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Original Research

Mood States Across a Competitive Season in Collegiate Female Rowers: A Prospective Observational Analysis

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Abstract

International Journal of Exercise Science 19(5): 5005, 2026. This prospective observational study examined longitudinal changes in mood states, training load, sleep, and perceptual responses in collegiate female rowers over a competitive season, with the goal of informing applied athlete monitoring strategies. Twelve athletes completed the Profile of Mood States (POMS) twice weekly and reported rating of perceived exertion (RPE), sleep quantity and quality, and weekly training distance throughout the spring season. Menstrual status was recorded descriptively. Significant improvements in psychological well-being were observed as the season progressed. Fatigue (p = 0.002), confusion (p = 0.026), TMD (p = 0.033), and sleep quality (p = 0.009) were significantly lower in the late season compared with early season, reflecting small-to-moderate effect sizes. Other mood subscales, including tension, depression, anger, and vigor, did not change significantly across the season. Similarly, sleep quantity remained similar throughout the season; however, sleep quality increased significantly (p = 0.009). Across all observations, higher perceived exertion was strongly associated with greater negative mood states, while reduced sleep quantity was associated with elevated tension and depression. Weekly training distance was not significantly related to mood disturbance, suggesting psychological responses were more closely linked to perceptual and recovery-related factors than to external training volume. These findings highlight the value of longitudinal psychological monitoring in collegiate female athletes and suggest that mood states may improve as athletes adapt to training and competitive demands. Regular assessment of mood, sleep, and perceived exertion may support individualized wellness planning, inform coaching and recovery strategies, and facilitate early identification of maladaptation in female collegiate sport settings.

Keywords: Profile of mood states, self-motivation index, endurance, competition, rowing, collegiate athletes

Introduction

Mood states, as assessed by the Profile of Mood States (POMS) questionnaire, provide valuable insight into an athlete's psychological well-being across various phases of the training cycle.[1] The POMS questionnaire evaluates multiple dimensions, including vigor, fatigue, tension, depression, anger, confusion, and total mood disturbance (TMD). During periods of intensified training, mood disturbances typically increase in a dose-response manner, while reductions in training load are expected to alleviate these disturbances.[2-4] A failure to observe improvements in mood state scores following a taper or recovery period involving reduced training load may indicate insufficient recovery and an increased risk of overtraining syndrome.[5, 6]

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In addition to signaling recovery status, mood states are closely linked to athletic performance. Decreased endurance and self-paced performance have been associated with elevated negative emotional states.[7-9] Raglin et al.[1] investigated mood and self-motivation in female collegiate rowers attempting to qualify for a varsity team. While average ergometer times did not differ between successful (i.e., rowers were those selected to the final roster of the Women's Rowing Team after the tryouts) and unsuccessful (i.e., rowers were those who participated in the tryouts but were not selected for the final team) athletes, the latter group took longer to complete the rowing ergometer performance trial, demonstrated lower self-motivation, and were three times more likely to exhibit significant mood disturbances. Notably, following a reduction in training load, the successful athletes demonstrated improved mood states, whereas the unsuccessful athletes continued to report elevated negative mood states. These findings support the mental health model of athletic performance,[10] which posits that athletes with positive mood profiles are more likely to succeed than those exhibiting psychological distress.

While the relationship between training load and mood has been well studied in other endurance sports,[3,11] considerably less attention has been directed toward rowing, particularly in collegiate female athletes. Rowing is a sport characterized by high training volumes, repeated high-intensity efforts, and substantial psychological demands associated with team selection, competition, and academic responsibilities.[12] These combined stressors may place female collegiate rowers at increased risk for mood disturbance, underscoring the need for effective and practical monitoring strategies.[13]

Menstrual health is increasingly recognized as an important consideration in the holistic monitoring of female athletes.[14] Although menstrual-related symptoms and hormonal contraceptive use may influence perceived well-being, recovery, and training tolerance, methodological challenges have limited the integration of menstrual factors into applied sport science research.[15] Consequently, there is growing emphasis on incorporating menstrual status descriptively within broader athlete monitoring frameworks rather than relying solely on phase-based physiological assumption.[16] Such an approach may better reflect real-world practice and support individualized athlete care.

Despite growing interest in female athlete health, few longitudinal studies have examined mood states alongside training load, sleep, and perceptual responses across an entire competitive season in collegiate female rowers. Understanding how these variables interact over time may provide valuable insight into psychological adaptation, training tolerance, and athlete well-being. Therefore, the purpose of this study was to examine longitudinal changes in mood states, training load, sleep, and perceptual responses in collegiate female rowers across a competitive season. We hypothesized that mood disturbance would decrease as the season progressed, reflecting adaptation to training and competition demands, and that mood states would be closely associated with perceived exertion and sleep-related factors.

Methods

Participants

Fifteen eumenorrheic women between the ages of 18 to 30 years old were recruited for the study. To qualify for inclusion, participants were required to be current members of a collegiate rowing team; have no history of cardiorespiratory, neurological, metabolic, and musculoskeletal diseases; report no functionally limiting musculoskeletal injuries; self-report regular menstrual cycles (i.e., cycle length between 25 and 36 d)[7]; and have access to a smartphone. Exclusion criteria included the use of stimulant medication for attention-deficit/hyperactivity disorder (ADHD), irregular menstrual cycles, and use of hormonal contraceptives for the sole purpose of menstrual suppression. Prior to enrollment, all participants were informed of the study procedures and provided written informed consent to participate in the study. The final sample consisted of 12 healthy female rowers (21.5 ± 1.7 years old). Of these, seven participants were not using any form of hormonal contraceptives, while the remaining five reported using some form of hormonal contraception. Menstrual cycle characteristics for the final sample are presented in Table 1. Experimental procedures were approved by the Institutional Review Board for the Protection of Human Participants at Indiana University (IRB #21955), in accordance with the Declaration of Helsinki. This research was conducted in full accordance with the ethical standards of the *International Journal of Exercise Science*.[17]

Table 1. Participant Menstrual Cycle Length, Bleeding Duration, and Contraceptive Use.

Athlete	Contraception Option	Full MCs Recorded	Cycle Length (days)	Bleeding Length (days)
S01	OC	2	43.5 ± 11.5	5 ± 0
S02	-	4	23.8 ± 4.4	3.5 ± 1.1
S03	-	2	27 ± 0	5 ± 0
S04	OC	1	8 ± 0	4 ± 1
S05	IUD	3	27.7 ± 0.5	5 ± 0
S06	OC	3	28.3 ± 3.3	4 ± 1.9
S07	-	3	23.7 ± 2.5	6.3 ± 0.5
S08	-	3	29.3 ± 2.1	4.8 ± 0.4
S09	OC	3	25.3 ± 5.4	4 ± 1.2
S10	-	3	34 ± 1	5 ± 0
S11	-	2	27.5 ± 0.5	5.3 ± 0.5
S12		3	30.3 ± 2.5	5.3 ± 0.5
Mean ± SD		**2.7**	**27.4 ± 7.8**	**4.8 ± 1.0**

Team demographics and menstrual cycle characteristics of each female athlete. Cycle length in months and period length are shown as means ± SD. Bleeding length refers to both menstrual and withdrawal phase bleeding. OC, oral contraception; IUD, intrauterine device; MC, menstrual cycle; and SD, standard deviation.

Protocol

This study employed a prospective observational cohort design to examine changes in mood states, training load, and menstrual cycle phase across a competitive season in collegiate female rowers. Participants were monitored over time without experimental manipulation to assess naturally occurring variations in psychological variables (mood states and self-motivation) and physiological variables (menstrual cycle phase, sleep quality and quantity, and training load). Participants underwent a formal screening process, which included completion of a medical health questionnaire and informed consent form. This screening took place either before or after a regularly scheduled rowing team practice session. Individuals who met the eligibility criteria were enrolled in the study. Data collection was carried out weekly by a member of the research team, both before and after training sessions held every Monday and Thursday and continued through the end of the spring season. Data collection began during the spring break training camp (early March) and continued until the conclusion of the competitive season (early June). Training load metrics, including weekly distance and session intensity, were obtained from logs maintained by the team's head coach.

The POMS was administered following training sessions that occurred on Mondays and Thursdays. On each of these days, participants completed a training log that included self-reported menstrual cycle (MC) phase, Rating of Perceived Exertion (RPE) for that session, and the quantity and quality of sleep from the previous night. Additionally, the Self-Motivation Inventory (SMI) was completed every two weeks.

All study questionnaires were collected and managed using the REDCap (Research Electronic Data Capture) tool hosted at Indiana University.[18,19] REDCap is a secure, web-based software platform designed to support research data collection, offering: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export capabilities to common statistical packages; and 4) integration and interoperability with external sources.

Menstrual cycle phase was determined using a secure mobile application, which participants downloaded during the screening visit. The app was a secure, ad-free menstrual tracking app that enables users to log cycle length, symptoms (e.g., mood, cramps, sleep), premenstrual syndrome, fertility signs, and other variables. The app used predictive algorithms to estimate upcoming cycle phases and is designed with privacy in mind, offering local-only data storage and anonymous usage options. Participants were instructed to input as many previous menstrual cycles as possible into the app before beginning the study to improve the accuracy of phase predictions. During each study visit, the app was used to identify the participant's current menstrual cycle phase, helping to minimize inaccuracies when completing training logs. Upon completion of the study, participants were permitted to delete the app from their devices, and no data were stored or retained by the app or the researchers.

The POMS was used to assess mood states and total mood disturbance (TMD), throughout the study. POMS is a validated 65-item questionnaire widely used in exercise and sport research to assess six mood subscales: tension–anxiety, depression–dejection, anger–hostility, vigor–activity, fatigue–inertia, and confusion–bewilderment.[20] In the present study, the standard instructional set, which typically asks participants to rate their feelings over the "last week including today," was modified to assess their immediate psychological state. Participants were instructed to respond based on how they felt "right now", a change made to accommodate the frequent administration of the questionnaire throughout the study period. POMS responses were collected using the REDCap electronic data capture platform. TMD was calculated (eq. 1) by summing the five negative mood subscales (tension, depression, anger, fatigue, and confusion), subtracting the vigor score, and adding a constant of 100 to avoid negative values:

$$\text{TMD} = (\text{Tension} + \text{Depression} + \text{Anger} + \text{Fatigue} + \text{Confusion} - \text{Vigor}) + 100 \qquad [1]$$

A lower TMD score, as well as lower negative subscales, reflect a more positive mood state, whereas higher scores indicate greater mood disturbance. The scale ranges from 73 (no mood disturbance) to 300 (high mood disturbance).

The Self-Motivation Inventory is a psychological assessment tool designed to measure an individual's level of self-motivation: a trait associated with persistence, goal commitment, and adherence to training and performance demands. The assessment consists of 40 items; each rated on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").[21] Several items are reverse scored to control for response bias. The final score is calculated by summing all item responses, with higher scores reflecting greater levels of self-motivation.

Rating of Perceived Exertion (RPE) was assessed using a modified Borg scale (1–10) in place of the traditional Borg 6–20 scale to improve ease of use and comprehension, particularly in applied athletic settings. On this scale, a rating of 1 corresponds to "very light" effort, while a rating of 10 represents "maximal exertion."[22] Sleep quantity and quality were monitored through training logs completed immediately after each training session. Participants rated the quality of their sleep from the previous night using a 5-point Borg-style scale, where 1 indicated "very poor" sleep and 5 indicated "very good" sleep. This simple perceptual scale is commonly used in athlete monitoring due to its ease of use and consistency with other subjective rating tools (e.g., RPE).[23] Participants also recorded the number of hours slept during the previous night to capture overall sleep duration.

Statistical Analysis

Data from all participants were analyzed using SPSS software (version 24; IBM Corp., Armonk, NY, USA), and R. Data were assessed for normality using Shapiro–Wilk tests, with all variables meeting assumptions for parametric analysis ($p > 0.05$).

Paired-samples t-tests were used to compare early- and late-season measures of mood state (TMD and subscales), sleep quality, and sleep quantity. Effect sizes were calculated using Cohen's d for dependent samples (d_x), derived from the mean difference divided by the standard deviation of the difference scores. Effect sizes were interpreted as small (0.2), moderate (0.5), and large (0.8).

To examine relationships between training load and psychological variables, repeated-measures correlation (rmcorr) analyses were conducted in R using the rmcorr package. This method assesses the common within-individual association between variables across repeated observations while accounting for non-independence of data points. Separate rmcorr analyses were performed for internal load (session RPE) and external load (training volume) in relation to TMD, mood subscales, and SMI. For each analysis, the repeated-measures correlation coefficient (r_m), 95% confidence intervals, and p-values were obtained.

Statistical significance was set at $p < 0.05$. Data are presented as mean ± standard deviation (SD), along with mean differences, 95% confidence intervals, and effect sizes where appropriate.

A statistical power analysis for sample size estimation was conducted using G*POWER software (version 3.1.9.7; University of Kiel, University of Düsseldorf, and University of Mannheim, Germany). Based on an F-test for repeated-measures ANOVA, a sample size of 12 participants was estimated to achieve a statistical power of 0.80, assuming a medium effect size ($f = 0.25$) and $\alpha = 0.05$, as recommended by Cohen.[24]

Results

Mood State

Repeated-measures correlations revealed significant associations among mood subscales (Table 3). Tension was positively associated with depression ($r_m = 0.651$), anger ($r_m = 0.589$), fatigue ($r_m = 0.462$), and confusion ($r_m = 0.672$), and negatively associated with vigor ($r_m = -0.27$). Anger was positively correlated with fatigue (r_m = 0.530) and confusion (r_m = 0.602), and negatively associated with vigor (r_m = -0.24). Depression was positively associated with tension (r_m = 0.651), anger (r_m = 0.704), and confusion (r_m = 0.581), and negatively associated with vigor (r_m = -0.286).

Comparisons between early- and late-season time points (Table 2) indicated significant reductions in fatigue (p = 0.002, d = 0.35, 95% CI: 0.431 to 2.03), confusion (p = 0.026, d = 0.79, 95% CI: 0.09 to 1.454), and total mood disturbance (TMD; p = 0.033, d = 0.74, 95% CI: 0.057 to 1.403). No other mood subscales demonstrated statistically significant changes. Vigor did not change significantly and demonstrated a trivial effect size (d = 0.05).

Table 2. Psychological, Perceptual, and Sleep Measures Across the Competitive Season.

Variable	Early Season Mean ± SD	Late Season Mean ± SD	P value	95% CI Lower	95% CI Upper	Effect Size (Cohen's d)
Total Mood Disturbance	124.4 ± 28.9	105.2 ± 14.9	0.033*	0.06	1.40	0.74
Tension	9.2 ± 6.8	5.9 ± 4.8	0.119	-0.21	1.02	0.40
Depression	5.6 ± 8.9	0.8 ± 2.4	0.094	-0.09	1.19	0.56
Anger	5.0 ± 7.1	1.4 ± 2.2	0.069	-0.05	1.25	0.60
Fatigue	8.3 ± 5.4	2.5 ± 2.5	0.002*	0.43	2.03	0.35
Confusion	6.6 ± 3.6	4.7 ± 2.3	0.026*	0.09	1.45	0.79
Vigor	10.4 ± 3.9	10.1 ± 6.2	0.882	-0.55	0.64	0.05
Sleep Quality	2.5 ± 1.1	3.9 ± 0.7	0.009*	1.67	0.23	0.97
Sleep Quantity (min)	436.4 ± 100.1	480 ± 37.9	0.167	-1.06	.18	0.45

Values are means ± SD. SD, standard deviation. * indicates statistical significance (p < 0.05).

Table 3. Repeated Measure Correlation Matrix of Mood Subscales, Perceived Exertion, Sleep, and Training Volume.

	Tension	Depression	Anger	Fatigue	Confusion Vigor		TMD	Sleep Quality	Sleep Quantity	SMI	RPE	Training Volume
Tension	1											
Depression	0.651*	1										
Anger	0.589*	0.704*	1									
Fatigue	0.462*	0.518*	0.530*	1								
Confusion	0.672*	0.581*	0.602*	0.602*	1							
Vigor	-0.270*	-0.286*	-0.240*	-0.398*	-0.303*	1						
TMD	0.793*	0.829*	0.786*	0.762*	0.782*	-0.595*	1					
Sleep Quality	-0.263*	-0.220*	-0.167*	-0.186*	-0.215*	0.190*	-0.277*	1				
Sleep Quantity	-0.190*	-0.147*	-0.056	-0.063	-0.102	-0.102*	-0.178*	0.559*	1			
SMI	-0.053	0.007	0.138	-0.052	-0.009	-0.898	0.029	0.306	0.250	1		
RPE	0.156*	0.074	0.217*	0.314*	0.228*	-0.220*	0.259*	-0.126	-0.050	0.143	1	
Training Volume	-0.025	0.002	0.023	-0.116	-0.018	0.108	-0.059	-0.080	-0.025	0.291*	0.218*	1

Values represent rmcorr correlation coefficients (r_m); * indicates statistical significance (p < 0.05).

Self-Motivation Index (SMI)

SMI scores were not significantly correlated with TMD or mood subscales (p > 0.05). However, training load was positively correlated with SMI (r_m = 0.291).

Perceptual Responses

Weekly training distance was positively associated with RPE ($r_m = 0.218$, $p < 0.05$). Internal load, quantified using RPE, was significantly correlated with several mood variables, including tension ($r_m = 0.156$), anger ($r_m = 0.217$), fatigue ($r_m = 0.314$), confusion ($r_m = 0.228$), and TMD ($r_m = 0.259$), and negatively associated with vigor ($r_m = -0.22$) (all $p < 0.05$).

Sleep

Sleep quality increased significantly from early to late season ($p = 0.009$, Cohen's $d = 0.97$, 95% CI -1.672 to -.226; table 2). Sleep quality was significantly correlated with all the mood subscales and TMD **(Table 3)**. Sleep quantity was negatively correlated with tension ($r_m = -0.263$), depression ($r_m = -0.22$), fatigue ($r_m = -0.126$), anger ($r_m = -0.167$), confusion ($r_m = -0.215$) and positively associated with vigor ($r_m = 0.19$). Additionally, sleep quality and quantity were found to be positively correlated ($r_m = 0.559$).

Training Load

Average weekly training distance (i.e., external load; training volume) ranged from approximately 15 to 45 km across the season (Figure 1) and was not significantly associated with mood subscales or TMD ($p > 0.05$).

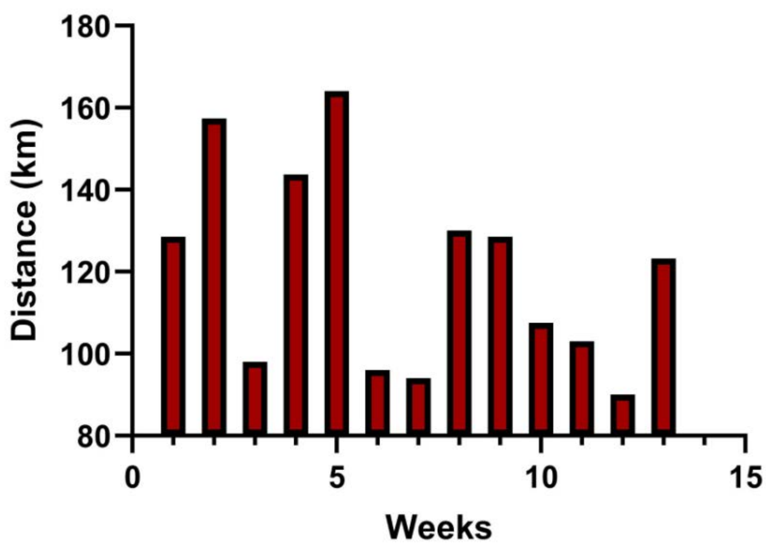

Figure 1. Weekly training distance (km) across the competitive season. Weeks 2, 3, 5, 7, 8, 11, and 13 included competitions during the weekends.

Discussion

This prospective observational study examined changes in mood states, training load, sleep, and perceptual responses across a competitive season in collegiate female rowers. We hypothesized that mood disturbance would decrease as the season progressed, reflecting adaptation to training and competitive demands, and that mood states would be associated with perceived exertion and sleep-related factors. The primary findings were that total mood disturbance (TMD), fatigue, and confusion significantly decreased from early to late season, while sleep quality improved. In contrast, training volume was not significantly associated with mood disturbance. However, perceived exertion and sleep variables demonstrated consistent relationships with mood states.

Additionally, training volume was positively associated with self-motivation (SMI), despite the absence of a relationship between SMI and mood disturbance.

Mood States Across the Competitive Season

A key finding of this study was the reduction in TMD, fatigue, and confusion across the competitive season. These improvements were supported by statistically significant differences and confidence intervals that did not cross zero, indicating a consistent reduction in negative mood states from early to late season. For example, the reduction in fatigue was associated with a 95% confidence interval ranging from 0.43 to 2.03 units, suggesting a meaningful improvement in perceived fatigue over time. Similarly, the reduction in confusion (95% CI: 0.09 to 1.45) indicates that athletes experienced greater psychological clarity as the season progressed. Although the confidence intervals were relatively wide, likely reflecting the modest sample size, they nevertheless provide an estimate of the magnitude and precision of the observed seasonal changes. The corresponding effect sizes further support the practical relevance of these findings, indicating meaningful improvements in psychological well-being as the competitive season progressed.

These findings are consistent with previous research demonstrating that mood states fluctuate in response to training demands and recovery status. Earlier work by Morgan and colleagues reported increases in mood disturbance during periods of intensified training in swimmers, with improvements occurring following reductions in training load.[3] Similarly, Raglin and colleagues observed changes in mood states across training cycles in collegiate athletes.[2] Mood state monitoring has therefore been widely used as an indicator of recovery status and potential maladaptation to training.[5,6]

In the present study, however, weekly training distance was not significantly associated with TMD or individual mood subscales. One possible explanation is that the overall training load experienced by the athletes may have been well tolerated due to progressive adaptation across the season. Additionally, the training program may have been effectively periodized, allowing athletes to adapt physiologically and psychologically to the demands of training. Rowing training programs typically involve high training volumes distributed across varied intensities, which may facilitate gradual adaptation and reduce the likelihood of cumulative psychological strain.[25]

Another potential explanation is that mood disturbance early in the season may have been influenced by factors beyond training load alone. Collegiate athletes often experience psychological stress related to academic responsibilities, team selection, and competition preparation.[13] Early-season uncertainty regarding crew selection or performance expectations may therefore contribute to elevated fatigue and confusion scores. As the season progresses and athletes become more accustomed to training routines and competitive demands, mood states may stabilize or improve.

Self-Motivation and Training Load

An interesting finding in the present study was that training volume was positively correlated with self-motivation (SMI), while SMI was not significantly related to TMD or the POMS mood subscales. This pattern suggests that motivation and mood disturbance may represent distinct psychological constructs in trained athletes.

The Self-Motivation Inventory is generally considered to assess a relatively stable psychological trait related to persistence, goal commitment, and willingness to sustain effort under demanding conditions.[21] In contrast, the POMS primarily measures transient mood states that may fluctuate in response to situational stressors such as fatigue, competition stress, or academic demands.[1] As a result, motivation may remain relatively stable even when athletes experience temporary fluctuations in mood.[26]

This interpretation aligns partially with earlier work by Raglin and colleagues examining mood and self-motivation in female collegiate rowers attempting to qualify for a varsity team.[1] In that study, unsuccessful rowers demonstrated lower levels of self-motivation and greater mood disturbance compared with successful athletes. However, the present findings differ in that training volume was associated with self-motivation but not with mood disturbance. One explanation may be that all participants in the current study were already established members of a varsity rowing team, resulting in a relatively homogeneous motivational profile compared with the selection-based environment examined by Raglin et al.[1] Consequently, training load may have reflected the athletes' motivation to engage in training rather than mood-related responses to training stress.

Another possible interpretation is that motivation may function as a psychological buffer that allows athletes to tolerate higher training loads despite fluctuations in mood.[27] Highly motivated athletes may perceive demanding training sessions as meaningful challenges rather than as psychological stressors.[28] Within the framework of the mental health model of sport performance, athletes who maintain a positive psychological profile and strong intrinsic motivation may be better equipped to sustain training engagement and performance under physically demanding conditions.[10]

Perceived Exertion and Mood States

Perceived exertion demonstrated consistent associations with several mood subscales, including tension, anger, fatigue, confusion, and TMD. These findings suggest that athletes experiencing greater internal training stress also reported higher levels of negative mood states. Importantly, perceived exertion represents an indicator of internal training load, reflecting the integrated physiological and psychological demands experienced during exercise.[29]

Previous research has demonstrated that subjective measures such as perceived exertion often provide valuable insight into athlete training responses and recovery status.[23] In many cases, subjective monitoring tools may capture athlete well-being more sensitively than external training metrics alone.[30] The present findings support this perspective, as RPE demonstrated relationships with mood states despite the absence of associations between mood disturbance and weekly training distance.

Sleep and Mood States

Sleep quality improved significantly over the course of the competitive season and demonstrated significant associations with multiple mood variables. Athletes reporting higher sleep quality tended to exhibit lower levels of tension, depression, anger, fatigue, confusion, and TMD. These findings are consistent with evidence suggesting that sleep plays an important role in psychological well-being and emotional regulation.[31]

Although sleep quantity did not change significantly across the season, it was associated with several mood variables, suggesting that both sleep duration and perceived sleep quality contribute to psychological recovery. However, sleep patterns in collegiate student-athletes are often influenced by academic and training schedules, which can introduce variability in sleep duration rather than promote consistency.[32] Despite this, sleep quality appears to be more closely linked to psychological well-being and mood regulation than sleep quantity alone.[32]

Practical Implications

Recent research highlights the importance of expanding scientific understanding of female athlete health and well-being.[14-16] Despite increasing participation of women in competitive sport, female athletes remain underrepresented in sport science research.[14] Additionally, collegiate athletes may face unique psychological stressors related to academic demands, competition schedules, and team dynamics.[13]

The present findings suggest that routine monitoring of mood states, perceived exertion, and sleep may provide valuable insight into athlete well-being across a competitive season. Importantly, internal load indicators such as perceived exertion and sleep quality may offer more sensitive indicators of psychological stress than external training metrics such as training volume alone. Integrating these measures into athlete monitoring programs may therefore assist coaches and practitioners in identifying early signs of maladaptation and optimizing recovery strategies.

Limitations and Future Directions

Several limitations should be considered when interpreting these findings, and each provides guidance for future research. First, the relatively small sample size limits generalizability and contributes to wider confidence intervals around some estimates; future studies with larger cohorts are needed to confirm these findings and improve precision. Second, the observational design precludes causal inference regarding relationships between training load, sleep, and mood states; future research should employ longitudinal or experimental designs to better determine cause-and-effect relationships. Third, additional factors that may influence psychological well-being - including academic stress, nutritional status, and recovery practices - were not directly assessed; future studies should incorporate these variables to clarify their contributions to mood and motivation in athletes. Fourth, although menstrual cycle phase was documented descriptively, hormonal verification was not performed, which may influence mood variability in female athletes; future work should include hormonal confirmation to account for potential effects of menstrual cycle fluctuations on mood and training responses.[14-16] Finally, while repeated-measures correlation was used to examine within-subject associations, more advanced repeated-measures statistical approaches, such as linear mixed-effects models or hierarchical modeling, could be employed in future studies to better account for individual variability and the nested structure of longitudinal athletic data.

Conclusion

In summary, this longitudinal study provides novel insights into the interaction between mood states, sleep, perceptual responses, and training load in collegiate female rowers across a competitive season. Significant reductions in TMD, fatigue, and confusion suggest that athletes experienced progressive psychological adaptation as the season advanced. Mood states were more closely associated with perceived exertion and sleep variables than with external training volume, highlighting the importance of monitoring internal training load and recovery status. Additionally, the observed association between training volume and self-motivation suggests that motivational factors may influence athletes' engagement with training demands independently of mood disturbance. Together, these findings support the integration of psychological and perceptual monitoring strategies to enhance athlete well-being and performance in collegiate sport environments.

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