Toombs & De Souza, 2011).

Osteoporosis is a component of the female triad that has not been extensively researched. There are few studies done on osteoporosis among athletes Turner and Bass, (2001), Ducher, Turner, Kukuljan, Pantano, Carlson, Williams and De Souza (2011) and Pollock, Grogan, Perry, Cooke, Morrissery and Dimitriou, (2010). Osteoporosis is generally thought to be seen in populations of postmenopausal women and the elderly. Many people are unaware that athletes can suffer from osteoporosis as well.

Turner and Bass (2001) focused on the knowledge and attitudes about osteoporosis, dietary calcium knowledge, and explored whether the variables were correlated with dairy product intake. They used a variety of questionnaires to acquire data about osteoporosis and nutrition. Turner and Bass (2001) found that 78% of the participants knew the definition of osteoporosis, 65% knew women needed higher calcium intake after menopause and 72% were aware of the affect amenorrhea has on bone mineral density. It was found that the lowest responses were on the topics of vitamin C and race (Turner & Bass, 2001). It was reported that 92% of the participants did have knowledge that adequate calcium intake could lower the risk of osteoporosis. Turner and Bass (2001) found that the mean osteoporosis knowledge score was 70%, which indicates a moderate level of knowledge of osteoporosis (Turner & Bass 2001).

Ducher et al. (2011) did not perform a study, but wrote an article titled, *Obstacles in the Optimization of Bone Health Outcomes in the Female Athlete Triad*. In comparison with the study done by Turner & Bass (2001), Ducher et al.(2011) focused on knowledge of osteoporosis, but did not focus on the clinician or practitioner side as Turner & Bass (2001) did. Ducher et al. (2011) found that 92% of physicians endorse oral contraceptives as a means of optimizing bone health. One of the most recent surveys reported that 80% of clinicians believed there were insufficient guidelines for the management of the female triad. A later survey suggested that physicians and gynecologist did not feel confident in treating patients with the female triad. Ducher et al. (2011) concluded that physical therapists play the largest role and that there has to be better education for physical therapists about detection, treatment and prevention of the female triad (Ducher, Turner, Kukuljan, Pantano, Carlson, Williams & De Souza 2011).

These articles by Turner and Bass (2001) and Ducher et al. (2011) suggest that there is a little education of the causes as well as the treatment and screening of osteoporosis. This suggests that there is a need for more education on the disorder for both athletes and clinicians. Athletes rely on clinicians to help treat the disorders that contribute to the female athlete triad which are eating disorders and disordered eating, menstrual dysfunction and osteoporosis.

The study done by Pollock et al. (2010) examines the relationship between training hours and bone mineral density. The study was designed to compare the distribution of bone mineral density in United Kingdom elite endurance runners with the characteristics established in healthy but nonathletic women. They argued that there is a relationship between disordered eating, menstrual dysfunction, and bone mineral density. To determine the relationship, Pollock et al. (2010) tested the association between training hours, bone mineral density, menstrual status, and disordered eating in elite endurance runners and non athletic women. In elite runners there was a

reduction of bone mineral density in the radius and lumbar spine. Of the runners, 38% had oligomenorrhea and 25% had amenorrhea. The bone mineral density for the lumbar spine was significantly lower in runners. They found that increase in hours of training and disordered eating was correlated to lower bone mineral density (Pollock, Perry, Cooke, Morrissery & Dimitriou, 2010).

Menstrual dysfunction is another area in which there has been an extensive amount of research. There is a great deal of knowledge about the cause of menstrual dysfunction. However, the knowledge about how menstrual dysfunction affects the body is lacking. The following studies completed by Punpilai, Sujitra, Ouyporn, Teraporn, and Sombut (2005), Dagostar, Razi, Aleyasin, Alenabi and Dahaghin (2009), Arends, Cheung, Barrack and Nattiv (2012) all investigate menstrual dysfunction and its effect on the body and on performance.

Punpilai et al. (2005) designed a study that compared menstrual status to the occurrence of osteoporosis. The researchers questioned whether exercise has an influence on menstrual status and if the menstrual status is somehow related to bone mineral density. The researchers argued that menstrual status and bone mineral density are related. Punpilai et al. (2005) acquired bone mineral density by taking a variety of measurements. First, the subjects were asked to fill out a questionnaire to assess menstrual status and hours of exercise a week, as well as undergo a blood test. The calcium intake was assessed by the Food Frequency Questionnaire. Stress in the past six months was measured using the Female Athlete Stress Inventory. Secondly, they recorded each subject's height and weight using a balance beam scale. And lastly, the bone mineral density was taken at the lumbar spine and femoral neck using DEXA. They found that menstrual status of the athletes was significantly correlated with lumbar spine bone mineral density. The researchers also found that menstrual status was correlated to age of menarche,

menstrual status during the first two years of menarche, and body fat percentage. One limitation of this study was that there was no control group of non-athletic females so no comparison can be drawn. Another limitation is that the finding of this study may not be generalized because it focused on weight-bearing activities (Punpilai, Sujitra, Ouyporn, Teraporn, & Sombut, 2005).

Dagostar et al. (2009) also designed a study to assess the prevalence of amenorrhea and oligomenorrhea in Iranian female athletes. They questioned how prevalent menstrual dysfunction is among female athletes. By using different questionnaires to assess menstrual status, Dagostar et al. (2009) concluded that menstrual dysfunction is in fact higher in athletes. The researchers also argue that females in endurance or weight-class sports had a higher prevalence of menstrual dysfunction (Dagostar et al., 2009). This study differs from the study done by Punpilai et al. (2005) in that it was only focused on the prevalence of menstrual dysfunction. The researchers were not focused on the effect menstrual dysfunction could have on bone mineral density. The authors' priority was to establish the prevalence of menstrual dysfunction (Dagostar, Razi, Aleyasin, Alenabi & Dahaghin, 2009).

Arends et al. (2012) conducted a 5-year retrospective study on the restoration of menses with nonpharmacological therapy, such as, increased dietary intake and decreased exercise expenditure. Arends et al. (2012) agree that menstrual disturbances are more prevalent in athletes in lean-build sports. The charts of University of California, Los Angeles, female athletes were reviewed by the team physicians over five years. To meet the criteria for menstrual dysfunction, “a woman must have had lack of menarche before age 15, absence of menses for 90 days or more consecutive days at a time, or menses with a cycle of 36 days or more (Arends et al., 2012)”. They found that the majority of athletes with menstrual disturbances were those

who participated in track and field, cross country, and gymnastics. During the 5 year study, return of menses was achieved in three of the 13 amenorrheic athletes and six of the 38 oligomenorrheic athletes. Return of menses for athletes suffering from menstrual dysfunction was defined as “return of spontaneous, regular bleeding, with cycles of 36 days or less for three months or longer (Arends et al., 2012)”. It was found that the athletes who regained menses had an increase in body weight and BMI. Therefore, it was found that with increased energy intake it is possible to reverse menstrual disturbances (Arends, Cheung, Barrack & Nattiv, 2012).

The interaction of disordered eating/eating disorders, menstrual dysfunction, and osteoporosis is where the severity of the female athlete triad occurs. Separately, the individual components do not have the same effect on the human body and performance as when all three are present in what is known as the female athlete triad. Education and proper preventative measures are needed to ensure that the progression of the female athlete triad is halted. The studies done by Rauh, Nichols and Barrack (2010), Doyle-Lucas, Akers and Davy (2010) all focus on the interaction of the three components that form the female athlete triad.

Rauh et al. (2010) argued that each of the individual components of the triad is related to the occurrence of musculoskeletal injuries in female athletes. The researchers used daily injury reports, the Eating Disorder Examination Questionnaire, DEXA scans, and a questionnaire on menstrual history and demographic characteristics to acquire data and results. Rauh et al. (2010) found that eating energy deficiency, menstrual dysfunction, and low BMD was associated with musculoskeletal injuries. However, the only significant relationship they found between the components and musculoskeletal injuries was among menstrual dysfunction and low bone mineral density. Low bone mineral density was strongly associated with injury. Dietary restriction led to menstrual dysfunction as well as low mineral bone density and, therefore, had

an effect on injury status as well. This study did have some limitations; one limitation being the use of self reports for collection of data. Another limitation is that the interpretation of menstrual data is a difficult process (Rauh, Nichols & Barrack, 2010).

In comparison with the previous study done by Rauh et al. (2010), Doyle-Lucas et al. (2010) designed a study that focuses on the interaction of the three components. However, their study was designed to compare the resting metabolic rate of professional female ballet dancers to women controls who were healthy but did not participate in dance. Doyle-Lucas et al. (2010) questioned was the relationship between resting metabolic rate, energy efficiency, and the characteristics of the female athlete triad in professional ballet dancers. The women and dancers were paired depending on age, body mass index, and fat free mass. The subjects had to complete a health history questionnaire, menstrual history questionnaire, a four-day food log, the three factor eating questionnaire, an eating attitude test, and the EAT-26 in order for the researchers to get the data needed. In the laboratory, Resting Metabolic Rate was calculated along with bone mineral density and body composition using DEXA. The researchers gathered data that supported their hypothesis that dancers would have a low habitual energy, intake which would make them susceptible to factors contributing to the female triad. The results suggest that bone mineral densities in dancers were not at optimal healthy levels. Energy efficiency increased and fat free mass decreased in dancers according to the level of menstrual dysfunction the dancers exhibited (Doyle-Lucas, Akers & Davy, 2010).

In comparison with Doyle-Lucas et al. (2010) Thomas (2007) focused on all three components of the female athlete triad. Thomas (2007) examined the calcium levels and consumption, as well as disordered eating and menstrual dysfunction prevalence. Thomas argued that each of the three characteristics of the female triad would be more prevalent in cross

country runners. Race, age, height and weight were self-reported by the participants. BMI was then calculated based on the height and weight. Participants were asked their age of menarche and their current menstrual status. Exercise time was assessed by asking, “How many times a week do you engage in vigorous physical activity long enough to work up a sweat?” and “How many days a week do you usually exercise?” To determine if the athletes suffered from an eating disorder, they were asked, “have you ever been told or perceived that you had an eating disorder?” If they answered “yes”, they were asked, “What age were you at the onset?” The results showed that the cross country runners who were suffering from amenorrhea and oligomenorrhea did not get the recommended daily amount of calcium. The runners who previously suffered and are currently suffering from eating disorders had higher scores on the self loathing questionnaire than runners who were not suffering from eating disorders. BMI was significantly correlated to the self loathing scores. One limitation of this study is that the self reported measures could be biased. Sensitivity of BMI also could have influenced the results of self reported measures. Another limitation is that BMI does not take into account fat free mass or muscle mass (Thompson, 2007).

The study done by Miller, Kukljan, Turner, Fligy, and Ducher (2012) differed from previous studies on osteoporosis because they wanted to determine the knowledge and behaviors about the female triad. They found that 10% of females could name all three of the components of the female triad. One fourth of the subjects identified rapid weight loss, absence of menstrual cycles, and stress fractures as warning signs of energy deficiency. Forty-four percent of people asked indicated that the presence of amenorrhea might indicate energy deficiency. However, some of the subjects asked considered menstrual dysfunction normal for female athletes. The study indicated that many women are unaware of the link between energy deficiency and

menstrual dysfunction. Miller et al.(2012) state that athletes as well as coaches and parents need to be better educated on the subject. Miller et al.(2012) explains that the lack of knowledge is one reason athletes are not taking preventative measures (Miller, Kukljan, Turner, Fligy, & Ducher 2012).

The factor that all three components of the female triad have in common is exercise. The name “female athlete triad” suggests that exercise plays a big role in the condition. There are not many studies done on the role exercise has in the female triad. Exercise is mainly thought to be beneficial to the body. Some of the benefits include speeding up resting metabolism, muscle hypertrophy, and decreasing the risk of cardiovascular disease. However, too much exercise can be harmful on the body. Punpilai, Sujitra, Ouyporn, Teraporn, and Sombut (2005) looked at the negative role exercise has in relation to the female athlete triad.

Punpilai et al. (2005) designed a study to determine the reasons and influence for female students to participate in exercise or physical activity. They also wanted to discover if female students knew about the female athlete triad. The research question was what factors encourage or put off physical exercise in young adults. The students who were physically active stated that their reasons were for themselves, meaning they are intrinsically motivated to exercise, knowledge of risk of inactivity, and for the social aspect. By being physically active, the students reported psychological improvements, improvements in physical appearance, and enjoyment. Students who were not physically active state their reasons as being low motivation and time constraints. Of the students who responded to the survey, 30% had knowledge of the female athlete triad. This article was useful because it answered the question if knowledge of the triad deterred females from participating in exercise (Punpilai, Sujitra, Ouyporn, Teraporn & Sombut, 2005).

One limitation of the research behind the female athlete triad is the self-reporting measure. Many female athletes over or under estimate the amount of food ingested on a daily basis as well as the amount of exercise in which they participated. It is also difficult to get unbiased and truthful data because the athletes feel vulnerable, out of control, denying or unable to open up about having abnormal eating behaviors. Many of the athletes are perfectionists and have issues with their bodies. The research found does not talk much about the psychological and emotional aspects of the triad. The studies that I reviewed dealt with females who have a high drive for thinness as well as a high dietary restraint, therefore the amount of dietary intake may have been underreported. Self-reporting of physical activity levels may not be a very accurate measure for detecting differences in energy expenditure. Another limitation of this study was that using the DT subscales has limitations because some women may have “fake profiles” meaning that they distort their answers. Women would use “fake profile” in order for protection.

Discussion

An abundant amount of research has focused on the physiological consequences to form the female athlete triad. The research examines how each of the components affects the various systems of the body. Therefore, when the components are in interaction with one another to the form the triad, there is an understanding of the physiological changes that are occurring as a response. The previous research also identifies the future conditions for which athletes are at risk due to the female triad.

The physiological consequences of the female triad are increased risk of cardiovascular disease, decreased immune functions, and an increased risk of stress fractures. All of the health

issues have a negative impact on performance. Performance can be inhibited by cardiovascular disease due to the lack of oxygen available to the working muscles. Also if an athlete has decreased immune function, it is more likely for he or she to become sick, which will also affect performance. An increased incidence of stress fracture will limit the athlete's involvement and training. Another aspect of the female triad that can affect performance is decreased energy intake. Without the recommended amount of dietary intake, performance is going to suffer because the body does not have an adequate fuel source to power the muscles. In addition, prolonged energy deficiency has an effect on muscles. The body will start to utilize muscle (i.e. protein) as a fuel source.

The some researchers in studies that I reviewed presented evidence and conclusive information that explains how the female triad has *both* physical and mental consequences. Many of the authors suggested that the main cause of the female athlete triad is the development of disordered eating and eating disorders which causes a lack of energy intake. Because the energy intake is so low, the body preserves energy by shutting down certain hypothalamic functions which then lead to menstrual dysfunction. Also, due to the lack of energy intake, there is a deficiency in calcium which leads to osteoporosis. The authors believe there is a need for education of the athletes, coaches, and parents. There is also a need for more clinical measures to be taken to prevent disordered eating and eating disorders.

Many scholars, if not all, agree that the female athlete triad is more prevalent in athletes who specialize in aesthetic sports. The authors focused on the causes of each of the three components as well as the female triad as a whole. The previous research also found health consequences that are brought on by the presence of the triad. For example, there can be lowered immune functions, stress fractures, and an increased risk of cardiovascular and kidney

disease. The previous research also examines and explains the link between the three components, such as, low energy intake being the central condition that caused menstrual dysfunction and osteoporosis to occur.

There were, however, many limitations to the previous research. One limitation is the use of oral contraceptives. Oral contraceptives regulate menstrual patterns and make it difficult to truly tell if an athlete suffers from menstrual dysfunction. Another limitation is self-reporting measures. Many female athletes over- or under-estimate the amount of food ingested a day as well as the amount of exercise. The scholars do not propose ways in which education can be enhanced and regulated.

In addition to physiological consequences of the female athlete triad that lead to decreased performance, there are clear psychological consequences, as well. However, many of the psychological aspects of the triad pre-exist the condition. Some of the psychological problems are a high drive for thinness, low self-esteem, perfectionism, and body dissatisfaction. These affect performance because they inhibit the athlete from doing his or her best and focusing on the sport. The previous research suggests that many of the psychological factors are sport-specific. Previous studies show that teammates, environment, coaches, and parents all contribute to dissatisfaction of the athlete. In aesthetic sports, there is an increased stress on athletes to be thin and lean. Many of the psychological issues were found to be a result a high desire to be lean for sports performance. Aesthetic sports also adopt the stereotypical image that is presented by the media and by past athletes. It is very rare that one sees an overweight ballerina or gymnast. Another mental issue that stems from the triad is disappointment which then leads to lower self esteem. Due to the physiological consequences and their effect on performance, athletes might

feel discouraged because their performance is suffering, thus lowering the athlete's confidence to perform in the future.

The female athlete triad is a very serious illness that is the product of the interaction of three separate conditions: eating disorders and disordered eating, menstrual dysfunction, and osteoporosis. The female athlete triad has both physiological and psychological consequences on performance. There needs to be increased education for coaches, athletes, and parents in order to prevent, catch and treat the female triad. Physicians should also feel more comfortable in treating athletes with the female triad. There also needs to be an increase in screening methods as well as the use of clinical sports psychologists and dietitians. Another means of prevention is for the aesthetic sports to promote all body types and not support the mentality that all athletes have to have a lean, thin and sickly body. In addition, coaches and athletes in aesthetic sports should be educated on proper nutrition and exercise regimens. There also needs to be a separation between toned and healthy body and a lean, thin, sickly one. Aesthetic sports should focus on increasing muscle mass while decreasing fat mass in order to help performance. In addition, the prevention and treatment of one of the components of the triad will stop the progression of other components of the triad.

Appendix 1

The quantitative study done by Krentz and Warshburger (2011) determined that the sports environment and the pressure brought on by coaches, teammates, and parents can have a detrimental effect on the mental stability of the athlete. In the current proposed study, both quantitative and qualitative data will be assessed to help determine why and how the athletes feel they are being pressured, and how these pressures relate to female triad symptoms they are

experiencing. The subjects in this future study would be dancers who are involved in a dance studio or on a dance team. The ages would range from 13 years of age to 22 years of age. Because dancers have such a high prevalence of eating disorders, these are the athletes I would focus on to determine why athletes are dissatisfied in sport and to see whether this dissatisfaction is correlated with their eating disorder.

Many previous studies used surveys in order to group the athletes into categories dealing with eating disorders and disordered eating based on their scores. Examples of surveys that were used were: menstrual history questionnaire, the three factor eating questionnaire, Eating Disorder Exam Questionnaire, Female Athlete Stress Inventory, and the Eating Attitudes Test (EAT-26). These surveys provide a categorization scale that rates athletes based on their answers to the questions. These surveys are designed to gather quantitative data based on answers athletes give. However, a limitation is that the general public does not know the questions asked unless they view the surveys or how the athletes were categorized based on their responses. They also do not know why these eating related behaviors are occurring. Therefore, the purpose of the proposed qualitative questions is to determine the source of pressure that is driving the abnormal eating habits, establish if the eating habits are a means of control, and get insight into why they answered “always” or “usually” to specific questions.

I will use the surveys that were previously used by Doyle-Lucas et al., Rauh et al., Punpilai et al., which include the Female Athlete Stress Inventory, the Eating Attitudes Test (EAT-26), and the three-factor eating questionnaire.

In addition, I will use in-person interviews to examine why the athletes believe or perceive the feelings (i.e. high drive for thinness, body dissatisfaction, sports-related body dissatisfaction and perfectionism) that they have around eating and thinness.

In the in-person interview questions will also address home life, social life, practices, stress, and the pressure they feel from daily life. The qualitative questions will explore if practices, teammates, and coaches influence an athlete's unhappiness or those feelings around eating and thinness.

If an athlete answered usually or always on the quantitative question "*other people think I am too thin,*" I would ask "*what indications do they have of this?*" or "*what evidence do they have of this?*" I would also be curious to see if practice and coaching style influence an "always" or "usually" response to questions regarding binge eating. For example, If an athlete answered "always", "usually", "yes", or "no" to "*Gone on eating binges where you feel that you may not be able to stop?*". I would ask about practice, coach/athlete relationships, teammate/athlete relationship, and parent/athlete relationship. The questions would be as follows:

- "Is practice fun?,"
- "Do you go home after practice feeling accomplished?,"
- "Do you think of practice as a chore instead of an enjoyment?,"
- "Do you have a good relationship with your coach?,"
- "Is your coach understanding of situations?,"
- "Does the coach work well with the team?,"
- "Do you have friends on the team?,"

- “Is the team divided into cliques?”
- ” What pressure do you feel from your parents?”
- “How supportive are your parents?”

The responses to these questions will help determine from where the pressure is coming and how to effectively set up interventions. By acquiring the answers to qualitative questions, sports psychologist can narrow down the source of the pressure that is the cause for psychological issues and provide specific interventions that address the source of pressure.

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