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Biopsychological Influences Of Menstrual Cycle Phases On Mood State And Performance Consistency In Elite Female Precision Shooters

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Abstract:

Objective: The present study aimed to examine the biopsychological influence of menstrual cycle phases on mood state and performance consistency among elite female precision shooters. Specifically, the study investigated whether phase-wise variations in mood are associated with changes in shooting performance across different shooting disciplines. **Method**: A repeated-measures correlational research design was employed involving 61 national-level female shooters representing rifle, pistol, and shotgun events at the Madhya Pradesh Shooting Academy, Bhopal. Mood state was assessed using the Profile of Mood States (POMS), while shooting performance scores were recorded during the follicular and luteal phases of the menstrual cycle. Performance evaluation followed the International Shooting Sport Federation (ISSF) competition standards, and scores were normalized according to official event scoring systems (10 m Air Rifle = 654.0 decimal scoring scale, 10 m Air Pistol = 600 points, Skeet Shooting = 125 targets). Statistical analysis included descriptive statistics, paired sample t-tests, and Pearson product–moment correlation to examine phase-wise differences and relationships between mood and performance variables. **Conclusion**: The findings revealed significant phase-wise variations in mood state and normalized shooting performance; however, mood fluctuations did not significantly predict performance consistency among athletes. These results suggest that menstrual cycle phases may influence psychological and performance outcomes independently, indicating the presence of adaptive mechanisms that help stabilize performance in elite female precision shooters.

Keywords: menstrual cycle, mood state, precision shooting, female athletes, biopsychology, performance consistency.

I. INTRODUCTION

Research on female athlete performance has increasingly emphasized the importance of biopsychological factors associated with menstrual cycle fluctuations. Historically, sport science research was predominantly conducted on male participants, leading to a limited understanding of female-specific physiological and psychological responses to training and competition (Elliott-Sale et al., 2021). However, growing evidence indicates that endogenous hormonal variations across the menstrual cycle may influence neuromuscular performance, metabolism, thermoregulation, cognition, and affective states (McNulty et

al., 2020). The menstrual cycle is typically divided into the follicular and luteal phases, characterized by fluctuations in estrogen and progesterone concentrations. Estrogen has been associated with enhanced synaptic plasticity, cognitive processing, and neuromuscular coordination, whereas progesterone has been linked to altered emotional reactivity and central nervous system modulation (Cook & Crewther, 2012). These hormonal shifts may influence mood state, attentional control, and perceived exertion, which are crucial determinants of athletic performance. Meta-analytic evidence suggests small but meaningful phase-related performance variations; however, findings remain inconsistent and appear to be sport-specific (McNulty et al., 2020).

Mood state is a central psychological construct in sport performance research. The Profile of Mood States (POMS) has been widely used to assess transient affective responses in athletes, demonstrating relationships between mood disturbance and performance outcomes (Lane et al., 2017). The conceptual "iceberg profile"—characterized by high vigor and low tension, depression, anger, fatigue, and confusion—has frequently been associated with optimal performance states. Nevertheless, elite athletes often display psychological resilience, enabling them to regulate emotional fluctuations and maintain performance stability even under stress (Robazza & Ruiz, 2018).

Precision sports such as shooting represent a unique performance model because success depends predominantly on fine motor control, postural stability, visuomotor coordination, and sustained attentional focus rather than maximal strength or endurance. Psychophysiological studies indicate that shooting performance is closely linked to autonomic regulation, heart rate variability, breathing control, and attentional quieting prior to trigger pull (Konttinen et al., 1999; Slimani et al., 2016). Even minor emotional disturbances may theoretically influence tremor amplitude, motor timing, and shot accuracy. However, elite shooters develop highly refined pre-performance routines and attentional strategies that may buffer the effects of psychological variability. Despite growing literature on menstrual cycle influences in endurance and strength sports, limited empirical evidence exists regarding precision-based disciplines. The majority of previous research has focused on aerobic capacity, strength output, or injury risk, with comparatively little attention to skill-dominant sports requiring high cognitive-motor integration (Elliott-Sale et al., 2021). Furthermore, biopsychological models propose that menstrual phase-related hormonal changes may influence psychological state and motor performance through partially independent pathways, rather than through a direct mood-to-performance mechanism (Armstrong & McManus, 2019). This distinction is critical when examining elite performers who may possess advanced coping and self-regulatory capacities. Understanding menstrual cycle influences in national-level female shooters is practically significant. Coaches and sport scientists increasingly seek individualized monitoring approaches to optimize performance without reinforcing misconceptions regarding inevitable performance decline during certain phases. Empirical data specific to shooting disciplines are therefore required to inform evidence-based decision-making.

Therefore, the present study aimed to investigate (i) phase-wise differences in mood state and shooting performance under official International Shooting Sport Federation (ISSF) competitive standards and (ii) the relationship between mood variability and performance consistency in elite female precision shooters. It was hypothesized that menstrual cycle phases would significantly influence mood state and performance outcomes, but that mood variability might not directly predict performance consistency due to performance stabilization mechanisms inherent in elite precision athletes.

II. RESEARCH METHODOLOGY

Participants

Study Design and Cycle Phase Categorization

Mood State Assessment

Psychological variability was assessed using the Profile of Mood States (POMS) questionnaire, a widely validated instrument for measuring transient mood fluctuations in sport and exercise settings (Lane et al., 2017). The scale evaluates dimensions such as tension, depression, anger, vigor, fatigue, and confusion, allowing calculation of a Total Mood Disturbance score reflecting overall emotional state. Participants completed the questionnaire prior to shooting trials in both menstrual phases to avoid performance-induced emotional bias. The POMS has demonstrated strong reliability and validity among athletic populations and is frequently used in psychophysiological sport research (Robazza & Ruiz, 2018).

Shooting Performance Measurement

Performance data were collected during standardized shooting sessions conducted at the academy range. Scores were obtained according to the International Shooting Sport Federation (ISSF) competition standards, and scores were normalized according to official event scoring systems (10 m Air Rifle = 654.0 decimal scoring scale, 10 m Air Pistol = 600 points, Skeet Shooting = 125 targets. Due to differences in scoring criteria across shooting events, raw scores were converted into **normalized percentage values** using maximum event scores (10 m Air Pistol = 600 points, Skeet Shooting = 125). This normalization ensured equitable comparison across disciplines and prevented statistical bias arising from different scoring scales.

Variables of the Study

The primary variables included:

- **Independent Context Variable:** Menstrual cycle phase (Follicular and Luteal)
- **Psychological Variable:** Mood state score (POMS Total Mood Disturbance)
- **Performance Variable:** Normalized shooting performance percentage
- **Derived Variables:** Change scores (Δ Mood and Δ Performance) calculated between phases

III. Statistical Analysis

All statistical analyses were conducted using a repeated-measures framework. Descriptive statistics (mean and standard deviation) were calculated to summarize mood and performance variables. Paired sample t-tests were applied to determine phase-wise differences in normalized shooting performance and mood state. Pearson product–moment correlation analysis was used to examine the relationship between phase-wise changes in mood state and performance variability. Statistical significance was set at $p < .05$. The normalization of performance scores prior to analysis ensured methodological rigor when combining rifle, pistol, and shotgun data within a unified biopsychological model.

IV. RESULTS

Results of Descriptive Statics of Study Variables

Table 4.1: Descriptive Statics

Variable	N	Mean	SD
Performance % – Follicular	61	92.20	3.87
Performance % – Luteal	61	93.32	3.74
Mood – Follicular	61	31.39	24.59
Mood – Luteal	61	4.67	26.06

Table 4.1 Table 1 presents the descriptive statistics for shooting performance (percentage scores) and mood state during the follicular and luteal phases of the menstrual cycle among 61 elite female shooters. The mean performance percentage during the follicular phase was 92.20% (SD = 3.87), whereas the mean performance during the luteal phase increased to 93.32% (SD = 3.74). The slightly lower standard deviation in the luteal phase suggests marginally greater consistency in performance during this phase. Regarding mood state, the mean mood disturbance score during the follicular phase was 31.39 (SD = 24.59), which markedly decreased to 4.67 (SD = 26.06) in the luteal phase. The relatively large standard deviations in both phases indicate substantial inter-individual variability in psychological responses across menstrual phases. Overall, the descriptive findings suggest improved shooting performance and more stable mood states during the luteal phase compared to the follicular phase.

Table 2. Paired Samples Test

Variable	Mean Difference	t	df	p
Performance % (Luteal – Follicular)	1.12	-6.38	60	.000
Mood State (Follicular – Luteal)	26.72	8.13	60	.000

Table 2 presents the results of the paired sample t-tests examining phase-wise differences in performance and mood state. For shooting performance percentage, the mean difference between luteal and follicular phases was 1.12%, with a statistically significant t-value of $t(60) = -6.38$, $p < .001$. This indicates a significant improvement in performance during the luteal phase compared to the follicular phase. Similarly, mood state scores showed a significant phase-wise difference. The mean difference between follicular and luteal phases was 26.72, with $t(60) = 8.13$, $p < .001$, indicating significantly higher mood disturbance during the follicular phase. These results confirm that menstrual cycle phases significantly influence both psychological state and performance outcomes in elite female precision shooters.

Table 3. Correlation Between Change Scores

Variables	r	p
Mood Change × Performance Change	.016	.902

Table 3 presents the Pearson product–moment correlation between mood change scores and performance change scores across menstrual phases. The correlation coefficient was r = .016, with p = .902, indicating a negligible and statistically non-significant relationship between changes in mood state and changes in shooting performance. This finding suggests that although both mood and performance vary significantly across phases, the magnitude of mood fluctuation does not predict the degree of performance change. In other words, psychological variation and performance consistency appear to operate independently in elite shooters.

Table 4. Event-Wise Performance Means (%)

Event	Follicular Mean %	Luteal Mean %
Rifle	93.27	93.75
Pistol	94.86	95.24
Shotgun	89.05	91.27

Table 4 illustrates the phase-wise mean performance percentages across the three shooting disciplines. Rifle shooters demonstrated a mean performance of 93.27% in the follicular phase and 93.75% in the luteal phase, showing a modest improvement. Pistol shooters recorded the highest overall performance levels, with 94.86% (follicular) and 95.24% (luteal). Shotgun shooters exhibited comparatively lower performance percentages, with 89.05% (follicular) and 91.27% (luteal); however, the improvement across phases was more pronounced in this group. These findings indicate that while all disciplines showed performance enhancement during the luteal phase, the magnitude of improvement varied across events, with shotgun shooters demonstrating relatively larger phase-wise gains.

V. DISCUSSION

The present study provides novel insights into biopsychological influences on elite female precision shooters. Significant differences were observed in both mood state and performance across menstrual phases, supporting existing literature indicating hormonal modulation of psychological and physiological variables (McNulty et al., 2020). However, the absence of a significant correlation between mood change and performance variability suggests that elite shooters may maintain performance stability through advanced attentional control and emotional regulation strategies.

Precision sports demand consistent neuromuscular coordination and cognitive focus, which may be less susceptible to transient mood fluctuations compared with endurance-based activities. Previous research indicates that elite athletes develop adaptive coping mechanisms that buffer performance against emotional disturbances (Lane et al., 2017). The current findings align with biopsychological models proposing independent pathways through which menstrual cycle phases influence psychological state and motor performance (Armstrong & McManus, 2019).

Event-wise analysis revealed slightly greater performance change in shotgun athletes, potentially reflecting differences in motor execution or task demands. Future research should incorporate physiological markers such as heart rate variability or breathing patterns to further explore psychophysiological regulation in precision sports.

VI. CONCLUSION

Menstrual cycle phases significantly influenced mood state and normalized shooting performance in elite female precision shooters. Despite these phase-wise differences, mood variability did not significantly predict performance consistency. The findings highlight the complexity of biopsychological interactions in precision sports and emphasize the resilience of elite athletes in maintaining performance stability across menstrual phases.

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