

## Sleep Status in Male Wheelchair Basketball Players on a Japanese National Team

Kenji Tsunoda<sup>1,2\*</sup>, Kazushi Hotta<sup>2</sup>, Hiroataka Mutsuzaki<sup>3</sup>, Kaori Tachibana<sup>4</sup>, Yukiyo Shimizu<sup>5</sup>, Takashi Fukaya<sup>6</sup>, Eiji Ikeda<sup>7</sup>, Naruki Kitano<sup>8</sup> and Yasuyoshi Wadano<sup>9</sup>

<sup>1</sup>Physical Fitness Research Institute, Meiji Yasuda Life Foundation of Health and Welfare, Tokyo, Japan

<sup>2</sup>Department of Occupational Therapy, School of Healthcare, Ibaraki Prefectural University of Health Sciences, Ibaraki, Japan

<sup>3</sup>Department of Orthopaedic Surgery, Ibaraki Prefectural University of Health Sciences, Ibaraki, Japan

<sup>4</sup>Department of Physical Therapy, School of Healthcare, Ibaraki Prefectural University of Health Sciences, Ibaraki, Japan

<sup>5</sup>Department of Rehabilitation Medicine, University of Tsukuba Hospital, Ibaraki, Japan

<sup>6</sup>Department of Physical Therapy, Faculty of Health Sciences, Tsukuba International University, Ibaraki, Japan

<sup>7</sup>Faculty of Education, Art and Science, Yamagata University, Yamagata, Japan

<sup>8</sup>Institute of Health and Sport Sciences, University of Tsukuba, Ibaraki, Japan

<sup>9</sup>Department of Rehabilitation Medicine, Ibaraki Prefectural University of Health Sciences, Ibaraki, Japan

\*Corresponding author: Tsunoda K, PhD, Physical Fitness Research Institute, Meiji Yasuda Life Foundation of Health and Welfare, 150 Tobuki, Hachioji, Tokyo 192-0001, Japan, Tel: 81426911163; E-mail: [tsunoda@my-zaidan.or.jp](mailto:tsunoda@my-zaidan.or.jp)

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### Abstract

**Background:** Sufficient sleep is required for optimal performance in athletes; however, there is no published information regarding sleep status in top wheelchair basketball players. This study has two objectives: to compare sleep status between the general population of young Japanese males and male wheelchair basketball players, and to examine differences in sleep status by physical disordered conditions of wheelchair athletes.

**Methods:** Study participants included 14 male wheelchair basketball players on a Japanese national team. Sleep status was assessed by the Pittsburgh Sleep Quality Index (PSQI). A higher PSQI score indicates poor sleep quality. To compare sleep status between the general Japanese population and wheelchair athletes, we used data from a previous study that assessed PSQI in the former population. We divided athletes' disordered conditions into two categories: spinal cord injury (n=9) and skeletal system diseases (n=5).

**Results:** The mean PSQI score was  $5.8 \pm 3.0$  points; six athletes (42.9%) were over the cutoff point (5.5) for insomnia. The wheelchair athletes had significantly higher scores for sleep quality, sleep efficiency, and total PSQI than the general population of young Japanese males. The PSQI score of athletes with skeletal system diseases was significantly higher than athletes with spinal cord injury. Additionally, athletes with skeletal system diseases were significantly more likely to score over the cutoff point for insomnia than those with spinal cord injury.

**Conclusions:** Top male wheelchair basketball players had poorer sleep than the general population of young Japanese men, and athletes with skeletal system diseases more frequently suffered from insomnia compared with athletes with spinal cord injury. Effective methods to improve sleep are needed to help top wheelchair basketball players to achieve optimal performance.

**Keywords:** Insomnia; Adapted sports; Disability; Top athlete; Wheelchair sports

### Introduction

Sufficient sleep is required to bring about maximal performance in athletes. According to previous studies, sleep can affect both physical [1] and technical performance [2,3]. For example, Mougin et al. [1] reported that peak oxygen consumption dropped after partial sleep deprivation compared with normal sleep conditions. Similarly, in the study by Reyner and Horne [2], serving accuracy in tennis players was decreased in situations of sleep deprivation. In a study on the benefits of sleep extension for performance in basketball players [3], subjects were required to spend at least 10 hours in bed each night. Results of

the extended sleep intervention showed that athletes' sprint time, reaction time, and three-point field goals were typically enhanced.

Since wheelchair basketball requires both physical and technical levels of performance that are similar to regular basketball [4], getting the best quality sleep is important to wheelchair athletes. However, no information has been reported on sleep status in wheelchair basketball players. People who have disorders of the spine and/or lower limbs frequently wake to change position, to prevent pressure ulcers [5] or because of pain [6-8]. Therefore, the sleep status of wheelchair basketball players could be poorer than that of healthy people. Additionally, disordered conditions in wheelchair basketball players are varied. For example, a healthy thermoregulation system is necessary to fall asleep smoothly [9]. Wheelchair athletes with spinal

cord injury have a weaker thermoregulation system than other wheelchair athletes [10]. Such differences of disordered conditions may affect sleep. Revealing the sleep status of wheelchair basketball players could help in building sleep assistance strategies that could lead to optimal athlete performance.

This study has two objectives: to compare sleep status between young Japanese males in the general population and male wheelchair basketball players, and to examine differences in sleep status by physical disordered conditions in wheelchair athletes.

## Methods

### Study participants

Study participants included 14 male wheelchair basketball players who were members of a Japanese national team. The mean age was 29.5 ± 5.2 years (range: 22 to 39 years). Of the total 14 participants, 9 athletes (64.3%) had spinal cord injury and 5 (35.7%) had skeletal system diseases. The study examination was conducted on June 18, 2014 as a part of a health checkup before the World Wheelchair Basketball Championship on July 3–15, 2014.

The athletes played wheelchair basketball 2 to 5 days/week for 2 to 4 hours/day. The mean years of experience playing wheelchair basketball was 10.4 ± 4.7 years. All participants provided informed consent. The Human Ethics Review Committee of Ibaraki Prefectural University of Health Sciences (No. 485) approved this study.

### Measurement variables

**Sleep:** We assessed sleep status during the past week using the Pittsburgh Sleep Quality Index (PSQI) [11]. The PSQI consists of seven domains: sleep latency, subjective sleep quality (very good, fairly good, fairly bad, and very bad), sleep duration, sleep efficiency (sleep duration per total time in bed), sleep disturbance, use of sleep medication, and daytime dysfunction. A higher PSQI score indicates poor sleep quality; a person with a PSQI score over 5.5 points is regarded as having insomnia.

### Conditions of physical disorders

Orthopedists and psychiatrists assessed the conditions of physical disorders. We divided the disordered conditions into two categories: spinal cord injury (n=9) including spinal injury (n=6) and spina bifida (n=3), and skeletal system diseases (n=5) including amputation (n=3), congenital lower limb loss (n=1), and arthropathy (n=1).

### Statistical analysis

A previous epidemiological study [12] reported the PSQI of the general Japanese adult population. To examine differences in sleep status between young Japanese males in the general population and male wheelchair basketball players, we used data of that previous study.

We compared sleep status between young Japanese males and male wheelchair basketball players using the Student's t-test. To examine difference in sleep status between disordered conditions, the Student's t-test for continuous variables and chi-squared tests for categorical variables were also used. We used IBM SPSS Statistics package, Version 21.0 (IBM Corp., Armonk, NY, USA) for statistical analysis, with the level of significance set at P<0.05.

## Results

Table 1 shows characteristics of the study participants. Mean sleep latency was 24.9 ± 21.5 minutes, sleep duration was 6.5 ± 0.9 hours, sleep efficiency was 87.8 ± 9.3%, and 6 athletes (42.9%) reported poor sleep quality. The mean PSQI score was 5.8 ± 3.0 points, and 6 athletes (42.9%) were over the cutoff point (5.5) for insomnia. With respect to the reasons for sleep disturbance, participants most frequently reported “wake up in the middle of the night or early morning” (42.9%), “feel too hot” (35.7%), and “cannot get to sleep within 30 minutes” (28.6%).

Age	29.5 ± 5.2
Spinal cord injury	9(64.3%)
Skeletal system diseases	5(35.7%)
Sleep latency (minutes)	24.9 ± 21.5
Sleep duration (hours)	6.5 ± 0.9
Sleep efficiency (%)	87.8 ± 9.3
Reasons for sleep disturbance (≥1 times/week)	
Cannot get to sleep within 30 minutes	4(28.6%)
Wake up in the middle of the night or early morning	6(42.9%)
Have to get up to use the bathroom	3(21.4%)
Cannot breathe comfortably	0(0.0%)
Cough or snore loudly	2(14.3%)
Feel too cold	0(0.0%)
Feel too hot	5(35.7%)
Have bad dreams	0(0.0%)
Have pain	2(14.3%)
Other reasons	0(0.0%)
Daytime dysfunction	
Daytime sleepiness (≥1 times/week)	2(14.3%)
Daytime enthusiasm (somewhat/very big problem)	3(21.4%)
Sleep medication usage	0(0.0%)
Sleep quality (fairly/very bad)	6(42.9%)
Total PSQI score (points)	5.8 ± 3.0
Insomnia (PSQI >5.5 points)	6(42.9%)

**Table 1:** Participant characteristics (PSQI: Pittsburgh Sleep Quality Index).

Table 2 shows differences in sleep status between young Japanese men in the general population and male wheelchair basketball players. The wheelchair athletes had significantly higher scores for sleep quality, sleep efficiency, and total PSQI than the general population of Japanese males.

Scores of PSQI domains	General Japanese men (aged 20-29 years)†	Male wheelchair basketball players	P
	(n=103)	(n=14)	
Sleep quality	1.05 ± 0.71	1.5 ± 0.65	0.027
Sleep latency	0.83 ± 0.85	1.07 ± 1.07	0.336
Sleep duration	0.99 ± 0.77	1.29 ± 0.99	0.196
Sleep efficiency	0.11 ± 0.31	0.36 ± 0.74	0.026
Sleep disturbance	0.62 ± 0.49	0.79 ± 0.43	0.231
Hypnotic medication use	0.04 ± 0.31	0 ± 0	–
Daytime dysfunction	0.84 ± 0.81	0.79 ± 0.89	0.817
Total PSQI score	4.51 ± 2.14	5.79 ± 3.02	0.049

**Table 2:** Differences in sleep status between general Japanese male population and wheelchair basketball players (PSQI: Pittsburgh Sleep Quality Index, A high score for each variable indicates poor sleep status, †Data were obtained from Doi et al. [12]).

Table 3 presents a comparison of sleep status by disordered conditions. Scores of sleep quality and PSQI of athletes with skeletal system diseases were significantly higher than that of athletes with spinal cord injury. Additionally, athletes with skeletal system diseases were significantly more likely to score above the cutoff for insomnia than those with spinal cord injury.

Scores of PSQI domains	Spinal cord injury	Skeletal system diseases	P
	(n=9)	(n=5)	
Sleep quality	1.22 ± 0.44	2 ± 0.71	0.025
Sleep latency	0.78 ± 1.09	1.6 ± 0.89	0.178
Sleep duration	1 ± 0.87	1.8 ± 1.1	0.156
Sleep efficiency	0.22 ± 0.67	0.6 ± 0.89	0.384
Sleep disturbance	0.67 ± 0.5	1 ± 0	0.169
Hypnotic medication use	0 ± 0	0 ± 0	–
Daytime dysfunction	0.67 ± 1	1 ± 0.71	0.525
Total PSQI score	4.56 ± 2.65	8 ± 2.45	0.034
Insomnia (PSQI > 5.5 points)	2(22.2%)	4(80.0%)	0.036
<b>Reasons for sleep disturbance (≥1 times/week)</b>			
Cannot get to sleep within 30 minutes	2(22.2%)	2(40.0%)	0.480
Wake up in the middle of the night or early morning	3(33.3%)	3(60.0%)	0.334
Have to get up to use the bathroom	1(11.1%)	2(40.0%)	0.207
Cannot breathe comfortably	0(0.0%)	0(0.0%)	–

Cough or snore loudly	2(22.2%)	0(0.0%)	0.255
Feel too cold	0(0.0%)	0(0.0%)	–
Feel too hot	3(33.3%)	2(40.0%)	0.803
Have bad dreams	0(0.0%)	0(0.0%)	–
Have pain	1(11.1%)	1(20.0%)	0.649
Other reasons	0(0.0%)	0(0.0%)	–

**Table 3:** Comparisons of sleep status by disordered conditions (PSQI: Pittsburgh Sleep Quality Index, A high score for each variable indicates poor sleep status).

## Discussion

This study investigated the sleep status of male wheelchair basketball players on a Japanese national team. The sleep variables of the wheelchair athletes were significantly poorer than those of the general population of young Japanese men, and about half of wheelchair athletes suffered from insomnia.

The wheelchair athletes had poorer sleep quality and sleep efficiency than the general population, and they frequently cited nocturnal awakening as a reason for sleep disturbance. Amputees frequently suffer from phantom pain and restless legs syndrome during the night [6]. Additionally, to prevent pressure ulcers, people with physical disordered conditions wake frequently to change sleeping position [5]. Such nocturnal awakening may be unavoidable for athletes with such conditions, to protect their bodies.

The wheelchair athletes cited feeling hot as a reason for sleep disturbance. To obtain restful sleep, downregulation of core body temperature is important [9]. Although core body temperature is typically increased with vigorous physical training [13], wheelchair athletes cannot effectively downregulate their core body temperature compared with people who have no physical disability [14]. In particular, it is known that people with spinal cord injury have seriously impaired thermoregulatory control [10,15]. Edinger et al. [16] reported that people with elevated core body temperature after vigorous exercise had longer sleep latency than those whose core temperature did not rise substantially. Susceptibility to such overheating could be a reason for poor sleep in wheelchair athletes. Additionally, nearly all study participants worked during the daytime so they typically trained at night. Vigorous exercise before sleep can interfere with falling asleep owing to enhanced physiologic excitement [13]. To moderate core body temperature and physical arousal level, it is important that vigorous physical training finish as early as possible before bedtime.

Although the sleep status of wheelchair basketball players was generally poor, athletes with skeletal system diseases suffered more frequently from insomnia than athletes with spinal cord injury. Compared with the latter, athletes with skeletal system diseases are assigned to higher ability classes [17], so they are required to perform more vigorously and precisely; therefore, excessive physical and mental stress may negatively affect sleep in these athletes. Additionally, vigorous performance in the athletes with higher ability classes could increase core body temperature extremely. It is also possible that people with spinal cord injury are frequently prescribed muscle relaxant [18] and analgesic [19] drugs, which can assist with sleep as a side effect [18,20]. However, in the current study, we did not have a

determinant reason for the higher ratio of insomnia among athletes with skeletal system diseases. Future studies should investigate these reasons with more detailed assessment of sleep and disordered conditions.

This study had some limitations. First, the sample size was small. With a more adequate sample size, greater statistical differences in sleep status between disordered conditions might be observed. Second, sleep variables were assessed by a self-reported questionnaire that may induce recall/reporting bias. Third, the study examination was conducted before the World Wheelchair Basketball Championship 2014. Athletes are more likely to have nervousness and insomnia before an important competition [21], and the study time may affect results. To build sound evidence, further studies with various seasons are needed. Fourth, although this study reported poor sleep status among top wheelchair basketball players, generalizability to other wheelchair athletes is uncertain. Finally, we did not assess actual performance in wheelchair basketball among athletes included in the study. Although a previous study revealed the effect of sleep on basketball performance [3], to clarify the importance of sleep in wheelchair basketball, future studies should examine the association between sleep and wheelchair basketball performance.

## Conclusion

Top male wheelchair basketball players had poorer sleep than young Japanese males in the general population. Additionally, athletes with skeletal system diseases more frequently suffered from insomnia compared with athletes with spinal cord injury. To promote optimal performance, sleep assistance strategies should be developed for top wheelchair basketball players.

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