

Harmonizing work with the treatment and prevention of sleep disordered breathing in commercial motor vehicle drivers: implications for health and productivity management

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Abstract: The disastrous traffic accidents to date have provided the relevance for promotion of harmonization of work with treatment and prevention of sleep disordered breathing (SDB) in transport sectors. SDB is highly prevalent in commercial motor vehicle (CMV) drivers and is one cause of cognitive impairment and consequent traffic accidents, potentially costing billions and leading to many deaths. Various screening, diagnostic, and therapeutic approaches, some well established, are explored in this paper. Although drivers with SDB need to be appropriately diagnosed and treated, some are reluctant to continue their treatment or never submit to screening because of a lack of information. Thus, CMV drivers need to be well informed and screened, in addition to being encouraged to continue the treatment. The harmonization of work with treatment and prevention aids these objectives, providing benefits not only for individual health but also for transport companies, and further being an essential step towards uptake of “health and productivity management” in the transport sectors.

Key words: Sleep disordered breathing, Driver, Traffic accident, Adherence, CPAP, AHI, OSA

Sleep Disordered Breathing (SDB) and its Occupational Implications

Clinical and occupational effects of SDB

The harmonization of work with treatment and prevention of medical conditions is currently promoted by the Japanese government but is receiving little recognition. The approach is not thought to be beneficial for the company and frequently regarded as a personal matter. This

paper describes the harmonization of work with the treatment and prevention of sleep disordered breathing (SDB), a condition that is increasingly considered as being of significant relevance in the transport sector.

Obstructive sleep apnea (OSA), one common type of SDB, is characterized by repeated partial and complete airway closure during sleep, which leads to intermittent hypoxemia, fragmented sleep, and cyclic changes of intrathoracic pressure. OSA is subsequently associated with the higher prevalence of higher coronary heart diseases^{1–3}, hypertension^{4, 5}, stroke^{3, 6, 7}, and diabetes^{8–10}. OSA also leads to impairment in the quality of sleep, which is associated with cognitive impairment such as daytime sleepi-

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ness, and impaired concentration and performance^{11, 12}. These impairments can result in mistakes or injuries during performance in the workplace, which may even lead to disastrous accidents in transport sectors. Increased awareness of the importance of both a sufficient quantity and quality of drivers' sleep is thus desirable^{13, 14}.

Epidemiology of SDB in commercial motor vehicle (CMV) drivers

The prevalence of SDB varies depending on definitions and surveyed populations, but was found to be higher in the obese and older male population. Where SDB is defined using an apnea-hypopnea index (AHI) ≥ 15 , the prevalence of SDB is up to 10–20% in community-dwelling male residents aged around 50 yr, while it is up to 10% in females (Fig. 1)^{15–24}.

Only limited data are available on SDB prevalence in occupational settings in Japan. A study investigating 1,313 Japanese truck drivers showed that the 3% oxygen desaturation index (3%ODI) was ≥ 5 for 337 drivers (25.7%) and ≥ 15 for 88 drivers (6.7%)²⁵. These subjects with SDB were at higher risk not only for hypertension²⁵ but also for cognitive impairment, the latter of which is associated with traffic accidents^{26–28}.

Screening in Sleep Medicine

Traffic accidents in drivers with SDB

An analysis in the US showed that OSA-related motor vehicle collisions cost US\$15.9 billion and 1,400 lives in the year 2000. It was also estimated that in the United States, treating all drivers suffering from OSA with continuous positive airway pressure (CPAP) would cost US\$3.18 billion annually, while it would save US\$11.1 billion in collision costs as well as save 980 lives²⁶. Drivers with OSA who underwent CPAP therapy with good adherence showed the same rates of traffic accidents as those who did not suffer from OSA. Interestingly, drivers with OSA undergoing CPAP therapy with poor therapeutic adherence failed to show this risk improvement²⁷. CMV drivers with OSA in the US had a 2 to 5-fold risk for traffic accidents^{26, 27}. Similarly, drivers in Japan with OSA experienced 2.4 times the amount of traffic accidents than those without OSA²⁸. It was believed that the higher risk of drivers with OSA could be lowered by CPAP treatment.

Screening methods

Questionnaire

OSA is diagnosed based on AHI levels, which are de-

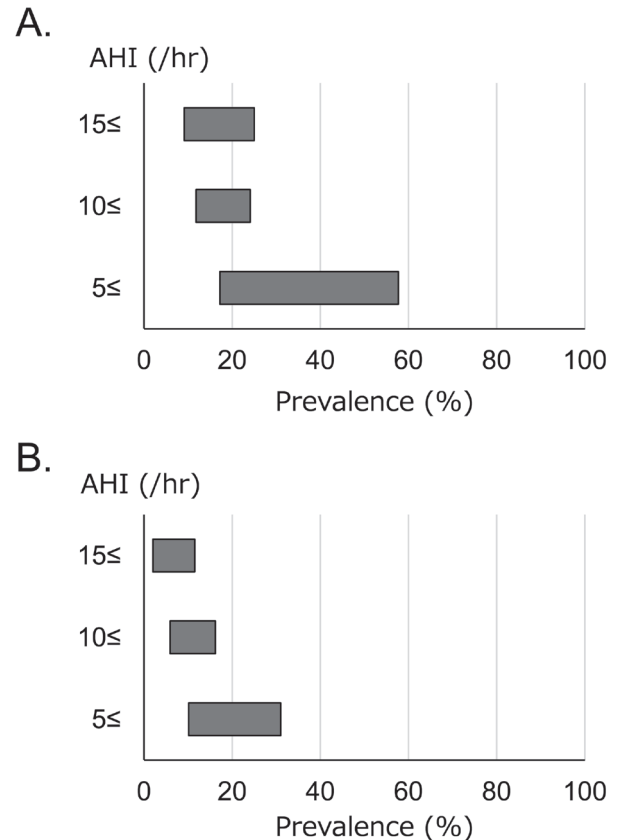


Fig. 1. Prevalence (%) of SDB according to its definition by AHI levels in males (A) and females (B) aged around 50.

rived from a full overnight polysomnography (full PSG). Since suspected individuals need to stay at least one night at sleep institutes, full PSG might not be appropriate to screen all of the drivers within the transport sector. Other screening methods sufficient to identify high-risk groups for OSA exist, including questionnaires and portable screening devices.

The Epworth Sleepiness Scale (ESS)²⁹, Berlin Questionnaire, and STOP-Bang³⁰ are among the frequently used questionnaires. ESS consists of 8 questions with a total score of 24 and is frequently used to identify those who have excessive daytime sleepiness (EDS), because EDS is a major symptom of OSA. An ESS score of 11 or more indicates individuals with EDS, and the score is associated with AHI levels. There are, however, some individuals with severe OSA who do not report EDS.

Snoring is another major symptom of OSA and employed as an indicator by some questionnaires such as STOP-Bang or the Berlin Questionnaire. This may be a better symptom-based indicator of AHI, although family members or partners are necessary to witness snoring and

Table 1. Recommendations for screening commercial drivers for OSA (data from references 31 and 32)

Criteria for OSA Screening	Drivers meeting one or more of the six criteria are considered to have OSA or probable OSA
Subjective Criteria (items: 1–8)	
-Historical Findings (items: 1–3) ³¹⁾	1. Any of the following symptoms: snoring, excessive daytime sleepiness, witnessed apnea 2. History of MVC likely related to sleep disturbance (running off road, at-fault, rear-end collision) 3. Previous OSA diagnosis; prior PSG with AHI >5; Reported CPAP prescription and/or use
-Historical Findings (items: 4–7) ³²⁾	4. Taking breaks at frequencies <1 h during long journeys 5. Likelihood of feeling sleepy while driving 6. Nodding off whilst driving in the last year 7. Any accidents in the last 3 yr related to sleepiness
-ESS (item: 8)	8. ESS score >10
Objective Criteria (items: 9–10) ³¹⁾	9. Sleeping in examination or waiting room 10. Two or more of the following: a. BMI \geq 35 kg/m ² b. NC >17 in in men, 16 in in women c. Hypertension (new, uncontrolled, or requiring \geq 2 medications for control)

MVC: motor vehicle collision; BMI: body mass index; NC: neck circumference; ESS: Epworth Sleepiness Scale.

describe its frequency and volume.

Since OSA patients are more likely to be obese, to have hypertension, and to snore, a combination of symptoms has been developed that suggest high-risk individuals for OSA. The Joint Task Force (JTF), which consists of the American College of Chest Physicians, the American College of Occupational and Environmental Medicine, and the National Sleep Foundation, proposed several symptoms that are linked to greater AHI levels such as snoring, high body mass index (BMI), and hypertension, published as recommendations for screening CMV drivers for OSA³¹⁾ (Table 1).

Another study identified four “red flag” parameters found in histories of CMV drivers: taking breaks at frequencies <1 h during long journeys, likelihood of feeling sleepy while driving, nodding off whilst driving in the last year, and any accidents in the last 3 yr related to sleepiness (Table 1)³²⁾. In addition, the Driver and Vehicle Licensing Agency (DVLA) in the UK recently launched a new drivers’ licensing criterion regarding SDB-like symptoms. Driver’s license applicants with symptoms should not drive or should report their SDB to DVLA depending on their AHI levels (whether or not they experience sleepiness) together with their licensing categories (car and motor cycles general drivers) or bus and lorry CMV drivers)³²⁾.

Screening tools

There are several tools to identify groups at high risk of OSA, which are classified into 4 types according to their properties and accuracy (Table 2)³³⁾. The sensitivity and

specificity for full PSG-dependent diagnosis are between 40 and 100%. The type 3 or type 4 devices, which are portable monitors with 4 items (type 3) or less (type 4), detect OSA-related events, such as airflow obstruction and oxygen desaturation or physical activities. Their sensitivity and specificity is 40–100%. Oxygen desaturation index (ODI) and respiratory disturbance index (RDI) are tightly associated, although ODI was found to sometimes be much lower than RDI based on airflow sensors in non-obese individuals³⁴⁾, suggesting that the measurement basis of the sensors is important.

Treatment in Sleep Medicine

Effect of treatment

A study in the US showed that OSA patients on CPAP therapy and drivers without OSA had the same level of risk for traffic accidents²⁷⁾. The study also showed that the risk for traffic accidents was associated with adherence to CPAP therapy. This emphasizes the relevance of harmonizing the workplace with treatment and prevention, although it has to be considered that CMV drivers may frequently change their employers. In some transport companies, as many as 80% of drivers quit within 5 yr, making screening, diagnosis, and treatment of SDB difficult at such locations³⁵⁾.

Transport sector

Our findings

We investigated the concept of the harmonization of work with treatment and prevention in the field of sleep

Table 2. Types of devices for the diagnosis or screening of OSA (data from reference 21)

Type	Definition	Sensitivity/specificity for the identification of patients with AHI ≥ 15
1	Facility-based PSG	-
2	Portable Most of the same channels as type 1, including 2 or more respiratory channels Differentiates sleep and awake states	Sensitivity 79–100% Specificity 71–100%
3	Portable Measures at least 4 channels including 2 or more respiratory channels	Sensitivity 64–100% Specificity 41–100%
4	Portable Measures 1 to 3 channels	Sensitivity 39–100% Specificity 32–100%

medicine. Cooperation between workers, management teams, sleep specialists, and occupational physicians is essential in this regard. Although the social insurance system in Japan requires a visit to clinics on a monthly basis, this does not always increase the adherence to CPAP therapy. When drivers in the transport sector are diagnosed with OSA, the occupational physician encourages them to visit a sleep specialist and to undergo the appropriate treatments. Our observations showed that in a sleep clinic with successful encouragement by a team of sleep physicians, as much as 89.8% of patients (310 in 344 drivers) with OSA patients in a transport sector continuously visited their doctor in a clinic and receive CPAP therapy. In a transport firm which maintains a hospital for employees, the adherence was perfect (165 of 165 train drivers)³⁵. The achievement perfect figure was the result of close communication between workers, the management team, occupational physicians, and sleep physicians in the hospital, where the appropriate treatment of OSA was part of their occupational duties. Furthermore, drivers who failed to visit sleep clinics regularly as required were reassigned to non-driving positions, which also contributed to the perfect adherence.

Implications

Several approaches to improve adherence can be suggested. First, the involvement of family is valuable, since OSA symptoms such as snoring and disturbed breathing may annoy family members more than the patients themselves. Second, the reimbursement of therapeutic costs by employers may encourage drivers to go visit physicians, as in Schneider National, Inc., whose voluntary medical insurance plan covered both diagnosis and treatment without copayment²⁷). Since CMV drivers with OSA may need to pay for the treatment or may be excluded from the transport sectors, the reimbursement will not only ensure their

Table 3. Suggestions to attain better adherence to CPAP therapy

1. Family involvement
2. Reimbursement of therapeutic cost
3. Companies showing their will to “invest” in the drivers
4. Form “ambassador” team
5. Close contact between company and drivers

freedom of career choice, but also be able to collect more skilled CMV drivers. Third, companies should show their support for an investment in the drivers by contributing to promoting their health. Fourth, an “ambassador” team of those already under CPAP therapy is helpful to encourage drivers with OSA on CPAP to continue treatment. Finally, close contact between company and drivers will result in better adherence (Table 3)³⁵. These processes will encourage drivers with OSA to undergo CPAP with better adherence. If the system is well established, it may be possible to identify individuals with poor adherence, who may not be appropriate for driving work. These methods suggest that the concept of harmonization of work with the treatment and prevention of SDB in the transport sector can be beneficial not only to workers with SDB, but also to the transport companies.

This harmonization may be further enhanced by the education of patients to improve their lifestyle, such as by a reduction in alcohol intake, weight reduction, exercise promotion, and dietary intervention. Weight reduction, for example, not only reduces future risk of cardiovascular disease, but may also obviate treatment for SDB, leading to the improvement of workers’ health and safety, the possible prevention of developing SDB, and the reduction of social insurance costs.

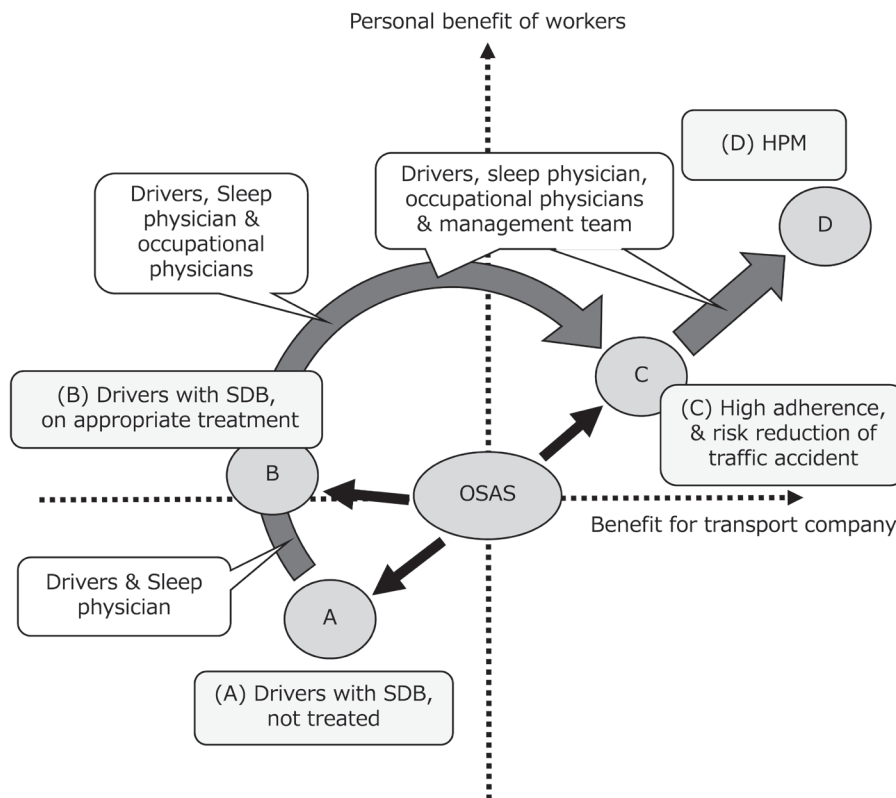


Fig. 2. Schematic process from the harmonization of work with treatment and prevention to health and productivity management (HPM). Both drivers and the management team are uninterested in OSA (condition A), employees go to see sleep physician (condition B), the employees, management teams, and occupational physicians cooperate (condition C), and HPM (condition D).

Towards Health and Productivity Management (HPM)

HPM has been promoted by the Japanese government³⁶. The concept of HPM maintains that improved health conditions of employees are beneficial not only for the subjects and for the prevention of traffic accidents, but also for subjects' motivation and mental condition in the workplace. Figure 2 shows a schematic of the HPM process. If both drivers and the management team are uninterested in OSA, a higher risk for traffic accidents may result, possibly leading to deterioration of the company's reputation (condition A). In Japan, where national insurance is well established and theoretically covers everyone (universal health coverage, UHC), employees can afford diagnosis and treatment of OSA (condition B), but will only seek it out, only if they are appropriately informed. Furthermore, as long as it is a high adherence to appropriate therapy that reduces the risk of traffic accidents by CMV drivers²⁷, it is essential for sleep physician and occupational physician to share information regarding

adherence and treatment in detail. Unless otherwise, mere information of diagnosis and treatment of SDB might lead to misjudgement in safety management, and may bring a loss to a transport company. The "Condition B" in Fig. 2 describes this uncertainty well by being placed either in the left (loss to a company) of the right (benefit to a company) of the "Condition A". If employees, management teams, and occupational physicians cooperate, this will be profitable to the company through avoidance of reputation loss from traffic accidents (condition C). Weight reduction and a healthy diet with lower alcohol, salt, and fat intake and more exercise will prevent not only OSA and its consequences but also other lifestyle-dependent disorders. Furthermore, this will make employees feel "invested in" by their company and be actively engaged in their duties. The harmonization of work with treatment and prevention, therefore, may possibly become the first step for a individual health promotion of the workers, together with a successive profitable corporate activity, towards the uptake of HPM in a transport sector (condition D).

Summary

In summary, the harmonization of work with the treatment and prevention of SDB can lead to several profitable results: high adherence to treatment, identification of high-risk drivers, and risk reduction in traffic accidents. In addition, the prevention of SDB by lifestyle changes may carry through into the future by preventing other lifestyle-dependent disorders, leading to a healthy workplace and a unified organization between management, employees, and HPM.

Issues to be Addressed

In this paper, we discuss the association between OSA and traffic accidents, and its management through the HPM approach. In both the US and Japan, the importance of screening, diagnosing, and treatment of OSA is recognized in society and by both drivers and clinicians. However, CMV drivers tend to be more concerned with their personal liberties. In addition, the transport sector in both countries employs many older drivers, the departure of which may substantially reduce the workforce in the near future. The exclusion of drivers with OSA from transport sectors is thus not necessarily practical, which may discourage screening for SDB as well as its diagnosis and treatment.

The EU countries, particularly the UK, have launched regulations for drivers with SDB³²). As noted above, the issue of CMV drivers and SDB is complicated by various social and clinical aspects, and future developments regarding the effects of regulations in the UK on transport sectors, workers, and society will be worth observing.

Both workers and their employers in the transport sector should be aware of the relevance of screening for SDB and its diagnosis and treatment. They should also be aware that these activities are beneficial not only to individual workers and companies, but also to Japanese society itself.

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