HEAVY GOODS VEHICLE DRIVERS AND THE ROAD TO SLEEP

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Abstract
Driver fatigue is a major principal and contributing factor of road traffic accidents, accounting for up to 20% of serious accidents on roads. HGV drivers are more prone to sleep-related accidents, as they are at risk of accident involvement due to the nature of their job (long hours, monotonous roads, high mileage and all weather conditions) and their high level of exposure to all of these '*fatiguing*' elements.
According to recent studies, lorry drivers are involved in more accidents per mile on motorways than cars. It is also reported that lorry drivers have a much better safety record than car drivers on all other types of road but on motorways this record is reversed. It can only be deduced that the monotony of the long dreary motorway is resulting in increased accidents on this road type.
The aim of this paper is to investigate the potential risk of HGV drivers by examining sleeping patterns, workload and tendency to doze throughout the day and levels of daytime sleepiness.
This paper reports interview surveys of HGV drivers in Northern Ireland in which the relationship between accidents and daytime sleepiness is investigated. The role of other characteristics – hours of driving, driving experience, nightly sleep, sleep disruption and accident history – known to influence daytime sleepiness or risk of accidents, have also been explored. A range of questions and scenarios were asked of the drivers, such as, chances of dozing whilst driving, accident history and causation and driving practices.
This paper proves that HGV drivers are put at risk of accident involvement as a result of their work/sleep patterns and behaviour. Results confirmed that HGV drivers are a high-risk group of drivers. This group of drivers tend to work more than a 38-hour week, which is well above the EU average weekly hours of work. Pilot study shows that 1 in 3 drivers have concern for excessive daytime sleepiness and 1 in 4 are not receiving their recommended nighttime sleep.

Keywords: Driver fatigue, driver performance, HGV, sleep deprivation, Road Traffic Accidents

Introduction

Road traffic injury accidents are a daily occurrence and are responsible for a vast number of deaths and serious injury in each society. The Global Burden of Disease study estimated traffic injury to be the ninth leading cause of death and disability in the world in 1990, and it projected that it would be the third leading cause by 2020 (Murray, 1997). Many causes and contributing factors of road traffic injury accidents have been identified, such as drink, drugs, use of mobile phones and speed. However, major reviews and in depth research have suggested that *fatigue* or *sleepiness* in drivers of cars or other road vehicles dramatically increases accident risk.

As research has proved fatigue related crashes have many of the characteristics of drink related accidents e.g. inability to brake or swerve until it is too late. Despite their similarities, fatigue has not been considered with equal concern. It must be said however, that fatigue is considerably more difficult to identify or measure; there is no device available to police officers that detects fatigue of a driver. Driver fatigue has particularly injurious consequences because of its ability to impair drivers from making critical, sound, spilt-second and in many cases life-saving decisions, such as swerving or braking.

Many earlier studies have indeed confirmed the significant risk, faced by HGV drivers, of involved in sleep-related accidents. This risk is quantifiable as a result of their exposure to many of the fatiguing elements associated with driving. Driving by its very nature is known to be fatiguing, it is monotonous and repetitive and demands chronic vigilance and alertness. HGV drivers sustain high level of driving exposure and drive in all fatigue inducing conditions, such as, long hours, irregular work/driving conditions, at times which conflict with natural circadian rhythms. They frequently drive alone, on long, monotonous, high-speed roads.

Sleep requirements

According to leading medical practitioners and researchers the average human being requires at least eight hours sleep to provide for sixteen hours of sustained wakefulness. Many projects have found that if people are deprived of much needed sleep at night they will become sleepy throughout the day and are more likely to fall asleep at inappropriate times. This has major implications for most of the population who drive and other road users. Moreover, a significant percentage of drivers have limited opportunities to obtain sufficient, restorative sleep and as a result undoubtedly accumulate a sizeable sleep debt. Sleep loss of as little as 1-3 hours a night has a cumulative effect and contributes to severe sleep debt that can build up over a week, a month and remains a problem until adequate sleep is obtained.

It has been suggested that after several hours of driving, rest has only a temporary benefit to the driver rather than permitting complete restitution (Haworth, 1991). In the road transport industry, even if driving hour regulations specify maximum hours driven, other factors such as, time of day, activities during rest periods and prior activities are all likely to heighten the experience of fatigue.

Fatigue in the Road Transport Industry

Driver fatigue and daytime sleepiness is a particular problem for truck drivers. National Transport Safety Board, USA pointed out that driver fatigue maybe a contributing factor in as many as 30% - 40% of all heavy truck accidents. In most countries, however, HGV and

PSV drivers are subject to regulations that set limits on the amount of time they can driver without breaks, the amount of time they can drive in a day and the amount of time they can be on-duty. These regulations can be flawed and loopholes in the system can mean drivers working over the recommended hours. Horne, 1995 found that all of the sleep related HGV accidents occurred within two hours of the start of the journey. Another study of more than one thousand commercial vehicles in Europe, found that most truck accidents take place in the first seven hours of the driving time (Kofalvi, 1994).

Especially in the road transport industry whereby delivery vehicles have to be loaded prior to the driver setting out on his/her delivery trip. Over the years in the general work environment, working conditions have been improved. With the introduction of the Health and Safety at Work Act 1974, employees have seen a reduction in working hours and an improvement in safety standards. There is also a restriction in the number of hours an employee can drive; this is governed by taco graphs being installed in vehicles.

It is crucial that drivers obtain adequate time off between one day's driving and the next. Even on it's own this is not enough; time off from paper work and/or manual work must also be considered (differentiate between working hours and driving hours). Time off from all work-related exercises must be gained to relax and rejuvenate for the next day of work – a total switch off is essential.

Road Transport Directive (RTD)

Legislation and directives, such as, the EU Working Time Directive 93/104/EC and Road Transport Directive (RTD) 2002/15/EC, are in place to control working/driving hours for road transport mobile workers. It is very frequent that the extent of working and driving hours is contributing to the HGV drivers' limited hours of sleep. The RTD is specific to the Road Transport Sector. It only affects mobile workers who participate in road transport activities covered by EU drivers' hour's rules (regulation (EEC) 3820/85). The UK has until 23 March 2005 to implement this directive. These proposals provide additional protection for drivers and their crews who undertake road transport activities covered by EU drivers' hour's rules (3820/85/EC). The main aspects of the RTD are as below:

- Weekly work time is limited to an average of 48 hours,
- Night workers are restricted to 10 hours working time for any 24 hour period and
- Working time records need to be kept by employers for 2 years.

Unlike other working time legislation, the RTD does not allow individuals to opt-out of the average 48hour weekly limit.

Northern Ireland (NI) Transport Statistics

The fact remains that NI is a relatively small area of 5,500 square miles (about the size of Yorkshire) with approximately 1,688,600 inhabitants, of which on average 150 people each year are killed as a result of a road traffic accident. Fatigue is an up and coming problem as NI moves ever closer to becoming a 24-hour society. Sleep for many is becoming less of a priority and hectic work schedules and over active social lives are taking over. Not only is individual health deteriorating but for the population who drive this is becoming a death weapon on our roads. Road Safety is stressed constantly and at the highest level, fatigue is a new phenomenon and is one that is not going away as it grows steadily affecting everyone.

The number of vehicles currently registered in Northern Ireland at 2000, stood at 730,730 of which 31,994 were classed as 'Heavy Goods Vehicles'. A representation of 4.4% of all vehicles registered in NI. There were 3,612 HGV registered for the first time in 2000.

What Is Already Known On This Topic?

- Statistics show that NI has not escaped without the ill effect of sleep related accidents, over a five-year period (1997-2001) NI has fallen victim to a total of 135 accidents occurred where the principal factor was driver fatigue. Of these 135 accidents, 12 were fatal, 58 serious injuries and 112 slight injuries. (PSNI, 2001)
- Driving while sleep deprived is clearly a risk factor to the majority of the populace particularly those who take the risk to driving whilst feeling sleepy / fatigued.
- Studies have indicated that it is as potentially dangerous as drink driving as the same inability to react until it is too late is a common denominator.
- There are an estimated high proportion of car crashes that are attributable to the driver and that a high percentage if these accidents involve single vehicles (hitting a tree, drifting lanes or plunging off the road).
- Persons whom are prone to sleep-related accidents are shift workers and people who work long hours or people with a sleep disorder.
- RAC motoring foundation released findings from a poll which showed 'more than 60% of drivers questioned said they had driven while sleepy. Of these 8%, said they had nodded off momentarily at the wheel'.
- The UK is vast becoming a 24 by 7 society with huge emphasis and pressures (time / work) put on HGV drivers.
- Due to their sheer mass, HGVs have the ability to cause mass death and disablement as a result of a sleep-related road traffic accident.

Method

An interview survey of 239 heavy goods vehicle (HGV) drivers was conducted over a 4-month period. The survey was designed to investigate and establish a relationship between HGV drivers' accidents, daytime sleepiness, nightly sleep and other characteristics. The drivers were targeted using two different methods, firstly drivers were randomly sampled at Belfast Port and secondly postal questionnaires were conducted within HGV companies throughout NI. Overall, the average age was 37.8 years old, their average driving experience was 15.9 years, and their average accident liability was 0.29 accidents. Accident liability increased as Epworth scores increased.
This study highlights the possibility of deteriorated driving performance as a result of lack of sleep. Driver fatigue may be a contributing factor to one in five road traffic accidents and this is a potentially dangerous problem for road safety.

Subjects

Drivers were interviewed at Belfast Port, upon boarding, between 5.00pm and 8.00pm, as the departure time was 8.30pm. These interviews were conducted on Monday, Tuesday and Wednesday evenings as these were highlighted as the busiest for HGV drivers. At this location a team of interviewers randomly selected drivers to sample in order to get as representative a sample as possible. Refusal rate at the Port was very small (<10% during

hours of 5.00pm and 7.00pm, but as time drew closer to the 8.30pm departure time drivers exemplified more reluctance to spare their time).
In addition to targeting drivers at Belfast Port, approximately 800 questionnaires were sent out to small, medium and large HGV companies in Northern Ireland. Prior permission had been received via phone calls to Transport / Operation Managers of individual companies. It was highlighted at this stage that research had been conducted at Belfast Port and drivers could already be part of this sample. This notification was essential to avoid or eliminate as much duplication as possible.
Refusal rate via this method of data collection proved more challenging, approximately 28% replied with completed questionnaires.

Questionnaire
Drivers who participated in the study were asked a range of questions. Firstly it was made clear to all interviewees that this questionnaire related to HGV driving experience and did not include private car driving experience. The study group were asked questions about themselves, such as, how old they were and how many years HGV driving experience they had. The drivers were questioned on their current journey, and were asked how long would they be expected to drive, how many breaks would this journey incur and what was the longest journey they had ever driven without stopping.
Drivers were also asked to self-report any accidents they had been involved in during the past 5 years. The interviewer quizzed the driver about coping strategies used when the driver felt drowsy. The interviewer continued, asking how many hours of nightly sleep is obtained, the driver's propensity to wake up during the night and how often and how long does it take the driver to fall asleep when in bed. The interviewer directly asked the drivers if they felt tired/drowsy whilst driving – allowing them to answer: always, sometimes, rarely or never.
The Epworth Sleepiness Scale (ESS) was also disseminated to the drivers. The ESS is a daytime sleepiness scale, which is used worldwide by researchers and scientists and is a simple and use-friendly method of measuring the level of daytime sleepiness in adults (John, 1991). The scale simply asks the interviewee to rate their chances, on a scale of 0-3, of dozing or falling asleep in eight real-life situations. The situations in question are:

i. Sitting and reading,
ii. Watching TV,
iii. Sitting inactive in a public place,
iv. As a passenger in a vehicle,
v. Lying down to rest in the afternoon,
vi. Sitting and talking to someone,
vii. Sitting quietly after lunch and
viii. In a vehicle stopped for a few minutes in traffic.

Each participant can have a total score between 0 and 24; depending on how likely they would be to doze under the above circumstances. A score of 10 or greater is said to be a cause for concern as it indicates significant daytime sleepiness. A score below 10 is not a concern for daytime sleepiness.

RESULTS

Driver Characteristics

This paper analytically presents the results of 239 completed HGV structured interviews and questionnaires. In the overall questionnaire study the average age range was 37.8years old (SD 10.1), with a spread of ages ranging from 21-64 years old. The drivers had on average 15.9 years driving experience (SD 9.97). Drivers reported an average accident liability of 0.29 accidents in the past five years.

Figure 1 below highlights the high presence of males HGV drivers, 98% compared to 2% of female drivers. Figure 2 expressed age group ranges, drivers ages were fairly evenly spread over 21 – 64 range.

Figure 1 Sex of Driver

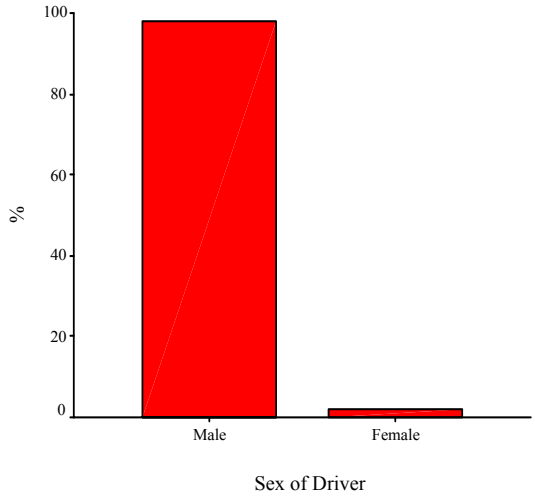
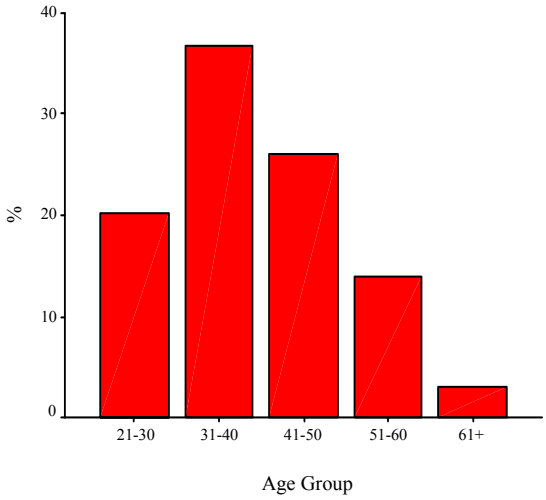


Figure 2 Age Group of Drivers



Accidents

Drivers were asked to report any accidents they had experienced in the past 5 year period – only relating to HGV accidents and not including private car accident involvement. Drivers were asked to self report any HGV related accidents and associated cause. Then they were asked if they had ever nodded off or fallen asleep (even momentarily) at the wheel. If yes, did this result in an accident.

Figure 3 clear indicates involvement in accident over a 5year period. Accident involvement for a phenomenal 79% was nil. 15%, 3%, 2% and 1% were involved in 1, 2, 3 and 4 accidents over the past 5years respectively. Figure 4 identifies the principal cause of these accidents to be mostly the fault of other drivers (75%). Other causes established were inattention (15%), fatigue (6%) and other (4%).

Figure 3 5year Accident History

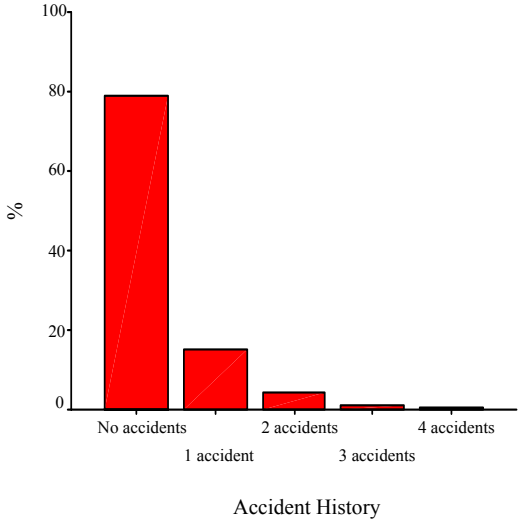
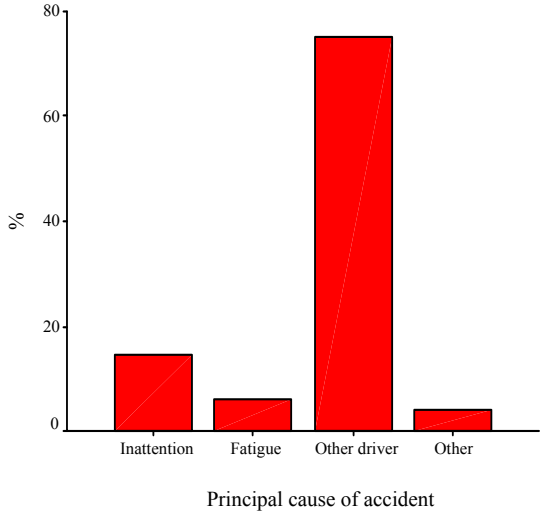


Figure 4 Principal Cause of Accident



Drowsy Driving

Nearly one in five (19%) HGV drivers have fallen asleep at the wheel as figure 5 highlights. Fortunately, referring to figure 6, not all of the incidents concluded in a collision. Only 5% of those drivers, who fell asleep at the wheel, resulted in an accident.

Figure 5 Asleep at the wheel

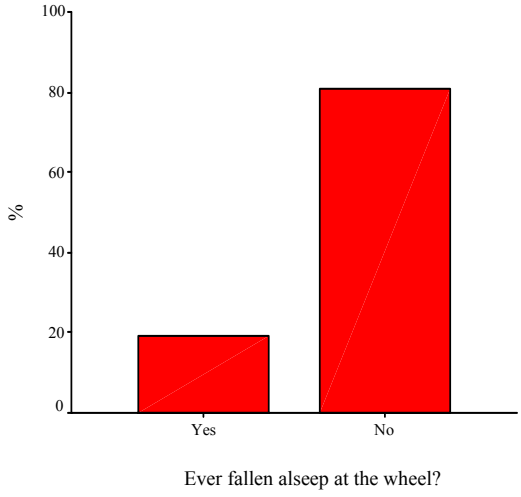


Figure 6 Result in Accident

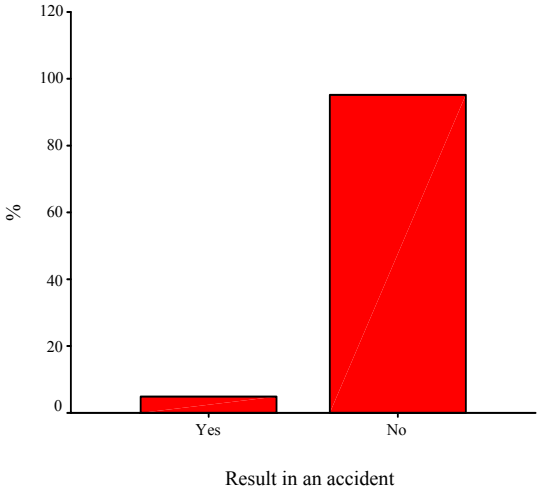
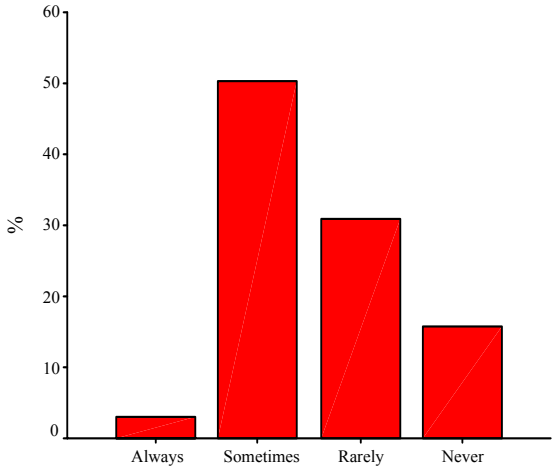


Figure 7 and 8 below show some indication as to why these drivers could have nodded off or fallen asleep at the wheel. Some 84% of drivers admitted to feeling drowsy whilst driving, be it *always, sometimes* or *rarely.* These are significant findings for road safety campaigners who endeavour to keep our roads safe. With 8 out of 10 HGV drivers feeling drowsy at the wheel, this can only lead to catastrophe on the roads. Figure 8 reflects the longest journeys ever driven by the drivers, without stopping for a break. Current legislation orders the drivers to take a 45minute break after 4.5hours of driving. A

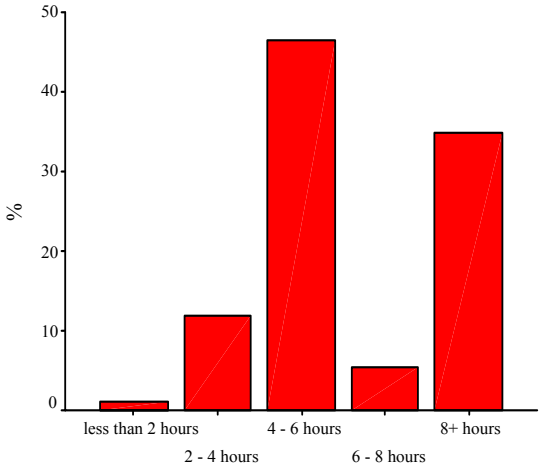
minimum of 40% of these drivers have driven 6 hours or more without stopping for a break. Surprisingly 35% of this group recorded 8+hours.

Figure 7 Drowsy whilst Driving



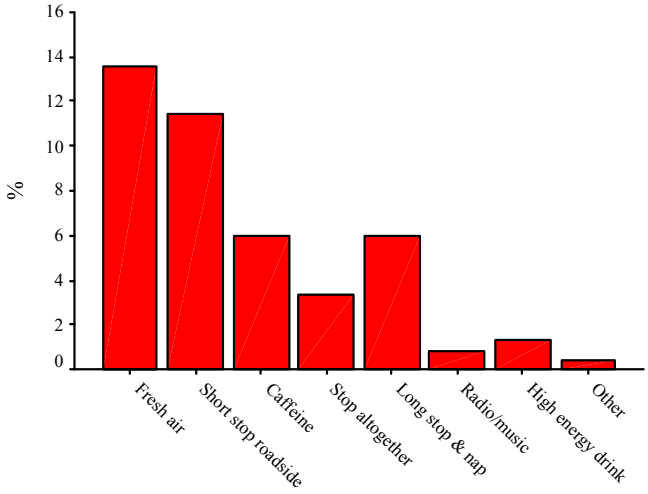
Ever feel drowsy whilst driving?

Figure 8 Longest Journey Driven



Longest journey in time (without stopping)

Figure 9 Coping Strategies



Coping Strategies

Figure 9 represents some of the coping strategies used by drivers when then are driving and feel tired/drowsy. Many drivers were insisted on using the 'quick fixes' to try to perk themselves to finish their journey. Action such as fresh air (14%), shortstop at roadside to walk around vehicle (11%) and caffeine (6%) were taken to avoid having to stop driving altogether. It was reassuring to find that 6% of drivers would pull in to a safe area and have a long stop incorporating a nap. Over half of the driver (57%) would frequently use a combination of the coping strategies. It was the older drivers (3%) who reported that they would stop altogether and continue the next day.

Nightly Sleep and Sleepiness

Falling asleep too quickly and waking during the night indicate both over tiredness and disruptive sleep. Both of which are indicators that one will be suffering from excessive daytime sleepiness and will not function with 100% alertness. As a HGV driver having responsibility for controlling and safe operation of such a large vehicle, elements such as alertness and non-drowsiness whilst driving are of utmost importance. Figure 10 draws attention to the time, in minutes; it takes the drivers to fall asleep. Over one fifth (22%) of

drivers are falling asleep within 5 minutes of getting into bed, others (8%) at the end extreme are taking as long as one to two hours to nod off.
Figure 11 emphasises the disruption in drivers sleep, the amount of times they are waking during the night (to visit the bathroom or snoring etc). Just over half (51%) of the study does not record any waking throughout the night. But for 26%, 16% and 6% of the study they record waking once, twice and three times respectively. Tragically 4% report waking as many as 4, 5 and up to 10 times throughout the night.

Figure 10 How long to fall asleep

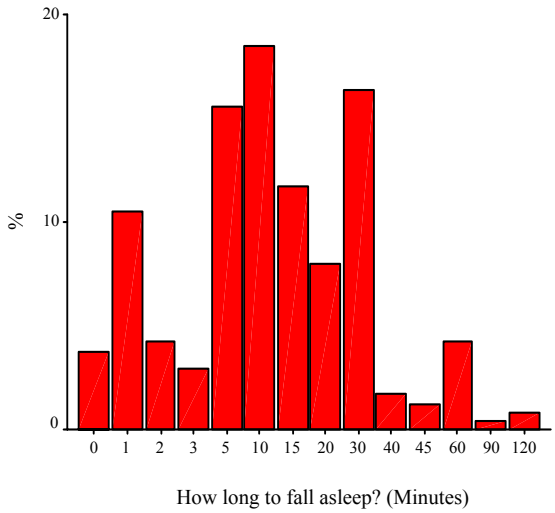
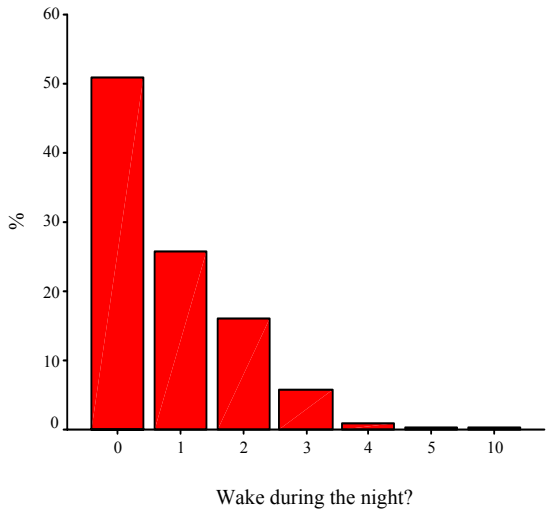


Figure 11 Waking during the night



Drivers were questioned on the hours of sleep they obtained each night. Figure 12 clearly shows that over half of the drivers are not receiving their recommended 8hours sleep. 52% report to be sleeping 7hours and under, with 9% claiming nightly sleep of 5hours and under. 24%, 14% and 10% obtain 8, 9 and 10hours sleep on average. No driver claimed to obtain more than 10hours sleep. In relation to average nightly sleep and sleep disruptions, drivers were then asked how did they feel on waking up (generally). Drivers responded with 22% feeling *very refreshed* on wakening. Over half (54%) stated that they felt *somewhat refreshed* and to the obvious detriment of road safety nearly one in four drivers (24%) noted a feeling of *fatigued* on wakening.

Figure 12 Average Nightly Sleep

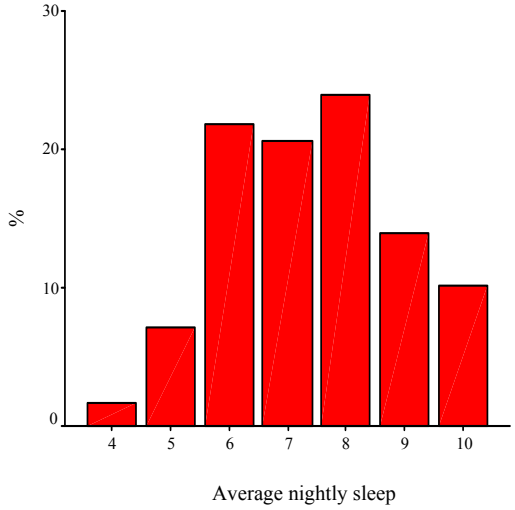
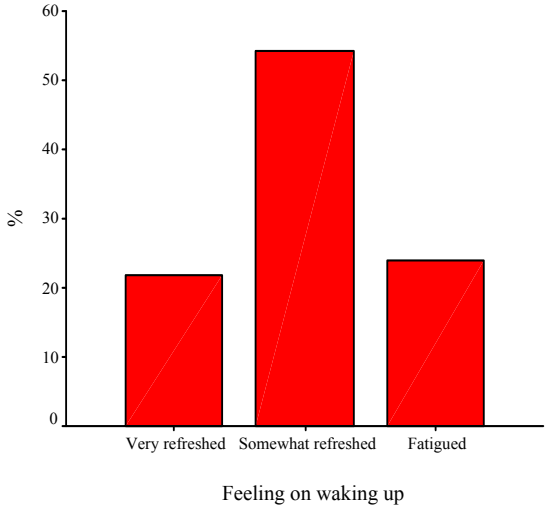


Figure 13 Feeling on Waking Up



Epworth Sleepiness Scale

The distribution of the Epworth totals reported a mean Epworth score of 7.4 (SD 4.08), with a 95%ile point of 8. Figure 14 below expresses the total scores for the drivers, the possibilities with the Epworth scale range from 0 to 24. A score that records 10 or more indicates concern for excessive daytime sleepiness for that sample. Figure 14 shows one in four drivers (26%) have expressed concern for excessive daytime sleepiness as a result of their Epworth scores. Figure 15 gives these results as a basic yes/no, highlighting that 26% show concern for daytime sleepiness.

Figure 14 Epworth Total

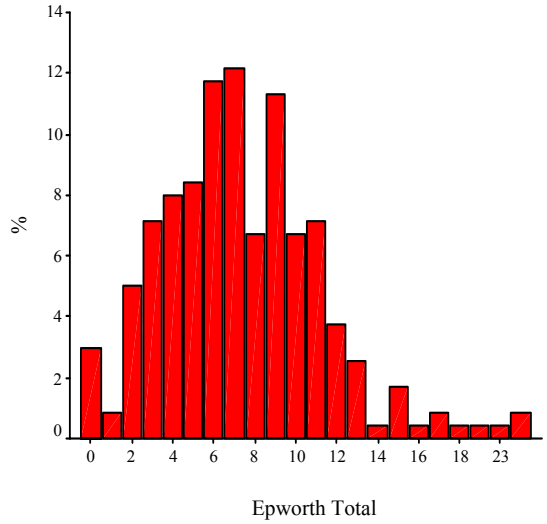


Figure 15 Excessive Daytime Sleepiness

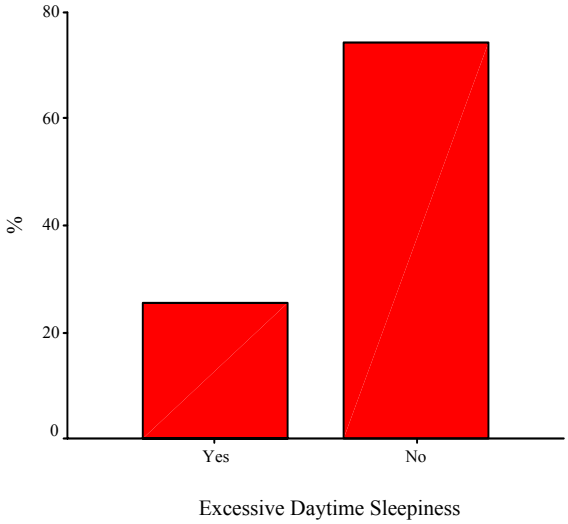


Figure 16 and 17 below are cross-tabulations that show a link between two factors of interest. Figure 16 presents 36% of drivers who admitted to falling asleep at the wheel also reported concern for daytime sleepiness on the Epworth scale. Compared this to only 14% of drivers who also fell asleep at the wheel but were not categorised as having concern for daytime sleepiness. Again figure 17 draws attention to the likelihood of falling asleep at the wheel and how the drivers feel on waking up. There is a noticeable progressive

increased from feeling *very refreshed* to feeling *fatigued* on wakening when coupled with falling asleep at the wheel. This indicates the chances of falling asleep at the wheel are heightened when one wakes up with a feeling of *fatigue*.

Figure 16 Epworth v Falling Asleep at the Wheel

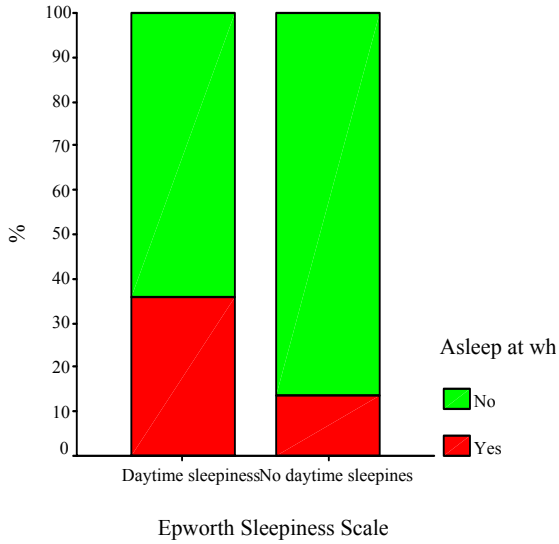
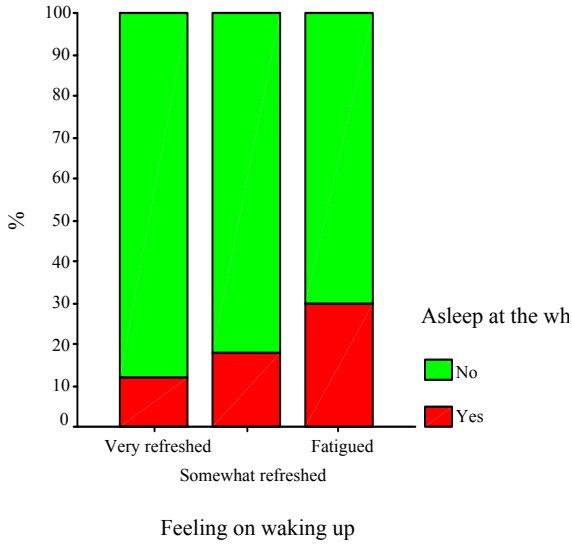


Figure 17 Feeling on Waking v Falling Asleep at the Wheel



Age is a determining factor when investigating sleep requirements, disruptions etc. Figure 18 underlines, somewhat surprisingly that the older this study group got the less likely they were to show concern for excessive daytime sleepiness. Figure 19 again complements this, as it suggests the more driving experience gained the less chance of expressing concerns for daytime sleepiness as measured using the Epworth scale.

Figure 18 Epworth v Age

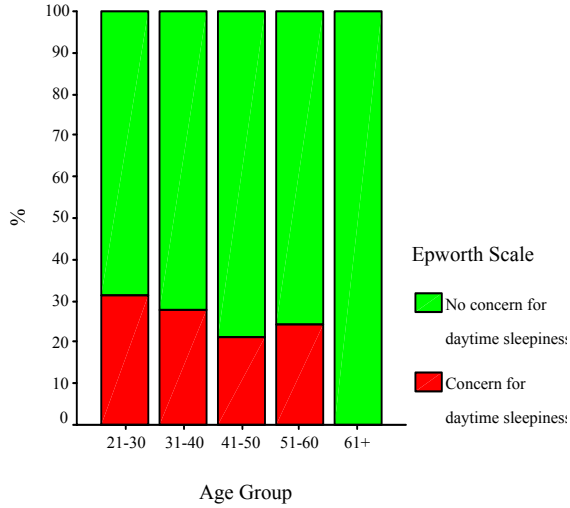
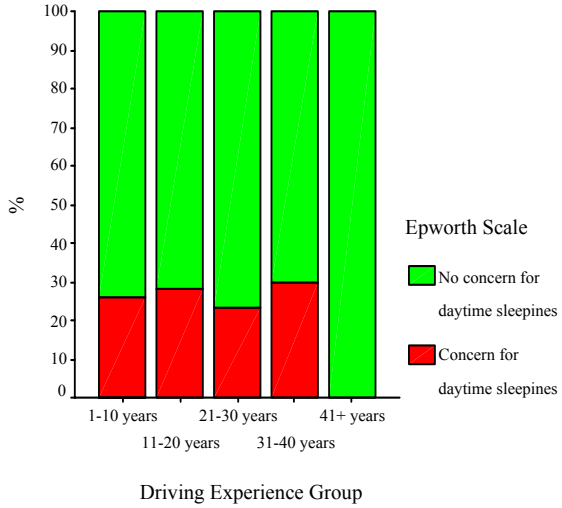


Figure 19 Epworth v Driving Experience



Discussion

This study has concentrated on structured interviews and questionnaire style research. It has made use of self-report data obtained from the drivers, to attempt to relate the driving experiences of a random population of HGV drivers in Northern Ireland, to daytime sleepiness and other characteristics such as, age. It is important to remember it is not possible to record every probability or all features of a HGV driver's lifestyle or driving experiences. However, there will always be some element of impracticality.

Fatigue whilst driving is a relevant factor and causation factor in road traffic accidents. It is also a growing concern for many within the road safety industry – it is not going to go away and is becoming more prevalent in all societies. Brown (1994) stresses that fatigue is more renowned within the heavy goods sector as a result of the long hours of driving, monotonous roads and all the other influential fatiguing elements associated. Maycock (1996) and Horne and Reyner (1995) confirm studies that fatigue is a significant contributor to road traffic accidents and can be a causal factor in up to 15-20% of accidents.

Awareness is a very successful key in the aim to reduce these types of accidents. Detection is very difficult for police officers as there are no mechanisms available to them for identifying sleep deprivation / drowsiness. Educating drivers through a range of mediums would be more beneficial than many in-car technology systems (as these often detect sleepiness when it is too late and the driver does not need to be asleep to be involved in a sleep-related accident). Fatigue is most frightening as no driver is exempt from the feeling of tiredness and anyone can have a disruptive night's sleep for many reasons. It is therefore, for these reasons that fatigue-related accidents will continue to dominate road traffic injuries and deaths on our roads.

Cumulative effects of induced tiredness could occur with a combination of elements happening to an individual at any one time. Examples include:

- *Disruption sleep, (waking during the night)*
- *Lack of sleep, (not receiving adequate – 8 hours nightly sleep)*
- *Driving at peak 'fatiguing' times (midnight-6am and mid afternoon)*
- *Driving after lunch (mid afternoon – especially older drivers)*
- *Whilst using sedating medicines (even OTC cough mixtures)*
- *Untreated or unrecognised sleep disorders*
- *After consuming even a low dose of alcohol.*

In conclusion, the overall study revealed some expected and surprising results. In relation to accident liability, those who are prone to falling asleep at the wheel are more likely to be those who have expressed concern for daytime sleepiness in the Epworth scale. There is strong evidence to show this link, as these 'fall asleep at the wheel' accidents were self-report.

REFERENCES

Brown, I. D., 1994. Driver Fatigue, Human Factors, 36 (2) pp298-314
Department for Regional Development, 2001. Northern Ireland Transport Statistics 2000-2001, Central Statistics and Research Branch, Belfast
Department for Transport, 2002. Working Time Directive for the Road Transport Sector, London (www.dti.gov.uk/er/work_time_regs/wtr0.htm).

Haworth, N., 1991. Testing of commercially available fatigue monitors, Accident Research Centre, Monash University
Horne, J., **Reyner**, L., 1995. Sleep Related Vehicle Accidents, British Medical Journal 310 (6979) pp 565-567

John, M.W., 1991. A new method for measuring daytime sleepiness: the Epworth Sleepiness Scale, Sleep 14 (6), pp 540-545

Kofalvi, G., 1994, Accidents of commercial vehicles in Europe, Proceedings of the third International Conference on Safety and the Environment in the 21st Century, Transport Research Institute, Israel

Maycock, G., 1996. Sleepiness and driving: the experience of UK car drivers, Journal of Sleep Research, 5; pp229237

Murray, C., **Lopez**, A., 1997. Alternative projections of mortality and disability by cause 1990-2020, Global Burden of Disease Study, Lancet 349, 1498-1504

Police Service of Northern Ireland, 2001. Road Traffic Accidents – Annual Report, Central Statistics Unit, Belfast
Work Place Law Network, 2003. New Working Time Proposals for HGV Drivers, Cambridge