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(2008)

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*Transportation Research Part F: Traffic Psychology and Behaviour*, 11(6), pp. 418-426.

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<https://doi.org/10.1016/j.trf.2008.04.002>

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Strahan, Clinton and Watson, Barry C. and Lennon, Alexia J. (2008) Can organisational safety climate and occupational stress predict work-related driver fatigue?. *Transportation Research Part F: Traffic Psychology and Behaviour* 11(6):pp. 418-426.

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# Can organisational safety climate and occupational stress predict work-related driver fatigue?

## Abstract

Road crashes are a significant cause of work-related injury and death. Driver fatigue is thought to cause 20-30% of fatal crashes. The current study utilised a survey to examine the relationship between safety climate, occupational stress and work-related driver fatigue. Drivers (n= 219) from two government organisations responded to items from the Job Related Tension Scale (Kahn, Wolfe, Quinn & Snoek, 1964), Safety Climate Questionnaire (Glendon & Litherland, 1991) and purpose-designed items on fatigue related behaviour. Outcome measures were current self-reported, fatigue-related behaviour and self-reported 'near (crash) misses' during the previous 6 months. Together, occupational stress and safety climate predicted fatigue-related behaviour, accounting for 29% of the variance over and above that explained by control variables. Further, logistic regression revealed occupational stress and safety climate to be significant predictors of fatigue-related near misses. Safety climate emerged as a stronger predictor of both fatigue-related behaviour and near misses than occupational stress. Results suggest that organisations can play a part in improving the safety-related behaviours of their workforce through attention to safety climate and occupational stress.

*Key Words:* Fatigue; Safety climate; Work-related driving; Occupational safety; Occupational stress

## **1. Introduction**

Workplace safety attracts considerable attention from governments, organisations, employees and safety researchers because it carries with it far reaching implications both economically and socially. Work-related vehicle crashes have been reported as the leading cause of work-related injury and death in a number of countries, including the US (Pratt, 2003), France (Charbotel, Chiron, Martin & Bergeret, 2001), UK (Health and Safety Executive, 2001) and Australia (Haworth, Tingvall & Kowaldo, 2000). In Australia reports suggest that crashes involving fleet vehicles account for 25% of overall road fatalities and 43% of work-related fatalities (Meers, 2002; Murray, Newnam, Watson, Davey & Schonfeld, 2003). Total direct cost of crashes (from all causes) in Australia are estimated in the order of \$15 billion per annum (1996 data) (BTE, 2000), making these work-related crashes expensive to businesses, with indirect costs from physical, psychological and economic consequences having substantial impact on the community.

Difficulties in fatigue measurement and reporting methods make it problematic to determine precisely what proportion of road crashes are due to fatigue. However, it is generally accepted that driver fatigue accounts for around 20-30% of fatal road crashes (House of Representatives Standing Committee on Communications, Transport and the Arts, 2000). In addition, fatigue has been shown to be a particularly prevalent factor in work-related crashes (Harrison, Mandryk & Frommer, 1993).

Though there is increasing awareness that driver fatigue plays a significant role in many work-related motor vehicle crashes, this area is under researched when compared to other road safety risks such as speeding and drink driving (Brown, 1994; Haworth, et al., 2000; Philip et al., 2003).

Recognising the importance of work-related driving to injury has led to research investigating the impact of organisational factors on driver safety and to a lesser extent, driver fatigue. This trend reflects a fundamental shift in thinking regarding the roles that organisations play in influencing the safety behaviours of employees. Historically, driver safety research has focussed on individual characteristics, attempting to elucidate what makes one individual safer than another (Wills, Watson & Biggs, 2007). At the organisational level a number of researchers have begun to investigate factors such as roster designs and consecutive hours spent working and how they relate to driver fatigue (Arnold et al, 1997; Baas, Charlton & Baston, 2000). However, this research has generally concentrated on high-risk groups such as long distance truck drivers. The present study aimed to extend previous research by focusing specifically on organisational influences of work-related driver fatigue rather than individual influences and by utilising a mixed driver population.

### *1.1. Driver fatigue*

For the purposes of description, fatigue is often referred to as a feeling of tiredness and reduced alertness that is associated with drowsiness, which impairs both capability and willingness to perform a task (Craig, Tran, Wijesuriya, & Boord, 2006; Lal & Craig, 2001). Fatigue contributes to crash risk by significantly increasing reaction times and degrading driving performance (Philip et al., 2003).

Typically fatigue research has focused on individual factors such as amount or quality of sleep, age, or physical health (Stutts, Wilkins, Osberg & Vaughn, 2003). Such studies have shown that lack of sleep, low sleep quality or excessive daytime sleepiness are significant predictors of driver fatigue as well as fatigue-related crashes

(Arnold et al., 1997; Gander et al., 2006; Hartley, 2004; Van den Berg & Landstrom, 2006). Driving at times of the day that would normally be spent sleeping, or driving for prolonged periods are also associated with increased crash risk (Folkard, 1997; Hartley, 2004). Other studies have examined personality-related (e.g. sensation seeking and extraversion) (Thiffault & Bergeron, 2003) and psychological characteristics such as depression and anxiety (Craig et al., 2006; Lal & Craig, 2001) showing an association between high levels of these factors and greater propensity towards driver fatigue.

Stress and its contribution to fatigue has also been extensively examined in the past and is well recognised in the literature (Maconnald, 2003; Mathews, 2002; Tepas & Price, 2001). Stress can be thought of as a result of a perceived imbalance between demands and resources (Lazarus & Folkman, 1984) such that the individual cannot mobilise sufficient resources to meet the current demands. This produces tension which may be experienced physically, emotionally or mentally. The impact of stress on fatigue is complex and person specific (Beehr, 2000), as individual factors such as coping style, personality traits and social support all play a role in moderating the extent to which stress is experienced (Legree, Heffner, Psoyka, Martin & Medsker, 2003).

### *1.2. Occupational stress*

Occupational stress is a term used to describe stress that originates from the work environment (Cartwright, Copper & Barron, 1996). Occupational stress is different from other life stresses in that organisations play a role in moderating the extent of the stress experienced (Cartwright, et al., 1996). For example, poor job/position design, poor job support, and high workload are all likely to contribute to

workers' experiences of occupational stress. Manifestations of occupational stress can include physical depletion, emotional drain, absenteeism, and reduced efficiency and performance (Cushway, Tyler & Nolan, 1996; Farber, 1990).

Though as highlighted above, there is considerable individual variation in the experience of stress, including occupational stress, research has provided strong support for a link between occupational stress and the safety behaviours and safety outcomes of workers (Sutherland & Cooper, 1991; Westerman & Haigney, 2000). Research has revealed that occupational stressors contribute to decreased driving performance and vigilance and therefore an increase in crash risk (Legree, Heffner, Psotka, Martin & Medsker, 2003). Further, Cartwright et al. (1996) reported that occupational stress was predictive of road crashes in work-related drivers.

While occupational stress has been linked to fatigue and road safety behaviours and outcomes, the relationship between occupational stress and work-related driver fatigue is yet to be examined. This relationship warrants further investigation and empirical evaluation particularly when considering the implications for both organisational safety management and organisational liability in cases of highly stressed employees.

### *1.3. Safety climate*

Safety climate represents another organisational influence on driver safety. A large body of research supports the role of organisational safety climate in predicting safety behaviors and safety outcomes (see Clarke, 2006). While it is noted that there is no consensus as to the specific definition of safety climate (see Griffin & Neal, 2000; Wills, Watson & Biggs, 2006) it is apparent that there are some commonalities

to the thinking behind the concept within the broader framework of organisational culture.

Organisational culture is typically described as the shared attitudes, values, beliefs and behaviors that occur within an organisation (Cooper, 2000; Glendon & Stanton, 2000). Those shared attitudes, values, norms, ideas, beliefs and behaviors that impact upon employees' exposure to risk while at work can be seen as the *safety* culture of the organisation (Guldenmund, 2000). Consistent with this, fleet safety culture may be considered an aspect of safety culture that is specific to road safety. Fleet safety culture encompasses not only the safety behaviors of fleet drivers, but also how management practices impact on driving and how driver safety is valued within the organisation (Wills, Biggs & Watson, 2005).

Organisational safety climate is a conceptually related construct described as the psychological mechanism through which safety culture impacts the way in which employees behave at work (Cooper, 2000; Glendon & Stanton, 2000; Wills et al., 2005). While debate exists as to the nature of the distinction between culture and climate (Flin, Mearns, O'Conner & Bryden, 2000), safety climate typically refers to workers' *perceptions* of the way in which the organisation views and manages safety (Cooper, 2000; Guldenmund, 2000). Important factors that comprise organisational safety climate include perceptions of: management values (e.g. management concern for employee well-being); management and organisational practices (e.g. adequacy of training, provision of safety equipment, quality of safety management systems, communication); and employee involvement in workplace health and safety (Neal, Griffin & Hart, 2000). The methodological advantage of the culture/climate distinction is that perceptions are amenable to quantitative measurement in a similar way to other psychological constructs such as attitudes or cognitive ability, whereas



culture manifests itself via shared values, norms, ideas, practices, beliefs and behaviors that are fundamentally more complex and abstract, and therefore difficult to measure quantitatively (Glendon & Litherland, 2001; Wills et al., 2005).

Road safety researchers have provided support for the link between safety climate and safety-related driver behavior and outcomes. For example, Wills et al. (2006) found that safety climate was able to significantly predict a number of driver safety-related behaviors including traffic violations, driver error, driving while distracted, and pre-trip vehicle maintenance in a sample of state government employees. In addition, Morrow and Crum (2004) reported that perceptions that trucking company employees held of management safety practices were predictive of reported fatigue while driving and fatigue-related near misses. However, the findings of Morrow and Crum (2004) are specific to high-risk drivers, and the relationship between safety climate and work-related driver fatigue in other driver populations is yet to be examined.

#### *1.4. Study aims*

The present study aimed to empirically evaluate the influence of occupational stress and organisational safety climate on fatigue-related driving behaviour after controlling for a number of individual control variables. In addition, the study aimed to evaluate whether these same variables could predict self-reported near misses that were attributed to driver fatigue.

## 2. Method

### 2.1. Participants

Drivers from two state-government organisations with an interest in driver fatigue were approached to participate in the study. Consistent with research of this nature, work-related drivers were considered to be those who drove at least once per week for work purposes (Newnam, Watson & Murray, 2004; Wills et al., 2006). The sample consisted of 219 participants from a total of 1,458 surveys distributed to the participating organisations, representing an overall response rate of 15%<sup>1</sup>. The final sample used in the hierarchical regression analysis was 211 work-related drivers (8 were excluded due to missing data), while a sample of 204 work-related drivers was used for logistic regression analysis due to an additional 7 cases of missing data on the near miss variable.

Respondents (53% male, 46.1% female, 2 unspecified sex) indicated that they drove in a variety of city, sub-urban and rural environments. The mean age of drivers was 42.6 years (SD = 10.1) with the majority (43.5%) of drivers in the 40-50 year age bracket. The reported average number of hours per week spent driving for work purposes was 9.8 hours (SD = 7.2). The majority (64.2%) of drivers drove cars, 29.8% drove 4WD vehicles and the remainder reporting driving utilities (2.3%), light trucks (.5%), and vans (3.2%).

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<sup>1</sup> It should be noted that this response rate was around half that anticipated given that similar studies conducted by the research team had achieved response rates of 30% (Wills et al, 2006). Based on feedback from safety representatives within the participating organisations, it appears that this lower than expected response rate was due to internal delays in the mailing of the questionnaires, which resulted in an unknown number received close to and after the specified return date. Moreover, this problem appears to have been general in nature and thus should not have contributed to any systematic non-response bias.

## *2.2. Procedure*

Prior to commencement of the study ethical approval was sought from the Queensland University of Technology human research ethics committee. Arrangements were then made to consult with safety representatives from the participating organisations; questionnaires were distributed to regional safety personnel via each organisation's internal mailing system for final distribution to work-related drivers. Drivers received a package consisting of: an information sheet detailing the nature of the study and assuring confidentiality; a covering letter from each organisation's management confirming support for the study; instructions for completing the questionnaire; the questionnaire itself; and a reply paid envelope. This procedure ensured the anonymity and confidentiality of the participants, and was designed to maximize the response rate.

## *2.3. Measures*

### *2.3.1 Control Variables*

The variables age, gender and time spent driving for work per week were included in the study as control variables since younger drivers, and males have been shown to be involved in a higher number of fatigue-related crashes than other older drivers and females, respectively (Horne & Reyner, 1995; Pack, et al., 1995). In addition, those people who drive more often (have greater exposure) have also been shown to be involved in greater numbers of fatigue-related crashes (House of Representatives Standing Committee on Communications, Transport and the Arts, 2000; Stutts, Wilkins, Osberg & Vaughn, 2003).

### *2.3.2 Occupational stress.*

The Job Related Tension Scale (JRTS) (Kahn, Wolfe, Quinn & Snoek, 1964) was included in the questionnaire to measure occupational stress. The scale has been found to have sound internal reliability of 0.81 and discriminant validity (Gonzalez-Roma, Luna, Espejo, & Baeza, 1992). MacKinnon (1978) provides further details of the psychometric properties of the scale. The JRTS is considered a measure of subjective stress rather than exposure to stressors, as the instructions direct participants to respond to questions based on how much each item bothers them (Gonzalez-Roma et al., 1992). The 15 items are scored on a five-point Likert scale ranging from “never” to “nearly all the time”, with higher scores indicating higher levels of occupational stress. An example of an item is “Feeling that you have too little authority to carry out the responsibilities assigned to you”. In this study the internal reliability of the scale was high, with Cronbach’s alpha = .90.

### *2.3.3. Fleet safety climate.*

A previously adapted version of Glendon and Litherland’s (1991) Safety Climate Questionnaire (SCQ) was used to measure safety climate. Wills, Watson and Biggs (2004) adapted the SCQ for a fleet vehicle setting with a focus on work-related driver safety where it proved useful in explaining driver safety-related behaviour. As such this adaptation was considered more suitable for the present study sample than the original SCQ. The scale contains 35 items scored on a 7-point Likert scale ranging from “never” to “always”, with higher scores indicating safer perceptions. Wills et al. (2005) report on the development and factor structure of the modified SCQ. The scale consists of 6 dimensions of safety climate: communication and procedures (13 items); work pressure (7 items); management commitment (4 items); relationships (5 items); driver training (3 items); safety rules (3 items). Wills et al. (2005) reported a

Cronbach's alpha of .95 for the scale. For this study, Cronbach's alpha was similarly high at .97.

#### *2.3.4. Self-reported, fatigue-related behaviour.*

Five purpose-designed items were generated from the driver fatigue literature to reflect the fundamental aspects of driver fatigue behaviour (Table 1). For example, some studies report that driving after working for extended periods of time is associated with driver fatigue (Arnold et al., 1997) hence the item "How often do you drive after working for extended periods of time?" was included. Furthermore, it is well recognised that driving after insufficient sleep is associated with driver fatigue (Arnold et al., 1997; Gander, Marshal, James & Le Quesne, 2006; Hartley, 2004) hence the item "How often do you drive after having insufficient sleep?" was included. All items were measured on a five point Likert scale from 1 (never) to 5 (very frequently) with higher scores indicating more frequent driving while fatigued. This scale had a Cronbach's alpha of .82 and thus demonstrated high internal reliability.

Insert table 1 about here

#### *2.3.5. Self-reported, fatigue-related near misses.*

A second outcome measure was utilised that consisted of a single-item question about fatigue-related near misses. This was used in place of a question about fatigue-related crashes for several reasons. Firstly, crashes themselves are relatively infrequent occurrences and often involve multiple causal elements. Moreover, drivers are less likely to admit they crashed due to fatigue for reasons such as avoidance of

self-incrimination and social desirability (Morrow & Crum, 2004). Lastly, near misses are reported to have a close association with actual accidents (Powell, Schechtman, & Riley, 2007)), thus making them a viable proxy.

The questionnaire item asked participants if they had experienced a near miss that they thought was attributable to driving while fatigued in the past 6 months. A description of a near miss was provided: “an incident on the road that, under different circumstances, could have resulted in personal harm, property damage or other loss”. The following example of a near miss was also provided: “e.g. Needing to brake suddenly to avoid hitting a vehicle in front because you failed to notice it was slowing down”.

#### *2.4 Data Analysis*

Descriptive statistics (means and standard deviations) and intercorrelations among the study variables were calculated. Scale variables (occupational stress, safety climate and fatigue-related behaviour) were calculated by averaging item scores. For the hierarchical regression analysis to predict fatigue-related driver behaviour, control variables (age, gender, hours per week driving) were entered at step 1. The organisational variables occupational stress and safety climate were entered at step 2. Logistic regression analysis was used to predict self-reported near misses as the near-miss variable was dichotomous in nature.

### **3. Results**

#### *3.1. Descriptive statistics and bivariate correlations*

The mean scores, standard deviations, bivariate correlations and Cronbach’s alpha for the sample were calculated for the study variables and are presented in Table

2. Intercorrelations among the scale variables was generally moderate ( $r = -.47$  to  $.41$ ). The near miss variable was moderately correlated with self-reported fatigue-related behavior ( $r = .40, p < .001$ ), and weakly correlated with occupational stress and safety climate ( $r = .23, p < .01$  and  $r = -.25, p < .001$  respectively). Driving hours per week only correlated weakly with both the near miss variable ( $r = .14, p < .05$ ) and self-reported fatigue-related behaviour ( $r = .27, p < .001$ ).

Insert Table 2 about here

### *3.2 Predictors of self-reported fatigue-related driver behaviour*

A hierarchical regression was conducted to examine whether occupational stress and organisational safety climate could predict self-reported fatigue-related driver behavior over and above other relevant factors. The results are presented in Table 3.

Overall, the model accounted for 39% of the variance in fatigue-related behavior,  $F(5, 205) = 25.82, p < .001$ . Occupational stress and organisational safety climate together were significant predictors of fatigue-related behavior, accounting for 29% of the variance over and above that contributed by control variables,  $F_{change}(2, 205) = 48.23, p < .001$ . The control variables together accounted for 10% of the variance in self-reported fatigue-related behaviour,  $F(3, 207) = 7.40, p < .001$ . Examining the unique variance revealed that organisational safety climate was a stronger predictor than occupational stress, accounting for 10% and 6% of the variance in fatigue-related behavior respectively.

Insert Table 3 about here

### *3.3. Predicting fatigue-related near misses*

A logistic regression was undertaken to examine whether the same variables used above could also predict self-reported near misses. The analysis (target = reported near miss) revealed that the predictors did significantly predict near misses  $\chi^2(5, N = 204) = 23.30, p < .001$  with Nagelkerke  $R^2$  indicating that 17.2% of the variance in near misses was accounted for by the predictors. Overall 17.5% of near misses were correctly classified. As shown in Table 4, examination of Wald statistics revealed only safety climate and occupational stress to be significant predictors of fatigue related near misses ( $p < .01$  and  $p < .05$  respectively). Assessment of the Wald statistics and odds ratios suggested that drivers who reported more positive perceptions of the way in which their organisations view and manage safety were less likely to report having a fatigue-related near miss; and those who reported higher levels of occupational stress, were more likely to report having a fatigue-related near miss.

Insert Table 4 about here

## **4. Discussion**

The central aim of the present study was to empirically examine and evaluate the influence of occupational stress and organisational safety climate on fatigue-related driver behaviour and fatigue-related near misses. As the results demonstrate, both organisational safety climate and occupational stress were predictive of self-reported fatigue-related driver behavior after controlling for several individual factors, with safety climate emerging as a stronger predictor than occupational stress. In



addition, both organisational safety climate and occupational stress were significantly predictive of self-reported, fatigue-related near misses.

The above results provide further support for the argument that safety climate exerts an influence over safety-related employee behavior. The emergence of safety climate as a stronger predictor of fatigue-related behavior than occupational stress serves to highlight the relative importance of safety climate with respect to the fatigue-related behavior of drivers.

These findings carry have strong practical utility. While the results are sample specific, at a broader level they suggest that organisations should be cognizant of the impact that policies, practices and procedures can have on fatigue-related driver behaviour as well as safety behavior in general, and consider this in terms of the management of work-related driver safety and future safety planning. In a practical sense, policies and procedures should be designed not only to enhance safety, but also they should be implemented in a way that ensures that employees perceive them as important and practical, given that safety climate represents the psychological manifestation of safety culture. In other words, organisations may benefit from taking steps to openly promote or publicise their commitment to safety in order to develop and create a more positive safety climate.

The issue of organisational liability is also particularly relevant and warrants consideration. The present results suggest that organisations can have a direct effect on the safety behaviour of their employees via organisational safety climate, hence organisations may wish to consider their role in influencing driver safety and the creation of positive safety climates.

The finding that occupational stress was predictive of fatigue-related behavior is particularly important for our understanding of occupational stress and its transfer

into the driving environment, as well as the implications for organisations.

Organisations have a responsibility to manage and understand the potential impact of occupational stress. One way to manage occupational stress is through intervention and prevention strategies. Such strategies can be approached at both the organisational level and the individual level. For example, at the organisational level clarification of roles through position evaluation and review, and careful position design have the potential to reduce occupational stress by reducing role ambiguity. Further, at the individual level counseling services, employee assistance programs and stress management training may also reduce occupational stress and in turn affect the safety behaviours of work-related drivers. The benefit of such strategies is not limited to driver safety as the link between occupational stress and other factors such as absenteeism, job satisfaction, staff turnover, and general well-being is well documented (Jex, 1998). Again managers would do well to consider exposure to liability and the role of organisations in occupational stress, particularly in cases where highly stressed individuals are involved in crashes.

In considering the points mentioned above it must be remembered that the occupational stress measure used in the present study was an overall measure, and that occupational stress is both complex and multifaceted. Notwithstanding this caveat, the relationship between occupational stress and work-related driver fatigue carries with it important implications for organisations.

As mentioned earlier the use of self-reported near misses as an alternative, or proxy, outcome measure to vehicle crashes in driver safety research appears to be increasing in popularity, primarily due to the relative infrequency of crashes and associated measurement difficulties, particularly in the case of fatigue-related crashes. The results indicated that both occupational stress and organisational safety climate

were significant predictors of fatigue-related near misses. However, only a relatively small proportion of the variance was explained by the independent variables and the classification of near misses based on these variables was limited suggesting that there are other important predictors of fatigue-related near misses not accounted for in this model. Future studies may consider using other outcome measures in order to more closely examine the influence of occupational stress and safety climate on driver fatigue. Despite this, the results serve to further strengthen the findings relevant to self-reported fatigue-related driver behaviour.

## **5. Limitations**

Despite the practical implications of this study, there are a number of limitations that must be considered when interpreting the results. There are limitations inherent to self-report research such as memory biases and social desirability, particularly with respect to the near miss measure. However, these concerns must be balanced with recognition of the value of self-report measures in that we can, and have, learnt much from studies that utilise self-report data. Further, the representativeness of the sample must be considered: though a response rate of 30% was anticipated, as mentioned previously the final response rate was only 15%. Thus care should be taken in attempting to generalise the results to drivers from other populations. Consequently future research should aim to utilise larger and more diverse samples of work-related drivers.

The use of a composite measure of safety climate should also be noted, as previous research has shown safety climate to consist of a number of dimensions, including training, relationships and management commitment (Wills et al. 2005). While the present study utilised a combined safety climate score, it is possible that

certain aspects of safety climate captured by the measure may have had differing levels of influence on fatigue-related driver behavior. Thus future research should aim to evaluate the influence of these dimensions of safety climate on fatigue-related driver safety.

Previous research has shown that occupational stress is relatively complex. As the present research used an overall measure of occupational stress, it is likely that it did not capture this complexity. Accordingly, future research could employ more sensitive measures of occupational stress that tap specific aspects such as role ambiguity and role conflict and examine their impacts on fatigue-related driver safety. Similarly the present study sampled a limited number of influences on fatigue-related behaviour and near misses. More complex investigations, involving a greater number of organisational, as well as individual factors are required to gain a more complete understanding of work-related driver fatigue.

Finally, our purpose designed items “Drive after insufficient sleep”, “Drive after not much sleep”, and “Drive after working for extended periods of time” were subject to the interpretation of respondents and these interpretations may have varied considerably. Specific definitions of insufficient sleep, not much sleep, and extended periods of time may have increased the sensitivity and face validity of the measure.

## **6. Conclusions and future directions**

The growing concern over the role of driver fatigue in work-related traffic safety is warranted given the number of fatalities and incidents that are believed to be attributable to fatigue. The present study suggests that the nature of the work environment influences work-related driver fatigue. Intervention strategies would do well to acknowledge the contribution of organisational factors to driver fatigue-risk.

The findings from our study suggest that organisations can play a part in reducing fatigue-related crashes through attention to safety climate and occupational stress. Effective organisations are likely to monitor individual workloads, as well as involve their workforce in developing and implementing clear procedures relating to work-related driving. Managers in such organisations will take active stances in formulating safety policies and demonstrating the organisation's commitment to these and to the safety of their workers.

Future studies should aim to investigate other individual and organisational factors that contribute to work-related driver fatigue as well as examine the interaction between the two. In addition, larger and more diverse samples as well as more diverse methodologies will counter the limitations noted in the present study. Further investigation will provide a more comprehensive understanding of work-related driver fatigue that will inform and direct the design of prevention efforts.

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Table 1.

List of scale items used in the study.

Scale and Items	
<i>Job Related Tension Scale</i>	
1.	Feeling that you have too little authority to carry out the responsibilities assigned to you
2.	Being unclear on just what the scope and responsibilities of your job are
3.	Not knowing what opportunities for advancement or promotion exist for you
4.	Feeling that you have too heavy a workload
5.	Thinking that you'll not be able to satisfy the conflicting demands of the various people over you
6.	Feeling that you're not qualified to handle the job
7.	Not knowing what your immediate supervisor thinks of you, how he or she evaluates your performance
8.	The fact that you can't get information needed to carry out your job
9.	Having to decide things that affect the lives of individuals, people that you know
10.	Feeling that you may not be liked and accepted by the people you work with
11.	Feeling unable to influence your immediate supervisor's decisions and actions that affect you
12.	Not knowing just what the people you work with expect of you
13.	Thinking that the amount of work you have to do may interfere with how well it gets done
14.	Feeling that you have to do things on the job that are against your better judgement
15.	Feeling that your job tends to interfere with your family life
<i>Safety Climate Questionnaire</i>	
1.	Safety rules relating to the use of motor vehicles are followed even when the job is rushed
2.	Safety rules relating to the use of motor vehicles can be followed without conflicting with work practices
3.	Safety rules relating to the use of motor vehicles are always practical
4.	Employees can express their views about safety problems
5.	Employees can discuss important safety policy issues
6.	Employees are consulted when changes to driver safety practices are suggested
7.	Safety problems are openly discussed between employees and managers/supervisors
8.	Changes in procedures and their effects on safety are effectively communicated to workers
9.	Employees are told when changes are made to the working environment such as the vehicle, maintenance, or garaging procedures
10.	Employees are encouraged to support and look out for each other
11.	Safety policies relating to the use of motor vehicles are effectively communicated to workers
12.	Driver training is provided on skills specific to the type of vehicle driven for work
13.	Potential risks and consequences are identified in driver training
14.	Motor vehicle training is carried out by people with relevant experience
15.	Employees trust the management in this organisation
16.	Management trust the employees in this organisation
17.	Employees are confident about their future with the organisation
18.	Good working relationships exist in the organisation
19.	Morale is good
20.	When driving employees have enough time to carry out their tasks
21.	There are enough employees/drivers to carry out the required work

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22. There is sufficient 'thinking time' to enable employees to plan and carry out their work to an adequate standard
  23. Problems that arise outside of employees' control can be dealt with in a way that does not affect driver fatigue
  24. Time schedules for completing work projects are realistic
  25. Workload is reasonably balanced
  26. Changes in workload, which have been made at short notice, can be dealt with in a way that does not affect driver safety
  27. Employees are consulted for suggested vehicle/driver safety improvements
  28. Employees can easily identify the relevant procedure for each job
  29. An effective documentation management system ensures the availability of safety procedures relating to the use of motor vehicles
  30. Safety procedures relating to the use of motor vehicles are complete and comprehensive
  31. Safety procedures relating to the use of motor vehicles match the way tasks are done in practice
  32. Management are committed to motor vehicle safety
  33. Driver safety is seen as an important part of fleet management in this organisation
  34. Management are committed to driver safety
  35. Driver safety is central to management's values and philosophies

*Fatigue-Related Behaviour*

1. Drive while fatigued
  2. Drive after having insufficient sleep
  3. Drive after not having much sleep
  4. Drive for longer than 2 hours without a break
  5. Drive after working for extended periods of time
-

Table 2

Means, standard deviations, correlations among study variables and Cronbach's alpha (for scale measures).

Variable	M	SD	Cronbach's alpha	1	2	3	4	5	6	7
1. Age	42.6	10.1		-						
2. Gender	-	-		.18**	-					
3. Driving hours/week	9.79	7.16		-.04	.05	-				
4. Safety climate	4.65	1.08	0.97	-.03	.13	-.04	-			
5. Occupational stress	3.44	.66	0.90	-.14	.02	-.09	.47***	-		
6. Fatigue- related behaviour	3.43	.81	0.82	.07	-.15*	-.27***	.44***	.41***	-	
7. Near misses	-	-	-	-.02	.04	.14*	-.25***	-.23**	-.40***	-

\* $p < .05$ . \*\* $p < .01$ .  $p < .001$ \*\*\*

Table 3.

Summary of hierarchical regression analysis for variables predicting fatigue-related driver behaviour .

Variables	<i>B</i>	<i>SE</i>	$\beta$	<i>sr</i> <sup>2</sup>	<i>R</i> <sup>2</sup>	<i>Adj</i> <i>R</i> <sup>2</sup>	$\Delta R^2$
Step 1 – Control Variables							
Age	-.01*	.01	-.08	.02			
Gender	.24**	.11	.15	.04			
Hours per week driving	-.03**	.01	-.26	.04			
					.10	.08	.10**
Step 2 – Organisational							
Factors							
Occupational stress	.36**	.08	.28	.06			
Safety climate	.26**	.35	.35	.10			
					.39	.37	.29**

\**p* < .05. \*\**p* < .01

Table 4.

Logistic regression analysis for fatigue-related near misses.

Variable	B	Std. error	Wald test	Odds ratio	95.0% C.I. for odds ratio	
					Lower	Upper
Age	-.02	.02	.65	.98	.95	1.02
Gender	-.33	.39	.72	.72	.33	1.55
Hours per Week Driving	.04	.02	2.15	1.04	.98	1.09
Occupational Stress	-.66	.32	4.20*	.52	.28	.97
Safety Climate	-.53	.20	7.22**	.59	.40	.87

\* $p < .05$  \*\* $p < .01$