*Journal of Athletic Training* 2021;56(10):1094–1099
doi: 10.4085/624-20

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# Presence and Perceptions of Menstrual Dysfunction and Associated Quality of Life Measures Among High School Female Athletes

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***Context:*** Adolescent female athletes are at risk for menstrual dysfunction in the setting of exercise and low energy availability. Education regarding menstrual dysfunction and its associated consequences is important to promote athlete wellbeing.

***Objective:*** The primary aim was to determine the prevalence and characteristics of female athletes who believed that losing their period was a normal response to high training demands. The secondary aim was to explore the relationship between menstrual dysfunction and patient-reported quality of life measures.

***Design:*** Cross-sectional study.

***Setting:*** Preparticipation evaluations for a local high school district.

***Patients or Other Participants:*** Female athletes, 13–18 years old (n = 90).

***Main Outcome Measure(s):*** Health history, family affluence, and patient-reported quality of life measures.

***Results:*** Forty four percent (n = 40) of 90 adolescent athletes answered that losing their period was a normal response to a high level of training, and this group had a lower body mass index, were less likely to report being worried about their current weight, and had a higher family affluence level than those who answered that losing their period was not a normal response to training. The overall prevalence of menstrual dysfunction was 28%. After adjusting for age and body mass index, we found that menstrual dysfunction was significantly associated with higher levels of anxiety, fatigue, and pain interference.

***Conclusions:*** Nearly half of our sample of adolescent female athletes perceived losing their period was a normal response to high training demands. Females with menstrual dysfunction reported higher levels of anxiety, fatigue, and pain interference than those without menstrual dysfunction. Understanding adolescent perceptions of menstrual dysfunction and the characteristics of those with menstrual dysfunction can guide the development of future educational interventions aimed at athletes at risk for the female athlete triad.

***Key Words:*** adolescence, female athlete triad, amenorrhea

**Key Points**

- Many young female athletes believed that losing their period was a normal response to high training demands.
- Menstrual dysfunction was associated with impaired quality of life measures, including anxiety, fatigue, and pain interference.
- Efforts should be made to promote education about menstrual health among female athletes, coaches, and health care providers.

Low energy availability, defined as an energy deficit for physiological functioning after removing the energy expenditure during exercise, is the foundation of the female athlete triad and relative energy deficiency in sport (RED-S).[1,2] Although the female athlete triad focuses on the interplay among low energy availability, bone health, and menstrual dysfunction, RED-S more broadly encompasses impaired functioning of other body systems (eg, gastrointestinal, immunological, cardiovascular, and psychological) as a result of low energy availability in athletes.[1,2] Low energy availability can lead to suppression of the hypothalamic-pituitary-ovarian axis, which in turn leads to reduced estrogen production and menstrual dysfunction.[3] A hypoestrogenic state, as well as other hormonal and metabolic alterations resulting from low energy availability, leads to decreased bone mass and bone mineral density, which are associated with an increased risk of bone stress injuries.[1,2]

Adolescent female athletes are at risk for low energy availability and resultant menstrual dysfunction, which includes primary and secondary amenorrhea and oligomenorrhea.[4,5] *Primary amenorrhea* is defined as absence of menarche by age 15 years, whereas *secondary amenorrhea* refers to the missing of 3 or more consecutive menstrual periods after a female has reached menarche. *Oligomenorrhea* describes menstrual cycles lasting longer than 35 days and is often classified as having 9 or fewer menstrual periods in a year.[4,5] These forms of menstrual dysfunction can be associated with *functional hypothalamic amenorrhea*, defined as chronic anovulation that is not attributable to organic causes and is often secondary to low energy availability.[3] The prevalence of menstrual dysfunction

among adolescent female athletes ranges from 7% to 54%, and the association between menstrual dysfunction and low bone mineral density in young female athletes has been well described.[1] Because peak bone mass is accrued during adolescence, low energy availability and menstrual dysfunction during this time can have deleterious consequences on bone health and may negate the potential benefit of weight-bearing activity on bone mineral density.[1,2,3,6]

In addition to the negative effects of low energy availability and menstrual dysfunction on bone health, psychological impairments have also been described.[2] The RED-S model illustrates the psychological consequences resulting from low energy availability, including impaired judgement, decreased concentration, increased depression, and increased irritability.[2] Limited data have described the neuropsychological associations with functional hypothalamic amenorrhea in adolescents, including increased anxiety and depressive symptoms.[7,8] One group[9] showed a relationship between psychosocial stress and menstrual dysfunction in young women, but little information exists regarding the adolescent population or adolescent athletes in particular.

Considering the adverse consequences that can arise from low energy availability and menstrual dysfunction, it is essential that young athletes, as well as their coaches and health care providers, understand the female athlete triad and RED-S. Prior authors[10–15] reported that high school and collegiate coaches, as well as health care providers, including physicians, athletic trainers, physical therapists, and nurses, possessed low levels of knowledge about the female athlete triad. Perhaps more importantly, young female athletes themselves had poor female athlete triad knowledge related to menstrual status and bone health.[10,16] One common misconception among coaches was that loss of menstruation was a normal response to a high level of training, yet little information regarding athletes' perceptions of menstrual dysfunction is currently available.[11,16] Understanding female adolescents' views of menstrual dysfunction is important for guiding identification and educational interventions for athletes at risk for the female athlete triad and the associated negative consequences.

The primary aim of our study was to determine the prevalence and characteristics of female athletes who believed that losing their period was a normal response to high training demands. The secondary aim was to explore how patient-reported quality of life measures differed between female athletes with and those without menstrual dysfunction.

## METHODS

### Participants and Study Design

We conducted a cross-sectional study of adolescent athletes presenting for a sport preparticipation evaluation in 1 local school district (5 high schools) in the spring of 2019. We included participants who were female, aged 13 to 18 years, and actively involved in at least 1 high-school–sponsored organized sport. Females who reported menarche within the past year were excluded from the study, as our criterion for menstrual dysfunction required at least 1 year of menstrual history. To reduce the potential effects of confounding variables on our quality of life and medical history outcomes, participants were excluded if they had any of the following: neurologic disorder, seizure disorder, or ongoing symptoms or dysfunction from a recent concussion or lower extremity injury. School district and institutional review board approval were each obtained before data collection began. Each participant and her parent or guardian provided written informed assent and consent, respectively.

### Participant-Reported Assessments

During the assessment, all participants completed a standard health history, the Patient-Reported Outcome Measurement Information System (PROMIS) questionnaires, and the Family Affluence Scale. Each person's parent(s) or guardian(s) was (were) present for the encounter and available to assist in providing health information if needed. Trained research personnel were also present and available for questions. The health history questionnaire used was adapted from the preparticipation examination monograph recommended as the standard of care by the American Medical Society for Sports Medicine, American College of Sports Medicine, American Academy of Family Physicians, and American Academy of Pediatrics.[17] Demographic data consisted of age, school grade, primary sport (sport in which the athlete was most competitive), hours of training and competing per week, and level of competition (varsity, junior varsity, etc). Physical measurements of height and weight were recorded, and body mass index (BMI) was calculated by trained research personnel. Self-reported medical history was collected, including diagnosis of stress fracture or other musculoskeletal injury, as well as information about the athletes' feelings regarding their weight and dieting behaviors. To assess socioeconomic status, we used the Family Affluence Scale, a validated tool designed to assess the socioeconomic status of the family based on an "assets approach."[18] Participants were asked about the material conditions of the family including the number of household bedrooms, cars, and computers.

Regarding menstrual status, we asked 5 questions intended to ascertain the most relevant information for our study purposes. Those addressing menstrual function were adapted from the standard preparticipation examination monograph[17]:

1. Have you ever had a menstrual period? (*yes/no*)
2. How old were you when you had your first menstrual period?
3. How many periods have you had in the last 12 months?

We included the question, "If you have started your period, have you gone more than 3 months without having a period? (*yes/no*)" to obtain further information about the athlete's menstrual health. We also posed the question, "Do you think it is normal to lose your period during high levels of athletic training? (*yes/no*)." Similarly worded survey statements were used by prior researchers[10,16] who assessed knowledge of the female athlete triad in female athletes of the same age as in our study, and we felt the question was age appropriate and understandable.

To address our secondary aim, participants completed the PROMIS v1.1 Pediatric Profile 25 (PROMIS Health Organization, PROMIS Cooperative Group). This scale is used to evaluate patient-reported quality of life in 6

**Table 1. Female Adolescent Athletes' Characteristics By Response to the Question, "Do You Think It Is Normal to Lose Your Period During High Levels of Athletic Training?"**

| Variable | Answer | | *P* Value |
|---|---|---|---|
| | *Yes* (n = 40) | *No* (n = 50) | |
| Current age, y | 15.5 (14.7, 16.5)[a] | 15.2 (14.4, 16.3) | .30 |
| Age of menarche | 12.3 (12.0, 13.0) | 12.0 (11.0, 13.0) | .26 |
| Body mass index, kg/m$^2$ | 21.2 (19.7, 23.3) | 22.8 (20.6, 25.6) | .04[b] |
| Menstrual dysfunction in past year | 12 (30%)[c] | 12 (24%) | .63 |
| Training, h/wk | 12 (10, 14) | 12 (10, 15) | .93 |
| History of stress fracture | 1 (3%) | 5 (10%) | .22 |
| Worried about weight | 1 (3%) | 8 (18%) | .04[b] |
| On a special diet | 5 (13%) | 4 (8%) | .73 |
| Family Affluence Scale score | 10 (9, 11) | 9 (8, 10) | .01[b] |
| Primary sport | Cheerleading = 2<br>Cross-country = 6<br>Dance = 1<br>Gymnastics = 2<br>Marching band = 1<br>Pom = 4<br>Soccer = 5<br>Softball = 4<br>Swimming = 2<br>Tennis = 1<br>Track and field = 3<br>Unspecified = 2<br>Volleyball = 7 | Basketball = 2<br>Cheerleading = 1<br>Cross-country = 3<br>Equestrian = 1<br>Gymnastics = 3<br>Martial arts = 1<br>Pom = 11<br>Skiing = 1<br>Soccer = 4<br>Softball = 7<br>Swimming = 2<br>Track and field = 2<br>Unspecified = 2<br>Volleyball = 10 | Not applicable |

[a] Continuous variables = median value (interquartile range).
[b] Indicates difference between groups ($P < .05$).
[c] Categorical variables = value (%).

domains: physical function mobility, anxiety, depressive symptoms, fatigue, peer relationships, and pain interference.[19] In each domain, participants were asked to respond to questions based on their status during the previous 7 days. The total score for each domain was calculated as the sum of all question responses for that domain (range = 0–24), and a higher score (range = 0–4) indicated increased frequency or severity of feelings or experiences.

### Grouping Variables

To examine the perception of menstrual dysfunction, we grouped participants based on their *yes/no* response to the question, "Do you think it is normal to lose your period during high levels of athletic training?" To examine the presence of menstrual dysfunction, we grouped participants who had an affirmative response to any of the following criteria: (1) age of menarche at $\geq$15 years of age, (2) three consecutive months without a menstrual period, or (3) $\leq$9 menstrual periods in the last 12 months. These criteria were consistent with accepted definitions of menstrual dysfunction and had been used in earlier investigations[4,5,20] of rates of menstrual dysfunction in adolescent female athletes.

### Statistical Analysis

Continuous variables were presented as medians (interquartile ranges) and categorical variables as the number and corresponding percentage. For our primary purpose, we performed descriptive statistics calculating the proportion of female athletes who answered that losing their period was a normal response to high training demands. In addition, we compared athlete characteristics between those who did and those who did not report that losing their period was a normal response to high training demands using the Mann-Whitney *U* test (continuous variables) and Fisher exact test (categorical variables). To address our secondary purpose, we compared PROMIS outcomes and athlete characteristics between the group classified as having menstrual dysfunction with those classified as not having menstrual dysfunction. We then constructed a series of linear multivariable regression models to assess the effect of menstrual dysfunction on PROMIS outcomes while adjusting for age and BMI, given the potential association of these variables with quality of life independent of menstrual function. All statistical tests were 2 sided and evaluated with a significance level of $\alpha = .05$. All statistical analyses were conducted using Stata (version 15; StataCorp).

## RESULTS

Initially, 101 female athletes were provided with the option of participating in the study, and 90 completed it (89% response rate, n = 11 excluded). Among the 11 who were excluded, 6 did not participate due to their choice (n = 2), age (n = 2), a current injury prohibiting sport participation (n = 1), or a pre-existing psychiatric disorder (n = 1). Five additional athletes were excluded as they reported menarche within the past year. Of the 90 participants who completed the study, the average age was 15.5 $\pm$ 1.2 years. Forty athletes (44%) reported that losing their period was a normal response to a high level of athletic training. This group had a lower BMI, lower proportion of girls who reported they were worried about their weight, and higher Family Affluence Scale scores compared with those who answered that losing their period was not a normal response (Table 1). No

**Table 2. Comparison of Female Athletes By Menstrual Dysfunction Classification**

| Variable | Menstrual Dysfunction | | *P* Value |
|---|---|---|---|
| | Yes (n = 26) | No (n = 64) | |
| PROMIS Outcome | | | |
| Mobility | 0 (0, 0)[a] | 0 (0, 0) | .58 |
| Anxiety | 4.5 (1, 7) | 2 (0, 5) | .08 |
| Depressive symptoms | 0 (0, 6) | 0 (0, 2) | .63 |
| Fatigue | 2.5 (1, 7) | 1 (0, 3) | .003[b] |
| Peer relationships | 15.5 (10, 16) | 14 (11, 16) | .51 |
| Pain interference | 0.5 (0, 4) | 0 (0, 1) | .04[b] |
| Athlete characteristics | | | |
| Age, y | 15.4 (14.3, 16.3) | 15.4 (14.5, 16.5) | .61 |
| Age of menarche, y | 12.0 (11.0, 13.0) | 12.0 (12.0, 13.0) | .74 |
| Body mass index, kg/m$^2$ | 21.3 (19.8, 22.8) | 22.5 (20.2, 25.6) | .11 |

Abbreviation: PROMIS, Patient-Reported Outcome Measurement Information System.

[a] Median value (interquartile range in parentheses).

[b] Indicates difference between groups ($P < .05$).

**Table 3. Multivariable Regression Results for PROMIS Outcomes Among Female Adolescent Athletes With and Those Without Menstrual Dysfunction, Adjusted for Age and Body Mass Index**

| PROMIS Outcome | β Coefficient | Standard Error | 95% CI | *P* Value |
|---|---|---|---|---|
| Mobility | 0.03 | 0.15 | −0.26, 0.32 | .84 |
| Anxiety | 1.72 | 0.80 | 0.13, 3.31 | .034[a] |
| Depressive symptoms | 1.05 | 0.75 | −0.44, 2.54 | .16 |
| Fatigue | 2.41 | 0.59 | 1.25, 3.58 | <.001[a] |
| Peer relationships | 0.15 | 1.04 | −1.92, 2.22 | .89 |
| Pain interference | 1.34 | 0.65 | 0.04, 2.64 | .043[a] |

Abbreviation: PROMIS, Patient-Reported Outcome Measurement Information System.

[a] Significantly associated with menstrual dysfunction.

differences were apparent in age at menarche, self-reported history of stress fractures, or hours of training per week between the groups (Table 1).

The overall proportion of participants who were classified as having menstrual dysfunction was 28%. Between the groups that reported losing their period was or was not a normal response to training, the proportion of those with menstrual dysfunction did not differ (Table 1). On univariable examination, we found that those who were classified with menstrual dysfunction had higher fatigue and pain interference scores on the PROMIS questionnaires than those without menstrual dysfunction (Table 2). After we adjusted for age and BMI, menstrual dysfunction was significantly associated with higher anxiety, fatigue, and pain interference scores on the PROMIS questionnaires (Table 3). The β coefficients from the multivariable regression provided a measure of expected differences between groups while adjusting for the potential covariates of age and BMI (Table 3).

## DISCUSSION

The primary aim of our study was to determine the proportion and characteristics of female athletes who believed that losing their period was a normal response to high training demands. The menstrual cycle has been referred to as an additional vital sign, and menstrual dysfunction should be considered an indicator of a possible underlying medical condition.[4] Unfortunately, almost half of our study population (44%) answered that it was normal to lose their period during high levels of athletic training. This value is within the range of similar studies,[10,16] in which 28% to 56% of athletes felt it was normal or "OK" to skip or miss a period during training. The high numbers of adolescent athletes with this view may reflect a lack of appropriate education on menstrual health. Female athletes should be informed that the lack of a period or missing periods should not be considered normal, and further evaluation is warranted by a medical provider to assess for an underlying condition.

As coaches spend a considerable amount of time with their athletes, they can serve as a source of information regarding menstrual health. Prior researchers[10,11,13] showed that coaches had a low knowledge of the female athlete triad, and many did not regularly ask about menstrual health or feel comfortable discussing it with their female athletes. A large number of high school and collegiate coaches also reported the misconception that skipping or missing periods was normal in female athletes.[10,11,13] Coaches with better knowledge of the female athlete triad were more likely to ask their athletes about their menstrual health and initiate referral to a health care provider if concerned,[13] indicating that improving the education of coaches may enhance health care access and appropriate referral for their female athletes with menstrual irregularity. Even among health care providers, including physicians, athletic trainers, physical therapists, and nurses, knowledge of and comfort with treating the female athlete triad is low.[12,14,15] Given the potential health implications of menstrual dysfunction, along with generally poor awareness and understanding of menstrual function among athletes, coaches, and health care providers, sports medicine professionals are uniquely qualified to develop educational initiatives related to menstrual health.

When comparing those who did and those who did not believe losing their period was a normal response to training, we found no difference in the proportion of females with menstrual dysfunction. This may indicate that an athlete's perception of menstrual dysfunction may not align with her own experience with menstrual dysfunction. However, the group that indicated losing their period was a normal response to training had a lower BMI than the group that did not. Due to the cross-sectional design of our study, we cannot infer a causal relationship, yet it is plausible that those with a lower BMI have a greater drive for thinness, resulting in the misconception that losing their period is acceptable when training hard.[21] Interestingly, this group was also less likely to worry about their weight, which could inherently stem from having a lower BMI. Although BMI is not necessarily a reflection of energy balance, having a low BMI is considered a risk factor for low energy availability in the female athlete triad and RED-S.[1,2] Health care providers should consider further questioning regarding an athlete's understanding of menstrual health if she has a low BMI, in addition to screening for other female athlete triad risk factors. Additionally, promoting awareness about the connection between low energy availability and menstrual dysfunction, as well as providing nutrition education, is important.

Between-group differences were also observed on the Family Affluence Scale score, which reflects socioeconomic status. Earlier investigators[22] found that socioeconomic status correlated with poorer health outcomes and negative health behaviors in children and adolescents; however, perceptions of menstrual health as it relates to socioeconomic status have not been previously described to our knowledge. Our findings indicated that female adolescent athletes who viewed losing their period as a normal response to training had greater family affluence than those who did not. We acknowledge that it is difficult to extrapolate the clinical significance of a 1-point difference between groups on the Family Affluence Scale. Nonetheless, the findings lead to the important question of how socioeconomics may relate to education regarding menstrual health in female athletes. Research[23] suggested a direct link between socioeconomic status and educational achievement in students, but in our study population, a higher level of family affluence did not appear to correlate with greater knowledge about menstrual health. In fact, the opposite seemed to be true. This supports the notion that educational efforts regarding menstrual health are necessary, regardless of an adolescent's family affluence.

Our data indicated that the presence of menstrual dysfunction in female adolescent athletes was associated with higher levels of anxiety, fatigue, and pain interference on the PROMIS questionnaires after controlling for age and BMI. In a previous investigation,[24] the minimally important difference in PROMIS pediatric measures was 2–3 points. Our difference in fatigue scores (2.41) falls within this range, yet the differences in anxiety (1.72) and pain interference (1.34) scores did not (Table 3). However, the minimally important difference described by Thissen et al was an estimate and based on a scale-judgement method that has limitations[24]; therefore, we feel that the findings may still be clinically significant and important to consider. The relationship between various forms of stress (psychological, exercise, energy deficiency, weight loss) and functional hypothalamic amenorrhea is well described.[3] Women with functional hypothalamic amenorrhea reported more depressive symptoms, dysfunctional attitudes, and difficulty coping with stress than eumenorrheic women.[25,26] Functional hypothalamic amenorrhea was associated with elevated cortisol levels due to alterations of the hypothalamic-pituitary-adrenal axis, and hypercortisolemia has been linked to increased anxiety levels in amenorrheic women compared with healthy control women.[27] Furthermore, chronic stress and elevated cortisol levels were associated with increased fatigue in adolescents.[28] Our observation that increased pain interference scores were associated with menstrual dysfunction may reflect poor coping skills or heightened anxiety surrounding pain associated with the psychological correlates described in functional hypothalamic amenorrhea. Although the female athletes enrolled in our study were not formally diagnosed with functional hypothalamic amenorrhea, this condition may represent an underlying cause of the menstrual dysfunction in these athletes and could be associated with the findings of increased anxiety, fatigue, and pain interference.

The correlation between menstrual dysfunction and psychological factors is meaningful when considering mental health screening in female athletes. In general, increased attention has focused on the importance of identifying mental health symptoms and disorders in athletes, as these conditions can significantly impair athletic performance and overall wellbeing.[29] Given our findings that adolescent female athletes with menstrual dysfunction reported higher levels of anxiety, fatigue, and pain interference, coaches and caregivers of female athletes should consider asking more questions about an athlete's mental health and quality of life in the context of menstrual dysfunction. Early detection of both menstrual dysfunction and mental health symptoms is imperative to prevent future adverse health consequences for these athletes.

Our research had several limitations. First, the study was cross sectional, and thus, we cannot infer any causal relationships or interpret our findings in this way. Second, all data were collected via self-reporting through questionnaires completed by the adolescent athletes (with possible input from the parent or guardian). Recall accuracy of medical information could be a limiting factor. Parental or guardian influence on participant responses to the questionnaires may also have impaired the accuracy of the results. Additionally, we categorized the presence of menstrual dysfunction based on self-reported answers to questions about menstrual health. The reliability of determining menstrual dysfunction through standard preparticipation evaluation screening has been brought into question.[30] Finally, our participants were identified, recruited, and tested during a single-day event, and all individuals were recruited from the same school district. As such, our results may not be generalizable to other geographic locations or populations of female athletes outside the adolescent age group. It is also important to note that a wide variety of sport types were represented in the study population, which could have influenced the results. Although our sample size was not large enough to conduct subanalyses among sport types, future researchers should examine how sport type is associated with athletes' perceptions of menstrual health.

## CONCLUSIONS

Adolescent female athletes are at risk for menstrual dysfunction associated with exercise and low energy availability, which can have many detrimental consequences. We observed that 28% of high school female athletes met the criteria for menstrual dysfunction, and almost half of female athletes reported that it was normal to lose their period during high levels of athletic training. Also, those with menstrual dysfunction had higher reported anxiety, fatigue, and pain interference levels than those without menstrual dysfunction. Improving knowledge about menstrual health among female athletes, coaches, and health care providers, including the importance of medical evaluation in the context of menstrual dysfunction and the role of nutrition, is important for promoting athlete wellbeing.

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