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## Brief Communication

# Insufficient sleep rather than the apnea–hypopnea index can be associated with sleepiness-related driving problems of Japanese obstructive sleep apnea syndrome patients residing in metropolitan areas



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## ABSTRACT

**Objective:** Obstructive sleep apnea syndrome (OSAS) and insufficient sleep might increase the risk of drowsy driving and sleepiness-related vehicular accidents. This study retrospectively investigated the factors associated with these driving problems, particularly addressing OSAS severity and sleep amounts of affected drivers.

**Methods:** This study examined 161 patients (146 male and 15 female) with OSAS (apnea–hypopnea index [AHI]  $\geq 5$ ) who drove on a routine basis and who completed study questionnaires. To investigate factors associated with drowsy driving during the prior year and sleepiness-related vehicular accidents or near-miss events during the prior five years, logistic regression analyses were performed with age, body mass index, monthly driving distance, habitual sleep duration on weekdays, the Japanese version of Epworth Sleepiness Scale score, AHI, and periodic limb movement index as independent variables.

**Results:** Of the patients, 68 (42.2%) reported drowsy driving experiences, and 86 (53.4%) reported sleepiness-related vehicular accidents or near-miss events. Analyses revealed the following: older age (46–65 years,  $\geq 66$  years) was negatively associated with drowsy driving ( $p < 0.05$ ,  $p < 0.05$ ), and habitually shorter sleep duration on weekdays ( $\leq 6$  hours) was positively associated with drowsy driving ( $p < 0.01$ ). Habitual sleep duration of  $\leq 6$  hours ( $p < 0.01$ ) and Epworth Sleepiness Scale score of  $\geq 11$  ( $p < 0.01$ ) were positively associated with sleepiness-related vehicular accidents and near-miss events. However, AHI was not associated with these driving problems.

**Conclusion:** Insufficient sleep, rather than severity of OSAS, was associated with sleepiness-related driving problems in these Japanese OSAS patients.

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## 1. Introduction

Reportedly, patients with obstructive sleep apnea syndrome (OSAS) have an increased risk of causing vehicular accidents or near-miss events, mainly because of excessive daytime sleepiness (EDS) brought about by fragmentation and shallowness of nocturnal sleep accompanied by respiratory events [1]. However, insufficient sleep is regarded as a major cause of EDS. Epidemiological surveys of the general population have revealed sleep deficit as predictive of falling asleep at the wheel [2] and increased risk of actual vehicular

accidents [3]. However, to date, few studies have evaluated the association between driving risk and OSAS severity and the current length of nocturnal sleep of study participants affected by OSAS [3]. Therefore, differences between the impact of chronic insufficient sleep and OSAS on the occurrence of EDS-related vehicular accidents in this population have not been determined. To clarify these differences, we conducted this preliminary retrospective study of OSAS-affected drivers to investigate the effects of respiratory disorder indices and insufficient sleep on the occurrence of sleepiness-related vehicular accidents or near-miss events.

## 2. Methods

The ethics committee of the Neuropsychiatric Research Institute approved this study. Written informed consent was obtained

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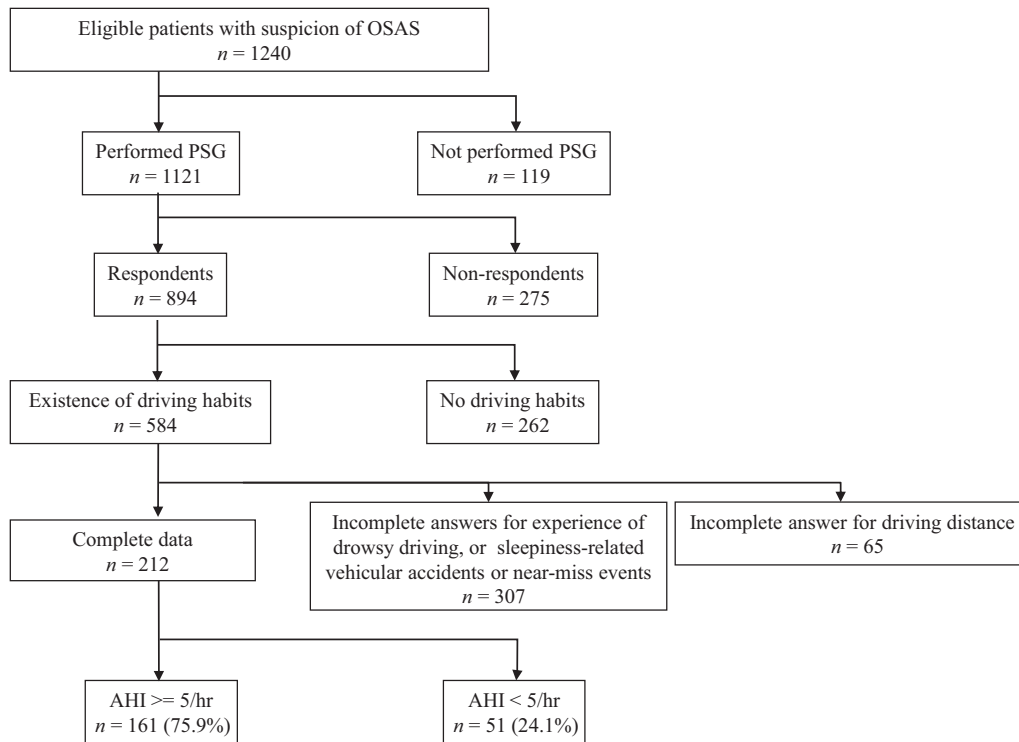


Fig. 1. Patient flow. AHI, apnea-hypopnea index; OSAS, obstructive sleep apnea syndrome; PSG, polysomnography.

from all participants. Consecutive patients with suspicion of OSAS who visited Yoyogi Sleep Disorder Center during November 2009 to March 2013 were eligible for participation ( $n = 1240$ ). After excluding patients who provided incomplete data or who had apnea-hypopnea index (AHI)  $< 5/h$  on a nocturnal polysomnogram (n-PSG), 161 patients (146 male and 15 female) with OSAS who drove routinely and who completed study questionnaires were enrolled in this study (Fig. 1). The study questionnaires included the following data: demographic information, self-reported monthly driving distance (km), presence or absence of the experience of drowsy driving during the prior year [4,5], experience of sleepiness-related vehicular accidents or near-miss events during the prior five years [6], the Japanese version of the Epworth Sleepiness Scale (JESS), a measure for evaluating subjective daytime sleepiness [7], and self-reported habitual sleep duration on weekdays. Sleep structure variables, AHI, and periodic limb movement index (PLMI) on n-PSG of all participants were evaluated according to the American Academy of Sleep Medicine (AASM) scoring rule [8]. Information related to coexisting psychiatric disorders, use of sedative drugs, and performance of shift work was obtained from patients' medical records.

To investigate factors associated with drowsy driving during the prior year and sleepiness-related vehicular accidents or near-miss events during the prior five years [4–6], logistic regression analyses were done with age, body mass index (BMI), existence of psychiatric disorders, use of sedative drugs, shift work, monthly driving distance, habitual sleep duration on weekdays, JESS score, AHI, and PLMI as independent variables. Age, body mass index (BMI), monthly driving distance, JESS score, AHI, PLMI and habitual sleep duration were categorized respectively as follows: (1) age 26–45 years, 46–65 years,  $\geq 66$  years [9,10], (2) BMI  $< 25 \text{ kg/m}^2$  and  $\geq 25 \text{ kg/m}^2$ , (3) monthly driving distance  $< 1000 \text{ km}$ , and  $\geq 1000 \text{ km}$  (median value), (4) AHI 5–15/h, 15–30/h, and  $\geq 30/h$ , (5) PLMI  $< 15/h$  and  $\geq 15/h$ , (6) JESS  $< 11$  and  $\geq 11$  [7], and (7) habitual sleep duration  $> 6 \text{ h}$  and  $\leq 6 \text{ h}$  (median value). All variables were examined initially with

univariate models. Multivariate logistic regression analyses were then conducted for all variables that showed significant correlation in univariate models.

### 3. Results

Subject characteristics were as follows (mean [standard deviation]): age, 48.9 [11.2] years BMI, 26.3 [4.4]  $\text{kg/m}^2$ ; AHI, 28.7 [23.1]/h; PLMI, 6.4 [14.8]/h; JESS score, 13.0 [5.4]; and habitual sleep duration on weekdays, 6.3 [1.2] h). Nine patients had coexisting psychiatric disorders: depression ( $n = 3$ ), bipolar disorder ( $n = 3$ ), social anxiety disorder ( $n = 2$ ), and obsessive-compulsive disorder ( $n = 1$ ). Ten patients used sedative drugs regularly. Three patients were employed in shift work. Of a total of 161 patients, 68 (42.2%) reported having had one or more experiences of drowsy driving during the prior year. Univariate logistic regression analyses revealed two items that were significantly associated with the experience of drowsy driving: age category of  $\geq 66$  years (odds ratio [OR] = 0.198, 95% confidence interval [CI] = 0.051–0.761,  $p < 0.05$ ) and habitually shorter sleep duration on weekdays (OR = 2.481, 95% CI = 1.298–4.744,  $p < 0.01$ ). Age category of  $\geq 66$  years (OR = 0.219, 95% CI = 0.055–0.864,  $p < 0.05$ ) and habitually shorter sleep duration on weekdays ( $\leq 6 \text{ hr}$ , OR = 2.632, 95% CI = 1.331–5.204,  $p < 0.01$ ) also showed significant association in the multiple logistic regression model.

Of the 161 patients, 86 (53.4%) had experienced sleepiness-related vehicular accidents or near-miss events during the prior five years. Univariate logistic regression analyses revealed two items that were significantly associated with the experience: habitually shorter sleep duration on weekdays (OR = 2.800, 95% CI = 1.476–5.312,  $p < 0.01$ ) and positivity for pathological sleepiness (JESS  $\geq 11$ , OR = 4.369, 95% CI = 2.131–8.958,  $p < 0.01$ ) [7]. In the multiple logistic regression model, habitually shorter sleep duration on weekdays (OR = 3.349, 95% CI = 1.665–6.735,  $p < 0.01$ ) and positivity for pathological sleepiness (OR = 5.106, 95% CI = 2.382–10.948,

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