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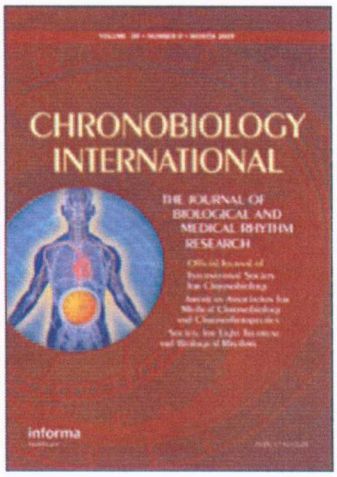

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Hypersomnolence and Accidents in Truck Drivers: A Cross-Sectional Study

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HYPERSOMNOLENCE AND ACCIDENTS IN TRUCK DRIVERS: A CROSS-SECTIONAL STUDY

Rachel S. N. de Pinho,[1] Francisco P. da Silva-Júnior,[2] João Paulo C. Bastos,[2] Werllen S. Maia,[2] Marco Túlio de Mello,[3,4] Veralice M. S. de Bruin,[2] and Pedro Felipe C. de Bruin[2]

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Truck drivers are more likely to suffer severe injury and death due to certain truck driving characteristics. Identifying and preventing factors associated with accidents in this population is important to minimize damage and improve road safety. Excessive daytime sleepiness is a major public health problem, leading to impaired cognitive function, reduced alertness, and increased risk of motor vehicle crashes. The aim of this cross-sectional study was to determine the prevalence and predictors of hypersomnolence (defined as an Epworth Sleepiness Scale score greater than 10) among truck drivers. Three hundred male truck drivers were studied. Quality of sleep was assessed by the Pittsburgh Sleep Quality Index, and the association between demographic, clinical, and occupational data with excessive sleepiness was analyzed. The mean daily sleep duration was 5.6 ± 1.3 h, and poor quality of sleep was found in 46.3% of the individuals. Hypersomnolence was found in 46% of the drivers and was associated with younger age, snoring, and working >10 h without rest. A positive correlation between hypersomnolence and previous accidents was detected ($p = 0.005$). These results show that sleep deprivation and hypersomnolence are frequent among truck drivers. The treatment of sleep-disordered breathing and the implementation of educational programs, particularly targeting younger drivers and promoting increased awareness of the deleterious effects of sleep loss and work overload, may help to reduce hypersomnolence and accidents among truck drivers.

Keywords Accidents, Hypersomnolence, Risk factors, Sleep-disordered breathing, Truck drivers

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INTRODUCTION

Excessive daytime sleepiness is recognized as a major public health problem that affects about 15% of the general population and can lead to impaired cognitive function, poor quality of life, and accidents (Hasler et al., 2005; Ohayon et al., 1997). It has been shown that sleepiness compromises vigilance and reaction time, psychomotor abilities considered essential for driving (Van Dongen et al., 2003).

The exact magnitude of the influence of drowsiness in motor-vehicle accidents is difficult to establish due to the multi-factorial nature of many crashes, underreporting of sleepiness by drivers, and lack of reliable objective tests for measuring driver sleepiness (Lyznicki et al., 1998; Marin and Queiroz, 2000). Previous studies have indicated that 1–10% of motor vehicle accidents in the United States are directly related to sleepiness, but these numbers are probably underestimated, with some suggesting that the real proportion may be greater than 30% (Leger, 1994). Moreover, 17–19% of all deaths in traffic accidents have been attributed to somnolence or driver fatigue (Pandi-Perumall et al., 2006). A survey of Brazilian interstate bus drivers found that 16% admitted to having dozed at the wheel. When the drivers were asked if they were aware of a similar situation arising among their colleagues, the figure rose to 58% (De Mello et al., 2000).

Passenger vehicle drivers are responsible for the majority of sleep-related crashes, but truck drivers are considered a priority target group for the prevention of drowsy driving and accidents (Lyznicki et al., 1998). Many characteristics associated with truck driving, such as truck weight, high mileage exposure, level of attention demanded, and monotony of the task of driving, could contribute to why these workers are more likely to suffer severe injury and death in an accident (Häkkänen and Summala, 2001; Morrow and Crum, 2004). For each truck driver killed in a crash, three to four other people are also killed (US Congress Office of Technology Assessment, 1988). Associated damages may be substantial, depending on factors such as the nature of the cargo.

Although the importance of identifying and correcting risk factors for drowsy driving is universally acknowledged (George, 2004), the literature on the determinants of excessive sleepiness among truck drivers is still scarce. The main objective of this study was to evaluate sleep quality and determine the prevalence and predictors of hypersomnolence among truck drivers.

MATERIAL AND METHODS

Three hundred long-haul truck drivers took part in the study. They were consecutively approached at a roadhouse, in Fortaleza, Brazil, after

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a period of at least 12 h rest. The protocol was approved by the local Ethics Research Committee and was conducted according to the ethical guidelines of the journal (Touitou et al., 2004). Written informed consent was obtained in all cases.

Data Collection

A standardized questionnaire was used to obtain relevant demographic, clinical, and occupational data, including age, current medical conditions, habitual snoring, smoking status, alcohol intake, use of hypnotic-sedative drugs, sleep habits, working conditions, and accident history. The presence of hypersomnolence was assessed by the Epworth Sleepiness Scale (ESS), where a total score >10 is considered indicative of excessive sleepiness (Johns, 1991). Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI). This scale has seven components, each one pertaining to a major aspect of sleep: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Individuals with a total score >5 are considered poor sleepers (Buysse et al., 1989).

Outcomes

The following independent variables were tested: age ($\leq$28 yrs vs. $>$ 28 yrs), systemic arterial hypertension, diabetes mellitus, snoring, smoking status, alcohol intake, hypnotic-sedative drug use, habitual sleep duration ($\leq$5 h vs. $>$5 h), sleep quality (poor vs. good sleepers), and hours of work without rest ($\leq$10 h vs. $>$10 h). The dependent variable was the presence of hypersomnolence. Continuous variables were dichotomized using cut-off points previously described in the literature and confirmed by receiver operating curve (ROC) analysis.

Statistical Analysis

Initially, the chi-square test was used to assess the relationship between each independent variable and hypersomnolence (bivariate analysis). Then, multivariate logistic regression was performed including all factors with $p < 0.10$ in the bivariate analysis, using a backward stepwise approach and accepting statistical significance at $p < 0.05$. Goodness-of-fit was evaluated by the Hosmer-Lemeshow test. Interactions were tested pairwise through the inclusion of an interaction term into the logistic regression analysis. The Statistical Package for Social Sciences (SPSS) was used for all the analyses.

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RESULTS

Three hundred male truck drivers with a mean age of 37.8 ± 9.3 yrs (range 20–60 yrs) were studied. Table 1 summarizes the demographic, clinical, and occupational data of subjects.

The daily sleep duration was, on average, 5.6 ± 1.3 h. One hundred and twenty drivers (40%) reported sleeping less than 5 h per day. The mean PSQI score was 5.8 ± 3.0, and 46.3% of the subjects were classified as poor sleepers. The mean ESS score was 9.6 ± 4.0 and hypersomnolence was diagnosed in 138 truckers (46%). By bivariate analysis, excessive sleepiness was found to be associated at a p level <0.10 with age ($p = 0.01$), snoring ($p = 0.05$), habitual sleep duration ($p = 0.07$), and working long hours without rest ($p < 0.001$). The logistic regression analysis revealed that three variables were independent predictors of hypersomnolence (see Table 2): age >28 yrs (OR = 0.45; 95% CI = 0.24–0.84; p = 0.01), snoring (OR = 1.89; 95% CI = 1.02–3.5; $p = 0.04$), and working >10 h without rest (OR = 2.07; 95% CI = 1.21–3.51; $p = 0.007$). The p value for the Hosmer–Lemeshow test was 0.522, indicating a good fit of the model to the data. No interaction between variables was detected.

A history of motor vehicle accidents was reported by 102 drivers (34%) and was associated with the diagnosis of excessive sleepiness ($p = 0.005$; see Figure 1). Causes of previous driving accidents according to the drivers' opinion are shown in Table 3.

DISCUSSION

The results show that a significant proportion of truck drivers suffer from hypersomnolence (46%). Chronic sleep debt (40%) and poor quality of sleep (46.3%) are also common in this population. Age, snoring, and work overload are independently associated with hypersomnolence. Truckers with excessive sleepiness are more likely to have a history of accidents. These results have important implications for the prevention of hypersomnolence and accidents among these workers.

TABLE 1 Demographic and Clinical Characteristics of 300 Brazilian Truck Drivers

Variable	n	(%)
Age >28 yrs	245	81.6
Systemic arterial hypertension	47	15.6
Diabetes mellitus	14	4.6
Snoring	55	18.3
Smoking	77	25.6
Alcohol intake	145	48.3
Use of hypnotic-sedative drugs	6	2.0
Working >10 h without rest	206	68.6

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TABLE 2 Logistic Regression-Independent Risk Factors for Hypersomnolence among Truck Drivers (n = 300)

	Coefficient (B)	Standard error	Wald X^2 test	*p* Value	Odds ratio	95% CI
Constant	−0.160	0.355	0.204	0.65	0.852	
Age	−0.794	0.316	6.318	0.01	0.45	0.24–0.84
Snoring	0.640	0.312	4.200	0.04	1.89	1.02–3.50
Work overload[a]	0.728	0.270	7.251	0.007	2.07	1.21–3.51

[a]Working more than ten consecutive hours.

In this study, the operational definition of sleepiness was derived from the Epworth Sleepiness Scale (ESS), a questionnaire containing eight items that measure a subject's expectation of dozing off or falling asleep in a variety of situations (Johns, 1991). The conceptual basis for this scale comes from the modern understanding that individuals under baseline conditions experience a level of sleepiness-alertness that changes little from day to day. The ESS is considered a practical and simple tool for the assessment of sleepiness, independent from subjective feelings of physical tiredness. The sensitivity and specificity for distinguishing hypersomnolent from normal individuals using this scale have been estimated as 93.5% and 100%, respectively, when a cut-off score of >10 is used (Johns, 2000). The ESS has been largely used in the identification of at-risk populations as well as in the clinical assessment and follow-up of sleep-disordered patients (Rosenthal, 2005).

The most important predictor of excessive sleepiness according to these data was driving more than 10 consecutive hours. Two-thirds of the drivers in our study reported exceeding this limit. It is believed that economic incentives may play a significant role for driving long hours in the trucking industry, and current regulations restricting working hours of commercial motor vehicle drivers in Brazil are inadequate to curb this practice. However, it is noteworthy that in Australia, where some states

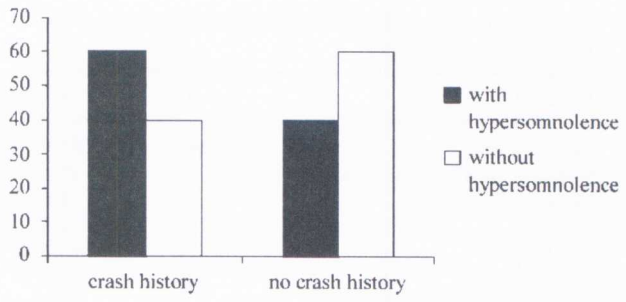

FIGURE 1 Frequency of hypersomnolence was higher among truck drivers with a history of previous accidents (n = 102) as compared to those without such a history (n = 198; $p = 0.005$).

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TABLE 3 Cause of Previous Accidents According to Truck Drivers

Cause of accident	n	%
Sleepiness	27	26.5
Technological fault	18	17.6
Road surface fault	12	11.8
Animals on the road	9	8.8
Misjudgment	8	7.8
Other road users' fault	8	7.8
Inattention/distraction	5	4.9
Weather conditions	5	4.9
High speed	1	1.0
Do not know	9	8.8
Total	102	100

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restrict truck driving of workers to a maximum of 11 to 12 h per day, no difference was found in the proportion of drivers exceeding this limit between the regulated and unregulated states (Arnold et al., 1997). This suggests that legal attempts to control the hours of service of truck drivers, by themselves, are insufficient to prevent drowsy driving and reinforces the need for educational programs that raise drivers' awareness of the consequences of sleep loss and work overload.

A protective effect of age in the development of hypersomnolence was observed in our subjects. Previously, it has been shown that the frequency of accidents falls with age (Maycock, 1997). Younger drivers appear to be more sensitive to motivational pressures and tend to delay taking a break from driving, despite being fatigued (Summala and Mikkola, 1994). In the present study, age was associated with sleepiness even after adjusting for workload, indicating that younger drivers are at an increased risk, independent of exposure. In fact, after an equal amount of sleep debt, young people exhibit a shorter sleep latency and more disturbed mood and performance than the elderly, suggesting the former have greater sleep necessity (Brendel et al., 1990). Thus, a combination of homeostatic pressure, poor sleep habits, and increased exposure might explain the higher risk for excessive sleepiness experienced by young truck drivers.

Snoring was reported by 18.3% of the subjects. The reported prevalence rates of snoring in male adults vary greatly, from 9 to 48% (Larsson et al., 2003; Lindberg et al., 1998; Neven et al., 1998; Ohayon et al., 1997; Stradling et al., 1991; Young et al., 1993). Snoring is caused by partial obstruction of the upper airways. It is considered a marker of obstructive sleep apnea (OSA) and may be a precursor of this disorder. In patients with OSA syndrome, repetitive episodes of airflow interruption lead to oxygen desaturation and transient arousals, causing sleep fragmentation and non-restorative sleep (Gibson, 2005). Sleep-disordered

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breathing (SDB) has a significant impact on alertness and driving performance and can lead to increased accident risk (Gottlieb et al., 2000; Howard et al., 2004; Stoohs et al., 1995). It has been suggested that patients with excessive sleepiness due to SDB are more prone to occupational accidents than those experiencing sleepiness from other causes because they are seldom aware of their disturbed sleep and fail to avoid risky situations (Lindberg et al., 2001). A previous study of 32 shift-working Brazilian bus drivers reported a 38% prevalence of OSA confirmed by polysomnography. The MSLT revealed that 42% and 38% of the bus drivers met the criteria for sleepiness when the test was conducted during the day and night, respectively (Santos et al., 2004). It has been estimated that nearly 26% of truck drivers are at high risk for OSA (Moreno et al., 2004). Despite the fact that available treatment for SDB can effectively improve health status and reduce the risk for motor-vehicle accidents (George, 2001; Munoz et al., 2000), a large proportion of cases of SDB still remain undiagnosed (Gibson, 2005; Young et al., 1993). A recent study has shown that even in developed countries, individuals experience difficulties in gaining access to diagnostic services and adequate treatment for SDB (Flemons et al., 2004; Pack, 2004). The current finding of a nearly two-fold risk for hypersomnolence among snorers highlights the importance of early detection and treatment of sleep apnea in truck drivers.

Alcohol use was not associated with excessive sleepiness in this study. Measures of alcohol blood levels were not performed, and the underreporting of alcohol intake is the most likely explanation for this finding. The sedating effects of alcohol have been confirmed using the Multiple Sleep Latency Test (Papineau et al., 1998; Roehrs et al., 2003). Other studies where somnolence was subjectively assessed failed to show an association between daytime alcohol consumption and sleepiness (Ohayon et al., 1997). It should be kept in mind that the sedating effects of alcohol can combine with sleep deprivation to impair driving performance (Koelega, 1995; Roehrs and Roth, 2001).

An association between excessive sleepiness and a history of accidents was found in this study. More than a quarter of the accidents in which these drivers had been involved were sleep-related. In addition, many accidents were attributed to inattention and misjudgment—conditions known to be associated with hypersomnolence (Leger, 1994), which is considered to be the most identifiable and preventable cause of accidents in all modes of transportation (Rajaratnam and Jones, 2004).

In summary, chronic sleep deprivation and excessive sleepiness are frequent among truck drivers. Younger drivers, snorers, and drivers who work long hours without rest are at an increased risk for hypersomnolence. The treatment of SDB, the implementation of educational programs (particularly targeting younger drivers) that aim to improve awareness about the deleterious effects of sleep deprivation and work overload,

and new research on countermeasures such as drowsy driving-detecting technology hopefully will reduce the risks of excessive sleepiness in this population.

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