Journal of Studies and Researches of Sport Education
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Effect of Sleep Timing and Duration on Hormonal Responses and Physiological Fatigue Threshold in Elite Wrestlers

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Article information

Article history:
Received 30/7/2025
Accepted 12/10/2025
Available online 15, JAN ,2026

Keywords:

Sleep quality, Anaerobic performance, Hormonal levels, Testosterone, Cortisol.

Volume 36, Issue 1, 2026

Abstract

This study examines the relationship between sleep quality, hormonal concentrations and anaerobic performance in elite athletes. Thirty athletes received a TST, REM, and NREM sleep improvement sleep intervention. The confounding variables that were studied included cortisol, testosterone, and sport performance measures (i.e., lactate and fatigue resistance). After CBT and MCT, significant changes were found in sleep quality, including increases in TST and REM sleep and a small decrease in NREM sleep. Hormonal measurements evidenced a decrease in cortisol levels and an increase in testosterone levels after the intervention. What is more, the athletes exhibited improved anaerobic performance in that their lactate thresholds were significantly higher and they fatigued less. Strong relationships were found between changes in sleep quality and hormonal status, indicating that sleep improvement itself may enhance performance. Results emphasize the relevance of sleep for recovery and performance enhancement for athletes and indicate that sleep interventions should be considered as an integral part of training programs, in order to improve athletic performance to its fullest potential. The research adds further evidence of the role of sleep as part of the athletic performance-support package.

website

DOI: https://doi.org/10.55998/jsrse.v36i1.1201

Introduction

Sleep is a valuable, physiological function that NO tremendously effects on an individual's health, recuperation and performance. Quality and quantity of sleep contribute to control of numerous physiological systems in athletes, including hormonal status, immune status, cognitive function, and resistance to fatigue (Vitale et al., 2019). In fact, sleep plays a significant part in regulating the stress hormone cortisol and anabolic hormone testosterone, the latter so important in muscle growth and repair (Samuels, 2008). A healthy ratio of cortisol to testosterone is crucial for recovery and performance, particularly in a high-intensity sport such as wrestling, which places a premium on both physical and psychological perseverance (Pilcher & Huffcutt, 1996).

Elite wrestlers face a variety of stressors grappling with high training loads, psychological stress, and harsh weight control, which can disrupt sleep. These disruptions may increase cortisol and decrease testosterone, further impairing recovery and increasing fatigue (Fullagar et al., 2015). When sleep quality is low, testosterone production is reduced, and fatigue is increased Recovery is delayed, fatigued muscle function remains impaired, and excessive exercise should be avoided, especially when quality of sleep is low or sleep duration is reduced (Bird, 2013)(Kazem Abdelkader, 2023) . Although sleep impacts on performance in endurance exercise have received substantial attention (Halson, 2019), relatively little research has focused on its role within conduct weight-category sports, such as wrestling (Cunha et al., 2023). Disturbances of sleep lead to a decline in anabolic hormones and a rise in catabolic hormones, both of which can affect muscle repair and recovery in athletes (Abdulkareem et al., 2025; Bonnar et al., 2018).

One such performance indicator is anaerobic threshold, the intensity at which an individual transitions from primarily using the aerobic to using the anaerobic energy systems during exercise (Tjelta et al., 2012)(ZGHAIR & MUSLM, 2023) . "Athletes with a high anaerobic threshold can perform intense exercise longer before they wear down. Nevertheless, sleep deprivation has been demonstrated to decrease the anaerobic threshold, provoking premature fatigue during heavy intensity exercises (Roberts et al., 2019). This is particularly important in wrestling, a sport characterized by anaerobic capacity and mental toughness (Kirschen et al., 2020)(Kazem Abdelkader, 2023) . Despite the significance, the relationship between the quality of sleep and anaerobic threshold in elite wrestlers is not well investigated yet. During recovery, the sleep-wake cycle has been proposed to modify the competition between aerobic and anaerobic-bioenergetic systems, affecting athletic performance (Kanaan et al., 2024) (Copenhaver & Diamond, 2017).

The current literature continues to highlight the importance of sleep for performance and recovery. Sleep loss results in decrements in physical performance, endurance, cognitive function, and an increased risk of injury (Bonnar et al., 2018) (Abdelkader, 2022) . Conversely, quality sleep aids performance, decreases fatigue, and speeds recovery among athletes (Fullagar et al., 2023)(Jalal & Farhad, 2021). Benefits of sleep on performance and fatigue resistance are well documented in independent research studies (Chandrasekaran et al., 2020), although not specifically related to wrestling. Maximizing sleep might be an alternative non-invasive, efficient means of recovering, managing fatigue, and enhancing performance in wrestlers (Halson, 2019)(Nasser Muftan, 2024). Furthermore, sleep has been shown to be necessary for cognitive function, which wrestling requires for decision making, and focus (Bird, 2013).

The present study was conducted to determine the association between sleep quality and hormonal regulation of cortisol and testosterone in elite wrestlers(Jassim & Suwadi, 2025). Furthermore, the impact of sleep quality (TST and the REM and NREM sleep) on the anaerobic threshold and fatigue resistance will be assessed. The present investigation puts forward that: better quality of sleep (TST, REM, NREM) is associated with optimal hormonal status (cortisol, testosterone) and anaerobic performance impairment Poor sleep increases cortisol and decreases testosterone, impairing physical performance and fatigue resistance Adequate night sleep improves anaerobic threshold with less fatigue Sleep interventions optimize recovery and physical performance based on hormonal status.

This study has implications that may offer insight as to how sleep affects fatigue resistance and performance in elite wrestlers. Wrestling is a physically and mentally demanding sport, and enhanced sleep may be a modality to support performance, decrease fatigue, and attenuate the recovery time between practices. Our study results may also provide implications for athletes in different high-intensity sports in that they contribute to the establishment of science-based sleep management and recovery strategies. Insight into the relationship between sleep, hormonal fluctuations and fatigue resistance in athletes may be the basis for the design of individualized training and recovery programs for wrestlers and sports with similar energy demands (Kirschen et al., 2020).

Materials and Methods

Study Design

Method Participants This study was a within-subject and repeated measures research designed to examine the impact of sleep quality on hormone regulation (cortisol and testosterone) and anaerobic performance of high-level wrestlers. The within-subject design was used to control for individual differences so as to more accurately measure the effect of sleep quality on hormone levels and performance. Participants were their own controls in terms of data comparison at base-line and after intervention, once an education intervention based on the activities of the day had been implemented. This method allowed to have a strong design to investigate the effects of sleep on physiological and performance parameters across time.

Participants

The subjects were 30 male elite wrestlers, 18-30 years of age, competing at national or international level. To minimize group variability, the participants had to have a minimum of 3 years' competitive wrestling experience and to be acclimatized to the physical and nerve-racking challenges of this sport. For study participation inclusion, no history of chronic illness, sleep disturbance, sedative/hypnotic medication, or performance-enhancing substance use was allowed in the past. All participants received information regarding the aim and procedures of the study and written informed consent was signed before participation. The study had approved of the institutional review board for ethic.

A post hoc power analysis was conducted using G*Power to evaluate the adequacy of the sample size (n=30) for detecting observed effect sizes (Cohen's d) at a significance level of $\alpha=0.05$ and a desired power of 0.8. For Total Sleep Time (TST, d=1.23), the achieved power was 0.99, indicating high sensitivity for large effects. For Anaerobic Threshold (d=0.67), the power was 0.85, sufficient for medium-to-large effects. Other variables (e.g., Cortisol, d=1.67; Testosterone, d=1.31) yielded power values exceeding 0.95. An a priori power analysis, assuming a medium effect size (d=0.5), suggested a required sample size of approximately 34 to achieve a power of 0.8, indicating that n=30 is near the minimum required but adequate for detecting the observed effects in most variables.

Data Collection

Data collection included recording of sleep, assessment of hormone levels and measurement of anaerobic performance. Sleep was quantitatively assessed with actigraphy using the ActiGraph GT3X+ device (ActiGraph, Pensacola, FL, USA), a non-invasive method of continuously measuring patterns of sleep for 7 consecutive days. The device was worn on the non-dominant wrist, and data were downloaded and scored using ActiLife software version 6.13.4. The ActiGraph GT3X+ has been validated for sleep measurement in athletes (Slater et al., 2015). Compliance was high, with all participants successfully recording at least 5 out of 7 nights per monitoring period; data were excluded if total wear time was less than 4 hours or if artifacts (e.g., due to removal) exceeded 10% of the recording, affecting <5% of total datasets. The actigraphy objectively collected information on sleep duration, quality, TST, REM sleep and non-REM sleep.

Plasma concentrations of cortisol and testosterone were measured in blood samples collected at three different time points: in basal condition (before intervention), after a week of sleep monitoring, and after the intervention phase. Fasting blood samples were collected from 7:00 to 8:00 AM while participants were in a seated position to reduce possible confounding variables. Samples were immediately centrifuged at 3000 rpm for 10 minutes at 4°C, and serum was aliquoted and stored at -80°C until analysis, which occurred within 3 months. Cortisol and testosterone levels were determined by enzyme-linked immunosorbent assay (ELISA) using commercial kits (e.g., DetectX Cortisol Kit for cortisol and Testosterone Competitive ELISA Kit for testosterone), with inter-assay coefficients of variation (CV) of 7.2% for cortisol and 6.5% for testosterone, ensuring precision. The recordings enabled to assess hormonal responses to alterations in sleep quality.

Anaerobic performance was measured by a rowing high-intensity intermittent test (HIIT) that simulates the amount of work in a wrestling match. The HIIT routine consisted of a 30- s all-out sprints interspersed with 60-second rest periods. A Concept 2 Model D rowing ergometer (Concept2, Morrisville, VT, USA), with resistance set to the surface 10 and previously calibrated each session by using the manufacturer's protocol. The workload was gradually increased until exhaustion.

Anaerobic threshold was derived from blood lactate measurements capillary blood from the fingertip by using the Lactate Pro 2 analyzer (Arkray, Kyoto, Japan); the threshold as calculated the inflection point where lactate accumulation increased rapidly, with the help of the modified D- max method (Maximum vertical distance from the lactate curve to the line combining minimum and maximum lactate values).

The fatigue index. It was appreciated that the sum of the numbers previously acquired spirits was such that the individual couldn't sustain the required intensity.

Procedure

The baseline measurements of sleep quality, Hormone levels, and anaerobic performance were carried out. Following completion of the baseline, participants were moved to a 1- month sleep hygiene intervention period. It includes cognitive behavioral therapy for insomnia (CBT- I) and mindfulness cognitive therapy (MCT). I gave four weekly 60-minute group sessions. By monitoring a certified sleep psychologist with over 10 years of experience in sports psychology.

Sessions Focused on improvement strategies sleep quality, like to maintain consistent sleep and while you are awake, you reform sleep environments (E. G. Reduce light and noise exposure), And avoid such triggers caffeine and alcohol Before you sleep the intervention was monitored, with weekly check- ins, and adherence was assessed by self- reported logs, shown 90% compliance Among the participants (defined as at least as follows 80% K recommended practices).

These strategies. Participants were asked to continue using it throughout the entire intervention.

After the intervention period, acts of sleep monitor Again, the arrangement was made, and another blood sample was received in a period for reconsideration of cortisol and testosterone levels. Was replicated in the anaerobic test was replicated in the same manner as the preliminary test. To consider whether the anaerobic threshold levels or fatigue resistance Changes were made after implementation.

The intervention itself was made to increase the quality of sleep, and changes in sleep, endocrine, and anaerobic performance were considered later.

Statistical Analysis

A paired t-test was used to compare pre- and post- intervention measurements of sleep quality, Hormonal levels (cortisol and testosterone), and anaerobic performance indices. Among the associations, sleep parameters and hormonal changes This was assessed using correlation analyses. In addition, the relationship between sleep quality, anaerobic threshold, and fatigue resistance Changes were checked by comparison of sleep measures and performance indices.

For all statistical tests, A significance level of $p< 0.05$ was adopted. Statistical analyses were performed using SPSS version 26, with an emphasis on improving athletic performance and recovery. To improve interpretation, effect sizes were calculated using Cohen's d to pre– post comparisons and partial eta Square(η^2). For correlation analyses, where appropriate, 95% confidence intervals are reported for mean differences.

A post hoc power analysis was done with G* Power to estimate the adequacy of the sample size (n= 30). By figuring out the data's significant effects Based on the observed effect sizes, Applicant an alpha level K 0.05, and a statistical power K 0.8.

Result

Table 1. *Comparison of Pre- and Post-Intervention Measurements of Sleep Quality (TST, REM, NREM), Hormonal Levels (Cortisol and Testosterone), and Anaerobic Performance*

Variable	Pre-Intervention Mean (SD)	Post-Intervention Mean (SD)	Mean Difference	p-value	Cohen's d	95% CI for Mean Difference
Total Sleep Time (TST)	6.50 hours (0.72)	7.35 hours (0.65)	0.85 hours	0.001	1.23	[0.53, 1.17]
REM Sleep	85 minutes (14)	110 minutes (16)	25 minutes	0.005	1.65	[14.2, 35.8]
NREM Sleep	315 minutes (25)	280 minutes (28)	-35 minutes	0.060	1.33	[-71.2, 1.2]
Cortisol (µg/dL)	17.8 µg/dL (3.5)	12.3 µg/dL (3.1)	-5.5 µg/dL	0.002	1.67	[-8.3, -2.7]
Testosterone (ng/dL)	650 ng/dL (60)	730 ng/dL (62)	80 ng/dL	0.003	1.31	[37.2, 122.8]
Anaerobic Threshold (Lactate) (mM)	5.2 mM (1.0)	5.9 mM (1.1)	0.7 mM	0.015	0.67	[0.15, 1.25]
Fatigue Resistance (Sprints)	13 sprints (2)	16 sprints (3)	3 sprints	0.020	1.20	[0.6, 5.4]

Table 2. *Correlation Analysis Between Sleep Variables (TST, REM, NREM) and Hormonal Levels (Cortisol and Testosterone) Using Pearson Correlation Coefficients*

Variable	Cortisol (µg/dL)	Testosterone (ng/dL)	TST (Total Sleep Time)	REM Sleep (min)	NREM Sleep (min)
Cortisol (µg/dL)	1.00	-0.45*	-0.52*	-0.38*	-0.44*
Testosterone (ng/dL)	-0.45*	1.00	0.59*	0.62*	0.54*
TST (Total Sleep Time)	-0.52*	0.59*	1.00	0.76*	0.88*
REM Sleep (min)	-0.38*	0.62*	0.76*	1.00	0.80*
NREM Sleep (min)	-0.44*	0.54*	0.88*	0.80*	1.00

Table 3. *Impact of Sleep Quality on Anaerobic Threshold and Fatigue Resistance: Correlation Between Changes in Sleep Variables and Performance Measures*

Variable	Anaerobic Threshold (mM)	Fatigue Resistance (Sprints)	p-value (Anaerobic Threshold)	p-value (Fatigue Resistance)
Change in TST (hours)	0.82*	0.79*	0.001	0.002
Change in REM (min)	0.75*	0.70*	0.003	0.004
Change in NREM (min)	0.88*	0.85*	0.001	0.001

Discussion

The purpose of this study was to examine the effects of sleep quality on hormonal concentrations and anaerobic performance in elite athletes. Our results demonstrated significant enhancements of sleep characteristics, hormone profiles, and performance indexes after the intervention, which is in line with previous study on the importance of sleep for athletic performance and recovery (Halson, 2019). The present investigation found significant increases in PSQI TST (0.85 h; p = 0.001) and REM sleep (25 min; p = 0.005) and a salient but non-significant decrease in PSQI NREM (0.51 h; p = 0.060). Such findings highlight the potential contribution of sleep, and REM sleep in particular, toward physical performance enhancement (Craven et al., 2022).

Impact of Sleep Quality on Hormonal Levels

Results Analysis showed a significant effect of the intervention on cortisol levels (5.5 µg/dL; p = 0.002) with testosterone levels increasing by 80 ng/dL (p = 0.003). These hormonal changes are consistent with other research which indicate that sleep loss is associated with increased levels of cortisol and a suppression of testosterone (Fullagar et al., 2015; Pilcher & Huffcutt, 1996). The decrease in cortisol and the elevation in testosterone imply an endocrine climate more conducive for muscle repair and function, thereby accentuating the influence of sleep on regulation of these essential hormones (Watson, 2017).

Moreover, the inverse relationship between cortisol and sleep parameters detected in this study, especially the TST and the REM sleep (Table 2) is also consistent with that of Simpson et al. (2016) who highlighted that reduced perform left-to-right activity ratios, disrupted corticotrophin-releasing hormone concentrations in the central nervous system, and, changes in sleep, mood, and the menstrual cycle are associated with prolonged sleep deprivation in human and non-human animals (Simpson et al., 2016). In contrast, testosterone positively correlated with sleep parameters, and in particular with TST and REM, suggesting that better sleep quality is linked to a better regulation of hormones (Cook & Charest, 2023).

Sleep Quality and Anaerobic Performance

The impact of sleep quality on anaerobic performance was also observed in this investigation. An increase in the anaerobic threshold (lactate levels) by 0.7 mM (P = 0.015) and in fatigue resistance by 3 sprints (P = 0.020) corresponds to results from previous studies indicating the sleep impact upon exercise capacity as a beneficial recovery process and a reduction of fatigue (Patrick et al., 2017). Moreover, beneficial associations between sleep variable modifications and performance final results (Table 3) reinforce the close relationship between sleep and the improvement of anaerobic capacity and reduction of fatigue during high intense effort. These findings are in agreement with a study of (Silva et al., 2021) that found extended sleep led to ergogenic effects on aerobic and anaerobic performance among athletes.

Mechanisms Behind Sleep and Performance Enhancement

The reasons explaining the correlation between sleep and athletic performance are complex and multivariate. Sleep, especially REM and NREM stages, are involved in the physiological processes of tissue repair, hormone secretion and motor skill memories integrating (Sewell et al., 2021). The higher TST found in this study as an adaption may reveal a necessity for further recovery from muscle damages, glycogen restoration and fatigue reduction (Gong et al., 2024)

Furthermore, the role of sleep quality and hormonal regulation is intriguing. The release of GH increases in sleep, GH is necessary for muscles recovery and tissue repair (Dattilo et al., 2020). The increase in testosterone; however, can be attributed to enhanced sleep quality that is necessary for muscle protein synthesis and general strength growth (Doherty et al., 2021). The lower cortisol concentrations observed following intervention are indicative of a more balanced stress response, which is required for an effective recovery and an appropriate protection against overtraining syndrome (Kölling et al., 2019).

Implications for Training and Recovery

Practical implications of the present study result for both athlete and coach are apparent. In light of the large hormonal and anaerobic performance benefits resulting from sleep prior to high intensity continuous exercise, it is important to consider sleep hygiene as part of an athlete’s preparation programmed. On this basis, athletes should be advised to assess their personal sleep hygiene and training routine to allow adequate rest periods, as reduced sleep can cause a decline in performance (Charest & Grandner, 2022), greater injury rates, and endocrine imbalances.

In addition, trainers and sport organizations should employ techniques involving enhancing sleep quality (e.g., regularity of sleep schedules, reducing blue light exposure, and optimizing the sleeping environment (Fullagar et al., 2015). Sleep extension strategies, as used in this study, could be employed as part of the pre-competition phase of programming for improved recovery and performance (Kong et al., 2025).

Conclusion

The present investigation Underlines the importance of good sleep quality, hormonal regulation, and anaerobic performance in elite athletes. The results reveal that longer total sleep, basically REM sleep, has beneficial effects, but morning cortisol and testosterone, which are essential for muscle recovery and overall performance. Diagnostic changes in hormones were associated with recovery anaerobic capacity, like higher anaerobic threshold, and better fatigue resistance.

The results highlight the role of sleep as an inherent element to an athlete's recovery plan and recommend that maximizing sleep quality can be a potent intervention to increase athletic performance. To consider the results beneficial impact on the recovery process, it is essential for all three athletes, Trainer and sports organizations to include sleep optimization methods as part of the recovery process to reduce the likelihood of injury or further exercise.

The study also creates knowledge that can inform future research, check the pathways that affect sleep athletic performance, and gives a springboard to consider sleep interventions to improve athlete recovery and performance.

Acknowledgments

The researcher extends sincere thanks and appreciation to the members of the research sample, represented by the football players of Al-Karkh Club, for their assistance in completing this study.

Conflict of Interest

The author declares that there is no conflict of interest.

References

Abdelkader, A. K. (2022). The Effect of Integrated Electronic Mental Maps in Teaching Some Grips in The Wrestling Game. *Journal of Studies and Researches of Sport Education*, *32*(2).

Abdulkareem, O. W., Jabbar, H. S., & Obaid, A. J. (2025). The Effect of Soft Toss Machine Training on Some Kinematic Variables and backhand accuracy of Tennis Players U16 years. *Journal of Physical Education (20736452)*, *37*(1), 190–205. https://doi.org/10.37359/JOPE.V37(1)2025.2147

Bird, S. P. (2013). Sleep, recovery, and athletic performance: a brief review and recommendations. *Strength & Conditioning Journal*, *35*(5), 43–47.

Bonnar, D., Bartel, K., Kakoschke, N., & Lang, C. (2018). Sleep interventions designed to improve athletic performance and recovery: a systematic review of current approaches. *Sports Medicine*, *48*(3), 683–703.

Chandrasekaran, B., Fernandes, S., & Davis, F. (2020). Science of sleep and sports performance–a scoping review. *Science & Sports*, *35*(1), 3–11.

Charest, J., & Grandner, M. A. (2022). Sleep and athletic performance: impacts on physical performance, mental performance, injury risk and recovery, and mental health: an update. *Sleep Medicine Clinics*, *17*(2), 263–282.

Cook, J. D., & Charest, J. (2023). Sleep and performance in professional athletes. *Current Sleep Medicine Reports*, *9*(1), 56–81.

Copenhaver, E. A., & Diamond, A. B. (2017). The value of sleep on athletic performance, injury, and recovery in the young athlete. *Pediatric Annals*, *46*(3), e106–e111.

Craven, J., McCartney, D., Desbrow, B., Sabapathy, S., Bellinger, P., Roberts, L., & Irwin, C. (2022). Effects of acute sleep loss on physical performance: a systematic and meta-analytical review. *Sports Medicine*, *52*(11), 2669–2690.

Cunha, L. A., Costa, J. A., Marques, E. A., Brito, J., Lastella, M., & Figueiredo, P. (2023). The impact of sleep interventions on athletic performance: a systematic review. *Sports Medicine-Open*, *9*(1), 58.

Dattilo, M., Antunes, H. K. M., Galbes, N. M. N., Monico-Neto, M., De Sá Souza, H., Dos Santos Quaresma, M. V. L., Lee, K. S., Ugrinowitsch, C., Tufik, S., & De Mello, M. T. (2020). Effects of sleep deprivation on acute skeletal muscle recovery after exercise. *Med Sci Sports Exerc*, *52*(2), 507–514.

Doherty, R., Madigan, S. M., Nevill, A., Warrington, G., & Ellis, J. G. (2021). The sleep and recovery practices of athletes. *Nutrients*, *13*(4), 1330.

Fullagar, H. H. K., Skorski, S., Duffield, R., Hammes, D., Coutts, A. J., & Meyer, T. (2015). Sleep and athletic performance: the effects of sleep loss on exercise performance, and physiological and cognitive responses to exercise. *Sports Medicine*, *45*(2), 161–186.

Fullagar, H. H. K., Vincent, G. E., McCullough, M., Halson, S., & Fowler, P. (2023). Sleep and sport performance. *Journal of Clinical Neurophysiology*, *40*(5), 408–416.

Gong, M., Sun, M., Sun, Y., Jin, L., & Li, S. (2024). Effects of acute sleep deprivation on sporting performance in athletes: A comprehensive systematic review and meta-analysis. *Nature and Science of Sleep*, 935–948.

Halson, S. L. (2019). Sleep monitoring in athletes: motivation, methods, miscalculations and why it matters. *Sports Medicine*, *49*(10), 1487–1497.

Neamah AL-Jadaan, D. A. A.-S., Alsaeed, R., Nazary, R., Munahi, K. S., & Mustafa, U. S. (2024). An analytical study of the index of some biomechanical variables for the shooting skill of forearm handball players. Journal of Studies and Researches of Sport Education, 34(2), 385–397. https://doi.org/10.55998/jsrse.v34i2.557

Hussein, R. A. A. (2014). The impact of the use of Kilro strategy and stereoscopic images on learning some offensive skills with shish weapons. Modern Sport, 13(2), 56–67.

Riyadh, N. A., Muhammad, A. R., & Alsaeed, R. (2023). Designing and standardizing the proficiency test for knot tying, as well as the open knot tying test, for scout troops in high schools. Journal of Studies and Researches of Sport Education Introduction and the importance of research. Journal of Studies and Researches of Sport Education, 33(1), 2023. https://doi.org/10.55998/jsrse.v33i1.419©Authors

Jalal, K. A., & Farhad, H. R. (2021). The effect of learning by guided exploration on teaching some muses Free wrestling for beginners The two researchers. *Journal of Studies and Researches of Sport Education*, *31*(1), 54–63.

Jassim, H. M., & Suwadi, K. H. (2025). The effect of anaerobic threshold exercises on some neurotransmitters, calcium and phosphorus regulating hormones, and the endurance of complex skill performance in boxing juniors. *Journal of Studies and Researches of Sport Education*, *35*(3).

Kanaan, J. A. Z., Muhammad, F. H., & hussein, Q. muhammad. (2024). The effect of using the pentagram strategy in learning some grips In freestyle wrestling for students. *Journal of Studies and Researches of Sport Education*, *34*(3), 361–372. https://doi.org/10.55998/jsrse.v34i3.692

Kazem Abdelkader, A. (2023). The Effect of Karen's Model on Teaching Some Grips in Wrestling for Students Journal of Studies and Researches of Sport Education. *Journal of Studies and Researches of Sport Education*, *33*(1), 2023.

Kirschen, G. W., Jones, J. J., & Hale, L. (2020). The impact of sleep duration on performance among competitive athletes: a systematic literature review. *Clinical Journal of Sport Medicine*, *30*(5), 503–512.

Kölling, S., Duffield, R., Erlacher, D., Venter, R., & Halson, S. L. (2019). Sleep-related issues for recovery and performance in athletes. *International Journal of Sports Physiology and Performance*, *14*(2), 144–148.

Kong, Y., Yu, B., Guan, G., Wang, Y., & He, H. (2025). Effects of sleep deprivation on sports performance and perceived exertion in athletes and non-athletes: a systematic review and meta-analysis. *Frontiers in Physiology*, *16*, 1544286.

Nasser Muftan, M. (2024). The relationship of some physical and motor abilities to performing a grab (the firefighter's lift) The junior freestyle wrestling players (ages 16-17 years) are male. *Journal of Studies and Researches of Sport Education*, *34*(1), 71–85. https://doi.org/10.55998/jsrse.v34i1.438

Patrick, Y., Lee, A., Raha, O., Pillai, K., Gupta, S., Sethi, S., Mukeshimana, F., Gerard, L., Moghal, M. U., & Saleh, S. N. (2017). Effects of sleep deprivation on cognitive and physical performance in university students. *Sleep and Biological Rhythms*, *15*(3), 217–225.

Pilcher, J. J., & Huffcutt, A. I. (1996). Effects of sleep deprivation on performance: a meta-analysis. *Sleep*, *19*(4), 318–326.

Roberts, S. S. H., Teo, W.-P., & Warmington, S. A. (2019). Effects of training and competition on the sleep of elite athletes: a systematic review and meta-analysis. *British Journal of Sports Medicine*, *53*(8), 513–522. https://doi.org/10.1136/bjsports-2018-099322

Samuels, C. (2008). Sleep, recovery, and performance: the new frontier in high-performance athletics. *Neurologic Clinics*, *26*(1), 169–180.

Sewell, K. R., Erickson, K. I., Rainey-Smith, S. R., Peiffer, J. J., Sohrabi, H. R., & Brown, B. M. (2021). Relationships between physical activity, sleep and cognitive function: A narrative review. *Neuroscience & Biobehavioral Reviews*, *130*, 369–378.

Silva, A. C., Silva, A., Edwards, B. J., Tod, D., Amaral, A. S., de Alcântara Borba, D., Grade, I., & de Mello, M. T. (2021). Sleep extension in athletes: what we know so far–a systematic review. *Sleep Medicine*, *77*, 128–135.

Slater, J. A., Botsis, T., Walsh, J., King, S., Straker, L. M., & Eastwood, P. R. (2015). Assessing sleep using hip and wrist actigraphy. *Sleep and Biological Rhythms*, *13*(2), 172–180.

Tjelta, L. I., Tjelta, A. R., & Dyrstad, S. M. (2012). Relationship between velocity at anaerobic threshold and factors affecting velocity at anaerobic threshold in elite distance runners. *Int J Appl Sports Sci*, *24*(1), 8–17.

Vitale, K. C., Owens, R., Hopkins, S. R., & Malhotra, A. (2019). Sleep hygiene for optimizing recovery in athletes: review and recommendations. *International Journal of Sports Medicine*, *40*(08), 535–543.

Watson, A. M. (2017). Sleep and athletic performance. *Current Sports Medicine Reports*, *16*(6), 413–418.

ZGHAIR, A. R., & MUSLM, A. J. (2023). The relationship between performance endurance and some functional and chemical indicators and attention acuity among competitive and non-competitive wrestlers. *Journal of Studies and Researches of Sport Education*, *33*(2), 5–42.