

Countermeasures to driver fatigue: a review of public awareness campaigns and legal approaches

A. Fletcher, K. McCulloch, S.D. Baulk and D. Dawson

Centre for Sleep Research, University of South Australia

The relationship between fatigue and road crashes has received increased attention over the past 15 years.¹⁻⁵ Figures stating the extent of fatigue as a contributor generally range from 10 to 40%.⁶⁻⁹ Estimates in the higher end of this range are usually for fatal fatigue-related crashes. While some researchers have suggested that the overall figure is lower (e.g. 1.6%,¹⁰ 5-15%¹¹), there is evidence to suggest that such figures underestimate the contribution of fatigue based on generally accepted definitions.¹² In Australia, 16.6% of fatal crashes in 1998 involved driver fatigue.¹³ A crash is generally assessed as being fatigue-related if the driver was described by police as being asleep, drowsy or fatigued and/or if the vehicle's path suggested a loss of concentration of the driver due to fatigue.⁷ Given the worldwide contribution of road traffic crashes to death and injury (1.2 million in 1998¹⁴), and World Health Organization (WHO) projections of 2.3 million by 2020, the United Nations has predicted¹⁵ that the problem will escalate to a "global public health crisis".

The 10-40% contribution rate of fatigue to crash risk is comparable with that of alcohol intoxication. The literature suggests that alcohol intoxication contributes to 5% of all crashes,¹⁶ 20% of all serious injury crashes,¹⁶ and between 31% and 40% of all fatal crashes.¹⁶⁻¹⁷ Additional research has confirmed that fatigue and alcohol risk are broadly comparable.¹⁸⁻²³ Governments throughout the world have spent considerable resources educating the public regarding the risks associated with drink-driving.¹⁴ However, relatively little effort has

been given to raising awareness on the consequences of fatigue-related impairment.

From a management perspective, fatigue may be more complex and difficult to address, as alcohol has legal frameworks in place in the form of limits for blood alcohol concentration (e.g. 0.02%: Norway, Sweden; 0.05%: Australia, Germany, Spain, France, Greece, Italy; 0.08%: New Zealand, UK, Ireland, Switzerland; 0.08/0.10%: US^{24,25}). Laws have only very recently begun to be passed for fatigue in relation to driving. For example, 'Maggie's Law', which became effective in New Jersey in August 2003, allows prosecutors to charge drivers involved in a fatal crash with vehicular homicide if there is evidence that it was caused by sleepiness. Fatigue is specifically defined in this law as more than 24 hours of continuous sleep deprivation.²⁶

Research shows that the only way to minimise fatigue-related crashes, other than to avoid driving, is to obtain sufficient restorative sleep and avoid periods of prolonged wakefulness.²⁷⁻²⁹ A study by Arnold and colleagues (1997³⁰) revealed that individuals who obtained less than six hours of sleep were twice as likely to be involved in a dangerous event while driving. To date, the development of effective countermeasures for fatigued driving has taken several directions: public awareness campaigns; legal approaches; environmental measures; roadside initiatives; and in-vehicle technologies.

These countermeasures can be divided into those aiming to reduce the *likelihood* of fatigue-related driving, and those aiming to reduce the *consequences* of driving while

Abstract

Objective: Driver fatigue accounts for 10-40% of road crashes and is a critical area for public health. As other major road safety issues are more successfully managed, driver fatigue becomes proportionately more important. Both public awareness and legal developments have been slow to reach the same levels as for other road safety risks. The aim of this article is to review countermeasures for non-commercial drivers that are designed to reduce the likelihood of fatigue-related crashes through education and legislation.

Methods: This review outlines information from a wide variety of sources including governments, road safety groups and the scientific literature. Educational and legislative approaches are discussed in terms of both their effectiveness and the associated implications for public health.

Conclusions: Areas for improvement in education include personalising the risk to drivers and developing simple metrics for the self-assessment of fatigue. Legal implications should be more clearly defined and specific laws are needed to more effectively prosecute fatigued drivers who cause crashes. Additional research is needed to further investigate the efficacy of available countermeasures.

Implications: Increasingly, road traffic injury is being discussed more broadly as a public health issue. However, the specific issue of driver fatigue still receives less attention than other main causes of road crashes, despite making a significant and comparable contribution to crash rates. Countries such as Australia and New Zealand have a responsibility to counter driver fatigue, as well as other causes of road crashes, and to further pursue improvements for the benefit of public health.

(*Aust N Z J Public Health* 2005; 29: 471-6)

Correspondence to:

Mr Drew Dawson, Centre for Sleep Research, University of South Australia, level 5, Basil Hetzel Institute, Queen Elizabeth Hospital, Woodville, South Australia 5011. Fax: (08) 8222 6623; e-mail: drew.dawson@unisa.edu.au

Submitted: May 2004

Revision requested: November 2004

Accepted: May 2005

fatigued. It is probable that the positive impact of multiple countermeasures is additive, or even multiplicative, but in order to review them systematically on their merits they are presented individually in sequence. Details of possible inter-relationships between countermeasures discussed in this article are outlined in the discussion section.

The specific countermeasures addressed in this review are those that focus on reducing the likelihood of fatigue-related driving. The paper also aims to define their basic role for non-commercial drivers. Furthermore, it discusses details of existing initiatives in a number of State and international jurisdictions, possible future directions, and implications for public health. A separate article will review the remaining countermeasures.

Public awareness and education campaigns

Awareness and education campaigns have been effective, to varying degrees, in addressing road safety issues. The most notable of these have targeted drink-driving, speed, and seatbelt use.¹⁴ The premise of such campaigns is to: a) raise awareness of the problem; b) educate the audience on actions they can take; and c) develop social norms to effect a change in behaviour.

To develop appropriate programs for driver fatigue the current knowledge, as well as perceptions and beliefs of the general population, must first be determined. The reason for this is that, to our knowledge, there is no generally agreed report of these details. Importantly, all drivers have the ability to recognise when they are feeling sleepy.³¹⁻³³ Despite this, however, many choose to keep driving in dangerous circumstances. Reasons for continuing driving are many and varied. Examples include: a) poor understanding of fatigue-related crash risk (inaccurate knowledge); b) underestimating the speed of transition between sleepiness and sleep (incorrect perception); c) no history of fatigue-related incidents (belief based on experience); d) choosing to ignore the warning signs (risk taking); e) pressure to reach destination (motivation); and f) no perceived threat of penalty.^{34,35}

In an attempt to direct campaigns towards addressing such factors, several specific aspects should be considered.³⁶ Most importantly, the demographics of the target populations and strategic 'voice' of the campaign(s) need to be determined.³⁷ Ideally, the populations that are experiencing the highest level of fatigue-related crashes should be statistically determined. These groups, with the exception of commercial operations, are likely to include: a) males aged between 16 and 24 years;³⁸ b) shiftworkers;^{12,39} c) individuals with sleep disorders;⁴⁰⁻⁴² d) holiday makers;⁴² e) people with young children;⁴³ and f) specific professionals (e.g. surgeons, emergency workers⁴⁴). It is important to recognise that each of these specific groups may benefit from different messages or approaches to education.

To determine the strategic 'voice' of the campaign, the desired reaction from the audience must be decided. Consideration should therefore be given to whether the individual will be emotionally affected by the given message, or discover a new knowledge

regarding the message on a conceptual level. Emotive approaches portray images that individuals can relate to on a personal level (e.g. a fatal crash scene caused by a tired driver). Knowledge-based approaches assume that the audience has an awareness of, and/or a capacity to identify with, fatigue as a risk. Possible themes include:

- Educating the community that driving when fatigued is a risk equal to driving drunk.¹⁸⁻²³
- Tactical use of driver rotation, caffeine and napping.⁴⁵
- Encouraging drivers to consider fatigue-related driving risks as a personal responsibility.⁴⁶
- Educating the community on minimum sleep requirements and fatigue warning signs.⁴⁷⁻⁴⁹
- Challenging existing beliefs about personal ability to cope with fatigue,^{49,50} including gender-specific differences.⁵¹
- Targeting specific populations with direct education (e.g. learner driver schools, sleep disorder clinics, timed television advertising).

Global campaign trends

The use of campaigns aimed at non-commercial drivers is growing internationally. Some examples are listed below.

The United States *Drive Alert – Arrive Alive* national campaign has used a combination of media, ranging from national publications, newspaper articles and television programs.⁵² The British Government regularly targets fatigue as part of its annual national *Think!* Campaign.⁵³ This campaign is structured as a comprehensive road safety initiative, targeting aspects such as drink-driving, speed, seatbelts, child road safety, mobile phone use and fatigue.⁵⁴ Australia has been active in using awareness campaigns to educate the public about the dangers of driver fatigue. Media has included: brochures, posters, television and radio commercials, newspaper columns, information cards, state transport websites, and full-page newspaper/magazine advertisements.

A nationally distributed brochure, *Fatigue: The Hidden Killer*, is available in Australia by request from the Australian Transport Safety Bureau, and is also provided to hotels, motoring organisations and community road safety groups. Numerous state transport authorities have also developed brochures for safe country driving and related topics such as foods that may assist in maintaining alertness.⁵⁵⁻⁵⁷ One Victorian television campaign focused on napping, stating that "a 15-minute nap could save your life!" to reinforce its powernap message. This campaign has also used billboards and full-page magazine and newspaper notices.⁵⁵ Western Australia has also committed substantial efforts to television campaigns.⁵⁵ One particular television commercial shown throughout Western Australia also uses an emotive response. A driver is shown to be fighting sleep, repeating "I can make it". After a crash, an ambulance officer is then seen telling a police officer that "the driver didn't make it". Three 15-second commercials have also been created, each providing a 'solution' to help combat fatigue. The first suggests a 15-minute nap, the second a stop for coffee, and the third suggests sharing the drive.

New Zealand has a well-developed range of publicity that takes a direct focus on driver fatigue.⁵⁸ One approach involves the distribution of a fatigue-related fact sheet from driver reviver stops and to callers at the Land Transport Safety Authority. In addition, local road safety co-ordinators are involved in fatigue projects using local advertising – generally conveyed via local radio stations, billboards, and community newspapers. Other international jurisdictions have also demonstrated a commitment to educational initiatives focusing on driver fatigue. These include South Africa,⁵⁹ France⁵⁴ and Germany,⁵⁴ and have typically included leaflets and billboard campaigns.

Numerous studies into the effectiveness of road safety campaigns have shown the need for increased public knowledge of personal responsibility.⁴⁶ In addition, improved effectiveness may be gained from better dissemination of clear information relating to: traffic offences; enforcement tactics; likelihood of apprehension; and associated penalties. There are, however, relatively few thorough evaluations of campaign implementations and this is an area where further research is required.

Legal and judicial initiatives: monitoring and enforcing against driver fatigue

Studies of road safety campaigns indicate that the benefits of education are reduced without the inclusion of facts relating to potential physical and legal consequences.⁴⁶ Indeed, studies^{37,60} have indicated that even where impairment due to sleep loss or sleep disorders is acknowledged by individuals, they are only likely to stop driving if there is a perceived threat of penalty. The perception of penalty can be created by the use of quantitative pro-active tools, as has been the case with breathalysers to deter driving under the influence of alcohol. Unfortunately, in the authors' opinions, none of the technologies developed for fatigue detection have such potential at this point in time.^{61,62} The main reason for this is that there are significant within- and between-individual differences seen in the outputs of such technologies, which have not been adequately investigated. This is true of both in-cab monitoring technologies and roadside performance impairment assessment technologies. Therefore, it is necessary, at this point in time, to use improved crash investigation, licensing processes, public education and also countermeasures that reduce the consequences of fatigue-related crashes.

Crash investigation

Laboratory studies using driving simulators^{32,33} and field studies using questionnaires^{9,63} have lent further credence to the fact that fatigue impairment is a major contributing factor to crashes. Qualitative evidence supports this via admissions by commercial and non-commercial drivers who have reportedly driven while drowsy and/or fallen asleep at the wheel.⁹

As awareness of driver fatigue increases, investigators are slowly being trained to determine the likelihood that fatigue was a contributing factor to a crash. This is another essential step towards a broadly acceptable enforcement strategy for managing the

problem.¹³ Such efforts will improve the quality of data, which will in turn lead to the development and evaluation of more effective countermeasures.⁶⁴ It should be cautioned, however, that training improvements must not only be in the detection of drowsiness but in all potential factors contributing to a crash, including, for example, various forms of awake inattention such as mobile phone usage.⁶⁵

Studies of crash data show that fatigue-related events are typified by certain characteristics, defined in a set of criteria used by Horne and Reyner.⁸ These include:

1. Breathalyser alcohol levels below the legal driving limit.
2. The vehicle either ran off the road or into the back of another vehicle.
3. No signs of the brakes being applied beforehand (i.e. no skid marks).
4. No mechanical defect in the vehicle, no tyre blow-out.
5. Good weather and clear visibility.
6. Elimination of speeding and driving too close to the vehicle in front.

Similar criteria have been used in other studies^{11,66} and have found comparable results. Importantly, investigators must be aware of potential interactions of fatigue with alcohol (and other drugs). Traditionally, crashes in which illegal blood-alcohol concentrations (BAC) were detected had alcohol intoxication identified as the major cause. Research has recently shown, however, that fatigue and alcohol interact, even at legal levels, resulting in greater impairment to driving than caused by fatigue or alcohol alone.⁶⁷ This is a key area that requires further research to inform crash investigation. We therefore support research into methods of quantifying fatigue in the same way as alcohol.²¹

Laws concerning fatigue in transport are broadly inconsistent⁶⁸ and especially so for non-commercial drivers. Typically, authorities will attempt to bring prosecutions against drivers who fall asleep at the wheel with charges of “dangerous driving” or “driving without due care and attention”.⁶⁸ Many defences contest that while a driver is asleep, he/she cannot be held responsible for “dangerous driving” simply because they are effectively unconscious and therefore not voluntarily driving dangerously. However, it is also argued that in falling asleep, a driver will typically (unless suffering from certain sleep disorders) experience a state of increasing sleepiness.^{32,33} The main issue now is whether drivers are aware that a) this increasing sleepiness will eventually lead to falling asleep, and b) their driving will be impaired to a significant level. We support the proposal to create an offence of fatigued driving.⁶⁸

One of the major success factors in addressing road safety issues is the perception of being caught breaking the law. Indeed, evaluations of fatigue awareness campaigns in Australia indicate that laws and enforcement increase the efficacy of programs.¹⁴ However, at present there is no meaningful reproach for motorists who drive when tired, except in rare cases. To date, such cases have generally involved commercial vehicles and fatalities. Referring to the coroner's report of the Bunker's truck crash⁵ involving six fatalities, fatigue was cited as one of the key causes

of the crash. In this case, the driver was held responsible. However, it must be noted that there is also contrary evidence as illustrated by the decision in the Jiminez case.⁶⁹ This finding stated that a person is no longer legally responsible after they have fallen asleep.

Case study: Selby, North Yorkshire, UK

On 28 February 2001, a UK express passenger train crashed near Selby, North Yorkshire, at approximately 0612 hours. Ten passengers were killed and more than 70 injured. The train had been travelling at about 125mph, and became derailed before colliding with an oncoming freight train. The crash was caused when the driver of a Land Rover ran down a motorway embankment, coming to a stop on the railway line. The driver had not slept at all the previous night. It was concluded that he fell asleep at the wheel, and he was convicted of 10 charges of death by dangerous driving. He was sentenced to five years in jail.⁷⁰

It should be remembered that although in certain cases drivers may claim not to have fallen asleep at the wheel due to insurance or legal reasons, there are also physiological reasons why they may not remember having done so.⁷¹ This area is one that requires further investigation.^{32,33}

Licensing and 'fitness to drive'

Sleep disorders also pose a difficult challenge for driver licensing bodies.^{72,73} Although commercial drivers and some company personnel are subject to medical fitness testing that covers their impacts, this is unlikely to be so for non-commercial drivers. In addition, general guidelines may not be sufficient given that some medical professionals argue that every case needs to be treated individually.⁷¹ In some jurisdictions, medical practitioners may be obliged to inform local licensing authorities if a patient is considered unfit to drive.^{74,75}

Another issue that is being increasingly investigated is the response of drivers to treatment of sleep disorders, and the resulting implications for fitness to drive. For example, one study that investigated obstructive sleep apnoea syndrome (OSAS) showed that simulated driving performance improved after only a few days of treatment.⁷⁶ Surprisingly, improvements were sustained for up to a week after treatment was withdrawn. This latter finding is contrary to earlier reports showing minor residual benefits after treatment withdrawal, and a return of daytime sleepiness and reactions to untreated levels after a single night without treatment.⁷⁷ Further research is needed to understand how fitness to drive is affected during cessation of treatment, and what the time course of benefit is. The investigation of these issues is of major practical, clinical, economic and public health importance, particularly since OSAS patients are known to use treatment intermittently.⁷⁷ Current AustRoads fitness to drive guidelines do not answer these questions, and there is therefore scope for some improvement.²⁵

Discussion

Previous efforts to reduce road crash risk have been effective to varying degrees. Objective improvements following the implementation of countermeasures have only been investigated in a limited number of studies. There are, however, lessons to be learned, especially from studies using pre- and post-implementation evaluation structure. If such methodological templates can be used more frequently in future study designs, then reductions in risk may occur at a faster pace than by using other, as yet untested, methods. This approach is therefore not only likely to have high impact, but might also have high cost efficacy.

Based on previous research, there is evidence that awareness campaigns could benefit from being coupled with legal and judicial initiatives.⁴⁶ Therefore, approaches might include a number of inclusions: For example:

- a) Creating communication between local, national and international transport authorities as well as developing legal and judicial approaches for the reduction of fatigue crash risk.
- b) More formal identification of fatigue as a risk, e.g. being tired is like being drunk.
- c) Emotional stimulation of the consequences of fatigue, e.g. if you fall asleep and kill someone, you are personally responsible, and therefore criminally liable.
- d) Techniques to promote self-awareness of fatigue and also to identify fatigue in others, e.g. if you cross a rumble strip more than twice within 10 minutes then you need to take a break.
- e) Practical approaches to assist drivers and passengers to minimise driver fatigue by obtaining adequate sleep and maximising the use of other preventive strategies, e.g. you will know when you are tired, but you will not know when you are going to fall asleep.
- f) Evaluation programs to collect and interpret data for the international road transport community on actual efficacy of specific strategies.

Although road safety is becoming increasingly discussed as a public health issue, rather than a transportation issue,^{14,78} the focus is still primarily on speeding, alcohol intoxication and not wearing seatbelts. While the authors fully support the inclusion of road safety as a public health issue, we believe that driver fatigue must be a more prominent factor, particularly as it is now listed among the most common causes of road crashes.¹⁴ Despite increased awareness in some jurisdictions, the WHO fails to mention fatigue in action plans along with speed, alcohol, seatbelts and helmets in terms of enforcement.¹⁵

We support the proposal that driving while fatigued should be punishable by law⁶⁸ and that research should focus on the development of roadside measures to quantify fatigue at the individual level. Further research is also needed to fully understand who is most at risk from fatigue-related crashes in order to better direct effective education campaigns to the appropriate target populations. Countries such as Australia and New Zealand are well placed to aid the global community in developing effective countermeasures through research, education and legislation.

Acknowledgments

The University of South Australia was contracted by Transport SA to undertake a review outlining the relative merits of driver fatigue countermeasures. This paper represents a condensed version of part of that review. The authors therefore wish to thank Transport SA as well as Kirstin Mitchell and Kerri Clements for help with the review and updates. The authors also wish to extend the appreciation to the two reviewers who aided in guiding the manuscript through its final stages.

References

- Haworth NL, Triggs TJ, Grey EM. *Driver Fatigue: Concepts, Measurement and Crash Countermeasures* [report]. Canberra (AUST): Federal Office of Road Safety; 1988.
- Summala HM. Fatal Accidents among car and truck drivers: Effects of Fatigue, Age, and Alcohol consumption. *Hum Factors*. 1994;36(2):315-26.
- American Thoracic Society. Consensus Statement on Sleep Apnea, Sleepiness and Driving Risk. *Am J Respir Crit Care Med*. 1994;150:1463-73.
- National Transportation Safety Board. *Factors That Affect Fatigue in Heavy Truck Accidents*. Washington (DC): National Transportation Board; 1995. Safety Study 95/01.
- Chivell WC. *Findings of Inquest Concerning the Deaths of S. Duffy, W. Duffy, V. Claxton, C. Claxton, N. Hastwell & I. Hastwell on 3 August 1998*. Adelaide (AUST): State Coroner of South Australia; 1999.
- Shafer JH. The decline of fatigue related accidents on the NYS Freeway. *Proceedings of the Highway Safety Forum on Fatigue, Sleep Disorders and Traffic Safety*; 1993; New York, 1993. p. 85-8.
- Driver Fatigue Safety Action Plan for 2002-2004*. Sydney (AUST): New South Wales Roads and Traffic Authority; 2002.
- Horne JA, Reyner L. Sleep related vehicle accidents. *Br Med J*. 1995;310:565-7.
- Maycock G. *Driver Sleepiness as a Factor in Car and HGV Accidents*. TRL Report 169. Berkshire (UK): Transport Research Laboratory; 1995.
- Knipling RR, Wang JS. Revised estimates of the US Drowsy driver crash problem size based on general estimates system case reviews. *The 39th Annual Proceedings, Association for the Advancement of Automotive Medicine*; 1995 October 16-18; Chicago, USA.
- Garbarino S, Nobili L, Beelke M, De Carli F, Ferrillo F. The contributing role of sleepiness in highway vehicle accidents. *Sleep*. 2001;24(2):203-6.
- Brown ID. Driver Fatigue. *Hum Factors*. 1994;36(2):298-314.
- Dobbie K. *An Analysis of Fatigue Related Crashes on Australian Roads Using an Operational Definition of Fatigue*. Canberra (AUST): Australian Transport Safety Bureau; 2002. Report No.: OR-23.
- Road Safety in Australia: A Publication Commemorating World Health Day 2004*. Canberra (AUST): Australian Transport Safety Bureau; 2004.
- World Health Organization. *A 5-year WHO Strategy for Road Traffic Injury Prevention*. Geneva (CHE): WHO; 2002.
- Fell J. Personal Communication to Dr. Alison Smiley, as cited in *Fatigue Management: Lessons from Research*. In: Hartley L, editor. *Managing Fatigue in Transportation*. Oxford (UK): Elsevier Science; 1998. p. 1-23.
- Keall MD, Frith WJ, Patterson TL. *New Zealand Road Safety Research 2003: Alcohol Case Control Study*. Wellington (NZ): New Zealand Land Transport Safety Authority; 2003.
- Dawson D, Reid K. Fatigue, alcohol and performance impairment. *Nature*. 1997;388:235.
- Lamond N, Dawson D. Quantifying the performance impairment associated with fatigue. *J Sleep Res*. 1999;8(4):255-62.
- Fairclough SH, Graham R. Impairment of Driving Performance Caused by Sleep Deprivation or Alcohol: A Comparative Study. *Hum Factors*. 1999;41(1):118-28.
- Williamson AM, Feyer A-M. Moderate Sleep Deprivation Produces Impairments in Cognitive and Motor Performance Equivalent to Legally Prescribed Levels of Alcohol Intoxication. *Occup Environ Med*. 2000;57(10):649-55.
- Fletcher A, Lamond N, van den Heuvel C, Dawson D. Prediction of performance during sleep deprivation and alcohol intoxication by a quantitative model of work-related fatigue. *Sleep Res Online*. 2003;5(2):67-75.
- Falletti MG, Maruff P, Collie A, Darby DG, McStephen M. Qualitative similarities in cognitive impairment associated with 24 h of sustained wakefulness and a blood alcohol concentration of 0.05%. *J Sleep Res*. 2003;12(4):265-74.
- Digitalbreathcheck [legal limits page on the Internet]. Lanarkshire (SCO): Network Automotive; 2003. Available from: http://www.digitalbreathcheck.co.uk/legal_limits.html [cited 2005 September 9].
- Assessing Fitness to Drive for Commercial and Private Vehicle Drivers*. Sydney (AUST): Austroads; 2003.
- New Jersey Criminal Code, Vehicular Homicide. 2003; NJS2C:11-5.
- Folkard S, Åkerstedt A. A three process model of the regulation of alertness-sleepiness. In: Broughton RJ, Ogilvie RD, editors. *Sleep, Arousal and Performance: Problems and Promises*. Boston (MA): Birkhäuser; 1992. p. 11-26.
- Pilcher JJ, Huffcutt AI. Effects of sleep deprivation on performance: a meta analysis. *Sleep*. 1996;19(4):318-26.
- Van Dongen HP, Maislin G, Mullington JM, Dinges DE. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep*. 2003;26(2):117-26.
- Arnold PK, Hartley LR, Corry A, Hochstadt D, Penna F, Feyer A-M. Hours of Work, and Perceptions of Fatigue among Truck Drivers. *Accid Anal Prev*. 1997;29(4):471-7.
- Kecklund G, Åkerstedt T. Sleepiness in long distance truck driving: an ambulatory EEG study of night driving. *Ergonomics*. 1993;36:1007-17.
- Reyner LA, Horne JA. Falling asleep at the wheel: are drivers aware of prior sleepiness? *Intl J Legal Med*. 1998;111:120-3.
- Horne JA, Baulk SD. Awareness of Sleepiness when Driving. *Psychophysiology*. 2004;41(1):161-5.
- Baranski JV, Pigeau RA, Angus RG. On the Ability to Self-monitor Cognitive Performance During Sleep Deprivation: A Calibration Study. *J Sleep Res*. 1993;3.
- New South Wales Roads and Traffic Authority. *Road Traffic Accidents in New South Wales, 1994. Statistical Statement Year ending 31 December 1994*. Sydney (AUST): RTA; 1995.
- Haworth NL. Factors affecting the success of educational programs to reduce driver fatigue. *Proceedings of 2nd International Conference on Fatigue and Transportation: Engineering, Enforcement and Educational Solutions*; 1996 February; Fremantle, Western Australia.
- Donovan R, Henley N, Jalleh G, Slater C. *Road Safety Advertising – An Empirical Study and Literature Review* [public education market research report]. Canberra (AUST): Federal Office of Road Safety; 1995.
- Swann P. New Countermeasures to Reduce Young Driver Fatigue Accidents. *Proceedings of the Insurance Commission of Western Australia Conference on Road Safety 'Green Light for the Future'*; 1999; Perth, Western Australia.
- Horne JA, Reyner LA. Sleep-related vehicle accidents: some guides for road safety policies. *Transportation Res Part F*. 2001;4:63-74.
- George CF, Nickerson PW, Hanley PJ, Millar TW, Kryger MH. Sleep apnoea patients have more automobile accidents. *Lancet*. 1987;2(8557):781-7.
- Falling Asleep at the Wheel* [proceedings of a seminar on sleep disorders and road safety. Brisbane (AUST): Queensland Department of Transport; 1993 November. Q.D.T. Road Safety Division, Report No.: RUB 93-1.
- Minter G, Blaxland S. *Public Education Market Research Report: Development of Guidelines for Effective Public Education Strategies Targeting Driver Fatigue*. Canberra (AUST): Federal Office of Road Safety; 1998.
- Gay CL, Lee KA, Lee SY. Sleep patterns and fatigue in new mothers and fathers. *Biol Res Nurs*. 2004;5(4):311-18.
- Steele MT, Ma OJ, Watson WA, Thomas HA, et al. The occupational risk factor of motor vehicle collisions for emergency medicine residents. *Acad Emerg Med*. 1999;6(10):1050-3.
- Tepas D. Educational programmes for shiftworkers, their families, and prospective shiftworkers. *Ergonomics*. 1993;36(1-3):199-209.
- Cameron M, Haworth N, Oxley J, Newstead S, Le T. *Evaluation of Transport Accident Commission Road Safety Television Advertising*. Melbourne (AUST): Monash University Accident Research Centre; 1993.
- Ferrara M, De Gennaro L. How much sleep do we need? *Sleep Med Rev*. 2001;5(2):155-79.
- Dinges DE, Pack F, Williams K, Gillen KA, Powell JW, Ott GE, et al. Cumulative sleepiness, mood disturbance, & psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. *Sleep*. 1997;20(4):267-9.
- Belenky G, Wesensten NJ, Thorne DR, Thomas ML, Sing HC, Redmond DP, et al. Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study. *J Sleep Res*. 2003;12(1):1-12.
- Dorrian J, Lamond N, Dawson D. The ability to self-monitor performance when fatigued. *J Sleep Res*. 2000;9(2):137-44.
- Baulk SD, Reyner LA, Horne JA. Gender Differences in Afternoon Driver Sleepiness. *Intern Med J*. 2004;34(3):A38.
- National Campaign on Drowsy Driving. *National Sleep Foundation's Drive Alert, Arrive Alive* [drowsydriving.org page on the Internet] Washington (DC): National Sleep Foundation; 1993. Available from: <http://www.sleepfoundation.org/activities/daaamain.cfm> [cited 2005 September 9]
- Department of the Environment, Transport and the Regions. *Tomorrow's Roads: Safer for Everyone. The Government's Road Safety Strategy and Casualty Reduction Targets for 2010*. London (UK): DETR; 2000.

54. Flatley D, Reyner LA. *A Survey of Public Education Literature Regarding Driver Sleepiness* [report for the Department of the Environment, Transport and the Regions]. This report is not available in printed form, but is available to download from dft Internet website. London (UK): Department for Transport; 2000. Available from: <http://www.roads.dft.gov.uk/roadsafety/sleepiness/index.htm>
55. Transport Western Australia. *Fatigue Campaign 2000*. Perth (AUST): Road Safety Council, Transport WA; 2000.
56. Wurtman JJ. *Managing Your Mind and Mood Through Food*. New York: Harper Collins; 1998.
57. Roshier-Taks M, White I. Healthy Eating on the Road, Contributing to Road Safety through Improved Fatigue Management. *Proceedings of the 4th Local Government Road Safety Conference*; 1999: Sydney, Australia.
58. Bliss T, Badger S, Frith B, Graham P, Guria J, Jones W, et al. *Safety Directions; Estimated Effects of Interventions on Road Safety Outcomes to 2010 – Working Paper 7. Land*. Wellington (NZ): New Zealand Transport Safety Authority; 2000.
59. *Awake at the Wheel Campaign, 2000*. Pretoria (ZA): Arrive Alive Road Traffic Safety Foundation; 2000. Available from: <http://www.arrivealive.co.za/>
60. de Weerd AW. Excessive Daytime Sleepiness and Driving. In: *SLEEP-WAKE Research in The Netherlands*. Vol 8. The Hague (NL): Centre for Sleep and Wake Disorders, Westinde Hospital; 1997.
61. Dinges D, Mallis M. Managing fatigue by drowsiness detection: can technological promises be realised? In: Hartley L, editor. *Managing Fatigue in Transportation*. Oxford (UK): Elsevier Science; 1998. p. 201-30.
62. Centre for Sleep Research. *Fitness for Duty* [CFSR report]. Adelaide (AUST): University of South Australia; 2003.
63. Fell DL, Black B. Driver Fatigue in the City. *Accid Anal Prev*. 1997;29(4):463-9.
64. Dobbie K. *Fatigue-related Crashes: An Analysis of Fatigue-related Crashes on Australian Roads Using an Operational Definition of Fatigue*. Canberra (AUST): Australian Transport Safety Bureau; 2003.
65. McKnight AJ, McKnight AS. The effect of cellular phone use upon driver attention. *Accid Anal Prev*. 1993;25(3):259-65.
66. Pack AI, Pack AM, Rodgman E, Cucchiara A, Dinges DF, Schwab CW. Characteristics of crashes attributed to the driver having fallen asleep. *Accid Anal Prevent*. 1995;27(6):769-75.
67. Horne JA, Reyner LA, Barrett PR. Driving impairment due to sleepiness is exacerbated by low alcohol intake. *Occup Environ Med*. 2003;60:689-92.
68. Jones C, Dorrian J, Dawson D. Legal Implications of Fatigue in the Australian Transportation Industries. *J Industrial Relations*. 2003;45(3):344-59.
69. *Jimenez vs The Queen* (1992) 173 CLR 572.
70. *R vs Gary Neil Hart* (2003) EWCA Crim 1268.
71. Bonnet MH, Moore SE. The threshold of sleep: Perception of sleep as a function of time asleep and auditory threshold. *Sleep*. 1982;65:267-76.
72. Aldrich MS. Automobile accidents in patients with sleep disorders. *Sleep*. 1989;12(6):487-94.
73. Terán-Santos J, Jimenez-Gomez A, Cordero-Guevara J. The association between Sleep Apnea and the Risk of Traffic Accidents. *N Engl J Med*. 1999;340(11):847-51.
74. George CFP, Findley LJ, Hack MA, McEvoy RD. Clinical commentary: across country viewpoints on sleepiness during driving. *Am J Respir Crit Care Med*. 2002;165:746-9.
75. Turkington PM, Sircar M, Saralaya D, Elliott MW. Time course changes in driving simulator performance with and without treatment in patients with sleep apnoea hypopnea syndrome. *Thorax*. 2004;59:56-9.
76. Kribbs NB, Pack AI, Kline LR, Getsy JE, Schuett JS, Henry JN, et al. Effects of one night without Nasal CPAP treatment on sleep and sleepiness in patients with obstructive sleep apnea. *Am Rev Respir Dis*. 1993;147:1162-8.
77. Kribbs NB, Pack AI, Kline LR, Smith PL, Schwartz AR, Schubert NM, et al. Objective measurement of patterns of nasal CPAP use by patients with obstructive sleep apnea. *Am Rev Respir Dis*. 1993;147:887-95.
78. Ozanne-Smith J. Road traffic injury – a global public health scourge: a review for World Health Day. *Aust N Z J Public Health*. 2004;28:109-12.