



Original Article

Correlation between sleep and psychological mood states in female wheelchair basketball players on a Japanese national team

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Abstract. [Purpose] Although some studies suggest the importance of getting adequate sleep for enhancing mood, there is not yet sufficient evidence on the relationship between sleep and mood states in athletes, especially for athletes with physical disability. The purpose of this study is to reveal relationships between sleep and psychological mood states in female wheelchair basketball players. [Subjects and Methods] Seventeen female wheelchair basketball players (30.9 ± 9.4 years old) on a Japanese national team participated. Sleep states were assessed with the Pittsburgh Sleep Quality Index (PSQI), and mood states with the Japanese version of the Profile of Mood States short form (POMS-SF). Spearman's rank correlations were computed. [Results] The mean PSQI score was 5.4 ± 2.6 points, and 9 athletes (52.9%) exceeded the cutoff point (5.5) for insomnia. Higher sleep efficiency ($r_s=0.58$), fewer sleep disturbances ($r_s=-0.58$), and lower total PSQI score ($r_s=-0.51$) were significantly correlated with higher vigor. Lower likelihood of daytime dysfunction was also significantly correlated with lower tension ($r_s=0.50$). [Conclusion] Vigor was the mood state most frequently correlated with sleep variables. Because vigor is a known key psychological factor in optimal performance, the findings are valuable for wheelchair basketball players.

Key words: Insomnia, Adaptive sports, Wheelchair sports

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INTRODUCTION

Numerous studies have reported that psychological mood determines performance in athletes¹⁻⁴), and that winning athletes have lower negative mood states and higher positive mood states than do losing athletes²⁻⁴). Wheelchair basketball, as well as regular basketball, requires intense movement and precise ball control. The relationships between performance of basketball and mood states have been examined^{2, 3}). For example, Hoffman et al.³) examined relationships between win/loss ratios and mood states during a league match season in professional basketball players, and reported that of the various mood states studied, vigor was the most strongly related to winning. To gain optimal performance, athletes must control their moods.

Sleep has also been documented as a determinant of mood⁵⁻⁷). Kamdar et al.⁶) observed increasing vigor and decreasing fatigue through an intervention of sleep extension in healthy college students. Additionally, in a study of male collegiate

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basketball players⁷), when players obtained as much extra sleep as possible, their various mood states were significantly improved. Although these studies suggest the importance of getting adequate sleep for enhancing mood, there is not yet sufficient evidence on the relationship between sleep and mood states in athletes, especially for athletes with physical disability. People who have disorders of the spine and/or lower limbs are frequently awakened by pain^{8–10} or by the need to change position to prevent pressure ulcers¹¹). A recent study reported that male wheelchair basketball players are more likely than the general population to suffer from insomnia¹²). Elucidation of relationships between sleep and psychological mood states in wheelchair basketball players could inform management of psychological moods in athletes with disability.

The purpose of this study is to investigate characteristics of sleep and psychological mood, and to reveal which types of mood are related to sleep in female wheelchair basketball players.

SUBJECTS AND METHODS

Participants were female wheelchair basketball players who were members of a Japanese national team. The examination was conducted on the first day of training camp, November 26, 2015. The time of the examination corresponded to a training season for the national team.

Because sleep medication can affect the condition of athletes, e.g., hangover effects¹³), the use of such medications was an exclusion criterion. The sample size was small; therefore, to ensure personal privacy, the specific number of players who were using sleep medications is not disclosed here. In the end, we obtained eligible data from 17 players.

The mean age was 30.9 ± 9.4 years. Of the 17 participants, 10 (58.8%) had central nerve system disease including spinal cord injury, spina bifida, or cerebral palsy; 7 (41.2%) had skeletal system diseases including amputation, congenital lower limb loss, or arthropathy.

All participants provided informed consent. The Human Ethics Review Committee of Ibaraki Prefectural University of Health Sciences approved this study (approval No. 485).

We used the Japanese version of the short form of the Profile of Mood States (POMS-SF)¹⁴) to assess psychological mood. The POMS-SF contains 30 items and evaluates 6 mood states (tension, depression, anger, vigor, fatigue, and confusion) during the past week. Each mood score was converted to T score based on data from Japanese females aged 30–39 years in the general population¹⁴). A high score on any variable except vigor indicates an undesirable mood state.

We assessed sleep states with the Pittsburgh Sleep Quality Index (PSQI)¹⁵). Although the original version of the PSQI assesses sleep states during the past month, to match the recall period used with the POMS-SF, we asked about sleep during the past week. The PSQI comprises 19 self-rated questions and calculates 7 sleep components: latency, subjective quality, duration, efficiency (sleep duration per total time in bed), disturbance, use of sleep medication, and daytime dysfunction. A higher PSQI score indicates poorer sleep states, and a person with a score above 5.5 points is regarded as having insomnia¹⁶).

A previous study reported the PSQI scores of the general Japanese population¹⁷); these data were used to examine differences in sleep states between Japanese females in the general population and female wheelchair basketball players. To compare sleep states in the two populations, we used the Student's t-test via manual analysis with Excel 2013 (Microsoft Corp., Redmond, WA, USA). To examine the relationship between sleep and mood states in our small sample, we used Spearman's rank correlation. Analysis was performed with IBM SPSS Statistics package, Version 24.0 (IBM Corp., Armonk, NY, USA). The level of significance was set at $p < 0.05$.

RESULTS

Table 1 shows the characteristics of the study participants. Mean sleep latency was 17.6 ± 28.5 minutes, sleep duration was 5.9 ± 1.0 hours, sleep efficiency was $90.0 \pm 11.3\%$, and 6 athletes (35.3%) reported poor sleep quality. The mean PSQI score was 5.4 ± 2.6 points, and 9 athletes (52.9%) scored above the cutoff for insomnia. The scores of wheelchair athletes demonstrated iceberg profiles (i.e. vigor was higher than other moods), but the mean score for vigor (48.6 ± 9.6) did not exceed 50. Table 2 shows

Table 1. Characteristics of the sample of female wheelchair basketball players

Age (years)	30.9 ± 9.4
Type of disease, n (%)	
Central nervous system	10 (58.8)
Skeletal system	7 (41.2)
Ability class in wheelchair basketball (points)	2.8 ± 1.3
Sleep items on PSQI	
Sleep quality (fairly bad/very bad), n (%)	6 (35.3)
Sleep latency (min)	17.6 ± 28.5
Sleep duration (hours)	5.9 ± 1.0
Sleep efficiency (%)	90.0 ± 11.3
Sleep disturbances (range: 0–27)	2.4 ± 2.7
Daytime dysfunction (range: 0–6)	1.1 ± 1.2
PSQI score	5.4 ± 2.6
Insomnia (PSQI >5.5 points), n (%)	9 (52.9)
T scores of POMS-SF†	
Tension	45.7 ± 6.7
Depression	47.4 ± 6.4
Anger	46.2 ± 8.4
Vigor	48.6 ± 9.6
Fatigue	45.8 ± 7.5
Confusion	45.4 ± 7.5

PSQI: Pittsburgh Sleep Quality Index; higher scores indicate poorer sleep.

POMS-SF: Short form of the Profile of Mood States.

Data are presented as mean \pm standard deviation, unless indicated otherwise.

†Higher scores on any variable except vigor indicate undesirable mood states.

Table 2. Differences in sleep states between the general Japanese female population and the sample of female wheelchair basketball players

	Japanese women (aged 30–39 years)† (n=143)	Study participants (n=17)
Component scores of the PSQI		
Sleep quality	1.00 ± 0.65	1.24 ± 0.83
Sleep latency	0.79 ± 0.84	0.88 ± 0.93
Sleep duration	1.05 ± 0.78	1.71 ± 0.77*
Sleep efficiency	0.05 ± 0.31	0.35 ± 0.86*
Sleep disturbance	0.78 ± 0.51	0.59 ± 0.51
Hypnotic medication use	0.07 ± 0.44	–
Daytime dysfunction	0.70 ± 0.67	0.65 ± 0.70
Total PSQI score	4.44 ± 2.09	5.41 ± 2.60

PSQI: Pittsburgh Sleep Quality Index. Data are presented as mean ± standard deviation. Each range of component scores is converted to 0 to 3 based on the scoring algorithm of the PSQI¹⁵. Higher scores on each variable indicate poor sleep states. Users of hypnotic medications were excluded from the study.

*p<0.05

†Data obtained from Doi et al.¹⁷⁾

Table 3. Rank correlations between sleep and mood states in the sample of female wheelchair basketball players

	Tension	Depression	Anger	Vigor	Fatigue	Confusion
Sleep quality (range: 0–3)†	0.06	0.45	0.10	–0.44	0.16	0.14
Sleep latency (min)†	0.10	0.17	0.04	–0.48	0.04	0.02
Sleep duration (hours)	–0.20	0.09	0.11	0.19	–0.33	0.29
Sleep efficiency (%)	0.21	0.15	–0.04	0.58*	–0.21	0.05
Sleep disturbances (range: 0–27)†	–0.44	0.31	–0.34	–0.58*	0.14	0.41
Daytime dysfunction (range: 0–6)†	0.50*	0.38	0.39	–0.17	0.26	0.27
PSQI score (range: 0–21)†	0.13	0.17	0.14	–0.51*	0.25	–0.06

PSQI: Pittsburgh Sleep Quality Index

*p<0.05

†Higher scores on each variable indicate poorer sleep states.

differences in each PSQI score between Japanese women in the general population and our participants. The wheelchair athletes had significantly higher scores for sleep duration and sleep efficiency than did their counterparts in the general population.

Table 3 presents rank correlations between sleep and mood states in the female wheelchair basketball players. Higher sleep efficiency ($r_s=0.58$, $p=0.014$), fewer sleep disturbances ($r_s=-0.58$, $p=0.015$), and lower total PSQI scores ($r_s=-0.51$, $p=0.037$) were significantly correlated with higher vigor. Lower likelihood of daytime dysfunction was also significantly correlated with lower tension ($r_s=0.50$, $p=0.039$).

DISCUSSION

This study investigated the relationship between sleep and mood states in female wheelchair basketball players on a Japanese national team. In general, our participants were more likely than age-matched females in the general population to suffer from insomnia. Higher sleep efficiency, fewer complaints of sleep disturbances, and lower PSQI scores were correlated with higher vigor scores on the POMS-SF. Sleep may be a key factor in managing vigor. Because there is insufficient information on the relationship between sleep and psychological mood states in top wheelchair athletes, our findings could be a valuable contribution to the management of mood in athletes with physical disability.

The study participants were more likely to have shorter sleep duration and lower sleep efficiency compared with general population, and more than half of the sample suffered from insomnia. A recent study of male Japanese wheelchair basketball players also reported that these players had poorer sleep states than the general population of young Japanese males¹². Insomnia could be a common problem in wheelchair athletes. For restful sleep, downregulation of core body temperature is important¹⁸). Although core body temperature of wheelchair athletes typically increases with training, these players cannot effectively downregulate their temperature because of impairments in autonomic and somatic nervous systems that control surface blood flow and sweating¹⁹). Most players practiced after their jobs, and practice sessions were more likely to finish at night; therefore, core body temperature might still be high at bedtime. There is an additional reason for insomnia of

wheelchair athletes: people who have disorders of the spine and/or lower limbs frequently wake to change position to prevent pressure ulcers¹¹, or because of pain⁸⁻¹⁰). Our findings confirm that insomnia is a serious problem for wheelchair athletes.

Of the all mood states addressed in the POMS-SF, vigor was most frequently correlated with sleep variables including sleep efficiency, sleep disturbances, and PSQI scores. A large part of both sleep efficiency and sleep disturbances is explained by waking after sleep onset. As was discussed in the previous paragraph, nocturnal awakening is a common problem in people with lower body disabilities and insomnia because awakening could decrease vigor. Because vigor has been reported as the most important psychological factor for winning in a study of professional basketball players³, our observed correlation between vigor and sleep variables is important for wheelchair basketball players. An intervention study reported that vigor of young adults decreased with restriction of nocturnal sleep and recovered over two days with adequate sleep⁵). Our results expand on these findings and reveal that a way of improving sleep of wheelchair athletes is needed to enhance their vigor. In a previous study of male college basketball players, improvement of mood states, including vigor, was observed with sleep interventions that required maximum possible extension of nocturnal sleep duration⁷). The positive effect of sleep extension on vigor has also been observed in healthy college students⁶). Although extending nocturnal sleep duration could be effective for improving mood states in wheelchair athletes, there are two concerns. First, long sleep duration may exacerbate tissue damage from pressure ulcers in people who have difficulty changing positions during sleep^{11, 20}). Additionally, since this study did not observe a significant correlation between sleep duration and mood states, it is uncertain whether extending nocturnal sleep duration would be effective for improving mood states in wheelchair athletes. Both the safety and efficacy of extending nocturnal sleep duration in wheelchair athletes should be carefully confirmed in future studies. Waterhouse et al.²¹) reported that in a situation of partial sleep deprivation, short naps had a beneficial effect on decreasing sleepiness and increasing sprint performance. Short naps could be also effective for wheelchair athletes.

Daytime dysfunction scores on the PSQI were correlated with tension scores on the POMS-SF. In a physiological study, increased activity of the sympathetic nervous system and cortisol concentrations were observed in a condition of sleep deprivation²²). Additionally, an intervention study that required sleep restriction reported increases in sleepiness and tension⁵). These previous studies support our results, and indicate that poor sleep that induces daytime sleepiness should be avoided to prevent increases in tension.

Although the T scores on the POMS-SF in our participants demonstrated iceberg profiles, the mean score for vigor was below 50. It is known that top athletes have better mood states, including higher vigor, than the general population as well as athletes at other levels^{23, 24}), and Horvat et al.²³) has reported that this finding of higher vigor holds for wheelchair athletes as well. The presented results were discordant to the previous studies. The higher prevalence rate of insomnia in the female wheelchair basketball players may be linked to lower vigor mood as top athletes. Measurements were made after main competition were finished, and this could have affected mood. When athletes are away from the competition environment, their vigor is more likely to decrease²⁴). Further studies during various parts of the season are needed to clarify environmental effects on mood states in wheelchair athletes.

This study had some limitations. First, although we were able to secure rare data from top wheelchair athletes and obtain valuable results, the sample size was small. With a larger sample, further significant correlations between sleep aspects and mood states might be observed. Second, both sleep and psychological variables were assessed with a self-reported questionnaire that may induce recall/reporting bias. Finally, because this study is cross-sectional, we cannot conclude that improvement of sleep produces better mood states.

In conclusion, more than half of the top female Japanese wheelchair basketball players we studied face insomnia. Vigor was the mood most frequently correlated with sleep variables. Because vigor is a known key psychological factor in optimal athletic performance, our results have important training implications for wheelchair basketball players.

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