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Managing Fatigued Driving:

Public Information and Education

By Ken Smith, Smithworks Consulting

Abstract

The paper discusses fatigue and its impact on driving performance and crashes. Definitions of fatigue are described, and the difficulty of identifying fatigue related crashes and thus their true extent. It is argued that there is need for much greater public knowledge of contributing factors to fatigue and the extent to which people are at risk. Fatigue is a much greater road safety problem than is commonly understood and efforts to manage it are only just beginning.

Introduction

Over the last decade or so there has been a good deal of research and discussion about driver fatigue or, perhaps more correctly, the effect of fatigue on driving and its implications for safety. In Australia most of this work has been in relation to heavy vehicle safety, with research and policy development being centred around heavy vehicle driver hours of work and related issues such as sleep disorders. More recently attention

has been drawn to the dangers of sleepiness while driving, which has resulted in advertisements warning of the danger of 'microsleeps'. Recently, some survey work amongst the general population has been carried out.

Motoring organisations and authorities provide messages about the dangers of fatigue, the need to take rest breaks, plan trips and the like but there appears to be relatively little information in the public domain about the contributing factors and impairment effects of fatigue. The research work carried out in relation to heavy vehicle safety, although relevant, is not generally made available to the wider community.

This paper seeks to review this and other work in relation to fatigue and sleepiness, and to provide a basis for further consideration of ways to better inform the community to reduce what is becoming more clearly understood as a serious road safety problem. The paper will discuss definitions of fatigue, identifying fatigue as a contributing factor in crashes and other research work bearing on the issue.

Defining fatigue

Fatigue needs to be defined so that its character and effects can be distinguished from other forms of impairment, such as impairment from the use of prescription and non prescription drugs, cannabinoids and other 'recreational' substances and alcohol.

While use of alcohol and other drugs (and some associated behaviours) can lead to fatigue and give rise to much the same psychophysiological impairment as fatigue, a person can be impaired by fatigue without use of drugs and alcohol.

This requires a definition that relates specifically to fatigue, even if some of the impairment outcomes are common to other contributing factors. For the purposes of driving impairment, this does not matter.

Much of the research on fatigue in Australia has been in relation to the road transport industry. The outcome of this research is relevant to all drivers and riders. Most research has tended to use operational definitions of fatigue, focussing on psychophysiological outcomes and linking them to sleep deprivation(1). The report of the Neville Inquiry(2) summed up various definitions and concluded:

“fatigue is the result of inadequate rest over a period of time and leads to physical and mental impairment”.

A Fatigue Expert Group convened by the Australian Transport Safety Bureau, the Land Transport Safety Authority of New Zealand and the National Road Transport Commission(3) suggested a combination of symptoms and contributory factors:

“The symptoms or effects associated with fatigue include impaired performance (loss of attentiveness, slower reaction times, impaired judgement, poorer performance on skilled control tasks and increasing probability of falling asleep) and subjective feelings of drowsiness or tiredness;

Contributory factors include long periods awake, inadequate amount or quality of sleep over an extended period, sustained mental or physical effort, disruption of circadian rhythms, inadequate rest breaks and environmental stresses (heat, noise and vibration)”.

Job and Dalziel(4) noted that a definition of fatigue should identify fatigue as a construct or state of the person, not a performance or a behavioural outcome; it should identify the cause of the state of the person, to distinguish from other things producing the same performance outcomes, and should reflect, as far as possible, the meaning ascribed to the term by the general population. On these criteria they define fatigue as follows:

“Fatigue refers to the state of an organism’s muscles, viscera or central nervous system, in which prior physical activity and/or mental processing, in the absence of sufficient rest, results in insufficient cellular capacity or system wide energy to maintain the original level of activity and/or processing using normal resources.”

Any of these definitions is suitable. It will be obvious that even where formulated for heavy vehicle drivers these definitions apply in every respect to all drivers and riders, whether professional or private and whether working or on personal affairs. Although as noted it is probably most generally associated with long distance driving, impairment caused by fatigue can affect short trips as well, as discussed a little later.

Fatigue and Crashes

Certain kinds of crashes are said to be fatigue related or characteristic. At present there are three ways in which fatigue can be identified as a cause or major contributing factor to a crash. The first is by indirect evidence or by inference from investigation of the crash(1). The second is an admission by the driver or rider that fatigue played a part in loss of control. The third is through the evidence of a witness that the driver or rider was too tired to operate the vehicle safely, either through physical signs of fatigue or through the evidence of long hours of work or wakefulness.

The second and third ways are less frequently available to investigators either because the driver does not survive or is unwilling to admit that his or her driving was impaired by fatigue, or because there are no witnesses.

Many fatigue related crashes are fatal, and unlike drugs or alcohol, fatigue cannot be detected in a post mortem.

Therefore investigators have to infer fatigue as a contributing factor through the circumstances of the crashes that occur.

This is very important for determining whether fatigue played a part in the crash, and in relation to the limitations of the data.

Criteria used for identifying fatigue related crashes

The criteria used for identifying fatigue related crashes are essentially a matter of best judgement on the crash circumstances that can most reliably be associated with driving impaired by fatigue. These are commonly held to be:

- severe crashes
- crashes where the driver is the only occupant
- crashes involving running off the road or colliding with another vehicle or object, especially where there is no evidence of braking or swerving; or
- crashes occurring at the high risk times of mid afternoon, late at night or in the early hours of the morning, corresponding to the circadian rhythm low points(5).

The times of day commonly used (2-4pm and 10pm or midnight to 6am) only represent those hours in which circadian rhythms are at a ‘low’ point and there is greater propensity to sleep. These periods are somewhat arbitrary and there is room for variation according to individual differences and a person’s need for sleep. A person who is seriously sleep deprived may fall asleep or be impaired by fatigue at any time, so the ‘high risk’ crash times are neither exclusive nor fully inclusive.

There is therefore great uncertainty about the number or proportion of crashes that can reliably be identified as fatigue related. It is likely, and is frequently acknowledged, that the numbers commonly cited represent an underestimate rather than an overestimate, even if they include crashes that might have been ascribed to fatigue because there is no other identifiable cause. Figures of 4% to around or above 30% have been cited(6). Dobbie(7) estimated that 16.6% of fatal crashes

were caused by fatigue, on a very restricted definition. One study of crashes in NSW expressed the view that up to 60% of the crashes investigated could have involved some element of fatigue(8). Moore and Brooks(6) have suggested that even the best estimates of heavy vehicle fatigue crashes almost certainly understate the true figure.

But even that does not account for all factors. Swann(9) in an Austroads paper that has not been noticed very much, has suggested that crashes identified as fatigue related might only be those that result from the driver falling asleep, since the core characteristic of these crashes is that the driver is no longer in control. But there might be significant impairment at levels well below the point of falling asleep that also contributes to crashes. Swann thinks there are levels of sleepiness in which

‘...drivers have significant withdrawal of attention from road and traffic demands which can be both general, impairing vehicle control and collision avoidance ability, and can also be selective, impairing collision avoidance ability but leaving vehicle control intact. At these impaired levels of information processing drivers may not detect critical events, such as stop signs and red lights and may fail to appreciate high accident risk situations.’

If Swann is correct, it is probable that only crashes involving greater levels of sleepiness are reliably identified as fatigue related, and that crashes arising from lesser (but still present) fatigue impairment are incorrectly ascribed to other causes such as inattention or ‘negligent driving’ or sundry breaches of the road rules.

Without firm indication that a driver or rider was impaired in these crashes, or admission by the driver or rider that he or she was fatigued and therefore failed, it is unfortunately not possible to include such crashes in any definition of a fatigue related crash.

Does this amount of underestimation matter? On these and all available figures, it is clear that fatigue related crashes are a significant portion of the total and warrant action to reduce them. It is reasonable to estimate that the number of fatal crashes that result when the driver falls asleep, let alone those that result from lesser levels of sleepiness, are in the range from 16.6% (Dobbie(7) to possibly as high as 30%. To put this in perspective, it should be recalled that in 1999 28% of drivers and riders killed in Australia had a blood alcohol concentration over the Australian legal limit of 0.05g/100ml (5, p.119). The most recent figures are very little different. On this basis it is not unreasonable to suggest that fatigue could be implicated in as many crashes as alcohol. In fact effective action on driver fatigue could have a significant impact on a stagnating road toll, and the more so since available figures underestimate the true number. No greater precision than is now available would be required to justify investment in measures to reduce the number of crashes and resulting trauma that have fatigue as a major contributing factor.

Misunderstood and underestimated

So why is fatigue such a widespread phenomenon and apparently so little understood?

One view is that people misunderstand the nature of fatigue. It is widely considered to be a problem in long distance driving, with the driving itself being the major contributing factor. Warnings about fatigue feed this impression to some extent by promoting the need for regular rest breaks (‘every two hours stop, revive, survive’). Further, there are warnings about sleepiness (‘a microsleep can kill in seconds’) but there is often little in the way of information base on which to understand the point of the slogan.

The very term ‘driver fatigue’ suggests the idea that driving makes one tired, and therefore that the problem or contributing factor is extended periods of driving. But the problem is not ‘driver fatigue’ (although that is certainly part of it) but ‘driving when fatigued’. If understood in this way then the importance of other factors becomes evident. And apart from the matter of hypovigilance, it is only in this context that warnings about microsleep make sense.

Much of the considerable amount of research on fatigue of the last few years has tended to focus on hours awake and sleep deprivation, with some attention to the impact of sleep disorders which is part of the same theme. In Australia it began with research into heavy vehicle driver fatigue, and from that research and a considerable amount of background literature came the realisation that circadian rhythm effects and loss of sleep time were if anything more important than the number of hours worked and time on task(3). Much of this work has stayed in the road transport industry where the associated research and policy development had its genesis, and until very recent times has not gained much attention outside it.

But there is more than one phenomenon that is thought of when people think about fatigue. Some writers and researchers draw a distinction between fatigue resulting in measurable impairment and subjective feelings of sleepiness or tiredness (1,2,9). This is also referred to as hypovigilance, which was the subject of a workshop held at CARRS-Q late in 2004(10). These feelings are related to boredom or lack of stimulation and rapidly dissipate on arousal. Unaroused states can be just as dangerous as sleep deprivation or work induced fatigue if they mean loss of attention and consequent failure to perceive hazards and slowness to react. Swann(9) talked about the effect of sleepiness as a phenomenon in its own right, without referring to sleep deprivation or other cause. Subjective feelings of boredom or sleepiness are relieved by taking periodic rest breaks and a snack, following the usual advice.

Note that physiologically this is the same phenomenon as sleepiness from causes normally associated with fatigue in terms of the definitions earlier cited: insufficient sleep, energy

depleting activity, or too long awake since the last sleep.

In safety terms it is just as dangerous.

It may be worth considering that easier driving environments such as improved road surfaces and more favourable geometry, quieter, air conditioned vehicles with automatic transmissions and cruise control may all reduce attentional demands on the driving task. Have we increased the potential for hypovigilance?

An important issue in fatigue

We have noted in the discussion of definitions of fatigue that fatigue impairs performance. One of the factors in fatigue impairment is that fatigue, like alcohol, affects cognition(1,p.50). This means that the fact that a person is becoming impaired by fatigue is itself masked in the same way as impairment from alcohol consumption. Perception, attention and judgement are impaired(9). Therefore, as with alcohol a person's own judgement as to whether they are impaired by fatigue may not be able to be trusted, and in the interests of safety probably should not be.

The impact of fatigue on driving capability is not insignificant. Research carried out comparing performance effects of sleep deprivation and alcohol by Dawson and Reid(11) and Feyer and Williamson(12) found that 17-19 hours continuous wakefulness brought a decrement in performance equivalent to being at the Australian legal blood alcohol concentration (BAC) limit of 0.05, and that the performance effect of 24-27 hours or so without sleep was equivalent to being at a BAC of 0.10. Amounts of sleep deprivation that occur quite easily in daily work and social activities can bring about serious levels of incapacity. This incapacity manifests itself in identifiable driving errors (e.g. failure to dim headlights for oncoming traffic, tracking errors, speed variability, poor headway maintenance and others easily brought to mind) but also more subtly in failure to identify hazards, lapses in concentration, errors of judgement, fidgetiness and discomfort, or sudden awareness of having covered some considerable distance. These manifestations of impairment can occur at levels of sleepiness well below the 0.05 BAC equivalent, but towards the more extreme end can occur with startling suddenness and little warning.

It is often argued that road and traffic situations that demand high levels of attention (coming upon slower vehicles and overtaking them, more demanding road geometry, roadworks and so on) can overcome attentional deficits. To some degree this is true where hypovigilance is concerned but at higher levels of impairment even this can be insufficient to overcome the effects, any more than the effects of alcohol impairment can be overcome. For the same reason, and especially because of the cognitive deficit that is part of fatigue impairment, driving faster to increase arousal and attentional demands is fallacious and of course extremely dangerous.

Perceptions about Fatigue

Without firm survey evidence to substantiate the view, it is possible that the public has little understanding of the impact of insufficient sleep and sustained wakefulness, together with stressful or physically and mentally demanding work, time on task, rest breaks and so on, and the consequent danger of falling asleep or being significantly impaired even on short urban journeys. These issues have been canvassed in the road transport industry but not to a great extent outside it.

It is especially likely that there is very little knowledge of the specific, impairment related reasons why ordinary people as road users should give attention to fatigue and sleepiness, and accordingly modify their behaviour. A well developed survey would be required to determine the reasons and influences, but it is reasonable to suggest that they would include

- insufficient understanding of how much fatigue can impair driving,
- insufficient self-awareness of growing loss of alertness and concentration (but with at the same time a perception that impairment could be identified when it begins)
- a desire to press on and complete the journey or to meet a time or stage
- not enough good, safe, convenient places to stop
- transient effects such as weather which lead to reluctance to stop and get out of the vehicle.

Some recent survey findings support this view. RACV(13) conducted market surveys and focus groups in Victoria to determine peoples' attitudes to rest breaks and rest areas, with some significant findings. Drivers 18-25 years of age were less likely to take rest breaks than older drivers, as were people who undertook long trips more frequently and rural residents than people who lived in urban areas. Significantly, inattention or inexperience (ranked third) were ranked higher than fatigue (fifth) as contributors to crashes. About rest areas and rest taking, respondents 'totally agreed' with the following statements:

- On long driving trips I want to get where I'm going as quickly as possible (48%)
- When I do stop it's only for petrol or a toilet break rather than a rest (41%)
- There is not enough advertising warning drivers about fatigue (31%)
- I only stop driving when I've nearly fallen asleep at the wheel (9%)
- Breaking a drive to have a rest is just wasting time (7%)

Another survey conducted by Bartlett et al(14) found sometimes confused and sometimes insufficient knowledge by 17-25 year olds compared with older drivers on the amount of sleep needed by young people compared with older people, on whether raising the volume of the radio would help a driver keep awake, and on whether younger people were more likely to fall asleep at the wheel than older people.

Other findings of those studies seem to suggest that urban residents who take long country journeys relatively infrequently are more likely to take rest breaks than rural residents who habitually take longer journeys. But on other evidence suggesting that fatigue related crashes often happen at holiday periods and weekends it is clear that many also just want to get to their destination as quickly as possible, as the RACV survey also suggests, and it is a reasonable supposition that many of those will be fatigued when they begin and be less inclined to take rest breaks.

These findings are by no means comprehensive but indicate that there is scope for deeper and more extensive public education about fatigue. In the same way as for alcohol, for example, such public education should be directed towards changing public perceptions and encouraging behaviour change.

Risk factors

So what are the risk factors and what do we know about them? To begin with, we are all at risk. Obviously some are more at risk than others, but not always for the reasons we think.

The risks in long distance holiday driving have been well documented. But leisure activities may reduce sleep time and impair driving. The RACV survey(13) noted that young people are less likely to take rest breaks than older drivers, to have less knowledge about the amount of sleep they need and what should be done (and what is ineffective) when fatigue symptoms are detected.

Some medical conditions may lead to fatigue, whether through sleep loss or for some other reason. Researchers like Grunstein have pointed to the risks arising from various kinds of sleep disorder.

Here are some basic fatigue risk factors.

Work

There is little in the literature that covers the effect of work on driving. Work that is stressful and mentally or physically demanding means that a tired worker on his or her way home will have impaired driving capacity. The journey home from work is typically undertaken under the most difficult, crowded and stressful driving conditions.

Shift work brings a great many more problems. There is a broad literature on shift work. Anecdotally, shifts of eight, ten or twelve hours are worked in different industries, and the trend appears now for there to be relatively short periods on any one shift to prevent the body's habituation to one regime and to provide more periods for rest at night.

Shift work is at high risk for fatigue. The body is governed by inbuilt biological rhythms attuned closely if not precisely to the cycles of day and night. Work is best performed during the day when the bodily system is (other things being equal) awake and alert; the best sleep is obtained at night when there is a strong propensity to sleep((1), p.50). By definition, shift

work includes periods of work at night during the low points of the circadian rhythm, and that work is more fatiguing than work during the day. Further, in shift work rest and sleep are often taken at times of the day when sleep is less 'efficient' than at night: it may be shorter because of disturbances and interruptions and may be less restorative. The Fatigue Expert Group has suggested in relation to long distance road transport that there should be a limit of 18 hours night work (the period midnight to 6am) and that after this two nights' unrestricted sleep should be available(3; also in (1), p.52). This probably applies equally to shift work.

There is a strong possibility that people on shift work are permanently fatigued to a greater or lesser degree. In turn, shift workers' driving capacity is also likely to be impaired, the more so since some driving to and from work is likely to be at the most risky time of the day, ie at low periods in the body's circadian rhythm.

Young people

Evidence on crash risks for young drivers late at night and in the early hours of the morning suggests that they are at high risk(5, p.227). Of course there are many reasons for this but sleepiness is one of them. Young people may also be at risk at other times if they are sleep deprived because of leisure activities, the more so because of a less than accurate perception of how much sleep they need(13). Even small amounts of alcohol, possibly well under the legal limit, potentiate the need for and propensity to sleep.

Sleep and sleep depriving medical conditions

To recapitulate the issues briefly, the need for sleep is biologically determined(1, see p.50). Fatigue must be relieved by sleep. Sleep 'debt' arising from loss of effective night sleep accumulates and must eventually be 'repaid'. It may be repaid involuntarily if the person does not stop to rest. When the need for sleep becomes acute a person may fall asleep with little warning. This can take the form of 'microsleeps' of a few seconds duration, or for longer periods of time.

Sleep depriving conditions such as sleep apnoea and other medical conditions, the effects of medication and social or psychological conditions that disturb sleep can put sufferers at great risk.

You and me

If these are some identifiable high risk groups – and there are others – it is clear that most of us are at some degree of risk at some time or other, some frequently or habitually for occupational or lifestyle reasons, and some only at intervals. It should be recalled that the risk factors are sleep loss or deprivation, continuous periods awake, the effect of work or leisure activities and others. Conditions such as work, financial or personal concerns that disturb sleep can put people at risk.

For some these are temporary, for others longstanding emotional and similar disturbances make for chronic and continuing sleep loss and risk. Parents and especially mothers of small children are chronically sleep deprived, and the problem is made worse because of unrelenting daytime activities in caring for them, or in doing so and working part or full time as well.

Clearly, many are at risk more than they think they are. Harrison(15) conducted surveys and discussion groups to assess the impact of ordinary day to day activities and found these often very significant in terms of general fatigue and consequently on driving. Parenting responsibilities, social activities and work were main contributors to fatigue while driving. An important issue with respect to policy and countermeasures for driving while fatigued is that respondents to Harrison's surveys also pointed out that because of those activities driving could not be avoided: the option to postpone or avoid it altogether, or often to take necessary rest breaks, was simply not available.

Where do we go from here?

Clearly there is a strong case to be made for significantly more and better education on the characteristics and driving risks associated with fatigue than is available at present. As already noted, the number of crashes in which fatigue probably plays a part, even at the most conservative estimate, warrants action. Information on fatigue, its risks and driving performance impacts needs to be much more comprehensive and much more widely available than it is at present. Such education needs to cover more areas (for example issues relating to shift work and normal daily activities), and there is need to determine the extent and depth of public knowledge so that public education is directed most effectively.

Activities such as Driver Reviver stations during holiday periods are valuable and should be continued. But even for those who do not use them they serve a purpose in raising traveller awareness.

As a guide to the measures we might need to consider it is worth looking back to see the amount and depth of education and public information that went into informing the public about drink driving. A vast amount of that related to enforcement but there has also been a significant component devoted to 'knowledge' matters such as standard drinks and so on. That effort is continuing with present education focussing on such things as morning after effects.

It might be considered that comparing fatigue with alcohol is unreasonable, but there are two aspects to be considered. In the first instance, in the 1960s when alcohol began to be considered as a problem in road trauma requiring significant effort there was probably little better public understanding of the dangers of alcohol than there is now about, for example, sleep deprivation. It is argued that there is need and

justification for significant effort to develop countermeasures even though alcohol was a much bigger killer in the 1960s than fatigue is now. Secondly even if fatigue or sleepiness is a less serious problem than alcohol it is still a significant problem in terms of even relatively conservative estimates (e.g. Dobbie(7)) of the number of crashes involved. If as has been argued fatigue is likely to play a greater part in road trauma than the best estimates show then the case for action becomes significant. And in a time when we are struggling to make real inroads to further reduce road trauma, here is a very significant contributor on which our efforts are only just beginning.

Conclusions

Fatigue is a widespread and serious road safety problem. Research evidence and inference based on the available evidence indicates that fatigue is probably more pervasive, and its effect in terms of driving impairment worse, than is commonly believed.

All sectors and groups in the community are affected at least at intervals, and some groups such as shift workers severely and predictably so, even if their problems are not often generally known. But survey evidence also highlights the severe fatigue impacts of normal, day to day activities of people leading ordinary lives, often with no relief and perhaps no alternative to driving. Much improved public education and information is probably required to highlight the dangers.

Society's effort in dealing with driver fatigue is only just commencing. Much more work is needed to create awareness of the degree to which a person can be impaired by fatigue and its effect on performance, and that fatigue is as much a concern in ordinary, day to day activities as it is in holiday travel. Fatigue is everyone's problem.

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PARSO Birth and Growth

A background to the development and work of the Professional Association of Road Safety Officers (PARSO) in New South Wales Inc.

by Janet Hogge, Road Safety Program Coordinator, Hawkesbury City Council

Until recently, PARSO members talked of the Association as being in its infancy. After more than six years of operation, we now feel we have moved on to another stage of development. This is reflected in the success of the recent PARSO Community Road Safety Summit. The Summit was the highlight in what has been, at times, an arduous journey.

The need for a professional body to represent Road Safety Officers (RSOs) was initially identified in September 1997. Discussion about how this might come about began and, in May 1998 a working group for the founding of a Professional Association of RSOs in NSW was established. Draft objectives, benefits and outcomes were produced to be canvassed with RSOs across the State.

It was clear that most RSOs wanted to form an organisation that was independent. It was agreed that incorporation was the most appropriate method to provide the Association with:

- a framework (constitution) in which to carry out its functions and role;

- a legal identity; and
- provide a simple and affordable means for achieving the above two.

The Professional Association of Road Safety Officers in NSW Inc. (PARSO) was incorporated under the Incorporation of Associations Act, 1984 in May 1999. A number of RSOs who were instrumental in establishing PARSO became members of the first Executive Committee. PARSO's objectives are:

- To provide an umbrella organization for all Road Safety Officers in NSW to do all such things as may be necessary to enhance and expand the NSW Local Government Road Safety Program (LGRSP) including, inter alia, the following:
- To facilitate opportunities for association and interchange of thought and experience among members of the Association.
- To develop a framework for effective education, training and publicity for Road Safety Officers.
- To arrange for an interchange of knowledge and experience of road safety matters between members of the Association.
- To provide opportunities to members for interchange of knowledge and experience of road safety matters between professional bodies both national and international.
- To ensure that specialised knowledge and experience of the Association is available to other organisations.