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Adolescent female athletes with menstrual dysfunction report worse sleep and stress than those without menstrual dysfunction

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Adolescent female athletes with menstrual dysfunction report worse sleep and stress than those without menstrual dysfunction

Abstract

Context: Menstrual dysfunction among adolescent female athletes is associated with both an increased musculoskeletal injury risk and poor psychological health.

Objective: To examine if adolescent flag football athletes with menstrual dysfunction report different levels of energy, mood, sleep, and stress during the season compared to those without menstrual dysfunction.

Design: Prospective cohort study

Setting: A series of questionnaires pre-season, in-season weekly, and post-season to athletes in Denver Metro Area

Patients or Other Participants: Female athletes with and without self-reported menstrual dysfunction who participated in a high school flag football season.

Main Outcome Measure(s): Quality of life measures (energy, mood, sleep, and stress) rated weekly from 0 (low energy, poor mood, poor sleep, low stress) to 10 (high energy, best mood, great sleep, and high stress).

Results: Of the 60 adolescent female flag football athletes enrolled, 15 (25%) reported menstrual dysfunction. The groups were not significantly different in mean ratings for energy (5.3±1.1 vs. 5.1±1.4; p=0.70) or mood (5.6±1.1 vs. 6.0±1.5; p=0.32). However, the menstrual dysfunction group reported significantly worse sleep (4.2±1.3 vs. 5.2±1.4; p=0.02) and more stress (7.0±1.0 vs. 5.9±1.3; p=0.005) than those without menstrual dysfunction. When adjusting for school year, BMI, and injuries sustained during the season, menstrual dysfunction was significantly

associated with worse sleep (β= -0.98; 95% CI= -1.82, -0.13; p=0.03) and more stress (β=1.11; 95% CI=0.35, 1.87; p=0.005).

Conclusion: Flag football athletes with menstrual dysfunction reported worse sleep and more stress compared to those without menstrual dysfunction. These findings contribute to the importance of monitoring and addressing menstrual dysfunction and its association with quality of life factors in female adolescent athletes.

Key words: menstrual dysfunction, adolescence, mental health

Key points:

- Adolescent female athletes participating in flag football reported significantly worse sleep and significantly more stress in-season than those without menstrual dysfunction.
- Weekly ratings of energy and mood were not significantly different between adolescents with and without menstrual dysfunction participating in flag football.
- These findings contribute to the importance of monitoring and addressing menstrual dysfunction and its association with quality of life factors in female adolescent athletes.

Introduction

There are numerous health benefits to sport participation for female adolescents.[1,2,3] Participating in sports helps promote female adolescents' confidence, self-esteem, resilience, academic performance, and improves emotional health by fostering social interactions.[1,2,3,4] However, up to 70% of female adolescents may drop out of sports by the age of thirteen.[5] One of the reasons for premature dropout in sports participation is female athletes have a greater tendency to be more self-conscious of their bodies, be more self-critical, and compare themselves to others more than their male athlete peers.[4,6,7] These concerns only become more apparent with the many physical and psychological changes that occur with puberty during adolescence.[4,6,7] Therefore, it is imperative to understand ways in which individuals can encourage female adolescents to participate in sports. One of those growing avenues for female sports participation is flag football. Flag football is a non-contact version of American football, which can include both boys and girls, representing an emerging and under-studied sport.

Although sports participation is associated with a myriad of health benefits,[1,2,3] it may also lead to detrimental effects such as sport-related injuries or relative energy deficiency in sport (REDs).[8,9] REDs was introduced in 2014, with the intention to expand the previous diagnosis of the female athlete triad.[8] REDs refers to a condition in which energy imbalance leads to impaired physiological function of multiple organ systems.[8,9] One of the components of REDs is menstrual function and when there is a disruption to this component, it is referred to as menstrual dysfunction.[8] Menstrual dysfunction is often defined as menarche ≥15 years of age, three consecutive months without a menstrual period in the past year, and/or ≤9 menstrual periods in the last 12 months of those who are not taking hormonal contraceptives.[9,10] As such, female athletes who participate in lean sports (such as gymnastics, wrestling, and running; 35.6%,

p=0.01), and who are younger (ages 15-24; 35%, p=0.033) are at highest risk for menstrual dysfunction.[13,14] Furthermore, menstrual dysfunction is also associated with more missed participation days in sport (OR 1.79, 95% CI 1.05-3.07).[14] As flag football typically represents a younger age-group of female adolescent athletes, it is important to better understand the prevalence of menstrual dysfunction in flag football, which is currently unknown.

Previous work has suggested associations between poor quality of life, poor psychological health (e.g., stress, mood), poor perceived sleep quality, and menstrual dysfunction among adolescent females and adolescent female athletes.[12,15,16] Elite female athletes with menstrual dysfunction had worse quality of life ratings, such as mood and energy, and higher levels of stress.[17] Additionally, out of 235 female adolescents with menstrual dysfunction, and 60 adolescents with a regular menstrual cycle, the group with menstrual dysfunction had significantly lower quality of life scores in the domains of general health and social functioning compared to the controls.[18] Menstrual dysfunction was also associated with shorter perceived sleep duration[19] and poor perceived sleep quality in adolescent females.[20,21] Thus, menstrual health, mental health, and sleep health may interact among adolescent female athletes. It is reasonable to anticipate that menstrual dysfunction among adolescent athletes may be associated with poor perceived sleep quality or reduced quality of life during a season of athletic participation.

The purpose of this study was to examine if female adolescent athletes participating in flag football with menstrual dysfunction report different levels of energy, mood, sleep, and stress during the season compared to those without menstrual dysfunction. We hypothesized that adolescent athletes participating in flag football with menstrual dysfunction would report worse

levels of energy, mood, perceived sleep quality, and stress during the season compared to those without menstrual dysfunction.

Materials and Methods

Study Participants

We conducted a longitudinal prospective cohort study of female adolescents who were participating in flag football throughout the XXXXX Metro Area during the fall season of 2023. Study participants were included if they were active participants on a flag football team at one of the local high schools offering the sport and had no injury that limited physical activity participation at the time of enrollment. The study protocol was approved by the Colorado Multiple Institutional Review Board before study commencement and all participants and their parents (if under 18 years of age) completed consent/assent prior to completing any study procedures.

Study Design

Study participants were recruited through flyer dissemination by high school coaches provided by the research team. Participants enrolled in July/August 2023 and were followed throughout the 10-week season, which ended in October/November 2023. All participants completed a study visit prior to the beginning of fall season. At this pre-season visit, participants completed several assessments that detailed demographics, medical history, and other baseline characteristics. Menstrual history was obtained, which included whether they had their first menstrual period, age at menarche if so, number of periods in the prior 12 months, and date of most recent menstrual period. Participants were also asked if they were currently taking any hormonal contraceptives, and excluded from analysis if they reported any hormonal contraceptive use. Following the pre-season visit, participants completed weekly online surveys

throughout the season. These surveys were sent via text message or email (dependent on participant preference) each week and were completed by the participant to assess physical activity levels, engagement in flag football games and practices, perceived sleep quality, mood, stress, and energy levels, and any injuries sustained.

Weekly Surveys

During each week of the fall season, athletes completed a brief questionnaire. The questionnaires were distributed electronically via email or text message at the same time each week. Information collected within the weekly questionnaire included physical activity levels, athletic competition participation volume, any injuries sustained, and a brief rating of mood, stress, perceived sleep quality, and energy levels. These ratings were individually performed using a 10-point slider Visual Analog[22] with the scale including 0, 5, and 10 as verbal anchors. The slider could move anywhere along 0 to 10 with the software calculating the severity of the perceived ratings. A score of 0 indicated very low energy, very poor mood, very poor perceived sleep quality, and no stress, while a 10 indicated very high energy, very good mood, very good perceived sleep quality, and very high stress. Each week, participants completed the 0-10 rating scale for all four domains of interest. For analysis, we used participants' self-reported averages throughout the season of mood, energy level, perceived sleep quality, and stress ratings. On average, participants completed 6.9 (SD=1.5) out of 8 possible surveys during the season (86% adherence rate). We excluded those who completed not one of the surveys throughout the season.

Menstrual Dysfunction

Participants were classified as having menstrual dysfunction if they reported age of menarche ≥15 years of age, three or more consecutive months without a menstrual period up to the point of the pre-season visit/initial assessment, and/or ≤9 menstrual periods in the last 12

months. Additionally, if participants were ≥15 years of age and never had a menstrual period, they were classified as having menstrual dysfunction. Participants taking any hormonal contraceptives were excluded.

Statistical Analysis

Descriptive statistics are presented as mean (standard deviation) for continuous variables and number of participants within group (corresponding percentage) for categorical variables. We calculated descriptive statistics for demographic variables, medical history, and menstrual dysfunction. Independent t-tests and Cohen's d effect sizes (0.00-0.19= no effect, 0.20-0.49= small effect, 0.50-0.79= moderate effect, ≥0.80= large effect) were used to compare average weekly ratings during the season for energy levels, mood, perceived sleep quality, and stress between those who did and did not report menstrual dysfunction. Additionally, we constructed four separate linear regression models to determine the association between group (menstrual dysfunction or normal menstrual function: predictor variable) and weekly rating of energy, mood, perceived sleep quality, and stress (outcome variable). We adjusted each model to include school year, BMI, and whether a sport-related time-loss injury occurred during the season as covariates. All statistical analyses were two-sided and preformed using Stata Statistical Software: Version 16 (StataCorp, LLC, College Station, TX, USA).

Results

We enrolled 83 participants into the study. We excluded 14 participants who reported active hormonal contraceptive use and 9 who completed none of the surveys. Therefore, we monitored 60 adolescent female flag football athletes over the course of a season, 15 (25%) of which reported menstrual dysfunction at the start of the season. Those who did and did not report menstrual dysfunction demonstrated similar baseline characteristics and in-season survey

adherence, including age (mean=16.3±1.1 years of age), number of weekly surveys completed (7.0±1.6), BMI (21.7±2.7 kg/m^2), and hours/week of time playing flag football during the season (8.0±4.9 hours/week). Upon univariable examination, the groups were not significantly different in weekly ratings of energy (Figure 1A, no effect) or mood (Figure 1B, small effect). However, the menstrual dysfunction group reported significantly worse weekly perceived sleep quality (Figure 1C, moderate effect) and significantly more stress (Figure 1D, large effect) during the season than the no menstrual dysfunction group. After adjusting for school year, BMI, and injuries sustained during the season, menstrual dysfunction was significantly associated with worse perceived sleep quality and worse stress (Table 2).

Discussion

We examined if female adolescent athletes participating in flag football with menstrual dysfunction report different levels of energy, mood, perceived sleep quality, and stress during the season compared to those without menstrual dysfunction. We found no significant differences in weekly ratings of energy or mood between groups. However, the menstrual dysfunction group reported significantly worse perceived sleep quality and significantly more stress in-season than those without menstrual dysfunction. When adjusting for school year, BMI, and injuries sustained during the season, menstrual dysfunction was significantly associated with worse perceived sleep quality and more stress. These findings partially support our initial hypothesis, as adolescent athletes participating in flag football with menstrual dysfunction reported worse levels of perceived sleep quality and stress during the season compared to those without menstrual dysfunction. However, we identified that adolescent athletes with menstrual dysfunction did not report different mood and energy levels compared to adolescent athletes without menstrual dysfunction.

Of the 60 adolescent female flag football athletes we monitored over the course of a season, a quarter, (25%) reported menstrual dysfunction at the start of the season. The prevalence of menstrual dysfunction in our study was higher compared to other studies that report a prevalence between 15-18% in adolescent female athletes.[23,24] The higher prevalence of menstrual dysfunction in our study may reflect the high prevalence of menstrual dysfunction specifically in flag football rather than across a variety of different sports. Although menstrual dysfunction is most common in endurance, aesthetic, and weight-based sports,[13] it is imperative to also monitor for menstrual dysfunction in team sports, such as flag football. Additionally, the higher prevalence may also reflect a rise of menstrual dysfunction among youth athletes over the years with the rise of female adolescents participating in sports.[25] Our findings emphasize the importance of monitoring for menstrual dysfunction among adolescents athletes of all sport types, including flag football.

Adolescent female athletes with menstrual dysfunction reported significantly worse weekly perceived sleep quality during the season than the no menstrual dysfunction group. Our findings are consistent with previous work that suggest menstrual dysfunction is associated with poor perceived sleep quality among both adults, adolescent females, and adolescent female athletes.[19,20,21,26,27] A systematic review including adult females found that not only is worse sleep quality associated with menstrual dysfunction, but each sleep characteristic, including perceived sleep quality, efficiency, and duration is independently associated with menstrual disturbances.[26] Specificically in adolescent females between the ages of 15-18, 194 participants reported poor sleep quality. Of those 194 participants, 19% had menstrual dysfunction, indicating there was a significant relationship between perceived poor sleep quality and menstrual dysfunction in adolescent females.[21] Menstrual dysfunction may be characterized by

hormonal fluctuations (i.e., increased or decreased) of estrogen and/or progesterone which may in turn affect sleep.[28] For example, elevated progesterone levels can impact sleep-regulating neurotransmitters such as gamma-aminobutyric acid (GABA) and serotonin.[28] Changes in these neurotransmitters can influence sleep quality, ultimately leading to negative changes in sleep efficiency and subjective sleep quality.[28] Additionally, factors of mental health, such as heightened anxiety or stress, can cause sleep disturbances such as falling and staying asleep.[29] In female college students, going to bed later as well as irregular sleep/wake times (i.e., one or more hours of deviation from regular sleep/wake times) was associated with greater depressive symptoms and more severe menstrual dysmtpms, regardless of sleep duration.[29] This suggests that going to bed earlier and maintaining a consistent sleep schedule may be beneficial for those with menstrual irregularities.

We also found that athletes with menstrual dysfunction reported more stress during the season compared to those without menstrual dysfunction. Not only do previous studies suggest that female adolescents are more likely to experience more stress compared to male adolescents,[30,31] previous work also suggests that stress is associated with menstrual dysfunction.[12,15,16] High stress levels, depressive mood, and participating in psychological counseling have previously been linked to greater risks of menstrual cycle irregularity in Korean female adolescents.[32] Another study found that 235 female adolescents with menstrual dysfunction reported significantly lower quality of life scores in the domains of general health and social functioning compared to adolescents without menstrual dysfunction.[18] Although the association of stress and menstrual dyfcuntion have been less researched among adolescent athletes specifically, menstrual dysfunction was associated with higher levels of stress among adult, elite athletes.[17] Thus, our finding is in line with other work that suggests menstrual

dysfunction is associated with more stress in adolescent females and further research should examine this association specifically in adolescent female athletes.

We found no significant differences in weekly ratings of energy or mood between those with and without menstrual dysfunction. Research is scarce on the associations of menstrual dysfunction and energy and mood, particularly among adolescent athletes, compared to perceived sleep quality and stress. To the best of our knowledge, no studies have compared ratings of energy and mood in adolescent athletes with and without menstrual dysfunction. However, one study found that menstrual dysfunction was associated with higher levels of anxiety, fatigue, and pain interference among adolescent female athletes.[12] Other studies demonstrate an association between menstrual dysfunction and depression,[32,33,34] but we did not find a significant difference in self-reported history of depression or anxiety between groups. Our findings may suggest a protective effect of sport participation on mood and energy despite the presence of menstrual dysfunction. Research shows participating in sports or physical activity for at least 60 minutes daily has been shown to improve mood.[35,36,37] All athletes in our study participated in weekly physical activity that exceeded the recommended amount (9.6±4.7 hours/week) in an organized sport environment, which likely positively impacted mood.

Due to the higher prevalence of menstrual dysfunction in our study compared to other studies, it is possible that we saw more stress in these athletes due to the poor perceived sleep quality. On the other hand, poor perceived sleep quality could have led to more stress in these athletes. During adolescence, there is also an abundance of outside stress that is individual to each athlete, such as parental pressure, pressure from peers and friends, academic goals, and pressure to conform to societal norms that could be heightened from a myriad of outside

variables. Thus, future research should further identify specific stressors in adolescent female athletes and track these variables over time with specific perceived sleep quality ratings.

Limitations of this study include a small sample size, particularly in the menstrual dysfunction group which could limit detection of statistically significant findings between groups. Additionally, we used a 10-point slider Visual Analog scale for ratings of weekly perceived stress, mood, sleep quality, and energy which provides objective data points for subjective information, and thus can vary across individuals. For example, one athlete might perceive a higher rating as more or less severe than another individual. Furthermore, the Visual Analog scale was used as a brief and feasible method to obtain well-being data through the season, but has not yet been validated. However, strengths of our study include the prospective study design and examination of quality of life measures in the growing sport of flag football among adolescent female athletes.

Conclusion

Adolescent female athletes participating in flag football reported significantly worse perceived sleep quality and significantly more stress in-season than those without menstrual dysfunction. We found no significant differences in weekly ratings of energy or mood between those with and without menstrual dysfunction. We recommend healthcare providers regularly monitor for and address menstrual dysfunction and be aware of how menstrual dysfunction may relate to stress and perceived sleep quality in adolescent female athletes. It is imperative to identify screening practices pre-season to help improve quality of life in all female adolescent athletes, including those who participate in flag football. As flag football grows in popularity, future directions include prospectively examining the relationships of menstrual dysfunction, quality of life measures and injury risk in female athletes who participate in flag football.

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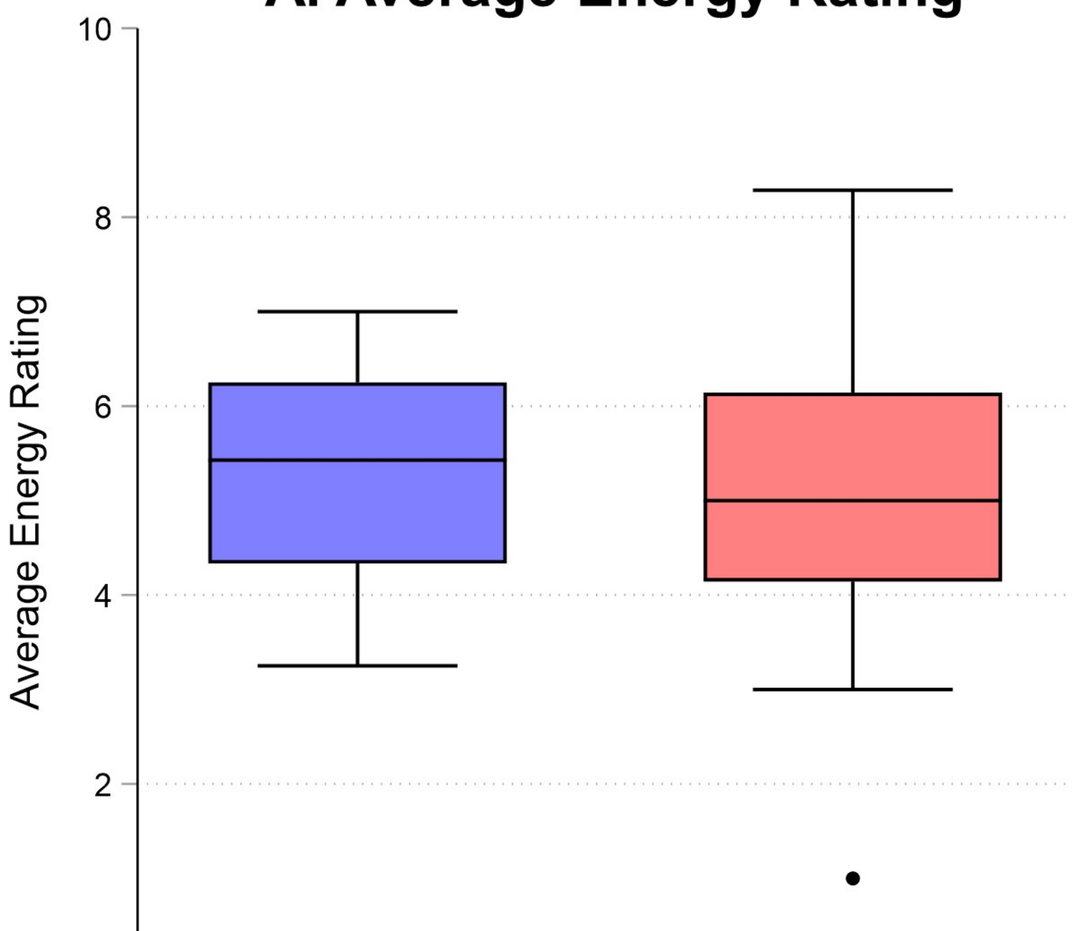
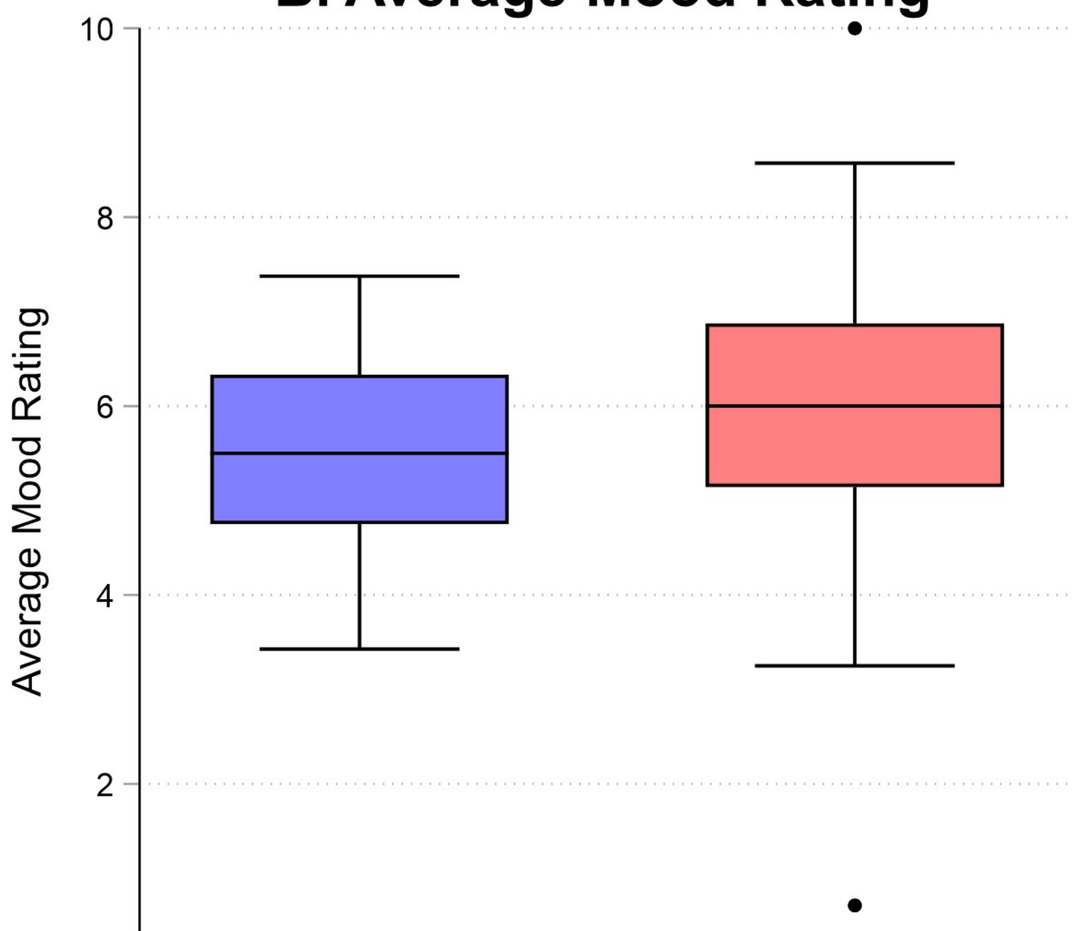
372 **Figure 1.** Comparison of participants who did and did not report menstrual dysfunction on

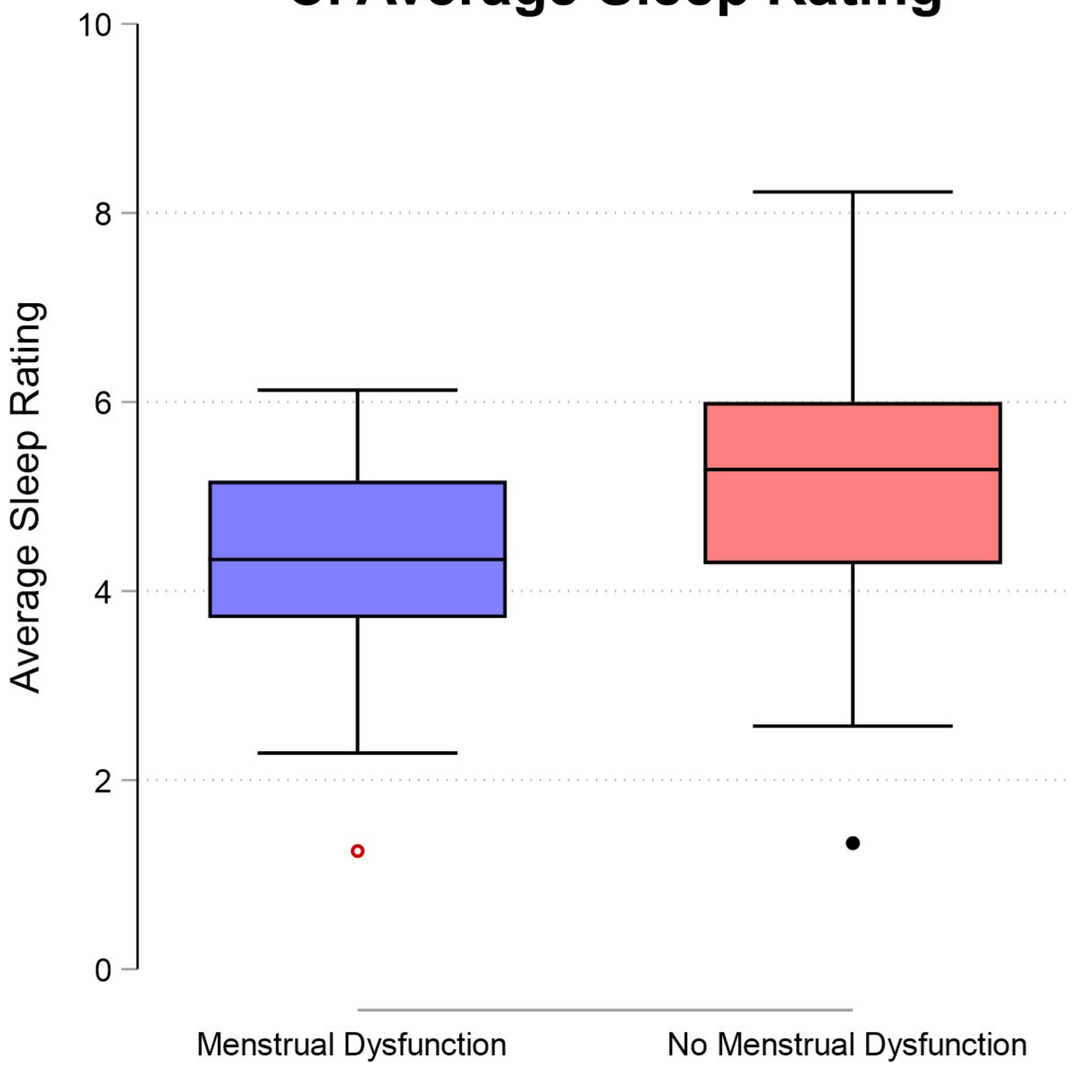
373 ratings of (A) energy, (B) mood, (C) sleep, and (D) stress during the flag football season.



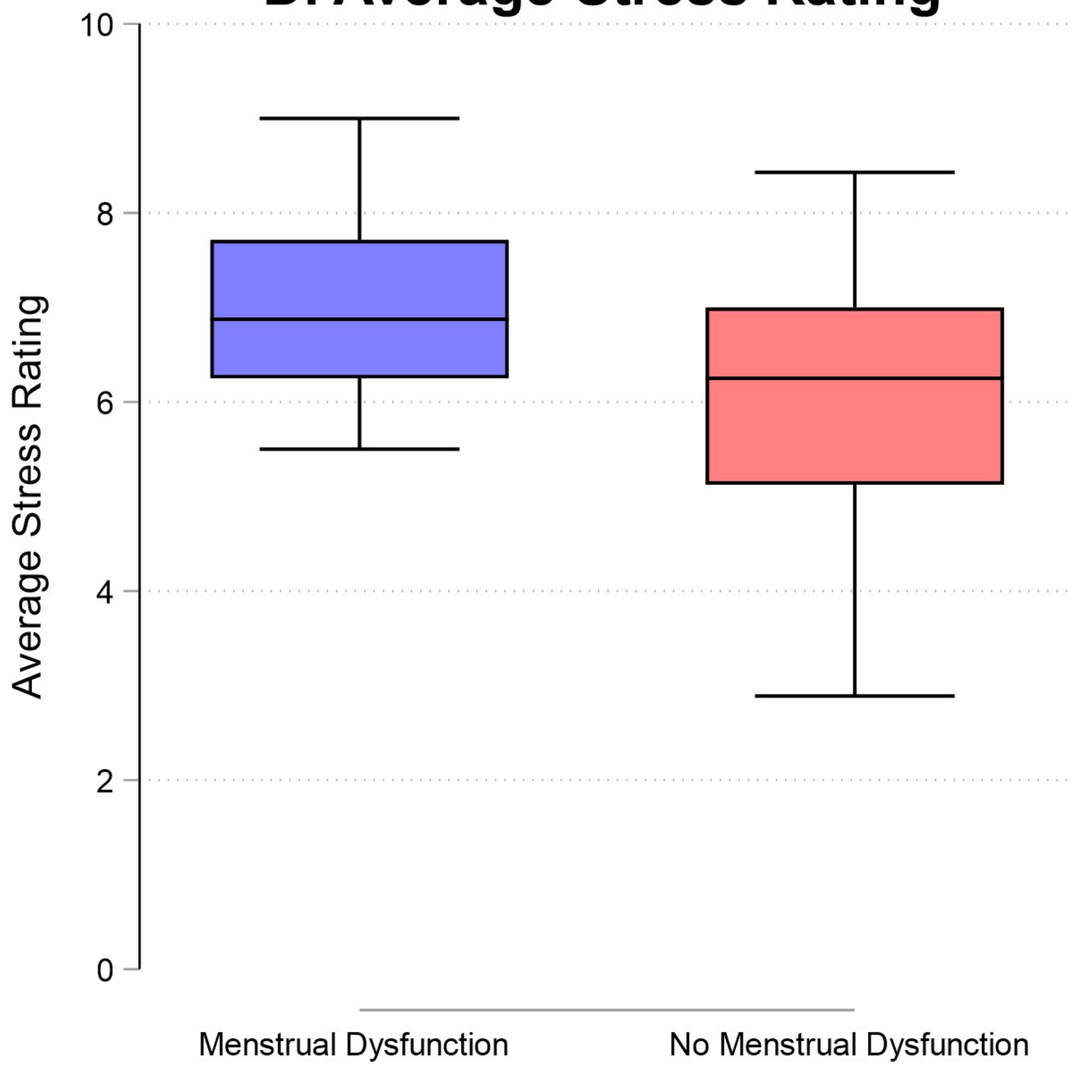
Between Group: p = 0.70; Cohen's d = 0.12



Between Group: p = 0.32; Cohen's d = 0.30



Between Group: p = 0.02; Cohen's d = 0.70



Between Group: p = 0.005; Cohen's d = 0.86

Table 1. Participant characteristic comparisons between female flag football participants who did and did not report menstrual dysfunction.

Variable		**Menstrual Dysfunction (N=15)**	**No Menstrual Dysfunction (N=45)**	**P value**
Age (years)		16.3 (1.2)	16.3 (1.1)	0.90
Number of weekly surveys completed during season		7.2 (1.1)	6.9 (1.7)	0.54
Race	American Indian or Alaska Native	0 (0%)	1 (2%)	0.56
	Asian	1 (7%)	3 (7%)	
	Black or African American	0 (0%)	5 (11%)	
	White	11 (73%)	30 (67%)	
	Native Hawaiian or Pacific Islander	0 (0%)	2 (4%)	
	More than one race	3 (20%)	4 (9%)	
Ethnicity (Hispanic/Latino/a/x)		4 (27%)	7 (16%)	0.44
Height (cm)		167.8 (8.4)	164.8 (6.6)	0.16
Weight (kg)		61.5 (13.2)	59.0 (8.5)	0.40
BMI (kg/m^2)		21.6 (3.0)	21.7 (2.6)	0.96
School year (grade)		10.8 (1.0)	10.9 (1.0)	0.84
History of anxiety		2 (13%)	9 (20%)	0.56
History of depression		1 (7%)	3 (7%)	0.95
Average physical activity (hours/week) at baseline		6.7 (4.7)	8.2 (6.5)	0.43
Average time playing flag football (hours/week) during season		6.4 (3.2)	8.7 (5.3)	0.14

Table 2. Multivariable linear regression model results evaluating the association between reported average weekly mental health ratings (outcome in each model) and menstrual dysfunction (predictor variable), adjusting for the independent effect of school year, BMI, and whether they reported an injury during the season (covariates).

Model predictor (adjusted for covariates)	**β coefficient**	**95% confidence interval**	**P value**
Energy	0.20	-0.63, 1.03	0.64
Mood	-0.41	-1.26, 0.44	0.34
Sleep	-0.98	-1.83, -0.13	0.03
Stress	1.11	0.35, 1.87	0.005