



The Effect of Yoga Exercise on Selective Attention of Collegiate Athletes Following Short-Term Sleep Deprivation

Morteza Taheri ^{1,*} and Shaghayegh Modabberi²

¹Imam Khomeini International University, Qazvin, Iran

²University of Tehran, Tehran, Iran

*Corresponding author: Associate Professor, Imam Khomeini International University, Qazvin, Iran. Email: m.taheri@soc.ikiu.ac.ir

Received 2019 May 15; Revised 2019 July 07; Accepted 2019 July 29.

Abstract

Objectives: As negative consequences of sleep disturbances on cognitive performance in all age groups are well documented the study was aimed at identifying the effect of Yoga practices on selective attention of collegiate athletes following short-term sleep deprivation.

Methods: Nineteen collegiate athletes were recruited in a cross-over design in two phases. In the control condition, their attention was measured after short-term sleep deprivation (6 hours), then, they were given Yoga exercises within a one week washout phase. The posttest was performed following a one week Yoga intervention (experimental condition). The quality of sleep was measured by Actiwatch Sleep Analysis in the washout phase (a 7-day period), and the total score was obtained based on their performance in the last three days. The subjects wore an Actiwatch-7 on their non-dominant wrist for seven consecutive days. In the experimental condition, they attended exercise physiology and were tested. Dependent *t*-tests was used to analyze the data.

Results: The results indicated that Yoga protocol improved both subtests of selective attention significantly, including the mean time for correct responses ($t = 4.98$; $P = 0.001$) and the mean time for correct rejections ($t = 3.73$; $P = 0.001$). Furthermore, the total score of sleep quality within the last three days of the washout phase improved significantly in the Yoga condition ($t = 2.68$; $P = 0.01$).

Conclusions: As known, sleep deprivation could result in poor psychomotor performance; hence, the Yoga exercise would attenuate the devastating consequences of sleep disorder in tasks needing decisions in individuals with such a problem. The results suggest that performing a Yoga exercise may play a major role in improving psychomotor performance in collegiate athletes who are vulnerable for sleep disturbances.

Keywords: Athlete, Sleep Deprivation, Attention, Yoga

1. Background

The promotion of physical and mental health indicators has always been of utmost interest among health policymakers. Sleep disorder, insomnia, and its possible consequences for various reasons have always been addressed in different groups, such as athletes, and college students (1). Providing the athletes with high potentials for performance during sporting events has been of interest for researchers, coaches, and athletes themselves. Student life, along with its implications, such as studying and doing things that students must do in their dormitory independently increases the potential for sleep problems than comparable groups. Additionally, sleep plays a key role in individual health. If sleep disorders and relevant problems are not resolved, there will definitely be harm to health. Brain functions, the cardiovascular system, the immune system, and the metabolic system are closely asso-

ciated with sleep. Based on recent epidemiological studies, almost 25% of adults had sleep complaints, 10% - 15% had insomnia symptoms accompanied with daytime consequences, and 6% - 10% met the diagnostic criteria of insomnia disorder. Thus, it is necessary to find effective therapies for insomnia (2).

The importance of cognitive and psychomotor skills in students is more important when they are athletic (3). On the other hand, these skills play a decisive role in the athletic performance, therefore, disorders such as insomnia can have a deleterious effect on them. In general, the effect of insomnia on cognitive functions such as reaction time (1), attention (4), memory (5), and motor perceptual skills has been well documented. In this regard, attention is a vital element of cognitive performance and has been characterized in two ways, that is, either as a resource or capacity or as a skill. Sustained attention (SA) is the capacity to focus on a specific issue for a required period of time. It is closely

associated with task difficulty or complexity (6).

A great deal of research reported a high rate of fatigue, anxiety, and mood disturbances in individuals with insomnia rather than peers; and accordingly, these signs are usually remained in the subclinical range (7-9). Thus, it's necessary to attenuate the negative consequences of such a problem in a vulnerable population. As noted, current literature supports the notion that motor functioning and psychomotor performance are highly affected by insomnia (10-12), especially when the individuals are in high demand for doing high challenging decisive tasks (13, 14). Furthermore, most studies have investigated long term hours of sleep disturbances on physical and psychological functioning. In light of the above considerations, rare research were found to study the short-term effects of insomnia, especially in collegiate athletes; meanwhile such kind of behavior are highly epidemic in this group. Additionally, attempting to reduce the potential effects of insomnia with athletic interventions can be effective. In the current decades, different modes of exercises have been designed in such a way to improve the physical and physiological state of individuals. In this regard, Yoga is a kind of exercises involving some mental and physical exercises, which focus on motor control, spatial awareness of body, and breathing control (15). It has been found to be an effective strategy and treatment for individuals with physical and psychological problems. It should be noted that although the effects of exercise on quality of sleep has been extensively studied, few studies are found to consider the restorative functions of exercise for destructive effects caused by sleep deprivation (16). Based on the research hypothesis, Yoga isn't just beneficial for improving core strength, flexibility, and stress levels; it can also improve sleep, especially in those with insomnia.

Taken together, it was hypothesized that Yoga would have positive effects on selective attention of collegiate athletes that experienced poor performance in attention demanding tasks after insomnia.

2. Methods

2.1. Participants

Nineteen collegiate athletes (age: 19.6 ± 1.3 ; BMI: 18.3 ± 1.4) who provided written informed consent were recruited in a cross over design in two phases. In the experimental condition, they performed Yoga exercises following the sleep deprived night; while in the control condition, they were asked just to perform the experiment tests on the test day. The inclusion criteria included the age of 18 - 25 years old, PSQI index ≥ 5 , non-smokers, no medication use. They were also removed if any of their first degree relatives had either a sleep disorder or any other mental illness.

They were asked to prevent eating any caffeinated drinks as well as taking a nap and exercising prior to the pretest. Sleeping time of subjects varied from between 11:00 p.m. to 1:00 a.m.; additionally, the time of waking up varied between 05:00 a.m. and 08:00 a.m. Their nutrition status was the same due to living in a university dormitory. The research design is seen in Table 1.

2.2. Measures

In the baseline, their attention was measured after a short-term sleep deprivation (6 hours), then, they were given Yoga exercises within a one week washout phase. During the period, they performed Yoga exercises daily (45 minutes each session). The subjects wore an Actiwatch-7 on their non-dominant wrist for 7-consecutive days in order to be analyzed in terms of sleep quality (16). The validity of Actiwatch has well documented sleep studies (17, 18). The total score of analysis was obtained in the last three days of wash-out phase as index of sleep quality. In the post-test condition, they attended the Exercise Physiology Laboratory of Imam Khomeini International University 8:00 a.m. and the tests were repeated.

2.3. Exercise Protocol

The exercise protocol consisted of three phases including warm up (5 minutes), asana exercises (10 minutes), pranayama exercises (10 minutes), meditation exercises (10 minutes), and cool down phases (10 minutes). In the asana exercise, they performed different stretching movements. In the pranayama exercises, they performed the movements while keeping the back in flat form and doing a deep inhalation and exhalation with a regular rhythm. In the next step, meditation exercises consisted of private sleeping, proper rhythm of breathing, stretching movements, and isometric contractions of the big muscles. Finally, the cooling down phase was conducted by walking and stretching exercises.

2.4. Ethical Considerations

All procedures were performed according to the ethical standards of the Institutional and/or National Research Committee and with the 1964 Helsinki Declaration. The study was approved by the Ethics Committee of Qazvin Medical University (IR.QUMS.REC.1397.393).

2.5. Statistical Analysis

Normality distribution of variables was approved by Kolmogorov-Smirnov test. Dependent *t*-tests was used to analyze the data using the statistical functions of SPSS (version 21, Chicago).

Table 1. Study Design

	Day																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Tests	PSQI measurement				Scoring quality of sleep			Sleep deprivation	Baseline	Wash out (Yoga exercises)						Posttest	
								12:00 - 4:00 a.m.	Attention test							Scoring quality of sleep	Attention test

3. Results

General characteristics of participants are seen in [Table 2](#). As indicated, all factors regarding sleep behavior were significantly improved following the exercise intervention.

As shown in [Figure 1](#), mean time for correct responses ($t = 4.98$; $P = 0.001$; effect size = 2.25) and mean time for correct rejections ($t = 3.73$; $P = 0.001$; effect size = 1.4) were improved significantly after exercise intervention.

4. Discussion

Given the importance of psychomotor performance, especially selective attention in collegiate athletes, this research attempted to study the effect of Yoga practice on the attention performance of the persons who had short-term sleep deprivation. The present study has two major findings. Firstly, Yoga protocol improved selective attention performance sleep-deprived athletes. Secondly, sleep quality was also in better condition rather than baseline. The result is consistent with Monleon who reported that a light aerobic exercise would alleviate the possible negative effects of sleep disturbances on psychomotor tasks (16). Besides, it has been well-documented that exercise can be considered as a non-invasive method leading to optimal status of sleep quality (19, 20). According to a study, sleep loss can affect pre-frontal cortex metabolism, which negatively impairs the executive functions (21). Additionally, our findings shed some light on the beneficial effects of

Yoga exercise on psychomotor performance, which possibly was attenuated by sleep deprivation.

One of the possible reasons for compensating the deleterious effects of sleep deprivation following Yoga exercises can be attributed to the fact that Yoga results in a greater focus on the brain by shifting more blood to the brain and lessens the mental fatigue caused by insomnia.

Recently, it was shown in a meta-analysis study that Yoga training causes substantial improvements such as alleviating impulsivity, anxiety, social problems, and a mild improvement in attention (22). It supports the notion that that sustained attention improves with Yoga exercise. As Yoga training needs to perform complex combinations of motor skills in a smooth and fluent manner, such as controlling body posture and relative space using vestibular sense, it seem logical to have improvement in attention of participants after exercise intervention.

It must be noted that giving instructions to students who are prone to sleep loss can be a good indicator for increasing the awareness toward the key role of exercise in improvement of health and athletic performance (23-26). In the view of the above mentioned psychological problems (27), it is highly recommended to investigate such issues in future studies.

One of the points that should be considered in upcoming research is the level of relaxation of the participants and their sporting background. Therefore, it is suggested that all of the subjects be selected by such considerations in future research. One of the points that should be considered in this research is the level of relaxation of the participants in the research and their background. Therefore, it is suggested that all of these subjects be selected by the subjects in future research by researchers. On the other hand, living in a dormitory with respect to student affairs creates differences that may affect the outcome of the research, therefore, it is important to consider these considerations in future studies.

4.1. Limitations

One limitation of the study was the low number of participants, limiting the extent to which the results can be generalized into people. Therefore, additional research involving more subjects along with a more controlled environment with different varieties of psychological and

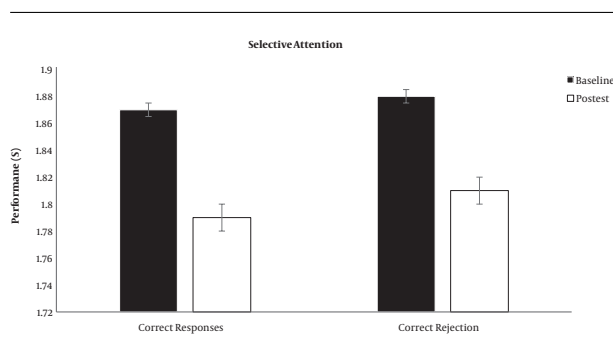


Figure 1. Selective attention of participants before and after exercise intervention

Table 2. General Characteristics of Subjects

	Control Condition ^a	Experimental Condition ^a	df	t	P Value	Effect Size
Age (y)	19.6 (1.3)		18			
BMI (kg/m ²)	18.3 (1.4)					
PSQI	6.3 (0.9)	4.9 (0.8)		7.28	0.001	1.55
Sleep efficiency ^b (%)	58.4 (5.1)	62.4 (3.9)		-4.47	0.001	0.78
Wake after sleep onset (min)	39.1 (4.1)	33.2 (3.2)		8.03	0.001	1.35
Movement and fragmentation index ^c	14.3 (4.6)	11.9 (3.9)*		2.68	0.01	0.58

^aValues are expressed as mean (SD).

^bReal sleep time reported as a percentage of time in bed.

^cThe sum of the 'Mobile time (%)' and the 'Immobile bouts ≤ 1 minute (%)'; this is an indication of the degree of fragmentation of the sleep period, and can be used as an indication of sleep quality (or the lack of it).

physical tests are required in order to make conclusive assumptions about a larger population.

4.2. Conclusions

In summary, it was shown that Yoga would attenuate the devastating effect of sleep disorder in tasks needing decisions in those with such a problem. The result supports the notion that Yoga practices can improve psychomotor performance in collegiate athletes who are vulnerable for sleep disturbances. Given the ambiguity interaction of sleep and psychomotor performance, more studies with larger sample sizes and more controlled experimental conditions are required to obtain a greater knowledge of the interaction between exercise, sleep, and psychomotor performance (i.e. selective attention).

Supplementary Material

Supplementary material(s) is available [here](#) [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Acknowledgments

We thank the Sport Sciences students of Imam Khomeini International University who generously gave their valuable time for the study.

Footnotes

Conflict of Interests: All authors have nothing to declare.

Ethical Approval: All procedures were performed according to the ethical standards of the Institutional and/or National Research Committee and with the 1964 Helsinki declaration. The study was approved by the Ethics Committee of Qazvin Medical University (IR.QUMS.REC.1397.393).

Funding/Support: The research has been granted by Imam Khomeini International University.

References

1. Taheri M, Arabameri E. The effect of sleep deprivation on choice reaction time and anaerobic power of college student athletes. *Asian J Sports Med.* 2012;**3**(1):15-20. [PubMed: [22461961](#)]. [PubMed Central: [PMC3307962](#)].
2. Wang X, Li P, Pan C, Dai L, Wu Y, Deng Y. The effect of mind-body therapies on insomnia: A systematic review and meta-analysis. *Evid Based Complement Alternat Med.* 2019;**2019**:9359807. doi: [10.1155/2019/9359807](#). [PubMed: [30894878](#)]. [PubMed Central: [PMC6393899](#)].
3. Serrano J, Shahidian S, Sampaio J, Leite N. The importance of sports performance factors and training contents from the perspective of futsal coaches. *J Hum Kinet.* 2013;**38**:151-60. doi: [10.2478/hukin-2013-0055](#). [PubMed: [24235991](#)]. [PubMed Central: [PMC3827762](#)].
4. O'Brien MJ, O'Toole RV, Newell MZ, Lydecker AD, Nascone J, Sciadini M, et al. Does sleep deprivation impair orthopaedic surgeons' cognitive and psychomotor performance? *J Bone Joint Surg Am.* 2012;**94**(21):1975-81. doi: [10.2106/JBJS.K.00958](#). [PubMed: [23014765](#)].
5. Alhola P, Polo-Kantola P. Sleep deprivation: Impact on cognitive performance. *Neuropsychiatr Dis Treat.* 2007;**3**(5):553-67. [PubMed: [19300585](#)]. [PubMed Central: [PMC2656292](#)].
6. Sheela, Nagendra HR, Ganpat TS. Efficacy of Yoga for sustained attention in university students. *Ayu.* 2013;**34**(3):270-2. doi: [10.4103/0974-8520.123117](#). [PubMed: [24501521](#)]. [PubMed Central: [PMC3902592](#)].
7. Ford DE, Cooper-Patrick L. Sleep disturbances and mood disorders: An epidemiologic perspective. *Depress Anxiety.* 2001;**14**(1):3-6. [PubMed: [11568977](#)].
8. Kaneita Y, Ohida T, Uchiyama M, Takemura S, Kawahara K, Yokoyama E, et al. The relationship between depression and sleep disturbances: A Japanese nationwide general population survey. *J Clin Psychiatry.* 2006;**67**(2):196-203. doi: [10.4088/jcp.v67n0204](#). [PubMed: [16566613](#)].
9. Carney CE, Harris AL, Falco A, Edinger JD. The relation between insomnia symptoms, mood, and rumination about insomnia symptoms. *J Clin Sleep Med.* 2013;**9**(6):567-75. doi: [10.5664/jcs.m.2752](#). [PubMed: [23772190](#)]. [PubMed Central: [PMC3659377](#)].
10. Scott JP, McNaughton LR, Polman RC. Effects of sleep deprivation and exercise on cognitive, motor performance and mood. *Physiol Behav.* 2006;**87**(2):396-408. doi: [10.1016/j.physbeh.2005.11.009](#). [PubMed: [16403541](#)].

11. Patrick Y, Lee A, Raha O, Pillai K, Gupta S, Sethi S, et al. Effects of sleep deprivation on cognitive and physical performance in university students. *Sleep Biol Rhythms*. 2017;**15**(3):217-25. doi: [10.1007/s41105-017-0099-5](https://doi.org/10.1007/s41105-017-0099-5). [PubMed: [28680341](https://pubmed.ncbi.nlm.nih.gov/28680341/)]. [PubMed Central: [PMC5489575](https://pubmed.ncbi.nlm.nih.gov/PMC5489575/)].
12. Mah CD, Mah KE, Kezirian EJ, Dement WC. The effects of sleep extension on the athletic performance of collegiate basketball players. *Sleep*. 2011;**34**(7):943-50. doi: [10.5665/SLEEP.1132](https://doi.org/10.5665/SLEEP.1132). [PubMed: [21731144](https://pubmed.ncbi.nlm.nih.gov/21731144/)]. [PubMed Central: [PMC3119836](https://pubmed.ncbi.nlm.nih.gov/PMC3119836/)].
13. Thun E, Bjorvatn B, Flo E, Harris A, Pallesen S. Sleep, circadian rhythms, and athletic performance. *Sleep Med Rev*. 2015;**23**:1-9. doi: [10.1016/j.smrv.2014.11.003](https://doi.org/10.1016/j.smrv.2014.11.003). [PubMed: [25645125](https://pubmed.ncbi.nlm.nih.gov/25645125/)].
14. Fullagar HH, Skorski S, Duffield R, Hammes D, Coutts AJ, Meyer T. Sleep and athletic performance: The effects of sleep loss on exercise performance, and physiological and cognitive responses to exercise. *Sports Med*. 2015;**45**(2):161-86. doi: [10.1007/s40279-014-0260-0](https://doi.org/10.1007/s40279-014-0260-0). [PubMed: [25315456](https://pubmed.ncbi.nlm.nih.gov/25315456/)].
15. Macy D. Yoga journal releases 2008 "Yoga in America" market study. *Yoga J*. 2008.
16. Monleon C, Hemmati Afif A, Mahdavi S, Rezayi M. The acute effect of low intensity aerobic exercise on psychomotor performance of athletes with nocturnal sleep deprivation. *Int J Sport Stud Health*. 2018;**1**(1). e66783. doi: [10.5812/intjssh.66783](https://doi.org/10.5812/intjssh.66783).
17. Morgenthaler T, Alessi C, Friedman L, Owens J, Kapur V, Boehlecke B, et al. Practice parameters for the use of actigraphy in the assessment of sleep and sleep disorders: An update for 2007. *Sleep*. 2007;**30**(4):519-29. doi: [10.1093/sleep/30.4.519](https://doi.org/10.1093/sleep/30.4.519). [PubMed: [17520797](https://pubmed.ncbi.nlm.nih.gov/17520797/)].
18. Kushida CA, Chang A, Gadkary C, Guilleminault C, Carrillo O, Dement WC. Comparison of actigraphic, polysomnographic, and subjective assessment of sleep parameters in sleep-disordered patients. *Sleep Med*. 2001;**2**(5):389-96. doi: [10.1016/s1389-9457\(00\)00098-8](https://doi.org/10.1016/s1389-9457(00)00098-8).
19. Irandoust K, Taheri M. The effect of strength training on quality of sleep and psychomotor performance in elderly males. *Sleep Hypn*. 2017;**20**(3):160-5. doi: [10.5350/Sleep.Hypn.2017.19.0148](https://doi.org/10.5350/Sleep.Hypn.2017.19.0148).
20. Taheri M, Irandoust K. The exercise-induced weight loss improves self-reported quality of sleep in obese elderly women with sleep disorders. *Sleep Hypn*. 2017;**20**(1):54-9. doi: [10.5350/Sleep.Hypn.2017.19.0134](https://doi.org/10.5350/Sleep.Hypn.2017.19.0134).
21. Dinges DF, Pack F, Williams K, Gillen KA, Powell JW, Ott GE, et al. Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. *Sleep*. 1997;**20**(4):267-77. [PubMed: [9231952](https://pubmed.ncbi.nlm.nih.gov/9231952/)].
22. Chou CC, Huang CJ. Effects of an 8-week yoga program on sustained attention and discrimination function in children with attention deficit hyperactivity disorder. *PeerJ*. 2017;**5**. e2883. doi: [10.7717/peerj.2883](https://doi.org/10.7717/peerj.2883). [PubMed: [28097075](https://pubmed.ncbi.nlm.nih.gov/28097075/)]. [PubMed Central: [PMC5237364](https://pubmed.ncbi.nlm.nih.gov/PMC5237364/)].
23. Sharif MR, Sayyah M. Assessing physical and demographic conditions of freshman "15" male medical students. *Int J Sport Stud Health*. 2018;**1**(1). e67421. doi: [10.5812/intjssh.67421](https://doi.org/10.5812/intjssh.67421).
24. Pavlovic R, Mihajlovic I, Idrizovic K, Vrcic M, Stankovic D, Joksimovic M. Differences in anthropometric traits and trend of changes in high school students. *Int J Sport Stud Health*. 2018;**1**(1). e68101. doi: [10.5812/intjssh.68101](https://doi.org/10.5812/intjssh.68101).
25. Rodrigues-Rodrigues T, Claudia Vieira Gomes A, Rodrigues Neto G. Nutritional status and eating habits of professors of health area. *Int J Sport Stud Health*. 2017;**1**(1). e64335. doi: [10.5812/intjssh.64335](https://doi.org/10.5812/intjssh.64335).
26. Irandoust K, Taheri M, Neto GR, Lotfi L. Physical and physiological literacy feedback improves the exercise behavior in TOFI governors and chief executive officers. *J Exerc Physiol Online*. 2017;**20**(6):24-30.
27. Irandoust K, Taheri M. The effect of vitamin D supplement and indoor vs outdoor physical activity on depression of obese depressed women. *Asian J Sports Med*. 2017;**8**(3). e13311. doi: [10.5812/asjasm.13311](https://doi.org/10.5812/asjasm.13311).