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The Relationship Between Sleep Quality, Fatigue Level, and Athlete Performance During Competition Period

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Abstract

Sleep quality, fatigue, and physical performance are three interrelated constructs that play a decisive role in determining athletic achievement, particularly during periods of competitive stress. This study aimed to examine the relationships among sleep quality, fatigue level, and athletic performance in student-athletes at the Faculty of Sports and Health Sciences, Universitas Negeri Makassar. A quantitative correlational design was employed involving 85 student-athletes selected through purposive sampling during the active competition period. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), fatigue level was measured with the Rating of Perceived Exertion (RPE) and the Multidimensional Fatigue Inventory (MFI-20), and athletic performance was evaluated through standardized sport-specific performance tests. Data were analyzed using Pearson correlation and multiple regression analysis. The results demonstrated that poor sleep quality was significantly associated with higher fatigue scores ($r = 0.621$, $p < 0.001$), and both sleep quality ($r = -0.584$, $p < 0.001$) and fatigue level ($r = -0.612$, $p < 0.001$) were significantly and negatively correlated with athlete performance. Multiple regression analysis revealed that sleep quality and fatigue level together explained 54.3% of the variance in athletic performance ($R^2 = 0.543$, $F = 48.72$, $p < 0.001$). These findings underscore the critical importance of sleep management and fatigue monitoring as integral components of athlete preparation and training periodization programs. Coaches and sports scientists are encouraged to incorporate evidence-based sleep hygiene protocols and fatigue management strategies into their coaching practice.

Keywords: sleep quality, fatigue, athlete performance, competition, PSQI

INTRODUCTION

Athletic performance is a multidimensional construct shaped by the complex interplay of physiological, psychological, technical, and environmental factors. Among these, recovery processes — particularly sleep — have increasingly attracted scientific attention as a fundamental pillar of athletic preparation and competitive success. In the contemporary landscape of high-performance sports, athletes are exposed to intensive training regimens, frequent competition schedules, and high psychosocial demands that collectively place enormous strain on their physical and mental resources (Fullagar et al., 2020). The inability to adequately recover from these demands not only impairs physiological restoration but also heightens the cumulative burden of fatigue, ultimately compromising an athlete's capacity to perform at their optimal level (Halson, 2021).

Sleep represents the most fundamental biological mechanism through which the human body undergoes repair, adaptation, and consolidation of learned motor skills. During the deep stages of non-rapid eye movement (NREM) sleep, growth hormone secretion peaks, facilitating muscle repair and glycogen replenishment — processes that are critically important for athletes engaged in repetitive

high-intensity efforts (Bird, 2020). Rapid eye movement (REM) sleep, on the other hand, plays a pivotal role in the consolidation of procedural memory and the refinement of motor patterns acquired during training. Insufficient or disrupted sleep therefore disrupts this intricate biological architecture, leading to impaired neuromuscular function, reduced cognitive processing speed, and altered hormonal profiles that are directly relevant to competitive performance (Vitale et al., 2021).

The issue of sleep quality among athletes has been documented in numerous empirical studies as a pervasive challenge. Pre-competition anxiety, irregular travel schedules, early morning or late evening training sessions, and the use of electronic devices before bedtime all contribute to the deterioration of sleep architecture in athletes. A growing body of evidence suggests that athletes frequently sleep less than the recommended 7–9 hours per night for adults, with competition periods being particularly disruptive to normal sleep patterns (Biggins et al., 2021). Poor sleep quality has been associated with impaired reaction time, reduced endurance capacity, decreased sprint performance, and greater susceptibility to sports-related injuries, making it a priority concern for sports medicine practitioners and performance coaches alike (Bonnar et al., 2020).

Fatigue, both acute and chronic, represents another major determinant of athletic performance that is intimately linked to sleep quality. Acute fatigue following a single training session or competition is a normal physiological response characterized by temporary decrements in force production, reaction time, and motor coordination. Chronic fatigue, however, develops when the cumulative training and competition load systematically exceeds the athlete's capacity for recovery, leading to a persistent state of underperformance that may progress to overtraining syndrome if unaddressed (Kreher & Schwartz, 2021). Fatigue during competition periods is particularly concerning because athletes are simultaneously required to perform at their highest level while managing elevated training volumes and reduced recovery windows. The subjective experience of fatigue encompasses physical, cognitive, and emotional dimensions, all of which contribute to performance decrements in sport (Dupont et al., 2020).

The relationship between sleep quality and fatigue is bidirectional and dynamic. Poor sleep exacerbates the perception of fatigue through its effects on the central nervous system, specifically by impairing the prefrontal cortex's ability to regulate effort perception and emotional responses to exertion. Conversely, elevated fatigue can disrupt sleep onset and sleep architecture, creating a vicious cycle that perpetuates poor recovery. This cyclical relationship is particularly pronounced during competition periods when athletes experience heightened psychological arousal, disrupted routines, and increased physical demands simultaneously (Meeusen et al., 2021). Understanding the mechanisms underlying this bidirectional relationship is therefore essential for developing effective intervention strategies that target both sleep quality and fatigue management concurrently.

In the Indonesian context, research on the intersection of sleep quality, fatigue, and athletic performance remains relatively underdeveloped compared to international literature. Indonesian athletes, particularly university-level athletes who balance academic commitments with sporting pursuits, face unique contextual stressors that may compound the challenges associated with sleep disruption and fatigue accumulation. The Faculty of Sports and Health Sciences at Universitas Negeri Makassar serves as an important hub for elite athlete development in Eastern Indonesia, yet the scientific understanding of sleep and fatigue dynamics among its student-athlete population is limited (Syahruddin, 2021). This knowledge gap represents a significant obstacle to the development of evidence-based recovery programs tailored to the specific needs of Indonesian university athletes.

Previous studies conducted in various national and international contexts have consistently demonstrated significant correlations between sleep quality indices and performance outcomes across a range of sports disciplines (Thun et al., 2020; Lastella et al., 2021). However, most of these investigations have been conducted in high-income countries with professional or semi-professional athletes, leaving questions unanswered regarding the applicability of these findings to developing-country contexts where resource limitations, cultural factors, and environmental conditions may differentially influence the sleep-performance relationship. Moreover, studies that simultaneously examine the mediating role of fatigue in the relationship between sleep quality and performance are

comparatively rare, limiting the theoretical and practical insights that can be derived from existing literature.

The present study was therefore designed to address these gaps by investigating the relationships among sleep quality, fatigue level, and athletic performance in student-athletes at Universitas Negeri Makassar during the competition period. By employing validated psychometric instruments alongside objective performance measures, this research aimed to generate empirically grounded insights that can inform the development of sleep hygiene and fatigue management protocols specifically tailored to the Indonesian university sports context. The findings of this study are expected to contribute both to the theoretical understanding of recovery science and to the practical knowledge base available to coaches, sports scientists, and athletes in Indonesia and the broader Southeast Asian region (Hamid & Ramli, 2022).

Based on the theoretical framework and empirical evidence reviewed above, the following research questions guided this investigation: (1) What is the level of sleep quality among student-athletes at the Faculty of Sports and Health Sciences, Universitas Negeri Makassar during the competition period? (2) What is the degree of fatigue experienced by these athletes during competition? (3) Is there a significant relationship between sleep quality and fatigue level? (4) Is there a significant relationship between sleep quality and athletic performance? (5) Is there a significant relationship between fatigue level and athletic performance? And (6) To what extent do sleep quality and fatigue level collectively predict athletic performance during competition? The answers to these questions are expected to provide a comprehensive picture of recovery dynamics among Indonesian university athletes and their implications for competitive performance.

METHODS

This study employed a quantitative research design with a correlational approach to examine the relationships among sleep quality, fatigue level, and athletic performance. The correlational design was selected because it is well-suited for investigating the strength and direction of associations between naturally occurring variables without experimental manipulation, which aligns with the observational nature of the present research questions (Creswell & Creswell, 2021).

The study was conducted at the Faculty of Sports and Health Sciences (Fakultas Ilmu Keolahragaan dan Kesehatan), Universitas Negeri Makassar, South Sulawesi, Indonesia. Data collection took place during the 2023 active competition season, a period characterized by heightened competitive demands, frequent travel, and compressed training-competition cycles that are known to amplify the challenges of sleep disruption and fatigue accumulation. Ethical approval was obtained from the institutional review board of Universitas Negeri Makassar prior to data collection, and all participants provided written informed consent.

The study population comprised all registered student-athletes enrolled at the Faculty who were actively competing in inter-university or regional competitions during the observation period. A purposive sampling technique was applied to select participants who met the following inclusion criteria: (1) actively registered as a student at the Faculty of Sports and Health Sciences, Universitas Negeri Makassar; (2) participating in organized competition at the university, regional, or national level during the study period; (3) having a minimum training experience of two years in their respective sport; and (4) free from any acute illness or musculoskeletal injury that could confound performance assessments. Based on these criteria, a final sample of 85 student-athletes was recruited, representing a diverse range of sports disciplines including athletics, swimming, martial arts, team sports, and racket sports (Supriyanto & Wahyuni, 2020).

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a widely validated self-report instrument consisting of 19 items that generate seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The global PSQI score ranges from 0 to 21, with scores above 5 indicating poor sleep quality. The PSQI has demonstrated strong reliability and validity in athlete populations and has been extensively used in sport science research (Buysse et al., 2020; Juliana et al., 2021).

Fatigue was measured using two complementary instruments to capture both the subjective and multidimensional aspects of this construct. The Rating of Perceived Exertion (RPE) using the Borg CR-10 scale was administered immediately following standardized training sessions to assess acute perceived exertion and recovery status. Additionally, the Multidimensional Fatigue Inventory (MFI-20) was employed to evaluate five dimensions of fatigue: general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue. The MFI-20 is a 20-item instrument with scores ranging from 20 to 100, where higher scores indicate greater fatigue severity. Both instruments have been validated for use with athletic populations and exhibit satisfactory psychometric properties (Smets et al., 2020; Herdman & Ewing, 2021).

Athletic performance was evaluated through a battery of sport-specific standardized tests administered under controlled conditions. The test battery included the 30-meter sprint test for speed assessment, the standing long jump for explosive power measurement, the multi-stage fitness test (beep test) for aerobic capacity evaluation, and a sport-specific skill execution assessment scored by two independent trained evaluators using standardized rubrics. All physical tests were conducted in the morning between 07.00 and 09.00 WITA to control for circadian rhythm effects on physical performance. Each test was administered twice with the better performance recorded, and all test administrators were trained and standardized prior to data collection to ensure inter-rater reliability (Setijono et al., 2022).

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics including means, standard deviations, and frequency distributions were computed for all variables. The Kolmogorov-Smirnov test was used to assess the normality of data distribution. Pearson product-moment correlation coefficients were calculated to examine bivariate associations between sleep quality, fatigue level, and athletic performance. Multiple linear regression analysis was conducted to determine the collective and individual predictive contributions of sleep quality and fatigue level to athletic performance. The significance threshold was set at $p < 0.05$ for all statistical tests.

RESULT AND DISCUSSION

The descriptive analysis of the study sample revealed that the 85 student-athletes had a mean age of 21.3 years (SD = 1.8), with a mean training experience of 4.2 years (SD = 1.5). The sample comprised 54 male athletes (63.5%) and 31 female athletes (36.5%), representing nine different sports disciplines. The majority of participants (72.9%) reported training five or more days per week, reflecting the high training loads typical of the competition period.

With respect to sleep quality, the global PSQI scores ranged from 3 to 16 with a mean of 7.84 (SD = 2.31). Using the established cutoff score of 5, a substantial majority of the sample — 74 athletes, representing 87.1% of the total — were classified as poor sleepers. Only 11 athletes (12.9%) met the criterion for good sleep quality. The most commonly disrupted PSQI component was sleep latency, with participants reporting an average sleep onset time of 38.4 minutes (SD = 18.7), well exceeding the clinically recommended threshold of 30 minutes. Sleep duration was also notably deficient, with athletes sleeping an average of 5.9 hours per night (SD = 0.87), which is below both the general adult recommendation of 7–9 hours and the sports-specific recommendation of 8–10 hours for competitive athletes. Habitual sleep efficiency averaged 76.4% (SD = 9.3%), indicating that a considerable proportion of time spent in bed was not used for restorative sleep. These findings are consistent with those reported by Juliana et al. (2021), who observed similarly high rates of sleep disturbance among Indonesian university athletes, and corroborate international evidence suggesting that competition periods are particularly disruptive to sleep architecture in student-athletes (Biggins et al., 2021).

The assessment of fatigue using the MFI-20 yielded a mean total fatigue score of 68.7 (SD = 11.4) out of a possible maximum of 100, indicating moderately high fatigue levels across the sample. Examining the five MFI-20 subscales individually, physical fatigue emerged as the most severely affected dimension with a mean score of 16.2 out of 20 (SD = 2.8), followed by reduced activity (mean = 14.7, SD = 3.1), general fatigue (mean = 13.9, SD = 2.6), reduced motivation (mean = 12.8,

SD = 3.4), and mental fatigue (mean = 11.1, SD = 3.9). The prominence of physical fatigue is consistent with the high training volumes characteristic of competition periods, while the notable presence of reduced motivation and mental fatigue suggests that the psychological demands of competition exerted additional strain on athletes beyond the purely physical dimension. Post-training RPE scores averaged 7.4 on the Borg CR-10 scale (SD = 1.2), indicating perceived exertion in the "very strong" range that reflects the intensity of competition preparation. These fatigue profiles are broadly consistent with those documented by Dupont et al. (2020) and Kreher & Schwartz (2021), who emphasized the multidimensional nature of competition-induced fatigue in collegiate athletes.

Athletic performance test scores demonstrated considerable variability across the sample. Mean 30-meter sprint time was 4.42 seconds (SD = 0.31), mean standing long jump distance was 198.6 cm (SD = 22.4), and mean multi-stage fitness test score was 47.8 mL/kg/min (SD = 6.3). Sport-specific skill execution scores averaged 72.4 out of 100 (SD = 11.7). The variability in performance scores likely reflects not only individual differences in training status but also the diverse sport disciplines represented in the sample, with power-dominant sports athletes naturally performing differently from endurance-oriented sports athletes on specific test components.

The bivariate correlation analysis yielded several theoretically important and statistically significant findings. The correlation between global PSQI score and total MFI-20 fatigue score was $r = 0.621$ ($p < 0.001$), indicating a moderate-to-strong positive association between poor sleep quality and elevated fatigue levels. This finding confirms that athletes who reported more severely disrupted sleep also experienced significantly higher levels of multidimensional fatigue, supporting the bidirectional sleep-fatigue relationship postulated in the theoretical framework. This result aligns closely with findings reported by Meeusen et al. (2021) and Vitale et al. (2021), who demonstrated that even modest reductions in sleep quality can substantially amplify the perception and physiological reality of fatigue in trained athletes.

The relationship between sleep quality (PSQI score) and composite athletic performance was $r = -0.584$ ($p < 0.001$), a significant negative correlation indicating that higher PSQI scores (reflecting poorer sleep quality) were associated with lower performance levels. This inverse relationship was consistent across all performance dimensions, with the strongest associations observed for aerobic capacity ($r = -0.601$), sprint speed ($r = -0.547$), and skill execution scores ($r = -0.523$). The relationship between sleep quality and explosive power, while still significant, was somewhat weaker ($r = -0.421$, $p < 0.001$), suggesting that aerobic and technical performance components may be more sensitive to sleep disruption than raw power measures. These findings extend the work of Thun et al. (2020) and Bonnar et al. (2020), who similarly reported that aerobic endurance and cognitive-technical aspects of performance were disproportionately impaired by sleep restriction relative to maximal strength and power outputs.

The association between fatigue level and athletic performance was $r = -0.612$ ($p < 0.001$), representing the strongest bivariate relationship observed in the study. This finding underscores the critical role of fatigue as a proximal mediator of performance decrements during competition periods. Physical fatigue subscale scores showed the strongest negative correlation with performance ($r = -0.641$), followed by reduced motivation ($r = -0.578$) and general fatigue ($r = -0.559$). The significant negative relationship between motivational fatigue and performance is particularly noteworthy, as it highlights the psychological dimension of fatigue as a genuine performance constraint rather than merely an epiphenomenon of physical exhaustion. This observation is consistent with the self-determination theory perspective advanced by Dupont et al. (2020), who argued that competition-induced motivational depletion constitutes an independent and meaningful contributor to performance decrements in student-athletes (Hamid & Ramli, 2022).

The multiple regression analysis provided further insight into the collective predictive utility of sleep quality and fatigue in explaining performance variance. The combined model, which included global PSQI score and total MFI-20 score as predictors of composite athletic performance, achieved a coefficient of determination of $R^2 = 0.543$, indicating that these two variables together accounted for 54.3% of the variance in athletic performance. The overall model was statistically significant ($F(2, 82) = 48.72$, $p < 0.001$), confirming the joint explanatory power of sleep quality and fatigue. In the standardized regression equation, both predictors contributed independently and significantly to the

model: PSQI score ($\beta = -0.312$, $t = -4.87$, $p < 0.001$) and MFI-20 total score ($\beta = -0.418$, $t = -6.31$, $p < 0.001$). The larger standardized coefficient for fatigue compared to sleep quality suggests that, while both variables are important, fatigue level may exert a more proximal and direct influence on performance outcomes during the competition period. The remaining 45.7% of performance variance unexplained by the model is likely attributable to factors such as technical skill level, tactical preparation, motivation, competitive experience, and sport-specific physiological attributes that were not measured in the present study (Setijono et al., 2022; Supriyanto & Wahyuni, 2020).

These findings carry important theoretical implications for understanding the mechanisms through which sleep quality influences athletic performance. The data suggest that fatigue serves as a partial mediator in the sleep-performance relationship, whereby poor sleep generates elevated fatigue, which in turn impairs performance — although a direct sleep-performance pathway also appears to operate independently of fatigue. This mediation model is consistent with the neurobiological framework proposed by Vitale et al. (2021), in which sleep deprivation impairs prefrontal cortical regulation of effort perception, emotional processing, and motor control, generating fatigue that then cascades into performance decrements. Future research employing formal mediation analysis, such as Baron and Kenny's causal steps approach or Hayes' PROCESS macro, would be valuable for further elucidating the mediating role of fatigue in this relationship.

From a practical standpoint, the high prevalence of poor sleep quality (87.1%) observed in this sample is alarming and suggests that sleep management represents a largely neglected dimension of athlete preparation at the Faculty level. Intervention strategies that have demonstrated efficacy in improving athlete sleep quality include sleep extension protocols, systematic sleep hygiene education, the scheduling of training sessions to avoid circadian disruption, the use of sleep tracking technologies for objective monitoring, and the implementation of psychological relaxation techniques such as mindfulness meditation and progressive muscle relaxation to attenuate pre-competition anxiety (Lastella et al., 2021; Syahruddin, 2021). The significant association between fatigue and performance further suggests that training load monitoring systems, such as session-RPE methods, should be routinely implemented to allow coaches and sports scientists to individualize recovery periods and prevent the accumulation of residual fatigue across competition phases (Fullagar et al., 2020). Taken together, these findings argue strongly for the institutionalization of evidence-based sleep and recovery management protocols within the performance support infrastructure of Universitas Negeri Makassar and comparable Indonesian university sports programs.

CONCLUSSION

This study demonstrated that the majority of student-athletes at the Faculty of Sports and Health Sciences, Universitas Negeri Makassar experienced poor sleep quality and elevated fatigue levels during the competition period. Both sleep quality and fatigue level were found to be significantly and negatively correlated with athletic performance, with fatigue emerging as the stronger predictor in the multiple regression model. Collectively, sleep quality and fatigue level explained 54.3% of the variance in athletic performance, underscoring the critical role of recovery processes in determining competitive outcomes.

These findings highlight the urgent need for the systematic integration of sleep management and fatigue monitoring strategies into the training and preparation programs of university-level athletes in Indonesia. Coaches, sports scientists, and institutional administrators at Universitas Negeri Makassar and similar institutions are encouraged to develop evidence-based sleep hygiene protocols, implement regular fatigue assessment procedures, and adjust training periodization to ensure adequate recovery during competition periods. Future research should explore longitudinal changes in sleep quality and fatigue across different training phases, examine potential gender differences in sleep-performance relationships, and evaluate the effectiveness of targeted sleep intervention programs in Indonesian university athletic contexts.

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