

Review Article

Sleepiness of Occupational Drivers

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Abstract: Drowsiness and sleeping at the wheel are now identified as the reasons behind fatal crashes and highway accidents caused by occupational drivers. For many years, fatigue has been associated to risk of accidents but the causes of this symptom were unclear. Extensive or nocturnal driving was associated to accidents but few reports differentiated fatigue from sleepiness. In the early nineties, epidemiological data started investigating sleepiness and sleep deprivation as cause of accidents. Sleepiness at the wheel, sleep restriction and nocturnal driving have been incriminated in 20% of traffic accidents. Drugs affecting the central nervous system (i.e., narcotic analgesics, anti histamine drugs), nocturnal breathing disorders and narcolepsy have been also associated with an increasing risk of accidents. Treatments improving daytime vigilance (i.e., nasal Continuous Positive Airway Pressure) reduce significantly the risk of traffic accidents for a reasonable economical cost. Sleep disorders among occupational drivers need to be systematically investigated. Chronic daytime sleepiness is still under diagnosed and sleep disorders (i.e. obstructive sleep apnea syndrome) are not enough explored and treated in this exposed population of sedentary males. Drivers education and work schedules integrating notions of sleep hygiene as well as promotion of sleep medicine could significantly improve road safety.

Key words: Sleepiness, Sleep deprivation, Sleep disorders, Driving, Accidents, Professional drivers

Introduction

Drowsiness and sleeping at the wheel^{1, 2)} have been identified as the reasons behind fatal crashes and highway accidents caused by car and/or truck drivers. European Union has decided to divide by two the number of deaths in 2010 and a vast program of road safety has been initiated. To gain 20,000 life per year in Europe, we need to get of better understanding of traffic accidents. Because professional traffic is going to increase by 50% in the next ten years in Europe and many other continents, it is a major issue to identify new causes of accidents and new strategies to prevent them.

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In the early nineties, epidemiological data started investigating sleepiness as cause of accidents³⁻⁵⁾. Since then many articles have been published to try to discriminate behavioural from pathological causes of sleepiness in professional drivers.

We will review in this article the main references regarding behavioural, pathological and iatrogenic causes of sleepiness at the wheel in professionals.

Sleepiness and Behaviour

Professional drivers are supposed to be healthy and responsible but lack of information on sleep hygiene and work or social pressure can explain a lot of sleep deprivation among this population. Until the mid 90's, no study clearly

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demonstrated the main factors responsible for sleep-related accidents. We questioned, apart from organic sleep disorders, if modifications of the sleep-wake schedules could be responsible for sleepiness at the wheel. Studying large populations of drivers^{6,7}, we demonstrated that long-distance driving was very frequently associated with sleep curtailment. Our first study performed on a freeway rest stop area in 1993, showed that 50% of drivers (n = 567 drivers) reduced their sleep duration in the 24 h before departure for a long-distance journey⁶. Ten percent of drivers had no sleep in the 24 h before the interview. These stunning results could have been explained by a selected sample of exhausted drivers that we recruited at a rest area. Therefore, we decided to run a larger study in partnership with the highway patrol to confirm our results⁷. We randomly stopped 2,196 automobile drivers at a freeway tollbooth. Fifty percent of the drivers decreased their total sleep time in the 24 h before the interview compared with their regular self-reported sleep time; 12.5% presented a sleep debt > 180 min and 2.7% presented a sleep debt > 300 min. Being young, commuting to work, driving long distances, starting the trip at night, being an “evening” person, being a long sleeper during the week, and sleeping in on the week-end were risk factors significantly associated with sleep debt.

Our studies clearly associated in car drivers, work and sleep restriction. We therefore decided to study a population of truck drivers on a week of work to confirm our results. A team of interviewers spent a week on a rest stop area and interviewed professional drivers⁸. The drivers completed a questionnaire concerning sleep-wake habits and disorders experienced during the previous 3 months. In addition, they were asked to complete a sleep and travel log that included their usual work and rest periods during the previous two days. They answered questions concerning working conditions and reported their caffeine and nicotine intake during their trips. A total of 227 drivers, mean age 37.7 ± 8.4 yr (96.2% acceptance rate), participated in the study. The drivers were found to have a fairly consistent total nocturnal sleep time during their work week, but on the last night at home prior to the new work week there was an abrupt earlier wake-up time associated with a decrease in nocturnal sleep time. Of the drivers, 12.3% had slept less than 6 h in the 24 h previous to the interview and 17.1% had been awake more than 16 h. Our study showed that shifting sleep schedules between work and rest periods can generate long episodes of wakefulness. This type of sleep deprivation is rarely investigated. It is usually not taken into consideration when creating work schedules, but affects the performance of drivers. Unsuspected shifts occur at the onset of a new

workweek.

Even if safety is a major concern for this population of drivers and their companies Sleep hygiene education for professional drivers is still far from perfect.

In a study of professional U.S. truck drivers, Mitler *et al.* recorded the EEG of 20 drivers on four different work schedules⁹. This study demonstrated a mean duration of sleep of 4.78 h in a five-day period. Fifty-six percent of drivers presented at least 6 non-continuous minutes of EEG-recorded sleep during the driving sessions. The vast majority of these micro-sleep episodes occurred during the late night and early morning.

Sleep Schedules and Traffic Accidents

In 1995, a study by the National Transportation Safety Board on fatal accidents in professional trucks drivers showed that the mean duration of sleep among drivers was below 6 h of sleep in the last 24 h before the accident⁴. Connor *et al.* showed that sleepiness at the wheel increased the risk of causing a traffic accident by 8.2 fold¹. Sleeping less than 5 h in the 24 h before the accident and driving between 2 and 5 a.m. were also significant risk factors for accidents (OR = 2.7 and OR = 5.6, respectively).

Other studies have shown that shift work, multiple jobs or extensive duration of work was associated with sleep related accidents^{1, 10}.

Sleep Disorders and Drugs among Professional Drivers

Teran Santos published a case-control study on the risk of car accidents among apneic subjects. The case patients were 102 drivers who received emergency treatment at hospitals, after highway traffic accidents¹¹. The controls were 152 patients randomly selected from primary care centers and matched with case patients for age and sex. As compared with those without sleep apnea, patients with an apnea-hypopnea index of 10 or higher had an odds ratio of 6.3 (95 percent confidence interval, 2.4 to 16.2) for having a traffic accident. This relation remained significant after adjustment for potential confounders, such as alcohol consumption, visual-refraction disorders, body-mass index, years of driving, age, history with respect to traffic accidents, use of medications causing drowsiness, and sleep schedule.

George *et al.* published complementary data on the relationship between the apnea hypopnea index and the risk of accidents¹². In this study on 460 apneic patients, only the most severe patients (AHI > 30) presented a accidents

risk factor higher than controls.

Stoohs *et al.* performed an integrated analysis of recordings of sleep-related breathing disorders, and self-reported automotive and company-recorded automotive accidents in 90 commercial long-haul truck drivers¹³. Seventy-eight percent of the drivers had an oxygen desaturation index (ODI) > or = 5 per hour of sleep; 10% had an ODI > or = 30 per hour of sleep. About 20% of drivers presented symptoms indicating very regular sleep disturbances. Truck drivers with sleep-disordered breathing had a two-fold higher accident rate per mile than drivers without sleep-disordered breathing. Accident frequency was not dependent on the severity of the sleep-related breathing disorder.

Hakkanen *et al.* replicated a study on professional drivers. Two separate groups consisting of both long-haul (N=184) and short-haul (N=133) truck drivers were surveyed to examine the frequency of driver sleepiness-related problems at work during the previous three months and to assess the incidence of sleep apnea syndrome symptoms². Over 20% of the long-haul drivers also reported having dozed off at least twice while driving. Near misses due to dozing off had occurred in 17% of these drivers. Factors indicating sleep apnea syndrome occurred in 4% of the long-haul drivers and in only two short-haul drivers. Howard *et al.* measured the prevalence of excessive sleepiness and sleep-disordered breathing and assessed accident risk factors in 2,342 respondents to a questionnaire distributed to a random sample of 3,268 Australian commercial vehicle drivers and another 161 drivers among 244 invited to undergo polysomnography¹⁴. More than half (59.6%) of drivers had sleep-disordered breathing and 15.8% had obstructive sleep apnea syndrome. Twenty-four percent of drivers had excessive sleepiness. Sleepiness measured by the Epworth sleepiness scale was associated with an increased risk of accidents. Among these drivers narcotic analgesic drugs and anti histamine use were also associated with an increasing risk of accidents.

All these studies, even if they report a great variability of prevalence of OSAS among occupational drivers (possibly explained by different techniques of diagnostic), confirm the risk of traffic accidents for apneic patients. Sleepiness at the wheel is obviously a main symptom to investigate in conjunction with the severity of the disease (AHI > 30). Knowing this risk, a major question regards the possibility to reduce accidents among these patients.

In 2001 George *et al.* studied the impact of CPAP treatment on risk of motor vehicle accidents (MVCs) on 210 non professional drivers¹⁵. The risk of MVCs due to OSAS is removed when patients are treated with CPAP if its

compliance would be kept good. More than 800,000 drivers were involved in OSAS-related MVCs in the year 2000. These collisions cost 15.9 billion dollars and 1,400 lives in the year 2000¹⁶. In the United States, treating all drivers suffering from OSAS with CPAP would cost 3.18 billion dollars, save 11.1 billion dollars in collision costs, and save 980 lives annually.

Discussion

Sleep hygiene and hours of work are very important factors to take in consideration for improving road safety. Due to these scientific findings, several governments and some truck companies have in recent years developed a greater interest in sleep schedules and road safety. The goals are to improve working conditions and decrease the risk of industrial accidents. Regulating a trucker's workload and amount of rest per 24-h period is a good strategy for improving safety, but it is crucial to consider the periods preceding the beginning of work when evaluating the ability to drive.

European legislation has imposed regulations (EU 3820/85 and 3821/85) on the trucking industry to improve driver safety. In particular, the regulations limit the amount of time truckers are allowed to work during a 24-h period to a maximum of 9 h per day, with the possibility of working 10 h per day two days a week. After six consecutive working days, drivers are mandated to take a weekly rest period of at least 45 consecutive hours of freely disposed time (section IV, article 6)¹⁷.

However, sleep loss is cumulative and the European Economic Community (EEC) law cannot regulate sleep behaviours during weekends. Health among occupational drivers also needs to be better investigated and sleep medicine need to be promoted in traffic medicine. Chronic daytime sleepiness is still under diagnosed and obstructive sleep apnea syndrome is not enough explored and treated in this exposed population of sedentary males.

Health care, educational programs and work schedules integrating notions of sleep hygiene and sleep medicine could significantly improve road safety.

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