

# The Effectiveness of the Female Athlete Triad in Identifying Athletes' Potential Risk of Long Term Health Consequences

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**Abstract:** The female athlete triad (FAT) is the relationship between the clinical manifestations of eating disorders, menstrual function, and osteoporosis, which research has reported female athletes being at a higher risk. The purpose of this study was to examine if predictive measures are indications of the FAT in collegiate track athletes. Twenty-five female cross-country, track and field athletes were evaluated for potential risk of the FAT by completing the 33 question Female Athlete Screening Tool (FAST) and a Student Athlete Health Questionnaire (SAHQ). The FAST identified the needs of the female athlete, while the SAHQ assessed risk and the prevalence of impaired bone health, menstrual dysfunction, nutritional concerns, and body dissatisfaction. None of the participants were identified as having the fully developed FAT, however 48% met at risk criteria. A Mann-Whitney U test was used to compare risk scores, with no comparisons demonstrating significance. It is clear the number of female athletes meeting the strict criteria of the current FAT is relatively low, yet many suffer from milder forms of the components. Any form of the components is harmful from a health and performance perspective and may be fatal with some not receiving the interventions needed.

**Key words:** Disordered eating, menstrual dysfunction, osteoporosis.

## 1. Introduction

In 2007 The American College of Sports Medicine published a position statement on the female athlete triad (FAT) and stated it “refers to interrelationships among energy availability, menstrual, function, and bone mineral density, which may have clinical manifestations including eating disorders, functional hypothalamic amenorrhea, and osteoporosis” [1]. Disordered eating and clinical eating disorders are terms frequently used interchangeably [2]. However, each demonstrates distinct differences [2]. Disordered eating is a broad term used to describe a spectrum of abnormal and harmful eating behaviors used in an attempt to lose weights [2, 3] Clinical eating disorders refers to anorexia nervosa, bulimia, nervosa and eating

disorder not otherwise specified (EDNOS) [2].

Prevalence of clinical eating disorders is considerably low in athletics; however, there is a higher prevalence of disordered eating practices used by athletes that are subclinical in terms of diagnosis [4]. In addition, researchers suggest that female athletes are at higher risk for developing disordered eating than are non-athletes in the same age range [4-8]. Many studies have been conducted among female collegiate athletes reporting the prevalence of disordered eating among various sports. Johnson et al. [7] reported only 1.1% met the criteria for bulimia nervosa; however, more than one quarter of the participants reported using harmful eating behaviors to lose or maintain their body weight. In another study conducted by Beals and Hill [9], only three of the athletes had previously been diagnosed with anorexia nervosa or bulimia nervosa. However, 20% of the athletes met the criteria for

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“disordered eating behaviors,” reporting they were dissatisfied with their body shape or weight and used at least one harmful weight control behavior. Lastly, a study conducted by Beals and Manore [1] stated only about 5% of the participants were diagnosed with either anorexia nervosa or bulimia nervosa, whereas about 50% of the participants were classified as being “at risk” for disordered eating.

The studies previously mentioned examined female collegiate athletes among various sports however, studies have been designed specifically to examine disordered eating in collegiate female runners [10-12]. In a study conducted by Thompson [10], the researcher looked at the characteristics of the female athlete triad strictly in 300 collegiate cross-country runners. Of the respondents, 19.4% responded they perceived or had been told they had a disorder and 26.3% stated they received treatment for eating disorders [10]. In other previous studies focusing primarily on female runners, the researchers identified a range of 11.3% to 27.2% of runners scoring above a level of concern on the Eating Attitudes Test, warning that many of the runners have disordered eating behaviors [10, 12-14].

These prevalent studies indicate subclinical disordered eating behaviors are more common in athletics, especially female runners, than are diagnosed clinical eating disorders [4, 9, 10-12, 15]. Even slight disordered eating behaviors, not just clinical eating disorders, pose serious health consequences, performance determinants, and can subsequently lead to other disorders of the FAT [1, 9, 16]. The purpose of this study is to examine if predictive measures are indications of the female athlete triad amongst collegiate track athletes.

## **2. Materials and Methods**

Prior to data collection, participants were made aware of any risks and benefits to the study prior to signing a University Human Subjects approved informed consent. Twenty-five female members of a Division I track and field team (age 19.68 years)

completed the Female Athlete Screening Tool (FAST) and Student-Athlete Health Questionnaires for their potential of being at risk for the female athlete triad components. FAST is a 33-question screening tool developed to be sensitive to the unique needs of the female-athlete. Utilizing a 4-point Likert scale, it was designed to assist in the identification of athletes: (1) who engage in excessive exercise for the purpose of weight loss, (2) who are perfectionists, (3) who have concerns with body size and shape, and (4) engage in abnormal eating behaviors. The Student-Athlete Questionnaire is designed to assess risk and prevalence for impaired bone health, menstrual dysfunction, nutritional concerns, and body dissatisfaction concerns.

Utilizing the FAST and the Student-Athlete Questionnaire, participants were classified as having a clinical eating disorder if their total score on the Female Athlete Screening Tool fell under the clinical range of  $> 94$  and/or they had current or previous history of anorexia nervosa, bulimia nervosa, or EDNOS. At risk participants were considered as having a subclinical eating disorder if their total-score on the Female Athlete Screening Tool fell under the subclinical range of 77 to 94 and/or the athletes reported dissatisfied to very dissatisfied with their body weight, size, or shape and engaged in at least one pathogenic weight control behavior.

Menstrual dysfunction was measured using the menstrual history section in the Student-Athlete Questionnaire. Participants were classified as having amenorrhea if they missed three or more consecutive menstrual periods, which would be categorized under the diagnosis of the female athlete triad. Athletes were considered to be at risk for menstrual dysfunction if they had one of the following: (1) oligomenorrhea as greater than 35 days between periods, (2) have fewer than 12 cycles in the past 12 months, (3) fewer than 6 cycles in the past 6 months, (4) greater than 10 day variation in their cycle, and (5) if they were taking birth control hormones in order to regulate their menstrual

cycle.

Participants were considered to have low bone density if they had a history of amenorrhea and stress fracture. In addition, the participants were considered to have low bone density if previously identified to have low bone density on the Student-Athlete Questionnaire. Participants classified were considered at risk for impaired bone health if they met any of the aforementioned risk factors associated with low bone mineral density and any menstrual dysfunction or subclinical disordered eating.

Participants were defined as fulfilling the current female athlete triad criteria if they were diagnosed with all of the following: (1) Clinical disordered eating: state they currently have or previous history of anorexia nervosa, bulimia nervosa, or EDNOS and/or a total score on the Female Athlete Screening Tool falls under the clinical score of  $> 94.45$ ; (2) Amenorrhea: as defined as 0-3 cycles per year, according to the menstrual information taken from the Student-Athlete Questionnaire [4, 16-21]; (3) Osteoporosis: based on current or history of a stress fracture according to the musculoskeletal history taken from the Student-Athlete Questionnaire and a history of amenorrhea [16].

Participants were defined as fulfilling the criteria for being at potential risk for future health decrements if they met one or more of the following: (1) Participants will be considered at risk for or as having a subclinical eating disorder if their total score on the Female Athlete Screening Tool falls under the subclinical range of 77 to 94 [5], and/or the athletes report that they are dissatisfied to very dissatisfied with their body weight, size, or shape and engage in at least one pathogenic weight control behavior according to the Student-Athlete Questionnaire [2, 16]. (2) Participants were considered to be at risk for menstrual dysfunction if they had one or more of the following: (a) oligomenorrhea as greater than 35 days between periods, (b) have fewer than 12 cycles in the past 12 months, (c) fewer than 6 cycles in the past 6 months, (d) greater than 10 day variation in their cycle, and/or (e) if

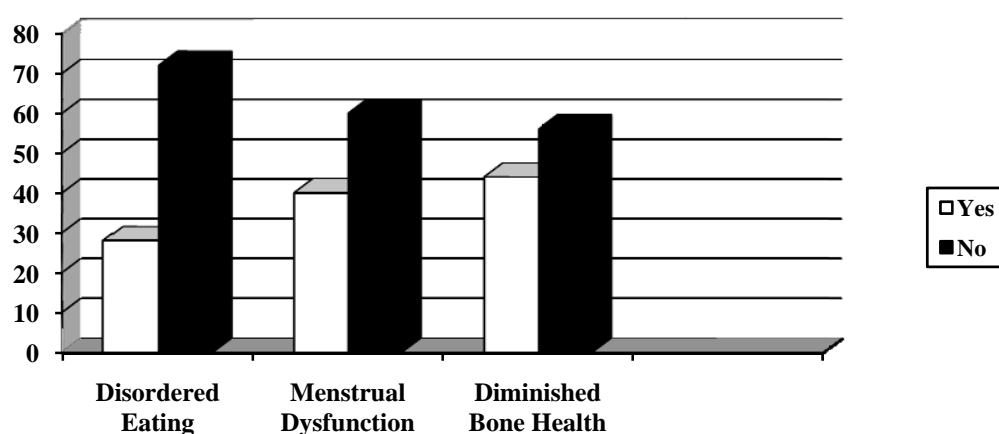
they are taking birth control hormones in order to regulate their menstrual cycle [1, 4, 16, 19, 21, 22]. (3) Participants were considered to be at potential risk for low bone mineral density if they met one of the above criteria and met one of the risk factors associated with low bone mineral density a family history of osteoporosis, diagnosis of scoliosis, stress fracture prevalence, or dairy product intake below the recommended daily allowance [16].

### **3. Results and Analysis**

Upon data completion, it was determined what percentage of female athletes would be overlooked by the current strict criteria female athlete triad components. None of the participants met any of the current standards for the fully developed female athlete triad. The percentages of the individual at risk components are outlined in Fig. 1. There were 12 of the 25 participants (48%) meeting the criteria of being at risk for the FAT. There were eight participants (32%) that were considered at risk for the FAT by meeting two or more of the components. Of these eight, 2 participants (8%) were considered at risk for disordered eating and diminished bone health, 1 participant (4%) was considered at risk for disordered eating and menstrual dysfunction, and 5 participants (20%) were considered at risk for menstrual dysfunction and diminished bone health. The remaining four participants (14%) met the criteria of all three components as being at risk for the FAT. Overall, 48% of the participants would be considered as being at risk for the FAT components and would be overlooked by the current standards of the FAT.

Once percentages were completed, a non-parametric analysis was performed (Mann-Whitney U Test) to test for significant differences between menstrual dysfunction (menstrual dysfunction current standards versus menstrual dysfunction at risk), disordered eating (disordered eating current standards versus disordered eating at risk), and bone health (bone health current standards versus bone health at risk). Post hoc testing

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**Fig. 1** Triad individual percentages.

was going to be utilized to determine significant differences between groups however, since previous comparisons lacked significance none were performed. An alpha level of  $P < 0.05$  was utilized to determine significance. Disordered eating versus menstrual dysfunction lacked significance at  $P \leq 0.375$ , disordered eating versus bone health lacked significance at  $P \leq 0.243$ , and menstrual dysfunction versus bone health lacked significance at  $P \leq 0.777$ .

The researcher also utilized the Mann-Whitney U test to compare significances between each component of the triad; those meeting the current standards versus those who are at risk of the component. When comparing disordered eating current standards versus disordered eating at risk there was a suggested significance with a score of  $P \leq 0.005$ , menstrual dysfunction current standards versus menstrual dysfunction at risk showed a significance of  $P \leq 0.001$ , and bone health current standards versus bone health at risk showed a significance of  $P \leq 0.001$ . When comparing those participants who met the current standards of the FAT versus those participants at risk of the FAT, the Mann-Whitney U test analyzed a significant difference at  $P \leq 0.001$ .

## 4. Discussion

The results of this study found that no statistical differences occurred in the following relationships: in

disordered eating versus menstrual dysfunction, disordered eating and diminished bone health and menstrual dysfunction versus diminished bone health. These three findings refute previous literature that suggested the FAT components are interrelated, in that having one disorder is linked to the others [9, 15]. Further, previous research found disordered eating to be associated with menstrual dysfunction [9, 20, 23-27] menstrual dysfunction is associated with low bone mineral density [9, 20, 20-34] and disordered eating is independently associated with low bone mineral density [3, 16, 18, 21, 35-37]. A potential reason why the current study yielded no significance was due to the small participant sample size. Previous research discovering this association between components had a range of 100-300 participants involved in the study; whereas, this research study had only 25 participants [9, 15]. A larger sample size would potentially show a more reliable and/or valid association between components.

No participants in this study met the criteria for a clinical eating disorder. The percentage of participants who were at risk for disordered eating was 28%. This is consistent with previous literature indicating disordered eating behaviors are more common in female athletes than are diagnosed clinical eating disorders [8-12, 19]. Specifically, in a study conducted by Beals and Hill, only three of athletes had previously

been diagnosed with a clinical eating disorder; whereas, 20% met the criteria for “disordered eating behaviors” [9]. Disordered eating behaviors, rather than clinical eating disorders, are more common in female athletes and these harmful behaviors pose serious health and performance consequences on the female athlete.

The current study discovered, of the 25 participants, 28% were at risk for disordered eating. Previous studies looking at disordered eating specifically in runners, identified a range of 11.3% to 27.2% scoring above concerning levels on the Eating Attitudes Test [11-14]. In the current study, an increased percentage of participants at risk for disordered eating was identified compared to previous studies discussed in the literature review. The increase could be due to the fact that the FAST was utilized as it is specifically designed for female athletes to identify disordered eating and to accurately assess the reason the female athlete engages in abnormal exercise and eating behaviors [5]. This is an interesting discovery because some of the most popular self-report questionnaires, like the Eating Attitudes Test used in previous research, are not specifically tested for validity in athletic populations and may result in invalid results [22]. This indicates when screening female athletes at risk for disordered eating behaviors it is important to use a screening tool specifically designed for female athletes.

Currently, amenorrhea is the diagnostic component for the female athlete triad [1]. The current FAT components fails to recognize any type of menstrual dysfunction may progress the female athlete into the triad [1, 9, 15, 29]. The current study suggests none of the participants met the criteria for the current standards of amenorrhea. However, 40% of the participants were considered at risk of menstrual dysfunction. This is consistent with the literature, specifically, Burrows et al. reported only 2% of participants were amenorrheic, whereas, 20% were classified as having any form of menstrual dysfunction [9]. In a study looking specifically at female runners

only 10% were amenorrheic and 36% were classified as having any form of menstrual dysfunction [12]. In these previous studies, the prevalence of amenorrhea is significantly lower than menstrual dysfunction. This is an important discovery because as the current triad's inclusion criteria stands, females suffering from menstrual irregularities could potentially be overlooked for intervention. However, even slight menstrual irregularities deviating from the average of 12 cycles per year produce an oestrogen-deficient environment large enough to decrease bone remodeling and increase the risk of fracture [29, 38]. Therefore, female athletes with any type of menstrual dysfunction, not just amenorrhea, suffer serious health consequences.

The final component of the FAT, osteoporosis, is used as the diagnostic component [1, 29]. However, none of the participants in the current study met the current standards for osteoporosis. In actuality, 44% were discovered to be at risk for diminished bone health. This finding is similar to a study conducted by Burrows et al. who found only 3% were classified as having osteoporosis; however, 24% were classified as having osteopenia [29]. Even minor diminished bone health causes the female athlete to be prone to increase in injuries, susceptible to stress fractures and osteoporotic fractures later in life [28, 39]. More importantly, a slight decrease in bone density is irreversible even when a healthy weight is maintained and menstruation is restored [37, 39, 40]. The current study, along with previous literature, demonstrates the importance that female athletes suffering from decreases in bone density potentially are being overlooked for treatment because they do not fit the strict criteria for osteoporosis.

## **5. Conclusions**

In conclusion the current research study and previous literature suggests that the current FAT components are ineffective in identifying female athletes who are at risk for long term health

consequences. This study further indicates the need for future research to develop a model that provides a more encompassing approach to the issue of the FAT.

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