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

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

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 well-being.

Objectives: The primary aim was to determine the prevalence and characteristics of female athletes who believe that losing their period is 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: Pre-participation evaluations for a local high school district.

Participants: Female athletes, 13-18 years old.

Independent Variables: Presence of menstrual dysfunction, and response (yes/no) to the question, “Do you think it is normal to lose your period during high levels of athletic training?”
Main Outcome Measures: 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 lower BMI, were less likely to report being worried about current weight, and had a higher family affluence level than those who answered losing their period was not a normal response to training. The overall prevalence of menstrual dysfunction was 28%. After adjusting for age and BMI, menstrual dysfunction was significantly associated with higher levels of anxiety, fatigue, and pain interference.

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

Key Words: Menstrual dysfunction, adolescence, female athlete triad, quality of life

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Key Points:

1. Many young female athletes believe that losing their period is a normal response to high training demands.
2. Menstrual dysfunction is associated with impaired quality of life measures including anxiety, fatigue, and pain interference.

3. Efforts should be made to promote education about menstrual health among female athletes, coaches, and healthcare providers.
Low energy availability, defined as an energy deficit for physiologic functioning after removing the energy expenditure during exercise, is the foundation of the female athlete triad and relative energy deficiency in sport (RED-S)\(^1,2\). While the female athlete triad focuses on the interplay between low energy availability, bone health, and menstrual dysfunction, RED-S more broadly encompasses impaired functioning of other body systems such as 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 that 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, while secondary amenorrhea refers to the occurrence of three or more consecutively missed menstrual periods after a female has reached menarche. Oligomenorrhea describes menstrual cycles lasting longer than 35 days and is often classified as having nine or less 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\(^3\). Studies report the prevalence of menstrual dysfunction ranges from 7-54\% among adolescent female athletes, and the association between menstrual dysfunction and low bone mineral density in young female athletes is well-described\(^1\). Since adolescence is the time of peak bone mass accrual, the presence of 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\textsuperscript{1,2,3,6}.

In addition to the negative effects of low energy availability and/or menstrual dysfunction on bone health, psychological impairments have also been described\textsuperscript{2}. The model of RED-S illustrates the psychological consequences resulting from low energy availability, including impaired judgement, decreased concentration, increased depression, and increased irritability\textsuperscript{2}. A limited number of studies on menstrual dysfunction have described the neuropsychological associations of functional hypothalamic amenorrhea in adolescents, including increased anxiety and depressive symptoms\textsuperscript{7,8}. Few studies have shown a relationship between psychosocial stress and menstrual dysfunction in young women\textsuperscript{9}, but little data 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 healthcare providers, understand the female athlete triad and RED-S. Prior studies report high school and collegiate coaches, as well as healthcare providers, including physicians, athletic trainers, physical therapists, and nurses, possess a low level of knowledge about the female athlete triad\textsuperscript{10–15}. Perhaps more importantly, young female athletes themselves have poor female athlete triad knowledge as it relates to menstrual status and bone health\textsuperscript{10,16}. One commonly reported misconception among coaches is that loss of menstruation is a normal response to a high level of training, yet little information regarding athletes’ perceptions of menstrual dysfunction is currently available\textsuperscript{11,16}. Understanding female adolescents’ views of menstrual dysfunction is important to guide identification and educational interventions for athletes at risk for the female athlete triad and the negative associated consequences.
The primary aim of this study was to determine the prevalence and characteristics of female athletes who believe that losing their period is a normal response to high training demands. The secondary aim of this study was to explore how patient-reported quality of life measures differ between female athletes with and without menstrual dysfunction.

Methods:

Participants and Study Design

We conducted a cross-sectional study of adolescent athletes presenting for a sports preparticipation evaluation within one local school district, including five high schools, in the spring of 2019. We included participants who were female, ages 13 to 18 years, and actively involved in at least one high-school sponsored organized sport. Females who reported menarche within the past year were excluded from the study, as our criteria for menstrual dysfunction required at least one 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: neurological disorder, seizure disorder, or experiencing ongoing symptoms/dysfunction from a recent concussion or lower extremity injury. School district and institutional review board approval were each obtained prior to study commencement. All participants and parent/guardians provided written informed assent and consent to participate in the study.

Participant-Reported Assessments

During the assessment, all participants completed a standard health history questionnaire, the Family Affluence Scale, and Patient-Reported Outcome Measurement Information System (PROMIS) questionnaires. The participants’ parent(s)/guardian 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 pre-participation exam monograph recommended as 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. Demographic data included age, school grade, primary sport (sport in which the athlete is 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 including diagnosis of stress fracture or other musculoskeletal injury was collected, 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”. Participants are asked about the material conditions of the family including number of household bedrooms, cars, and computers.

Regarding menstrual status, we asked five specific questions intended to ascertain the most relevant information for our study purpose. The following questions addressing menstrual function were adapted from the standard pre-participation exam monograph:

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
in two prior studies assessing knowledge of the female athlete triad in female athletes of the same age as in our study, and the question was felt to be age-appropriate and understandable.

To address our secondary aim, participants completed the PROMIS v1.1 Pediatric Profile. This scale is used to evaluate patient-reported quality of life in six different domains: physical function, mobility, anxiety, depressive symptoms, fatigue, peer relationships, and pain interference. In each of the six domains, participants are asked to respond to questions based on their status during the prior seven days. The total score for each domain is calculated as the sum of all question responses for that domain (range 0-24), and a higher score (range 0-4) indicates increased frequency or severity of feelings or experiences.

**Grouping Variables**

In order to examine the perception of menstrual dysfunction, we grouped participants based on their yes/no response to: “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 applied consistent with accepted definitions of menstrual dysfunction and have been used in prior studies assessing rates of menstrual dysfunction in adolescent female athletes.

**Statistical Analysis**

Continuous variables are presented as medians [interquartile ranges], and categorical variables are presented as the number included and corresponding percentages. For our primary purpose, we performed descriptive statistics calculating the proportion of female athletes who answered that period loss is a normal response to high training demands. In addition, we
compared athlete characteristics between those who did and did not report that period loss is a
normal response to high training demands using Mann-Whitney U tests (continuous variables)
and Fisher’s Exact Tests (categorical variables). To address our secondary purpose, we compared
PROMIS outcomes and athlete characteristics between the group classified as having menstrual
dysfunction compared to those classified as not having menstrual dysfunction. We then
constructed a series of linear multivariable regression models assessing 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 status. All
statistical tests were two-sided and evaluated with a significance level of \( \alpha = 0.05 \). All statistical
analyses were conducted using Stata version 15 (StataCorp, College Station, TX).

**Results:**

Initially, 101 female athletes were provided with the option to participate in the study,
and 90 completed it (89% response rate, n=11 excluded). Among the 11 who were excluded, n=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). N=5 additional athletes were
excluded from our analysis as they reported menarche within the past year. Of the 90 participants
who completed the study, the average age was 15.5 years (standard deviation = 1.2 years). Forty
athletes (44%) reported that losing their period is a normal response to a high level of athletic
training. This group had significantly lower BMI, a significantly lower proportion of girls who
reported they were worried about their weight, and significantly higher Family Affluence Scale
scores compared to those who answered that losing their period was not a normal response
(Table 1). There were no statistically significant differences 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 reporting losing their period was or was not a normal response to training, there was no significant difference in the proportion of those with menstrual dysfunction (Table 1). Upon univariable examination, those who were classified with menstrual dysfunction reported significantly higher fatigue and pain interference scores on the PROMIS questionnaires than those without menstrual dysfunction (Table 2). After adjusting for age and BMI, menstrual dysfunction was significantly associated with higher anxiety, fatigue, and pain interference scores on the PROMIS questionnaires (Table 3). The beta coefficients from the multivariable regression provide a measure of expected differences between groups while adjusting for the potential covariates of age and BMI (Table 3).

**Discussion:**

The primary aim of the study was to determine the proportion and characteristics of female athletes who believe that losing their period is 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 potential underlying medical pathology. Unfortunately, almost half of our study population answered that it is normal to lose their period during high levels of athletic training. Our data of 44% of female athletes reporting it is normal to lose their period falls in the range of 28-56% found in similar studies in which athletes were asked whether they felt it was normal or “OK” to skip/miss a period during training. The high numbers of adolescent athletes holding this view reflects a potential lack of appropriate education on menstrual health. Female athletes should be informed that lack of a period or missing periods should not be considered normal and warrants further evaluation by a medical provider to assess for underlying pathology.
As coaches spend a considerable amount of time with their athletes, they can serve as a source of information regarding menstrual health. Previous work shows coaches have low knowledge of the female athlete triad, and many do not regularly ask about menstrual health nor do they feel comfortable discussing it with their female athletes\textsuperscript{10,11,13}. A high number of high school and collegiate coaches also report the misconception that skipping or missing periods is normal in female athletes\textsuperscript{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 healthcare provider if concerned\textsuperscript{13}, indicating that improving education of coaches may serve to enhance healthcare access and appropriate referral for their female athletes with menstrual irregularity.

Even among healthcare providers, including physicians, athletic trainers, physical therapists, and nurses, knowledge and comfort with treating the female athlete triad is low\textsuperscript{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 healthcare providers, sports medicine professionals are uniquely qualified to develop educational initiatives related to menstrual health.

When comparing groups of those who did and did not believe losing their period is a normal response to training, we found no significant 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 who indicated that losing their period was a normal response to training had a significantly lower BMI than the group who did not. Although we cannot infer a causal relationship due to the cross-sectional design of our study, it is plausible that those with lower BMI have a higher drive for thinness, thus developing the misconception that losing their period is acceptable when training.
Interestingly, this group was also significantly less likely to worry about their weight, which could inherently come from having 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\textsuperscript{1,2}. Healthcare providers should consider further questioning regarding an athlete’s understanding of menstrual health if they have 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. Lower socioeconomic status has been shown to correlate with poorer health outcomes and negative health behaviors in children and adolescents\textsuperscript{22}, however perceptions of menstrual health as it relates to socioeconomic status has not been previously described to our knowledge. Our findings indicate female adolescent athletes who reported that losing their period is a normal response to training had higher family affluence than those who did not. We acknowledge that it is difficult to extrapolate the clinical significance of a one-point difference between groups on the Family Affluence Scale. However, the findings lead to the important question of how socioeconomics may relate to education regarding menstrual health in female athletes. Research suggests a direct link between socioeconomic status and educational achievement in students\textsuperscript{23}, but in our study population, higher family affluence did not appear to correlate with greater knowledge about menstrual health. In fact, the opposite seems to be true. This supports the notion that educational efforts around menstrual health are necessary regardless of an adolescent’s family affluence.
Our data indicate 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. When considering the clinical significance of the differences between groups in the PROMIS scores, it has been shown that the minimally important difference in PROMIS pediatric measures is 2-3 points. While the difference we found in fatigue scores (2.41) falls within this range, the differences in anxiety (1.72) and pain interference (1.34) scores do not (Table 3). However, the minimally important difference described by Thissen et al. is an estimate and based off of a scale-judgement method that has limitations; therefore, we feel that the findings may still be clinically significant and are important to consider. The relationship between various forms of stress (psychological, exercise, energy deficiency, weight loss) and functional hypothalamic amenorrhea is well-described. Women with functional hypothalamic amenorrhea report more depressive symptoms, dysfunctional attitudes, and difficulty coping with stress than eumenorrheic women. Functional hypothalamic amenorrhea is 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 to healthy controls. Furthermore, chronic stress and elevated cortisol levels have been found to be associated with increased fatigue in adolescents. Our observation that increased pain interference scores are 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, it is possible that it may represent an underlying etiology for 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, there has been increased attention on the importance of identifying mental health symptoms and disorders in athletes, as these conditions can significantly impair athletic performance and overall well-being. Given our findings that adolescent female athletes with menstrual dysfunction report 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 setting 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 study has several limitations. First, the study was cross-sectional, and therefore we cannot infer any causal relationships or interpret our findings in this way. Second, all data was collected by self-report through questionnaires completed by the adolescent athletes (with potential input from the parents/guardians). Recall accuracy of medical information could be a limiting factor. Parent/guardian influence on participant responses to the questionnaires may also have impaired the accuracy of results. Additionally, we classified the presence of menstrual dysfunction based on self-reported questions about menstrual health. The reliability of determining menstrual dysfunction through standard pre-participation evaluation screening has been brought into question. 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 there were a wide
variety of sport types represented in the study population, which could have influenced the
results. While our sample size was not large enough to conduct sub-analyses between sport
types, future studies should examine how sport type is associated with athletes’ perception of
menstrual health.

Conclusion:

Adolescent female athletes are at risk for menstrual dysfunction associated with exercise
and/or low energy availability, which can have many detrimental consequences. We observed
28% of high school female athletes met criteria for menstrual dysfunction, and almost half of
female athletes reported it was normal to lose their period during high levels of athletic training.
In addition, 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 healthcare providers, including the
importance of medical evaluation in the setting of menstrual dysfunction and the role of
nutrition, is important to promote athlete well-being.
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**Table 1.** Comparison of female adolescent athlete characteristics based on yes/no response to the question, “Do you think it is normal to lose your period during high levels of athletic training?” Continuous variables are presented as median [interquartile range], categorical variables are presented as n (%).

| Variable                          | Answered YES, losing my period is normal (n=40) | Answered NO, losing my period is not normal (n=50) | P value |
|-----------------------------------|-------------------------------------------------|--------------------------------------------------|---------|
| Current Age (years)               | 15.5 [14.7, 16.5]                               | 15.2 [14.4, 16.3]                                | 0.30    |
| Age of menarche                   | 12.3 [12.0, 13.0]                               | 12.0 [11.0, 13.0]                                | 0.26    |
| BMI (kg/m²)                       | 21.2 [19.7, 23.3]                               | 22.8 [20.6, 25.6]                                | 0.04*   |
| Menstrual dysfunction in the past year | 12 (30%)                                         | 12 (24%)                                        | 0.63    |
| Hours of training per week        | 12 [10, 14]                                     | 12 [10, 15]                                     | 0.93    |
| History of stress fracture        | 1 (3%)                                          | 5 (10%)                                         | 0.22    |
| Worried about weight              | 1 (3%)                                          | 8 (18%)                                         | 0.04*   |
| On a special diet                 | 5 (13%)                                         | 4 (8%)                                          | 0.73    |
| Family affluence scale score      | 10 [9, 11]                                      | 9 [8, 10]                                       | 0.01*   |

**Primary sport**

|                          | Answered YES, losing my period is normal (n=40) | Answered NO, losing my period is not normal (n=50) |
|--------------------------|-------------------------------------------------|--------------------------------------------------|
| Volleyball               | 7                                               | POMS: 11                                         |
| Cross Country            | 6                                               | Volleyball: 10                                   |
| Soccer                   | 5                                               | Softball: 7                                       |
| POMS                     | 4                                               | Soccer: 4                                        |
| Softball                 | 4                                               | Gymnastics: 3                                     |
| Track and Field          | 3                                               | Cross Country: 3                                  |
| Gymnastics               | 2                                               | Basketball: 2                                     |
| Swimming                 | 2                                               | Swimming: 2                                       |
| Cheerleading             | 2                                               | Track and Field: 2                                |
| Unspecified              | 2                                               | Unspecified: 2                                    |
| Dance                    | 1                                               | Cheerleading: 1                                   |
| Tennis                   | 1                                               | Martial arts: 1                                   |
| Marching Band            | 1                                               | Skiing: 1                                         |
|                          |                                                 | Equestrian: 1                                     |

* Significantly different between groups (p < 0.05).
Table 2. Comparison of female athletes who were classified as having menstrual dysfunction in the past year and those who were not. Variables are presented as median [interquartile range].

| Variable                      | Menstrual dysfunction (n=26) | No menstrual dysfunction (n=64) | P value |
|-------------------------------|------------------------------|--------------------------------|---------|
| **PROMIS Outcomes**           |                              |                                 |         |
| PROMIS Mobility               | 0 [0, 0]                     | 0 [0, 0]                        | 0.58    |
| PROMIS Anxiety                | 4.5 [1, 7]                   | 2 [0, 5]                        | 0.08    |
| PROMIS Depressive Symptoms    | 0 [0, 6]                     | 0 [0, 2]                        | 0.63    |
| PROMIS Fatigue                | 2.5 [1, 7]                   | 1 [0, 3]                        | 0.003*  |
| PROMIS Peer Relationships     | 15.5 [10, 16]                | 14 [11, 16]                     | 0.51    |
| PROMIS Pain Interference      | 0.5 [0, 4]                   | 0 [0, 1]                        | 0.04*   |
| **Athlete Characteristics**   |                              |                                 |         |
| Age (years)                   | 15.4 [14.3, 16.3]            | 15.4 [14.5, 16.5]               | 0.61    |
| Age of menarche (years)       | 12.0 [11.0, 13.0]            | 12.0 [12.0, 13.0]               | 0.74    |
| BMI (kg/m²)                   | 21.3 [19.8, 22.8]            | 22.5 [20.2, 25.6]               | 0.11    |

* Significantly different between groups (p < 0.05).
Table 3. Multivariable regression results for PROMIS outcomes among female adolescent athletes with and without menstrual dysfunction, adjusting for age and BMI.

| Variable                  | β coefficient | Standard Error | 95% Confidence Interval | P value |
|---------------------------|---------------|----------------|-------------------------|---------|
| Mobility                  | 0.03          | 0.15           | -0.26, 0.32             | 0.84    |
| Anxiety                   | 1.72          | 0.80           | 0.13, 3.31              | 0.034*  |
| Depressive Symptoms       | 1.05          | 0.75           | -0.44, 2.54             | 0.16    |
| Fatigue                   | 2.41          | 0.59           | 1.25, 3.58              | < 0.001*|
| Peer relationships        | 0.15          | 1.04           | -1.92, 2.22             | 0.89    |
| Pain interference         | 1.34          | 0.65           | 0.04, 2.64              | 0.043*  |

* Significantly associated with menstrual dysfunction.