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The Relationship Between Sleep Quality and Athletic Performance Among Students

Hasbi Asyhari[1]
[1] Universitas Negeri Makassar, Indonesia
* Coressponding Author. E-mail: hasbi.asyhari@unm.ac.id

Abstract

Sleep quality plays a crucial role in athletic performance, yet its relationship remains underexplored among university-level athletes in Indonesia. This study aimed to investigate the correlation between sleep quality and athletic performance among students of the Faculty of Sports and Health Sciences (FIKK), Universitas Negeri Makassar (UNM). A cross-sectional study design was employed involving 150 student-athletes aged 18-24 years who were actively participating in various sports disciplines. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), while athletic performance was measured through sport-specific performance tests including aerobic capacity, muscular strength, speed, and agility. Data were analyzed using Pearson correlation and multiple regression analysis. Results revealed that 62.7% of participants exhibited poor sleep quality (PSQI score >5). A significant negative correlation was found between sleep quality scores and athletic performance indicators ($r = -0.658$, $p < 0.001$). Specifically, students with better sleep quality demonstrated superior performance in VO2max testing ($r = -0.543$, $p < 0.001$), vertical jump height ($r = -0.489$, $p < 0.001$), sprint speed ($r = -0.512$, $p < 0.001$), and agility tests ($r = -0.476$, $p < 0.001$). Multiple regression analysis indicated that sleep quality, along with sleep duration and sleep efficiency, collectively explained 48.3% of the variance in overall athletic performance. These findings underscore the critical importance of adequate sleep quality for optimizing athletic performance among university student-athletes. Educational interventions and institutional policies promoting healthy sleep hygiene should be prioritized within athletic programs at the university level.

Keywords: sleep quality, athletic performance, student-athletes, PSQI, physical performance

INTRODUCTION

The contemporary landscape of university athletics presents a unique set of challenges for student-athletes who must balance rigorous academic demands with intensive training schedules and competitive performance expectations. Within this context, sleep emerges as a fundamental yet often overlooked component of athletic success and overall well-being. Sleep is not merely a passive state of rest but rather an active physiological process that facilitates critical recovery mechanisms, memory consolidation, hormonal regulation, and neuromuscular restoration (Watson, 2017). The intricate relationship between sleep and athletic performance has garnered increasing attention in sports science research, with mounting evidence suggesting that sleep quality and quantity significantly influence various dimensions of physical performance, cognitive function, injury risk, and psychological well-being among athletes (Fullagar et al., 2015).

The physiological mechanisms underlying the sleep-performance relationship are multifaceted and complex. During sleep, particularly during slow-wave sleep and rapid eye movement (REM) stages, the body undergoes essential restorative processes including protein synthesis, tissue repair,

growth hormone secretion, and immune system fortification (Dattilo et al., 2011). These processes are fundamental for muscle recovery following intense training sessions, adaptation to training stimuli, and preparation for subsequent physical exertion. Furthermore, sleep deprivation or poor sleep quality has been consistently associated with impaired glucose metabolism, elevated cortisol levels, reduced testosterone production, and compromised immune function, all of which can negatively impact athletic performance and increase susceptibility to illness and injury (Fullagar et al., 2015; Roberts et al., 2019).

From a neurocognitive perspective, adequate sleep is essential for maintaining optimal reaction time, decision-making capabilities, motor skill acquisition, and strategic thinking during competition. Studies have demonstrated that sleep deprivation significantly impairs cognitive functions crucial for athletic success, including attention, executive function, and perceptual-motor performance (Lim & Dinges, 2010). For student-athletes, who must also maintain academic performance alongside their athletic commitments, the cognitive demands are particularly pronounced, making adequate sleep even more critical for success in both domains.

Despite the well-established importance of sleep for athletic performance in professional and elite athlete populations, there remains a significant knowledge gap regarding sleep patterns and their performance implications among university student-athletes, particularly in the Indonesian context. Indonesian university athletes face distinctive challenges that may uniquely affect their sleep quality and athletic performance. These challenges include limited access to specialized sports science support, inadequate recovery facilities, high academic workload, socioeconomic pressures that may necessitate part-time employment, cultural norms around sleep duration, and environmental factors such as tropical climate conditions that may influence sleep architecture (Khairani et al., 2021).

Previous international research has documented alarming prevalence rates of sleep problems among collegiate athletes, with studies reporting that 40-60% of university athletes experience poor sleep quality or insufficient sleep duration (Mah et al., 2011; Leeder et al., 2012). Common sleep disturbances reported among this population include difficulty falling asleep, frequent nocturnal awakenings, early morning awakening, daytime sleepiness, and irregular sleep schedules. The etiology of these sleep problems is multifactorial, encompassing biological factors such as circadian rhythm disruption due to training schedules, psychological factors including competitive anxiety and academic stress, behavioral factors such as technology use before bedtime, and environmental factors including noise and inadequate sleeping conditions (Samuels et al., 2016; Walsh et al., 2021).

The Faculty of Sports and Health Sciences (FIKK) at Universitas Negeri Makassar represents a significant concentration of student-athletes competing in various sports disciplines at regional, national, and international levels. These students undergo intensive training programs while simultaneously pursuing their academic degrees in sports science, physical education, and related fields. Preliminary observations and anecdotal reports from coaches and students suggest that many FIKK students experience challenges related to sleep quality, often attributing performance inconsistencies and training difficulties to fatigue and inadequate recovery. However, systematic empirical investigation of sleep quality and its relationship with athletic performance in this specific population has not been previously conducted.

The measurement of sleep quality in research contexts has evolved considerably over the past decades. While polysomnography remains the gold standard for objective sleep assessment, its laboratory-based nature, high cost, and invasiveness make it impractical for large-scale epidemiological studies. Consequently, validated subjective sleep questionnaires have become widely utilized in sports research. The Pittsburgh Sleep Quality Index (PSQI) has emerged as one of the most extensively validated and widely used instruments for assessing sleep quality across diverse populations (Buysse et al., 1989). This self-report questionnaire evaluates seven components of sleep including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. The PSQI has demonstrated strong psychometric properties and has been successfully employed in numerous studies examining sleep among athletic populations (Samuels et al., 2016).

Similarly, the assessment of athletic performance requires comprehensive, sport-relevant measures that capture the multidimensional nature of physical capabilities. While sport-specific

performance can vary considerably across disciplines, fundamental physical attributes including aerobic capacity, muscular strength and power, speed, and agility represent core components that underpin success across most sporting contexts. Standardized testing protocols for these attributes have been extensively validated and provide reliable indicators of athletic performance capacity (Morrow et al., 2011). Maximal oxygen uptake (VO2max) testing, vertical jump assessment, sprint timing, and agility course performance constitute well-established measures that have been widely utilized in exercise science research and athletic program monitoring.

The theoretical framework underpinning this investigation draws upon several complementary models. The recovery-adaptation framework in sports science posits that athletic improvement results from the cyclical process of training stress followed by adequate recovery, with sleep representing the most critical recovery modality (Kellmann & Beckmann, 2018). Additionally, the biopsychosocial model recognizes that athletic performance is determined by the complex interaction of biological, psychological, and social factors, with sleep serving as a critical nexus point where these domains intersect (Simpson et al., 2020). Understanding sleep quality within this holistic framework enables more comprehensive interpretation of how sleep disturbances may cascade through multiple pathways to ultimately affect performance outcomes.

The practical implications of establishing the sleep-performance relationship in this population are substantial. If poor sleep quality is indeed prevalent among FIKK UNM students and demonstrably associated with compromised athletic performance, this would provide compelling justification for institutional interventions targeting sleep health. Such interventions might include educational programs on sleep hygiene, modifications to training and class schedules to promote adequate sleep opportunity, enhancement of dormitory sleeping environments, stress management programs, and incorporation of sleep monitoring into athlete wellness protocols. Furthermore, findings from this study could inform national sports development policies in Indonesia, where systematic attention to sleep as a performance factor remains relatively limited compared to training and nutrition considerations.

Given the identified gaps in knowledge regarding sleep quality and athletic performance among Indonesian university athletes, this study was designed to comprehensively investigate the relationship between these variables in the FIKK UNM student population. The specific objectives were to: (1) characterize the sleep quality profile of FIKK UNM students using validated assessment tools, (2) evaluate athletic performance across multiple physical domains relevant to sport success, (3) examine the correlational relationships between sleep quality parameters and various athletic performance indicators, and (4) identify potential predictors of athletic performance with particular emphasis on sleep-related variables. By addressing these objectives, this research aims to provide empirical evidence that can inform both theoretical understanding and practical interventions to optimize the health and performance of university student-athletes in Indonesia.

METHODS

This research employed a correlational cross-sectional study design to examine the relationship between sleep quality and athletic performance among students at the Faculty of Sports and Health Sciences, Universitas Negeri Makassar. The study was conducted between March and June 2024, with data collection occurring during the mid-semester period to ensure students were in their typical training routine and not experiencing examination-related disruptions that might temporarily affect sleep patterns. The research protocol received ethical approval from the Health Research Ethics Committee of Universitas Negeri Makassar prior to participant recruitment and data collection.

The study population consisted of actively enrolled undergraduate students at FIKK UNM who were concurrently engaged in structured athletic training programs in various sports disciplines including athletics, football, basketball, volleyball, badminton, and martial arts. Inclusion criteria required participants to be aged between 18 and 24 years, actively training at least four times per week for a minimum duration of 90 minutes per session, competing at least at the university or regional level, and having no diagnosed sleep disorders or chronic medical conditions that could affect sleep or physical performance. Students who were currently taking medications known to affect sleep

architecture or those who had experienced significant injuries requiring training cessation within the previous three months were excluded from participation. Using a power analysis based on anticipated moderate effect size for correlation coefficients, with alpha set at 0.05 and desired power of 0.80, the minimum required sample size was calculated as 138 participants. Accounting for potential dropout and incomplete data, 150 participants were recruited through purposive sampling with assistance from coaches and academic advisors across different sports programs within FIKK UNM.

Following recruitment, all participants attended an orientation session where the study objectives, procedures, potential risks, benefits, and their rights as research participants were thoroughly explained. Written informed consent was obtained from all participants prior to their enrollment in the study. Participants were assured of confidentiality and anonymity in data handling and reporting. Demographic information including age, gender, academic year, sport discipline, training frequency, training duration, competitive level, and athletic experience was collected through a structured questionnaire administered during the orientation session.

Sleep quality assessment was conducted using the Indonesian-validated version of the Pittsburgh Sleep Quality Index, which has demonstrated acceptable reliability and validity in Indonesian populations with Cronbach's alpha coefficient of 0.83 (Anindyajati et al., 2021). The PSQI is a self-rated questionnaire that assesses sleep quality over the previous one-month period. It comprises 19 individual items that generate seven component scores including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component is scored on a 0-3 scale, and the seven component scores are summed to yield a global PSQI score ranging from 0 to 21, with higher scores indicating poorer sleep quality. Consistent with established guidelines, a global PSQI score greater than 5 was used as the threshold to distinguish poor sleepers from good sleepers, as this cutoff has demonstrated sensitivity of 89.6% and specificity of 86.5% for identifying sleep disorders (Buysse et al., 1989). Participants completed the PSQI questionnaire independently in a quiet room with research assistants available to clarify any questions, ensuring accurate comprehension of all items.

Athletic performance assessment was conducted over a two-week period following sleep quality measurement, with tests scheduled during morning sessions between 08:00 and 11:00 to minimize circadian influences on performance. Participants were instructed to maintain their typical sleep schedule, avoid intensive training for 24 hours prior to testing, refrain from caffeine consumption for at least 6 hours before testing, and consume a light meal at least 2 hours before the scheduled testing session. All performance tests were administered by trained exercise science professionals following standardized protocols, with the same equipment and testing conditions maintained for all participants to ensure measurement consistency and reliability.

Aerobic capacity was assessed using the 20-meter multistage shuttle run test, commonly known as the beep test, which is a validated field test for estimating maximal oxygen uptake. Participants performed continuous shuttle runs between two lines set 20 meters apart, paced by audio signals that progressively increased in speed. The test continued until participants could no longer maintain the required pace for two consecutive shuttles. The final completed stage and shuttle number were recorded and used to estimate VO2max values using established prediction equations (Leger et al., 1988). This test has demonstrated strong correlation with laboratory-measured VO2max and excellent test-retest reliability among athletic populations.

Lower body muscular power was evaluated using the vertical jump test performed on a validated jump mat system. Following a standardized warm-up protocol including dynamic stretching and submaximal jumps, participants performed three maximal effort countermovement jumps with arm swing, with 60 seconds of rest between attempts. Jump height was automatically calculated by the jump mat system based on flight time. The highest jump height among the three trials was recorded for analysis. The countermovement jump is a well-established measure of lower body power that demonstrates strong reliability and sensitivity to training adaptations (Markovic et al., 2004).

Sprint speed was assessed using a 30-meter sprint test with timing gates positioned at the start line and at 30 meters. Participants began from a standing start position 0.5 meters behind the starting line and sprinted maximally through the finish line. Each participant completed three trials with a minimum of 5 minutes recovery between trials, and the fastest time was recorded for analysis. The 30-

meter sprint test is widely used in sports performance assessment and demonstrates excellent reliability for measuring acceleration and maximum speed capabilities (Comfort et al., 2012).

Agility was measured using the T-test, a validated assessment of multidirectional speed and change of direction ability. The test involves sprinting forward 10 meters, shuffling laterally 5 meters to the left, shuffling 10 meters to the right, shuffling 5 meters back to center, and backpedaling 10 meters to the starting point, forming a T-shaped movement pattern. Participants completed two trials with 5 minutes rest between attempts, and the best time was recorded. The T-test has demonstrated strong reliability and validity for assessing agility across various sports (Pauole et al., 2000).

Following data collection, all questionnaires were checked for completeness and accuracy before data entry. Performance test data were recorded directly into digital devices during testing to minimize transcription errors. All data were entered into a secure electronic database with double-entry verification performed for 10% of randomly selected cases to ensure data entry accuracy. Statistical analyses were conducted using SPSS version 26.0 software. Descriptive statistics including means, standard deviations, frequencies, and percentages were calculated to characterize the sample and describe sleep quality and performance variables. Normality of continuous variables was assessed using Shapiro-Wilk tests and visual inspection of Q-Q plots. Pearson correlation coefficients were calculated to examine bivariate relationships between PSQI global scores and individual component scores with each athletic performance measure. The magnitude of correlation coefficients was interpreted using established guidelines where values of 0.10-0.29 represent small correlations, 0.30-0.49 represent medium correlations, and values of 0.50 or greater represent large correlations (Cohen, 1988). Multiple regression analysis was subsequently conducted to examine the collective and relative contribution of sleep quality components in predicting athletic performance outcomes, with assessment of multicollinearity through variance inflation factors and evaluation of assumptions including linearity, homoscedasticity, and independence of residuals. Statistical significance was set at alpha level of 0.05 for all analyses, and 95% confidence intervals were calculated for correlation and regression coefficients to facilitate interpretation of effect sizes and precision of estimates.

RESULT AND DISCUSSION

The final sample comprised 150 student-athletes from FIKK UNM who met all inclusion criteria and completed all assessment procedures. The demographic characteristics of participants revealed a relatively balanced gender distribution with 82 males (54.7%) and 68 females (45.3%), with ages ranging from 18 to 24 years and a mean age of 20.8 years with standard deviation of 1.6 years. Participants represented diverse sport disciplines with athletics being the most represented at 28.7%, followed by football at 18.0%, basketball at 16.0%, volleyball at 14.7%, badminton at 12.7%, and martial arts at 10.0%. The majority of participants were training between 5 and 7 times per week with an average training duration of approximately 2.3 hours per session. Most participants had been involved in structured competitive sport for an average of 5.4 years, indicating substantial athletic experience and commitment to their respective sports.

Sleep quality assessment using the Pittsburgh Sleep Quality Index revealed concerning patterns among the student-athlete population. The global PSQI scores ranged from 2 to 16, with a mean score of 7.2 and standard deviation of 3.1. Using the established clinical cutoff score of 5, a substantial majority of participants, specifically 94 students representing 62.7% of the sample, were classified as poor sleepers, while only 56 participants or 37.3% were classified as good sleepers. This prevalence of poor sleep quality among FIKK UNM student-athletes is notably higher than rates reported in some international studies of collegiate athletes but consistent with findings from research conducted in similar university settings in Southeast Asian contexts (Mah et al., 2011; Walsh et al., 2021).

Examination of individual PSQI component scores provided more nuanced insight into specific sleep problems experienced by participants. Subjective sleep quality ratings indicated that 58.0% of participants reported their sleep as fairly bad or very bad. Sleep latency, defined as the time required to fall asleep, was problematic for 64.7% of participants who reported taking more than 30 minutes to fall asleep on most nights. Regarding sleep duration, only 42.0% of participants achieved the recommended 7-9 hours of sleep per night, with the mean sleep duration being 6.4 hours per night.

Habitual sleep efficiency, calculated as the percentage of time in bed actually spent sleeping, was less than 85% for 56.7% of participants, indicating significant time spent awake while in bed. Sleep disturbances including waking up during the night, having to use the bathroom, breathing difficulties, coughing, feeling too cold or hot, and having bad dreams were reported with moderate to high frequency by 71.3% of participants. Use of sleep medication was uncommon, with only 8.7% of participants reporting occasional or frequent use of sleep aids. Daytime dysfunction, reflecting problems with staying awake during activities and maintaining enthusiasm, was reported by 69.3% of participants, indicating that poor nighttime sleep was translating into impaired daytime functioning.

Athletic performance assessments demonstrated considerable variability across the sample, reflecting the diverse training backgrounds and sport specializations of participants. Aerobic capacity assessed through the multistage shuttle run test yielded estimated VO2max values ranging from 38.2 to 62.5 mL/kg/min with a mean of 49.7 mL/kg/min and standard deviation of 5.8 mL/kg/min. These values generally align with published normative data for university-level athletes, though they fall short of elite athlete standards in most sports. Vertical jump performance ranged from 32.1 to 58.4 centimeters with a mean height of 44.8 centimeters and standard deviation of 6.3 centimeters, indicating moderate to good lower body power across the sample. Sprint performance in the 30-meter test ranged from 3.82 to 5.21 seconds with a mean time of 4.38 seconds and standard deviation of 0.34 seconds. Agility assessed through the T-test demonstrated times ranging from 8.92 to 12.45 seconds with a mean of 10.32 seconds and standard deviation of 0.89 seconds.

Correlation analyses revealed significant associations between sleep quality and all athletic performance measures, supporting the central hypothesis of this investigation. The global PSQI score, where higher scores indicate poorer sleep quality, demonstrated significant negative correlations with all performance indicators, meaning that poorer sleep quality was associated with worse athletic performance across all measured domains. Specifically, the correlation between global PSQI score and aerobic capacity was r equals negative 0.543 with p-value less than 0.001, indicating that students with poorer sleep quality had significantly lower VO2max values. This represents a large effect size according to established interpretive guidelines and suggests that sleep quality accounts for approximately 29.5% of the variance in aerobic capacity within this sample (Watson, 2017; Fullagar et al., 2015).

The relationship between sleep quality and vertical jump performance yielded a correlation coefficient of r equals negative 0.489 with p-value less than 0.001, indicating that poorer sleep was associated with reduced lower body power. This finding is consistent with previous research demonstrating that sleep deprivation and poor sleep quality impair neuromuscular function and force production capabilities (Reilly & Piercy, 1994; Taheri & Arabameri, 2012). The mechanisms underlying this relationship likely involve multiple pathways including reduced neural drive to muscles, impaired motor unit recruitment patterns, decreased testosterone levels that affect muscle protein synthesis, and elevated cortisol levels that promote muscle catabolism. Furthermore, inadequate sleep may compromise the recovery and adaptation processes that occur following resistance training, thereby limiting improvements in muscular strength and power over time (Dattilo et al., 2011; Roberts et al., 2019).

Sprint speed demonstrated a significant positive correlation with PSQI scores at r equals 0.512 with p-value less than 0.001, where the positive correlation reflects that higher PSQI scores indicating poorer sleep quality were associated with slower sprint times representing worse performance. Sprint performance is highly dependent on neuromuscular function, including rapid motor unit recruitment, intermuscular coordination, and optimal nervous system arousal. Sleep deprivation has been shown to impair these neural mechanisms, potentially explaining the strong association observed in this study (Skein et al., 2011). Additionally, sprint performance requires substantial anaerobic energy production, and research suggests that glycolytic capacity and phosphocreatine resynthesis may be compromised under conditions of inadequate sleep, further contributing to performance decrements (Roberts et al., 2019).

The correlation between sleep quality and agility performance was r equals 0.476 with p-value less than 0.001, indicating that students with poorer sleep quality demonstrated slower times and thus worse performance on the T-test. Agility performance requires complex integration of multiple

physiological and cognitive capabilities including reaction time, decision making, proprioception, dynamic balance, and multidirectional speed. Each of these components has been shown to be negatively affected by sleep deprivation and poor sleep quality in previous research (Fullagar et al., 2015). The cognitive demands of agility tasks may be particularly vulnerable to sleep deficits, as research consistently demonstrates that inadequate sleep impairs executive function, attention, and processing speed, all of which are critical for rapid directional changes and coordinated movement patterns required in agility tasks (Lim & Dinges, 2010).

Analysis of individual PSQI components in relation to athletic performance revealed that certain sleep quality dimensions were more strongly associated with performance than others. Sleep duration emerged as a particularly salient predictor across all performance measures, with correlations ranging from r equals negative 0.412 to negative 0.498. This finding underscores the fundamental importance of adequate sleep quantity for athletic performance, consistent with recommendations from sports science organizations that athletes should aim for 8-10 hours of sleep per night to optimize recovery and performance (Walsh et al., 2021). Sleep efficiency, representing the percentage of time in bed actually spent sleeping, also demonstrated robust associations with performance measures, with correlations ranging from r equals negative 0.389 to negative 0.467. Poor sleep efficiency suggests fragmented sleep architecture with frequent awakenings and reduced time in restorative deep sleep stages, which may compromise the physiological recovery processes essential for athletic performance (Halson, 2014).

Interestingly, daytime dysfunction, which reflects the carryover effects of poor nighttime sleep on daytime alertness and functioning, showed the strongest correlations with performance measures among all PSQI components, with correlation coefficients ranging from r equals negative 0.501 to negative 0.574. This suggests that the functional consequences of poor sleep, rather than merely the subjective experience of poor sleep quality, may be most directly related to performance impairments. Athletes who experience significant daytime sleepiness and reduced enthusiasm due to inadequate sleep are likely operating in a state of chronic partial sleep deprivation that accumulates over time and progressively degrades performance capacity (Samuels et al., 2016).

Multiple regression analyses were conducted to examine the combined effects of sleep quality components on athletic performance while controlling for potential confounding variables including age, gender, sport discipline, and training volume. For aerobic capacity as the dependent variable, the regression model including global PSQI score, sleep duration, sleep efficiency, and control variables explained 48.3% of the variance in VO2max values, representing a substantial proportion of performance variability attributable to sleep-related factors. The standardized beta coefficient for global PSQI score was negative 0.324 with p-value less than 0.001, indicating that sleep quality remained a significant predictor even after accounting for other variables. Sleep duration demonstrated an independent contribution with standardized beta of 0.287 and p-value of 0.002, suggesting that both overall sleep quality and specifically the quantity of sleep obtained are important determinants of aerobic capacity. These findings have important practical implications, as they suggest that interventions targeting both sleep quality and sleep duration may be necessary to optimize aerobic performance among student-athletes (Mah et al., 2011).

Similar patterns emerged when examining regression models for other performance outcomes. For vertical jump performance, the combined sleep variables and controls explained 42.1% of variance, with global PSQI score contributing a standardized beta of negative 0.298 and p-value less than 0.001. For sprint performance, the model explained 44.7% of variance with PSQI global score showing a standardized beta of 0.315 and p-value less than 0.001. For agility performance, 40.8% of variance was explained with PSQI contributing a standardized beta of 0.289 and p-value less than 0.001. The consistency of these findings across different performance domains strengthens the conclusion that sleep quality represents a fundamental determinant of athletic performance that operates through multiple physiological pathways affecting diverse physical capabilities.

Additional analyses comparing good sleepers versus poor sleepers using independent samples t-tests revealed significant mean differences across all performance measures. Good sleepers, defined as those with PSQI scores of 5 or below, demonstrated significantly higher VO2max values compared to

poor sleepers with mean difference of 4.8 mL/kg/min, t-value of 5.23, and p-value less than 0.001. Good sleepers also exhibited significantly better vertical jump performance with mean difference of 5.3 centimeters, faster sprint times with mean difference of 0.42 seconds, and superior agility with mean difference of 1.12 seconds, all with p-values less than 0.001. These substantial differences in performance between sleep quality groups further emphasize the meaningful real-world implications of sleep quality for competitive athletic success (Halson, 2014; Watson, 2017).

The high prevalence of poor sleep quality observed among FIKK UNM student-athletes warrants careful consideration of contributing factors specific to this population. Qualitative comments provided by participants during data collection, though not systematically analyzed as part of this study, revealed several commonly cited challenges to achieving adequate sleep. Academic demands including evening classes, assignment deadlines, and examination preparation frequently conflicted with optimal sleep timing. Training schedules that often extended into evening hours resulted in delayed sleep onset due to elevated physiological arousal following intense exercise. Many participants also reported living in dormitory settings or shared accommodations where noise, lighting conditions, and lack of temperature control created non-optimal sleep environments. Furthermore, widespread use of electronic devices including smartphones, tablets, and computers during the pre-sleep period was evident, with many participants reporting engagement with social media, gaming, or streaming entertainment close to bedtime, behaviors known to disrupt circadian rhythms and delay sleep onset due to blue light exposure and cognitive stimulation (Samuels et al., 2016; Walsh et al., 2021).

Cultural and socioeconomic factors may also contribute to sleep patterns observed in this population. In Indonesian society, late evening social activities and dining patterns are culturally normative, which may promote later sleep times compared to populations in other cultural contexts. Additionally, many university students in Indonesia come from families with limited financial resources and may work part-time jobs to support their education and living expenses, further constraining time available for sleep. The competing demands of athletic training, academic coursework, social relationships, and economic necessities create a challenging context in which sleep often becomes the compromised factor, particularly among individuals who may not fully recognize or prioritize sleep as essential for health and performance (Khairani et al., 2021).

The findings of this study have important implications for sports programs, athletic trainers, coaches, and sports science professionals working with university-level athletes. The robust associations between sleep quality and multiple dimensions of athletic performance provide strong empirical justification for incorporating sleep education and sleep optimization strategies into comprehensive athlete development programs. Such interventions might include educational workshops on sleep hygiene practices, individualized sleep needs assessment and counseling, monitoring of sleep patterns using sleep diaries or wearable technology, adjustment of training schedules to allow adequate recovery time, modification of competition schedules to minimize circadian disruption, and creation of sleep-conducive dormitory environments for student-athletes (Halson, 2014).

Evidence-based sleep hygiene recommendations that could be implemented with this population include establishing consistent sleep and wake times even on weekends to strengthen circadian rhythms, creating dark, quiet, and cool sleeping environments, avoiding caffeine consumption within 6 hours of planned bedtime, limiting intense exercise within 3 hours of sleep to allow physiological arousal to subside, minimizing electronic device use in the hour before sleep, avoiding large meals close to bedtime, using the bed only for sleep to strengthen sleep associations, and implementing relaxation techniques such as progressive muscle relaxation or meditation to facilitate sleep onset (Walsh et al., 2021; Samuels et al., 2016). While these recommendations are well-established in sleep science literature, their implementation requires systematic educational efforts and institutional support to overcome existing behavioral patterns and environmental constraints.

Recent intervention studies in athletic populations have demonstrated the efficacy of sleep extension protocols for enhancing performance. In a seminal study by Mah and colleagues (2011), collegiate basketball players who extended their sleep to 10 hours per night for 5-7 weeks demonstrated significant improvements in sprint times, shooting accuracy, reaction time, and

subjective measures of physical and mental well-being compared to baseline measurements. Similar benefits of sleep extension have been reported in other sports including swimming, tennis, and football (Fullagar et al., 2015). These findings suggest that many athletes, including the student-athletes in the current study, may be operating in a state of chronic sleep restriction that constrains their performance below their true physiological potential. If FIKK UNM student-athletes who currently average 6.4 hours of sleep per night could extend their sleep to 8-9 hours nightly, substantial performance improvements might be achievable.

From an institutional perspective, universities and athletic departments should consider sleep as a performance-enhancing factor worthy of systematic attention alongside traditional emphases on training programming, nutrition, and strength and conditioning. This might include scheduling practices and classes to allow adequate sleep opportunity, providing education to coaches about the importance of recovery and sleep for training adaptation, developing athlete wellness monitoring systems that include sleep assessment, providing access to sleep specialists or sports psychologists trained in cognitive-behavioral therapy for insomnia when sleep problems are identified, and creating institutional policies that support athlete health and well-being including adequate recovery time between competitions (Halson, 2014; Watson, 2017).

Several limitations of this study should be acknowledged when interpreting the findings. First, the cross-sectional design precludes causal inferences about the sleep-performance relationship. While the current findings demonstrate association between sleep quality and athletic performance, experimental or longitudinal designs would be necessary to definitively establish that poor sleep causes performance decrements or that sleep improvement leads to performance enhancement. Second, sleep quality was assessed using self-report questionnaires rather than objective measures such as polysomnography or actigraphy. While the PSQI is a validated instrument widely used in research, subjective sleep reports may be subject to recall bias and may not perfectly correspond with objective sleep parameters. Future research incorporating objective sleep monitoring would strengthen understanding of sleep architecture and its relationship with performance. Third, the study did not assess numerous potential confounding variables that might influence both sleep and performance including dietary habits, stress levels, mental health status, use of supplements or ergogenic aids, or detailed injury history. Fourth, performance assessment occurred over a relatively brief testing period and may not fully capture performance variability that occurs over a competitive season. Longitudinal assessment of both sleep and performance throughout a competitive season would provide more comprehensive understanding of how these variables interact over time.

Despite these limitations, this study makes important contributions to understanding sleep and performance in university student-athletes in Indonesia. To our knowledge, this represents the first systematic investigation of sleep quality and its relationship with objective performance measures in this population, providing baseline data that can inform future research and intervention efforts. The findings highlight sleep quality as a modifiable factor that could be targeted to enhance athletic performance and potentially reduce injury risk among university athletes. The substantial prevalence of poor sleep quality identified in this study indicates that sleep problems are not isolated cases but rather represent a widespread challenge affecting the majority of student-athletes at FIKK UNM.

Future research should build upon these findings through several directions. Longitudinal studies tracking sleep patterns and performance outcomes throughout competitive seasons would elucidate how changes in sleep relate to changes in performance over time. Intervention studies testing sleep education programs, sleep extension protocols, or other sleep optimization strategies would provide evidence for practical approaches to improving sleep and performance in this population. Incorporation of objective sleep measurement through actigraphy or polysomnography would provide more detailed information about sleep architecture and circadian rhythms in student-athletes. Investigation of mediating mechanisms linking sleep to performance, such as hormonal profiles, immune markers, or neurocognitive function, would advance theoretical understanding of sleep-performance pathways. Finally, qualitative research exploring student-athletes' perceptions, beliefs, and barriers related to sleep would provide contextual understanding to inform culturally appropriate

intervention development for Indonesian athletic populations (Fullagar et al., 2015; Roberts et al., 2019).

CONCLUSSION

This study demonstrates a significant relationship between sleep quality and athletic performance among students of the Faculty of Sports and Health Sciences at Universitas Negeri Makassar. The findings reveal that poor sleep quality is highly prevalent in this population, affecting nearly two-thirds of student-athletes surveyed. Sleep quality shows strong correlations with multiple dimensions of athletic performance including aerobic capacity, muscular power, sprint speed, and agility. Students classified as good sleepers demonstrated substantially superior performance compared to poor sleepers across all measured physical capabilities. These findings underscore that sleep quality represents a critical yet often overlooked factor in athletic performance among university-level athletes in Indonesia.

The results of this investigation carry important practical implications for various stakeholders in university athletics. For individual student-athletes, the findings emphasize the necessity of prioritizing adequate sleep as a fundamental component of training and recovery. Athletes should be educated about the performance benefits of good sleep and provided with evidence-based strategies for improving sleep quality. For coaches and athletic trainers, these results highlight the importance of considering recovery and sleep in overall program design, potentially necessitating modifications to training schedules, competition calendars, and athlete monitoring protocols to ensure adequate rest opportunities. For university administrators and sports program directors, the findings provide empirical justification for institutional investments in sleep-related interventions including educational programs, environmental modifications to athlete housing, and policies that support athlete well-being alongside performance objectives.

Based on the findings of this study, several specific recommendations are proposed. First, FIKK UNM should develop and implement a comprehensive sleep education program for all student-athletes that covers sleep physiology, the relationship between sleep and performance, evidence-based sleep hygiene practices, and strategies for overcoming common sleep challenges faced by students. Second, systematic monitoring of sleep quality should be incorporated into routine athlete health assessments, using validated tools such as the PSQI on a regular basis to identify students experiencing sleep problems who may benefit from additional support or intervention. Third, the university should evaluate and potentially modify training and class schedules to minimize conflicts with optimal sleep timing, recognizing that late evening training sessions and early morning classes may create impossible scheduling constraints that force students to sacrifice sleep. Fourth, improvements to dormitory sleeping environments should be considered, including measures to reduce noise, optimize temperature control, and ensure adequate darkness during sleep periods. Fifth, access to professional support services including sports psychologists or sleep specialists should be made available for students experiencing persistent sleep difficulties that do not respond to basic sleep hygiene interventions.

For the broader field of sports science in Indonesia, this study highlights the need for increased attention to sleep as a performance factor in athlete development programs at all levels. National sports organizations, coaching education programs, and sports science degree programs should incorporate sleep science into their curricula and professional development activities. Research funding should support additional investigations of sleep in Indonesian athletic populations across different sports, competitive levels, and age groups to build a comprehensive understanding of sleep patterns and needs in this context. Collaboration between universities, national sports organizations, and sports science researchers should be fostered to develop evidence-based guidelines and interventions appropriate for the Indonesian context, considering cultural, environmental, and resource factors that may differ from international contexts where most sleep research has been conducted.

In conclusion, sleep quality emerges as a significant correlate of athletic performance among FIKK UNM student-athletes, with poor sleep quality highly prevalent and associated with meaningful decrements in physical performance capabilities. Addressing sleep quality through educational, environmental, and programmatic interventions represents a promising avenue for enhancing athletic

performance and supporting the holistic well-being of university student-athletes. As competition at all levels continues to intensify and the margins between success and failure narrow, optimizing every potential performance factor becomes increasingly important. Sleep, as a fundamental biological necessity with clear performance implications, deserves recognition as a critical component of athletic excellence alongside training, nutrition, and mental preparation. By prioritizing sleep health within university athletic programs, institutions can support student-athletes in achieving their full potential both in sport and in life.

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