COUNTERING DRIVER FATIGUE

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1. A BRIEF STATEMENT OF THE ISSUE

In recent years there has been growing interest in the role of driver fatigue in road crashes. Increasingly, it is being recognised that the problem of fatigue is not restricted to heavy vehicle drivers and is not simply a matter of long driving hours: it is also relevant to both urban and rural driving and can arise from sources other than driving.

2. AN ASSESSMENT OF THE ROAD SAFETY ISSUE

2.1 What is driver fatigue?

The Fatigue Expert Group report[1] concluded that there is no universally accepted definition of fatigue, but working definitions typically refer to a combination of symptoms and contributory factors including:

- **symptoms** - impaired performance (loss of attentiveness, slower reaction times, impaired judgment, poorer performance on skilled control tasks and increased probability of falling asleep) and subjective feelings of drowsiness or tiredness;
- **contributory factors** - long periods spent awake, inadequate amount or quality of sleep over an extended period, the impact of specific sleep disorders (especially sleep apnoea), sustained mental or physical effort, disruption of circadian rhythms (the normal cycles of daytime activity and night sleep), inadequate rest breaks and environmental stresses (such as heat, noise and vibration).

New Zealand data suggest that the factors leading to driver fatigue can have a heightened impact if accompanied by other conditions. In 1996-98, one-third of fatalities in which driver fatigue was coded as a factor also involved driver alcohol[2]. Speed and fatigue were also demonstrated to be a bad combination in that speed reduces the time allowed to make response at the same time as fatigue delays response times.

Laboratory experiments have demonstrated that performance on a number of tasks is impaired to a level equivalent to or exceeding a BAC of 0.05% after 17 to 19 hours without sleep in one study[3] or after 18 to 27 hours of wakefulness in another study[4]. Depending on environmental factors, such as the width of the roadway and the presence or absence of other vehicles, the performance deterioration resulting from fatigue may or may not result in a crash.

2.2 The role of driver fatigue in road crashes

There is no unequivocal method for identifying the involvement of fatigue in crashes, as there is for alcohol. Researchers and crash investigators, therefore, often rely upon evidence of erratic driving immediately prior to the crash - crossing the centre line, running off the edge of the road and the frequency of lane excursions - to indicate the involvement of fatigue.

Using this approach, fatigue has been identified as a contributory factor in 7% of the fatal crashes in Australia in 1990, 1992, 1994 and 1996 (from Federal Office of Road Safety Fatality File). Fatigue was identified in 10% of the fatal crashes involving a long-distance heavy vehicle, although most cases involved fatigue in the driver of the other vehicle.

However, these figures are based on very strict applications of the criteria and are considered to under-estimate the true incidence of fatigue. Using a less rigid set of criteria, the New South Wales Roads and Traffic Authority estimate that fatigue is involved in 20% of fatal crashes and 7% of injury crashes[5].

In New Zealand, fatigue was reported as contributing to an average of 10% of fatal crashes over the period 1998-2000.

In both countries, the contribution of fatigue is greater in night-time crashes and in rural areas, where average trip lengths are likely to be longer. Because speeds are likely to be higher in rural areas and fatigued drivers are less likely to take evasive action, the crashes are also likely to have more severe outcomes.

2.3 Quantifying the risk of driver fatigue in road crashes

Jones and Stein[6] found that drivers who had driven more than eight hours doubled their crash risk, meaning a crash risk equivalent to drivers with a blood alcohol concentration (BAC) of 0.05%.

More recently, in a case-control study conducted in the Auckland region in New Zealand, Connor and colleagues[7] found that:

- drivers who self-identified as sleepy had an 11-fold risk of injury crash relative to ‘alert or relaxed’ drivers
- drivers who reported five hours or less sleep the previous night had 2.7 times the risk of injury crash relative to drivers with more than five hours sleep
- drivers who drove between the hours of 2 am and 5 am had 5.6 times the risk of injury crash relative to drivers driving at other times of the day
- the population attributable risk for having at least one of these three factors was 19 per cent. Put another way, and assuming a simple causal association, if these three risk factors were eliminated, the incidence of all injury crashes would be expected to fall by 19 per cent.

3. CURRENT PRACTICES IN AUSTRALASIAN JURISDICTIONS

3.1 Education and publicity

Media campaigns are currently used throughout Australasia, and particularly in the periods leading up to major holidays, to teach drivers about fatigue. Generally, they have one of two messages:

- they stress the possible consequences of driving while fatigued;
- they advocate measures to manage or minimise fatigue.

In recent years there has been an increase in the latter. In New South Wales, the main countermeasure advocated has been to take a break at the first signs of fatigue, and in Victoria, the advertising promotes "Powernaps". The Driver Reviver program has operated nationally during peak holiday periods to encourage drivers to stop and take a break during their journey.

3.2 Road-based treatments to alert drivers

Most jurisdictions have applied audiotactile treatments to edge lines on sections of major routes that have an identified fatigue problem. In some jurisdictions, the treatments have been applied as transverse strips.

3.3 Provision of roadside rest facilities

Most jurisdictions provide roadside rest facilities to encourage drivers to take rest breaks, although the availability of these facilities varies greatly both within and across jurisdictions.

3.4 Methods for managing heavy vehicle driver fatigue

In Australia, the National Road Transport Commission has made recommendations on driving hours for bus and truck drivers and on means to enforce these limitations. The recommendations have been implemented in varying ways and to varying degrees by individual jurisdictions.

In New Zealand, a single set of uniform, prescribed driving hours has been used to manage commercial driver fatigue since the 1930's. The Land Transport Safety Authority is reviewing the system and released a policy proposal on driving hours and logbooks for comment in December, 2000.

In addition, the Australian Transport Council has approved, in principle, the development and use of fatigue management schemes which allow more flexible hours of driving in exchange for other processes related to driver fatigue management training, health and rostering. Work on developing and evaluating these schemes is currently underway.

4. A REVIEW OF THE RESEARCH INTO THE EFFECTIVENESS OF FATIGUE COUNTERMEASURES

4.1 A classification of measures to counter driver fatigue

As shown in Table 1, fatigue countermeasures may be categorised by objective and by target group.

Table 1: A classification of fatigue countermeasures (from Haworth, 1990).

COUNTERMEASURE TARGETS	COUNTERMEASURE OBJECIVES		
	Prevent Fatigue	Prevent Crashes	Reduce Crash Severity
DRIVER	Education, Limitation of hours of work, Rest breaks		
VEHICLE	Radio, Ventilation, Reduction of vibration	Fatigue monitors, Antilock brakes	Seat belts, Antilock brakes
ENVIRONMENT	Rest areas	Pavement treatments	Better shoulders, Treatment of roadside hazards (e.g. clear trees near roadways)

The most widely implemented of these countermeasures are discussed below.

4.2 Educational programs targeting all drivers

The two major factors affecting the effectiveness of educational programs are the ability of fatigued drivers to judge their level of risk and the incentives to continue driving[8].

Wertheim[9] proposed that drivers be taught to recognise the early signs of fatigue such as misjudgment of velocities, crossing marked lane lines, slow responses and yawning. However, experimental evidence suggests that subjective estimates of fatigue may not be reliable[10].

The incentives to continue driving are particularly strong for truck and bus drivers who have a need to meet schedules. However, for car drivers time can also be a factor. Another widely reported incentive to continuing driving is the lack of attractive and practical places to stop. While rest areas exist, they are often neither attractive nor secure.

While evaluations suggest that fatigue advertising seems to reach and to be recalled by the target audiences, there is little evidence to suggest that the programs bring about an immediate change in behaviour and thus prevent fatigue-related crashes. The ultimate benefit of increasing public awareness of fatigue as a road safety issue may be greater acceptance of technological or legislative measures to reduce fatigue-related crashes[7].

4.3 Limitation of hours of work targeting heavy vehicle drivers

Feyer and Williamson[11] note that current driving hours regulations have three critical shortcomings: they place limits on consecutive hours of work and rest irrespective of the time of day; they are not derived from empirical research; and they do not take into account inter- and intra-driver variability. "The omission of important factors affecting alertness levels, such as time of day, activity during rest breaks and prior activity, means that these regulations are incapable of being completely effective, even if problems related to enforcement were solved"[12].

The ability of regulatory driving hours to reduce fatigue-related crashes has been widely questioned in the last decade[13]. The development of alternatives, particularly driver alertness monitoring or fatigue management programs, appear to hold more promise in both safety and productivity terms but their effectiveness needs to be carefully evaluated.

4.4 Rest breaks targeting all drivers

Research suggests that rest breaks are most beneficial when taken before the driver is overly fatigued[14] and when food is taken[7 15]. Food alone (without a rest break) also appears to have some beneficial effects. It should be noted, however, that eating large meals (rather than snacks) can lead to a reduction in performance – and contributes to the well-documented post-lunch dip[16 17].

There is some evidence that a rest break does not lead to an improvement in performance per se, but rather a reduction in the rate of deterioration of performance.

4.5 Rest areas

The VicRoads ‘Guidelines for Rest Area Facilities’ states that "rest areas have the potential to encourage drivers to break their journey, and hence contribute to reducing fatigue related accidents; however the benefit to cost ratio of rest areas is likely to be low...although rest areas have relatively low safety benefits they are valued by road users".

The implication is that rest areas have only limited justification as a safety countermeasure.

4.6 Pavement treatments

Numerous studies have shown pavement treatments to be effective in alerting dozing drivers and in reducing run-off-road crashes in rural areas. Audio-tactile edgelining may also contribute to reducing wet weather crashes because the markings are highly reflective and 3 mm thick, thus easily visible above road water on rainy days.

4.7 Driver fatigue monitoring

Detection of driver fatigue can take one of two forms:

- performance tests, administered before work or at the roadside;
- in-vehicle systems, measuring either vehicle control inputs or physiological signs of driver alertness.

To be feasible, in-vehicle systems need high detection and low false alarm rates and need to achieve this at a realistic cost[7]. Further development is currently required to meet these criteria.

5. POLITICAL, SOCIAL AND OTHER FACTORS ASSOCIATED WITH DRIVER FATIGUE

The Report of the Fatigue Expert Group[1] identified the following broad social and economic factors leading to increased driver fatigue:

- competitive pressures based on utilisation of assets, reduction in inventory levels and a 24-hour service orientation
- customer and consumer demands
- productivity and flexibility methods to reduce workforce numbers and increase intensification of labour process
- employees' financial and lifestyle expectations.

Working and work-related travel also appear to play a significant role in driver fatigue. Fell and Black[18] reported that in the Northern Region of NSW, over a third of driver fatigue crashes or near-crashes occurred on trips related to work. When drivers in the Sydney region were interviewed, 43% of respondents who had a fatigue incident (a crash, near-miss or moved out of their lane because of fatigue) stated that their trip was work-related. Among the respondents who said that they had insufficient sleep, 55% attributed this to long working hours or overtime.

Recent increases in the length of the working week (more paid and unpaid overtime) and, perhaps, greater likelihood of meetings or travel to meetings outside of core hours are expected to exacerbate this problem.

6. CONCLUSIONS

The dangers of long hours of driving, often under monotonous conditions, have long been recognised. The more recent knowledge about other factors leading to driver fatigue - even in short distance driving - mean that the issue can no longer be viewed solely in terms of hours of driving. While difficulty in identifying fatigue-related crashes limits the ability to evaluate the effectiveness of possible countermeasures, behavioural means to counter fatigue and improve driver alertness that have been proposed[2] include:

- ensure adequate sleep immediately prior to taking a long journey;
- plan to drive during daytime hours and allow for overnight stays rather than driving into the night (ie do not drive during normal sleeping hours);
- schedule a rest break at least once every two hours, sooner if tired or sleepy;
- if sleepy, find the first safe place to stop and nap for up to 40 minutes [although other sources suggest rest or a shorter nap];
- use caffeine judiciously, keeping it for when tiredness starts to set in;
- eat sensibly throughout the journey and avoid large meals;
- where possible, share the driving;
- avoid alcohol immediately before and during the trip.

At a different level, pavement treatments, treatment of roadside hazards and developments of fatigue monitoring systems all hold considerable promise in reducing the occurrence of fatigue-related crashes.

It remains problematic whether public education or advertising campaigns are effective in developing the ‘safe’ behaviours listed above. The ultimate benefit of these campaigns may well be to increase public awareness of fatigue as a road safety issue and, thereby, perhaps leading to a greater acceptance of technological or legislative measures to reduce fatigue-related crashes.

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