



Special Article

Sleep Medicine and Transport Workers. Medico-Social Aspects with Special Reference to Sleep Apnoea Syndrome

Medicina del sueño y profesionales del transporte. Aspectos médico-sociales con especial referencia al síndrome de apneas del sueño

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Introduction

Driving is a complex task that involves many aspects, such as perception, response time, and physical ability.

According to official reports, excessive sleepiness during day time is a first line cause of up to 30% of the cases, which frequently involve accidents with high morbidity and mortality.¹

There is great difficulty in identifying sleepiness as a cause resulting in a road accident, since neither clear definitions nor measuring methods are set, and there is lack of training for an effective investigation into official reports for sleepiness as the possible cause. In addition, there are difficulties inherent in the nature of accidents, which many times affect only one passenger, that make those people involved in the accident hide information in fear of adverse legal consequences.²

The accidents involving sleepiness result in high morbidity and mortality rates, due to the characteristics they present. These types of accidents usually occur at midnight and in the afternoon, periods that correspond to 2 circadian peaks in sleepiness. Such accidents usually happen in high speed roads, most often involving only one vehicle getting out of the road (Figure).

Drivers involved in accidents caused by sleepiness are usually young people between 18 to 29 years of age, shift workers, those

under the effects of alcohol and/or psychotropic drugs, and those suffering diseases related to sleep problems.³

Road accidents are an important social and institutional problem due to the magnitude of human suffering they cause, together with the economic losses that, in turn, contribute to the economical decline in families, thus bringing on more suffering as a consequence of the latter. Estimate economic loss is around €16 billions per year, which is over 2% of the gross domestic product.⁴ According to the DGT (Spanish Traffic General Direction) the number of victims on the road in 2007 was 146,344. 69% of these accidents happened from Mondays to Fridays, that is on working days, from which it can be assumed that the people involved in those accidents were working at the moment they happened⁵ (Table 1).

Deadly accidents while working on the road outnumber those at the workplace. Accidents commuting to and from work plus those that occurred "during a mission" (on a work errand) are half of all the deadly labour accidents, which illustrates the seriousness of the problem and the fact that safety at work is increasingly depends on the road. This is logical because in the last decade there have been important transformations, such as the change from an industrial to a service society, which requires more intensive use of vehicles; plus changes in the territorial model, with the centres of work moved away from the workplace, which forces to an increased use of personal vehicles.^{6,7}

Driving is a complex task that requires much attention, a state of permanent alertness, and perfect psycho-physical capacities on part of the driver. The driver's abilities are impaired or reduced by, among

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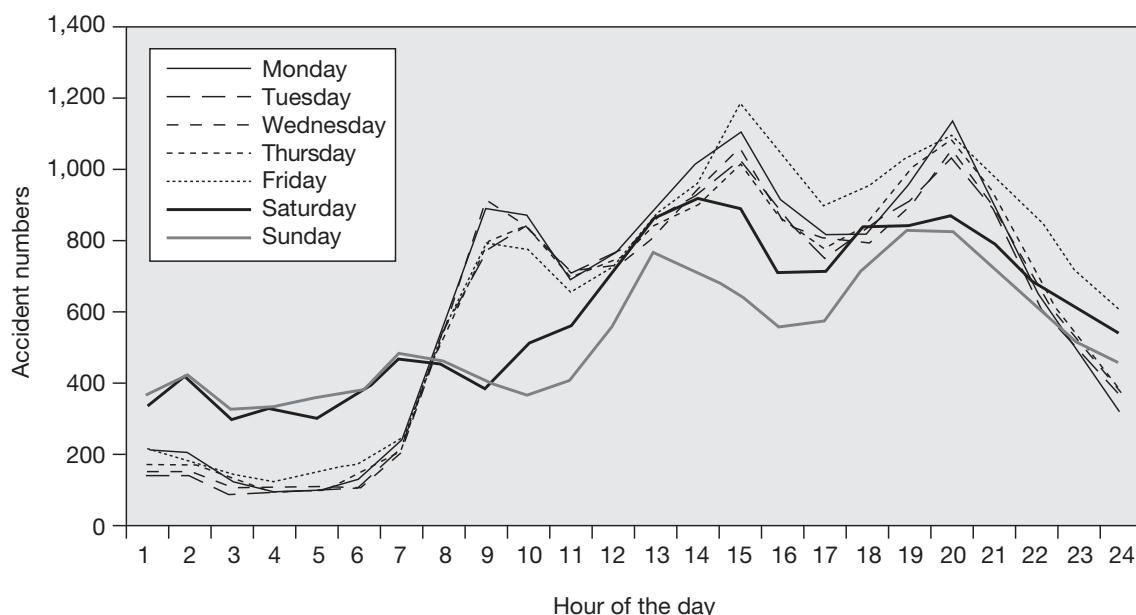


Figure. Accidents according to day and hour. It can be appreciated that although the number of accidents is small during these periods, incidence is high in relation to traffic at the same time (Source: Spanish Traffic General Direction, 2007).

Table 1
Evolution of accidents and victims in the period 2004-2007

	2004	2005	2006	2007
Total No. of accidents	94,009	91,187	99,797	100,508
Total No. of victims	143,124	137,251	147,554	146,344

Source: Spanish Traffic General Direction.

other factors, daily wear and tear suffered from working. As the working day goes on these abilities are reduced, as well as the response potential. Rest and sleep are fundamental to recovering these abilities and the problem becomes more serious when the driver presents with some type of sleep disorder.

There are not statistical data on the impact of some type of sleep disorder on road accidents, but the dimension of the problem can be indirectly inferred. According to the DGT,⁵ the second cause of accidents, after inadequate speed for existing conditions, is distracted or inattentive driving, with 19.6% incidence (Table 2). This lack of concentration is directly related to rest patterns. The 6th Spanish survey on working conditions (*VI Encuesta Nacional de Condiciones de Trabajo*) carried out by the Instituto Nacional de Seguridad e Higiene en el Trabajo (Spanish institute of health and safety in the workplace) offers other data in relation to labour requirements.⁸ 9.7% of workers are on night shifts, thus breaking the biologic sleep cycle. 46.5% do overtime. 67% of them have to keep up a high degree of attention during most of their working time. For 74.2% of them the working rhythm is determined by the direct demand from other people. This means that working hours are long and demand much attention and large workload with no possibility to choose the right moment for the rest the body requires. Rest patterns depend on production patterns. This type of rest does not have the same effect as if rest is provided according to bodily needs. Repercussions over sleep translate into sleep-hour reductions and less sleep quality. The same source indicates that 45% of road accidents are due to distraction, recklessness, absent-mindedness, and lack of attention, all conditions that are related to lack of rest.

The same survey⁸ contributes with some more direct data. Under the title Symptomatology associated with risk factors (*sintomatología*

asociada a los factores de riesgo

), demand for a high degree of attention and complex attention, such as required by driving, causes 20.9% of workers to suffer sleep disorders. Due to high demand from work 22.8% of workers experience the feeling of a continuing tiredness. For 6.6% it is hard to concentrate and maintain their attention, while 16.1% are emotionally exhausted and out of energy. Working conditions therefore interfere with sleep and it is expected that with time these people will suffer some type of problem related to sleep disorders.

These are the data about workers in general. Most of them use their automobiles to go to work. Data indicate that they do so in conditions that are far from optimal to drive due to lack of or ill quality of rest.

In October 2005 the Spanish Ministry of Development released a study carried out by Instituto Carlos III,⁹ "Survey on health and working conditions in goods transportation by road" (*Encuesta de salud y condiciones de trabajo en el transporte de mercancías por carretera*), over long-distance-professional drivers, which included all those who covered more than 200km per day. The data obtained re-enforce those from other sources. 57% of these workers sleep away from home 15 nights per months and most of them, 84%, sleep in their lorry cabin, on a 70cm-bunk bed; understandably, it is difficult to get proper rest in these conditions. 68% drive at night. Night driving causes alteration of the circadian rhythms and sleep disorders. 19% sleep less than 8 hours per day. 91.8% of them are not able to choose the moment to rest. To the data just mentioned it should be added that 53% drive under pressure by tight deadlines, that 87% of the work demands a high degree of attention, and that 65% are demanded to work at a high rhythm, thus increasing the harmful effects caused by each of these factors.

All these data confirm that work is being done in conditions that lack proper rest and favour diurnal sleepiness or the appearance of some sleep disorder. It is not far-fetched to state that there must be a large number of drivers currently suffering this type of problems.

This situation becomes even more alarming if it is considered that when prevention plans are set forth, changing the design of the work positions is not contemplated. Neither is it analysed the driver as a specific work position. The psycho-physical state of the driver is not either taken into account when preventing and analysing accident

Table 2
Causes of the accidents

	Total				On the road				In urban areas			
	2004	2005	2006	2007	2004	2005	2006	2007	2004	2005	2006	2007
Inadequate speed for the existing conditions	10.4	9.9	8.7	61.9	16.3	15.8	13.2	67.4	5.4	5	4.5	56.6
Drive over the speed limit	2	2.1	1.8	8.3	2.9	3.4	2.9	12.8	1.2	1	0.8	3.9
Distracted or inattentive driving	19.4	18.6	14.2	13.4	21.5	22.6	19.8	19.6	17.7	15.3	8.9	7.4
Not stop at the stop sign	3.1	2.9	2.3	2	3.6	3.1	2.7	2.5	2.6	2.7	2	1.5
No infraction	44.4	44.4	52.3	54	45.2	46.2	51.4	51.5	43.7	42.8	53.3	56.4

Source: Spanish Traffic General Direction.

rates. In sum, the approach remains as if dealing with classical work positions at the industry, for example. This lack of prevention is another symptom involved in the sleep-driving problem. Drivers' job demands to deal with prevention specifically, because, whereas in the industrial areas prevention can be set over machines, products and working processes, in driving safety resides with the driver, who must be provided with all the information that is presented to them, analyse it, and make decisions within a limited amount of time. Whereas in other activities the person occupies an adjacent place to prevention measures, in driving it is essential to control the physical and psychical condition of the driver.

Sleep Apnoea Syndrome and driving

Amongst sleep disorders special attention should be given to sleep apnoea syndrome and its relation to road accidents that has been extensively analysed in the medical literature.¹⁰

The data supporting increased risk in accidents come mainly from cross-sectional studies. This information includes patients admitted in clinics to be evaluated and it is based on subjective and objective data and subject to numerous biases. Many studies include a small number of patients and there are many others that include confusing factors such as drug or alcohol abuse and exposure times to driving.^{11,12} Despite these limitations, the results from all these clinically based studies point to the same direction and demonstrate the increased risk for accidents in patients with sleep apnoea.¹³⁻¹⁵

Although sleep apnoea influences accident occurrence, accidents are multifactorial and sleeping or working hours prior to the accident, drivers taking medication and other clinical situations also interact to cause accidents.

Bad driving caused by sleep apnoea syndrome is similar to that caused by alcohol ingestion or lack of proper sleep; additionally, other conditions or risk factors may play a role in causing excessive diurnal sleepiness, such as sleep apnoea syndrome, lack of sleep, medication, etc.¹⁶

Apnoea is a prevalent disease affecting 9% of women and 24% of men, but sleep apnoea syndrome, which includes excessive diurnal sleepiness and respiratory anomalies during nightly sleep, is present only in 2% of women and 4% of men. Some studies have pointed at a high prevalence of professional drivers, which would indicate a relation with obesity and sedentary activities.¹⁷⁻²¹

However, it is important to point out that, although prevalence of sleep apnoea may be increased in this sector of the population, there are not data indicating that the risk of accidents may differ for the general population.

It is estimated that total costs attributable to sleep apnoea are very high. Sassani et al²⁰ estimated that 800,000 road accidents could be attributable to sleep apnoea in the year 2000. The total cost was of 15 million dollars and 1,400 lives. In the USA positive pressure continues on all patients that present with sleep apnoea. With costs derived from accidents amounting to 13 billion dollars, a 70% efficacy rate from this therapy could save 11 billion dollars and 980 lives annually.

It is difficult for physicians to assess driving ability and driving risk for patients with sleep apnoea, and more so when it implies important concerns for these patients.

Many patients with apnoea have never had a road accident. It is hence necessary to define degree of intensity in the disease, mostly because there is a treatment called continuous positive airway pressure (CPAP) that has shown to be effective in controlling and reducing the risk of accidents.²²

In a simplistic manner, risk of accidents due to sleep apnoea could be reduced to zero by just not allowing patients without a treatment to drive vehicles. However, in practice this is neither possible nor justifiable, neither ethically nor departing from the data available.

Society has established a clear line to disallow driving under the influence of alcohol. It is acknowledged that there is certain concentration of alcohol in blood that reduces abilities in some drivers, although others with higher concentrations do not show any alteration.

Consequently, with regards to diagnosing sleep apnoea syndrome, there is an important difficulty when measuring its severity by using the apnoea-hypopnoea index (AHI). Despite its imperfection, this index is accepted as a risk marker of hypertension and other cardiovascular diseases; as a result, it has to be an unavoidable part of assessing a patient suffering sleep apnoea for his or her ability to drive vehicles.^{23,24}

Nowadays it is essential to include in drivers' examinations, and especially for professional drivers, tools to identify sleep disorders (sleep habits, medication, working hours, etc.). Especially relevant are those questions toward identifying sleep apnoea patient profile.

Assessing sleepiness is a clinical decision. Epworth sleepiness scale subjectively measures sleepiness by scoring the answers to 8 questions; if the score is < 10 it is considered normal, whereas those scores > 11-12 indicate excessive diurnal sleepiness, and those >15-16 are associated with a more intense sleepiness and an increased risk of road accidents (*odds ratio* = 15.2).^{25,26}

It is essential to assess each risk driver and warn them not to drive when they are sleepy. This measure should be applied to patients suspicious of sleep apnoea diagnosis, although not yet confirmed, as well as to those with a clinical diagnosis confirmed. Those patients with evident sleepiness and a history of road accidents associated with diurnal sleepiness must not drive, and diagnosis and treatment should be set in a period no longer than 15 days, during which a health leave at work should be implemented.

Regarding patients with whom sleep apnoea diagnosis is confirmed, it should be distinguished between those without diurnal sleepiness and those with diurnal sleepiness symptoms; in the latter using CPAP should correct both symptoms and objective sleep disorders.

All patients suspicious of sleep apnoea or other sleep disorders should be advised about the potential effects of their disease over safe driving. This advice should include:

Table 3

Fatigue or sleepiness alarm at the wheel

Increased consumption of gum, candy or anything to make up for tiredness	Increase of smoking to make up for tiredness from working overload.
Perform "automated" movements either at the wheel or while doing other activities; i.e. automatic actions such as step on the brakes when the vehicle is stopped, or respond with set phrase, or that of going "on automatic pilot".	
Restlessness in the driving seat, moving a lot or scratching your head, blink too much or start to see blurry, rub your eyes, and find it difficult to focus the sight or keep your eyes open.	
Yawn many times or have trouble to keep your head up, and even worse, "nodding off".	
To have to refresh your face and arms frequently to keep awake.	
To ask the passenger to speak to you to keep yourself awake.	
To need to turn up the radio, or chosen music, or to change music for some more lively (beware of soft or relaxing music at the wheel, mostly when driving at night).	
To turn down the temperature inside the vehicle because being warm causes sleepiness.	
Lack of concentration, incoherent thinking, such as "daydreaming".	
When you notice you cannot set your attention on more than one thing at a time, or that you have to force your attention to focus it only on the road, without perceiving some traffic signs or indicators in the panel, jump a traffic sign, etc.	
To perceive a sort of "hallucinations" and "structural alterations", or "false perspective" effects, such as images of lights that make you believe that there is an oncoming vehicle, or that there is a building, or trees, or animals ahead on the road when they are not. In some other cases, to perceive the stretch in front as long enough to overtake when it is not, or otherwise to perceive a long stretch as too short to overtake. It also happens that, due to tiredness, distance intuitive assessment fails us, either to overtake or to manoeuvre, and you realise your move turned out to be harder than it seemed or that it is taking longer than you initially thought it would.	
That dangerous feeling of not remembering the last kilometres covered, or to have passed by a site and not to remember it.	
To take a diversion, to change roads, or to enter a petrol station, or pull over unexpectedly, etc. only to realize that it was "automatic" or sort of "routine-like" and that it did not make any sense.	
Sleepiness effects may be detected by other drivers, such as changing lanes with no reason, coming too close to the vehicle in front, or driving over the lane band (which is why some of them make a sound to alert the driver).	
To accelerate with no reason and not to feel the speed increase, or have the same feeling when going downhill. It is a dangerous speeding effect, and it is not perceived unless you check against the panel. As it has been pointed out earlier, when there is sleepiness there is this tendency to focus on the road, without watching other things around.	

Source: International Symposium on Sleepiness and Driving (*Simposio Internacional de Sueño y Conducción de Vehículos*). Burgos, Spain. November 2008.

- Reduce driving time to the minimum.
- Set a minimum sleeping time.
- Avoid alcohol ingestions, sedatives, and sleep inducing drugs.
- Stop the vehicle and rest when sleepy.

It is necessary to identify high risk patients, such as those with acute diurnal sleepiness, with a history of frequent accidents due to sleepiness, and >16-24 score in the Epworth sleepiness scale. Such high risk patients with clinical evidence must be referred to sleep units, particularly in the case of professional drivers.

Treatment with CPAP reduces the risk of accidents to the rates observed in the general population, as long as it is complied with^{27,28}.

Education continues to be, therefore, a key tool to risk management, and it is necessary for official, health authorities and insurance companies to increase their knowledge and approach the problem properly to contribute to improving its diagnosis and treatment.

It is the driver's responsibility to avoid driving when sleepy, to comply with the treatment and maintain his/her CPAP system in good functioning conditions. It is also necessary that the driver attends periodic medical revisions and provides his physician with honest explanations of his or her current clinical situation.

In the case of professional drivers who are diagnosed with sleep apnoea and require CPAP treatment, these should attend annual checkups with a specialist, and it is recommended to employ treatment systems that are able to assess compliance. All this aims at the fundamental objective of ensuring an adequate maintenance of the treatment.

It is important to insist that diurnal sleepiness assessment (Table 3) be performed with objective sleepiness tests, especially when diurnal sleepiness symptoms persist despite treatment with CPAP.

The physician should suspect sleep apnoea, make an assessment through a clinical history of risk of accidents, inform the patients, and try to set treatment as soon as possible. Moreover, it is important to establish a follow-up plan to determine if the treatment has reduced sleepiness symptoms and, consequently, risk of accidents. It is necessary to individualise the approach, and recognise that not all the cases show sleepiness when driving and that more data is needed to establish acuteness levels for this disease.^{29,30}

From the point of view of prevention of road accidents associated with diurnal sleepiness, we think it is necessary to implement uniform legislation for the European Union regarding causes to excessive diurnal sleepiness, departing from the premise that sleep apnoea syndrome is not a professional disease, and that accidents during working hours associated with sleepiness are labour accidents.

It should be legally established how to take into consideration the sleep apnoea syndrome as an ability impairment at the moment of granting driving licences and permits. Such legislations should include:

- The person to check up on aptitude to drive for patients with sleep apnoea.
- Medical assessment of patients with sleep apnoea: By whom? Using what diagnostic tools?
- The moment in which patients with sleep apnoea are allowed to drive
- The frequency required for patients with sleep disorders to renew their driving licences.

Driving vehicles sets a clear chain of responsibilities, where health and official authorities, workers, employers, and insurance companies should draw up together the protocols and regulations with the fundamental objective of preventing and treating all possible causes associated with sleepiness and road accident rates.³¹

Conflicts of Interest

The authors affirm that they have no conflicts of interest.

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