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Work-related traffic crashes: A record linkage study

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Abstract

Aim: To examine the characteristics of work-related traffic crashes involving drivers in New South Wales (NSW), Australia.
Methods: Probabilistic data record linkage were used to merge police crash records and workers compensation data for the period 1998–2002.
Results: The record linkage identified 13,124 drivers who were injured or died as a result of work-related traffic crash in New South Wales over the 5-year period. Approximately three quarters of driver casualties occurred during commuting (74.8%) with the rest occurring in the course of work. Male drivers made up around three quarters of these crashes and 93% of those that resulted in a fatality. Transport workers were the most frequent victims of work-related crashes while on duty (20.8%), with drivers of heavy trucks representing about half (48%) of all fatalities resulting from on duty work-related crashes. Nearly 1 in 6 male drivers were speeding at the time of the crash (15%, 95% CI 14.2–15.7) compared to less than 1 in 10 female drivers (9%, 95% CI 8.3–9.8) of female drivers. Male drivers were also significantly more likely to be fatigued at the time of the crash 7.6% (95% CI 7.0–8.2) compared to females 4.2% (95% CI 3.7–4.8). No significant difference was observed in the proportion of crashes involving fatigue between on duty and commuting traffic crashes.
Conclusions: The study demonstrates the value of record linkage techniques in addressing some of the limitations of work-related data systems and in providing a more complete picture of the circumstances of occupational road crashes.

Keywords: Crashes; Occupational; Traffic; Record linkage

1. Introduction

Traffic crashes are one of the leading causes of occupational fatalities in various parts of the industrialised world. Road traffic crashes during the course of work or while commuting between home and work account for around 25% of work-related deaths in the USA (Toscano and Windau, 1994), 30% in Canada (Rossignol and Pineault, 1988), 49% in Australia (Driscoll et al., 2001) and 60% in France (Charbotel et al., 2001). Despite their significant burden, relatively few studies have investigated the characteristics and circumstances leading to occupational traffic crashes, particularly in terms of the impact of fatigue, speed and alcohol use. This is mainly due to the limitations of the most widely used data sources, namely insurance/workers compensations data and police crash records, in depicting work-related traffic crashes leading to deaths as well as injury. Insurance/workers compensation datasets capture most serious cases, which result in lost work time, but lack valuable information on the circumstances and risk factors contributing to work-related crashes. On the other hand, systems designed to collect information about all traffic crashes contain more relevant data, in terms of the circumstances of crash, but often fail to determine the work status of those involved in the crash.

Data record linkage is one method which has the potential to overcome these limitations and to maximise the strengths of each type of data system—work-related and crash-related; and to provide a more comprehensive and detailed picture of the circumstances of work-related traffic crashes. Record linkage is the joining of information from two or more records that are considered to relate to a common entity whether that entity is an individual, family, event, business, or address (Newcombe, 1998). Probabilistic record linkage links records between datasets through the calculation of linkage likelihood and adjusting for missing information and data errors.

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The current study used record probabilistic record linkage to merge police crash data and workers compensation datasets in order to examine in some depth the circumstances of work-related crashes involving drivers in New South Wales (NSW), Australia.

2. Methods

2.1. Data sources

The traffic accident database system (TADS) contains information on all crashes occurring on NSW roads that are reported to the police (Road and Traffic Authority, 2003). For the purpose of this study, we obtained 83,974 TADS records of controllers (drivers or riders) who had been injured or died in traffic crashes between 1 January 1998 and 31 December 2002. The dataset contains considerable information regarding the circumstances of traffic crashes including date, time and location of the crash as well as characteristics of persons involved such as age, sex and behavioural factors at the time of the crash (e.g. illegal alcohol levels).

Workers' compensation scheme statistics (WCSS) include all new accepted workers' claims in NSW for injury or disease which resulted in either death, permanent incapacity or a temporary incapacity for which payments were made (National Occupational Health and Safety Commission, 1999). Cases selected for the purpose of the study included 61,328 records of compensation claimants injured as a result a transport crash between 1 January 1998 and before 31 December 2002. This selection criterion was broader than that used to select TADS cases (i.e. controller involved in traffic crashes) because it was difficult to determine the nature of transport crashes (traffic versus non-traffic) and whether the victim was a driver, passenger or pedestrian. This made it practically impossible to determine the percentage of the "expected" matches that actually linked after completion of the record linkage process. The WCSS contains various data items including industry and occupation, personal characteristics of the employee (age and sex), as well as information on the injury such as the date of occurrence, the nature and the outcomes of the injury in terms of disability levels and death.

2.2. Data linkage process

Probabilistic record linkage techniques were used to link the two datasets using LinkageWiz record linkage software (LinkageWiz, 2002). Probabilistic record linkage attempts to mimic the steps a human would go through mentally when deciding whether two records from two separate datasets belong to the same person. Steps such as allowing for incomplete and/or error data; evaluating how common a particular name is in the sets of data being compared; how likely it is that a particular pair would match at random; and how likely it is that full or partial agreement on values in that field is indicative of agreement on the whole record (Clark, 2004).

Prior to linking the datasets, missing data and duplicate records were identified and standard formats were applied particularly to variables common to both datasets and which were used in the matching. Matching variables included surname, initials, date of birth, gender, postcode of residence, crash day month and year (TADS), and injury day, month and year (WCSS). Some of the cleaning tasks were carried out automatically by the LinkageWiz software. Examples include removing non-alphanumeric characters from fields and removing hyphens from family names. Phonetic encoding of family names was also carried out for both datasets using the linkage software. Phonetic coding used by LinkageWiz, also referred to as NYSIIS, is a sophisticated phonetic algorithm, developed by the New York State Identification and Intelligence System, that builds a phonetic code of up to six letters for each name (LinkageWiz, 2002). The main benefit of using phonetic coding is to take into account spelling errors when linking records.

Variables used to link datasets (matching variables) were then assigned a linkage weight according to their "reliability" and "discriminative power" (Clark, 2004). For example, agreement on date of birth is more suggestive of a match than is agreement on sex. Therefore, matches on date of birth are given a greater weight than sex.

Overall, this is the same process that would be used by an individual manually linking records from two data sets. Discriminatory power (u probabilities) refers to the probability of a given matching variable agreeing purely by chance for a comparison pair of two records not belonging to the same individual (i.e. a non-match). Reliability (m probabilities), on the other hand, refers to the probability of a given matching variable agreeing among records accepted as links. The m probability was estimated during the specification of the record linkage strategy based upon prior information, by initial manual review of data and at a later stage on the proportion of agreements among the comparison pairs accepted as links.

The formula used to calculate the weight for a given variable, according to Newcombe (1998) is as follows:

$$\text{global frequency ratio (GFR)} = \frac{\text{frequency of agreement in linked pairs } (m)}{\text{frequency of agreement in unlinked pairs } (u)},$$

$$\text{weight} = \log 2(\text{GFR})$$

The estimation of u and m probabilities and the corresponding weights was repeated for all matching variables. The likelihood or probability weights were estimated given all observed agreements and disagreements on all data variables used for linking records together. The total weight for each comparison pair is the sum of the agreement/disagreement weights for each matching variable used in the linkage. The probabilistic linkage software initially assigns default agreement and disagreement weights for each variable based

on the formulae/rules described above, but also allows the operator to modify the weights in later stages of the linkage.

Records in each data source were divided into groups (blocks) of records based on surname, date of birth and date of crash/injury to minimise the number of comparisons that must be undertaken. The probabilistic linkage process involved three linkage passes based on each blocking variable. That is, we compared records for those with similar phonetic names, then those who had similar date of birth and finally those with similar date of crash/injury according to a set of matching variables. Multiple passes were used to ensure that any linkages missed by one pass would be picked up by another.

The sum of comparison weights for each record pair was then calculated and if this value was below a defined 'cut-off' value, the record pair was rejected. If a total weight was above a much higher 'threshold', the record pair was defined as a 'definite' link. That is record pairs with a high probability of referring to the same individual. Records with values between the 'cut-off' and the 'threshold' were said to be 'possible' links. These 'possible' links were entered into the next pass and the process repeated, until the final remaining pool of 'possibles' linkages is checked manually and obvious mismatches discarded. Refinements of weights and thresholds were made at the end of each phase/pass in order to achieve a fine-tuned and data-sensitive record linkage.

After the three passes, 12,674 RTA records were categorised as definitely linked to WorkCover records and 1565 were classified as possible links and were checked manually. These records were reviewed independently by two researchers. The outcomes of this process were compared and a consensus was reached based on a set of predetermined criteria. As a result of the manual checking, a further 450 were added to the pool of definite links, raising their final number to 13,124. The resulting "definite" links were assembled into groups of linked records to form a one-to-one linkage result. Following linkage, personal identifying items were removed and replaced with unique numerical identifiers. Ethical approval for the conduction of the data linkage was obtained from the University of New South Wales Human Research Ethics Committee.

2.3. Analysis

The linked data was analysed according to the duty status at the time of the crash (on duty: in the course of work; or during commuting: the journey to or from work), characteristics of the driver involved in the crash (age, gender, occupation), the type of vehicle involved, time and place of the crash, behavioural factors contributing to the crash (speeding, alcohol and fatigue levels) as well as the severity of the crashes (temporary disability, permanent disability or death). When appropriate, 95% confidence intervals were computed when comparing various proportions. All analyses were carried out using SAS, version 8.1 (SAS, 2000).

3. Results

Data record linkage of police crashes and workers compensation datasets identified 13,124 drivers who were injured or died as a result of a work-related traffic crash in New South Wales over the 5-period 1998–2002. Approximately three quarters of driver casualties as a result of work-related traffic crashes occurred during commuting (74.8%) with the rest occurring in the course of work. The highest number of driver casualties was among those aged 25–35 years for both males and females. The proportions in each age group were similar for commuting and on duty crashes except for males aged 15–24 years where crashes resulting in injury or death were more likely to occur during commuting (24.8%, 95% CI 23.7–26.0) than in the course of work (18.4%, 95% CI 16.8–20.0) (Table 1).

More male drivers were injured or died as a result of a work-related crash than females particularly for crashes occurring while on duty where males make up around three quarters of cases. Males accounted for 93% of on duty traffic crashes. Overall, no significant difference was observed in fatality rates between on duty and commuting traffic crashes for males and females (Table 2).

Transport workers were clearly the most frequent victims of work-related crashes while on duty (20.8%) followed by manufacturing workers (10.2%) and retail workers (9.8%) (Fig. 1). The picture was different for crashes occurring during commuting where 16.9% of casualties were involved in manufacturing, 13.2% in health and community services and 11.3% in retail. For most industry sectors commuting crashes accounted for a higher proportion of crashes than on duty crashes. Transport workers were a major exception with the greater majority of crashes occurring while on duty.

While car drivers represented the majority (63%) of all work-related casualties followed by light trucks (13%), the distribution of vehicle type varied depending on the duty sta-

Table 1
Work-related traffic crashes by gender, age and duty status

	On duty		Commuting		All crashes	
Male						
15–24	440	18.4%	1360	24.8%	1800	22.9%
25–34	742	31.0%	1683	30.7%	2425	30.8%
35–44	590	24.7%	1272	23.2%	1862	23.7%
45–54	413	17.3%	815	14.9%	1228	15.6%
55–64	171	7.2%	313	5.7%	484	6.1%
65+	35	1.5%	37	0.7%	72	0.9%
Total	2391	100.0%	5480	100.0%	7871	100.0%
Female						
15–24	204	22.3%	1017	23.4%	1221	23.2%
25–34	291	31.8%	1203	27.7%	1494	28.4%
35–44	196	21.4%	1040	24.0%	1236	23.5%
45–54	173	18.9%	820	18.9%	993	18.9%
55–64	49	5.4%	251	5.8%	300	5.7%
65+	1	0.1%	8	0.2%	9	0.2%
Total	914	100.0%	4339	100.0%	5253	100.0%

Table 2
Outcomes of work-related outcome by gender and duty status

	On duty		Commuting	
	Number	Percentage (95% CI)	Number	Percentage (95% CI)
Male				
Temporary disability	1787	74.7 (73.0–76.5)	4067	74.2 (73.1–75.4)
Permanent disability	536	22.4 (20.7–24.1)	1291	23.6 (22.4–24.7)
Death	68	2.8 (2.2–3.5)	122	2.2 (1.8–2.6)
Total	2391	100.0	5480	100.0
Female				
Temporary disability	789	86.3 (84.1–88.6)	3510	80.9 (79.7–82.1)
Permanent disability	120	13.1 (10.9–15.3)	788	18.2 (17.0–19.3)
Death	5	0.5 (0.1–1.0)	41	0.9 (0.7–1.2)
Total	914	100.0	4339	100.0

tus (commuting or on duty) and on the outcome of the crash (Fig. 2). Drivers of heavy trucks represented about half (48%) of fatalities resulting from on duty work-related crashes followed by light trucks (20%) and car drivers (16.4%).

Nearly 1 in 6 male drivers involved in work-related crashes were speeding at the time of the crash (15%, 95% CI 14.2–15.7) compared to less than 1 in 10 female drivers (9%, 95% CI 8.3–9.8) of female drivers. Similarly male drivers were more likely to have been driving with illegal levels of alcohol and to be fatigued at the time of work-related crashes than their female counterparts (Table 3). In females, no significant difference was found in terms of alcohol, speeding and fatigue levels between crashes occurring during commuting and those in the course of work. In males, on the other hand, drivers were more likely to speed and less likely to drive under the influence of alcohol while on duty compared to during commuting.

One in five work-related traffic crashes resulting in driver casualty occurred on state highways this varied slightly between on duty crashes (22.7%, 95% CI 21.2–24.1) and during commuting (19.4%, 95% CI 18.6–20.2). This proportion also varied according to the type of vehicle with 45% of

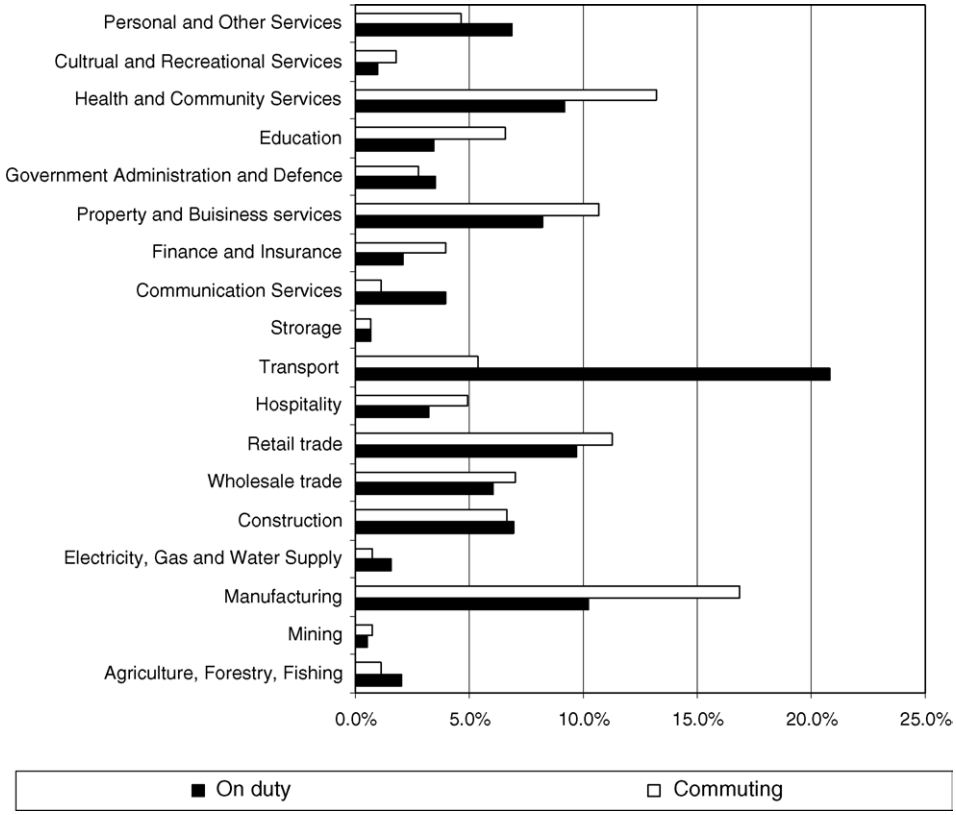

Fig. 1. Distribution of industry sectors of drivers involved in work-related traffic crashes by duty status.

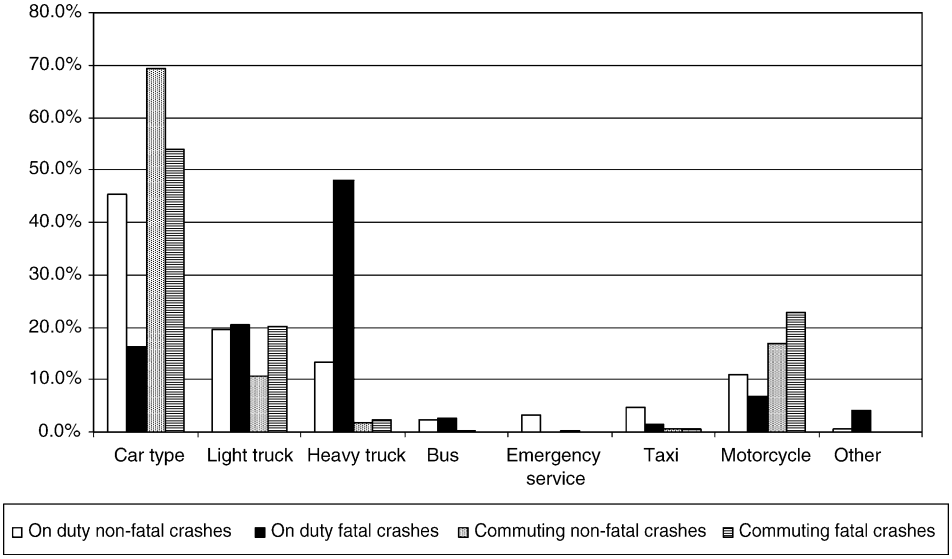

Fig. 2. Distribution of vehicle types of drivers involved in work-related traffic crashes by crash outcome and duty status.

Table 3
Drivers behavioural factors by duty status and gender

	On duty		Commuting		All crashes	
	Number	Proportion (95% CI)	Number	Proportion (95% CI)	Number	Proportion (95% CI)
Male						
Illegal alcohol	27	1.1 (0.7–1.6)	126	2.3 (1.9–2.7)	153	1.9 (1.6–2.2)
Speed over posted limit	439	18.4 (16.8–19.9)	738	13.5 (12.6–14.4)	1177	15.0 (14.2–15.7)
Fatigue	212	8.9 (7.7–10.0)	389	7.1 (6.4–7.8)	601	7.6 (7.0–8.2)
Female						
Illegal alcohol	3	0.3 (0.0–0.7)	23	0.5 (0.3–0.7)	26	0.5 (0.3–0.7)
Speed over posted limit	94	10.3 (8.3–12.3)	381	8.8 (7.9–9.6)	475	9.0 (8.3–9.8)
Fatigue	44	4.8 (3.4–6.2)	179	4.1 (3.5–4.7)	223	4.2 (3.7–4.8)

crashes involving heavy trucks occurring on state highways. While on duty traffic crashes resulting in driver casualties occurred all throughout the day, particularly between 0700 and 1900 h, the vast majority of commuting crashes occurred during peak hours 0700–0900 and 1500–1900 h (Fig. 3).

4. Discussion

This is the first study to link compensation and crash records in order to examine the nature and circumstances of work-related traffic accidents. The findings showed that drivers aged between 25 and 34 years have the highest number of commuting and on duty traffic crashes. Similar results have been found elsewhere (Charbotel et al., 2001). The proportions of traffic crashes in each age group were similar for commuting and on duty crashes except for the 15–24 years age group where it seems that traffic crashes were more likely to occur during commuting (24%) than in the course of work duty (18%). The relatively high proportions of those aged 15–24 years, particularly with respect to commuting crashes is worth noting, particularly when considering that younger workers are less likely to be involved in full-time work, and may be less likely to have a job where they drive and consequently have considerably less exposure time as result compared to older workers (Australian Bureau of Statistics, 1999). As with previous research (Charbotel et al., 2001; Salminen, 2003), this study also shows that male drivers were more likely to be involved in a work-related traffic crash than their female counterpart particularly while in the course of work.

Males were not only more numerous among crash victims but also more seriously injured with 93% of fatal on duty work traffic crashes leading involving males. This coincides with the findings of a previous Australian study of coroners death files which found that 95% of those killed in work-related road crashes were males (Harrison et al., 1993), and those of a study carried out in North Carolina where males made up 96% of work-related road fatalities (Loomis et al., 1997). This reflects the high concentration of males in transport related occupations particularly truck driving. The similarities between our results and those of the others studies, using different methodology, are also indicative of the accuracy of the data linkage approach used in this study.

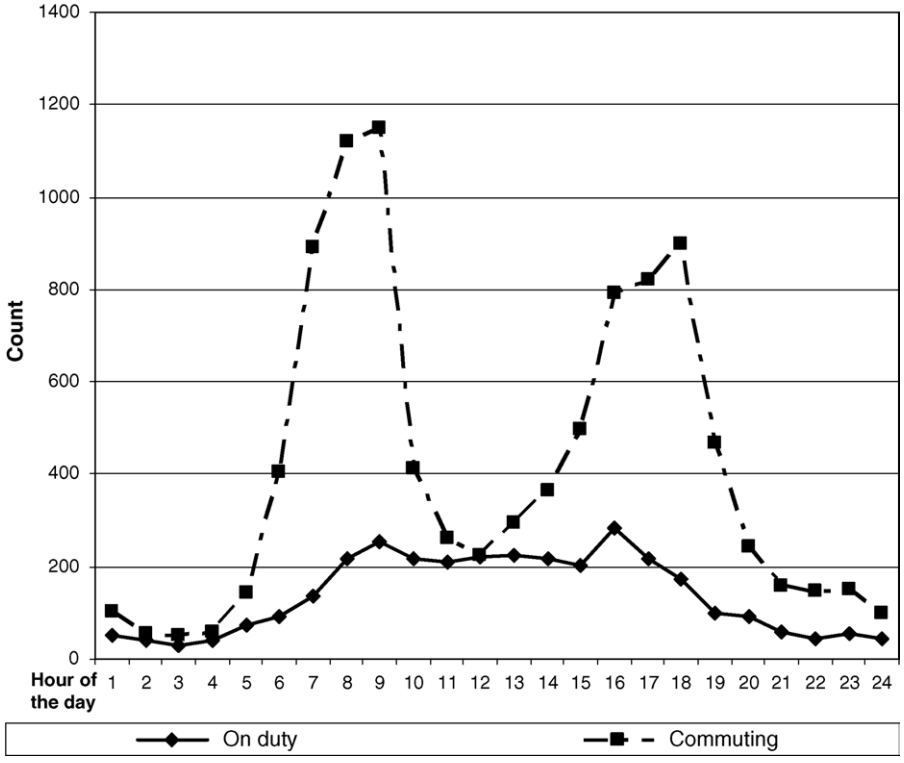

Fig. 3. Work-related traffic crashes by time of day and duty status.

This study indicated that transport workers made up 20% of drivers involved in work-related crashes occurring while on duty and that more than half of the fatalities resulting from on duty crashes were among heavy truck drivers. These findings are consistent with those of an American study which has also indicated that 50% of victims killed during the course of work were heavy truck drivers (Toscano and Windau, 1994). Other studies from different parts of the world have also found that truck drivers are more likely to be seriously injured and have higher mortality, as a result of work-related traffic crashes, than any other vehicle driver (Charbotel et al., 2001, 2003; Harrison et al., 1993; Pratt, 2003). It has been suggested that there is a proportional relationship between the size of the vehicle and the severity of injury, and that the high fatality among truck drivers might be due, at least partly, to less frequent use of seat belts by heavy truck drivers (Bylund et al., 1997).

While compliance with seat belt wearing was not assessed in this study we have examined the role of other behavioural factors such speeding, alcohol, and fatigue levels. Fatigue, in particular, was reported in 20% of work-related traffic crashes resulting in injury and 28% of fatalities involving heavy truck drivers compared to 6% and 17%, respectively, for all work-related crashes. Previous research has also identified fatigue as a major contributor to traffic crashes in this group of drivers (Hakkanen and Summala, 2000; Adams-Guppy, 2003).

Fatigue affects driving performance by impairing information processing, attention, and reaction times; and can also lead to a driver falling asleep. Time of day, duration of wakefulness, inadequate sleep, sleep disorders, road environment as well as prolonged working hours have all been identified as major causes of fatigue (Akerstedt, 2000; Thiffault and Bergeron, 2003; Stutts et al., 2003; Williamson et al., 1996). Our findings showed no significant difference in the proportion of fatigue related cases between on duty and commuting crashes. While most of the published research into the role of fatigue in traffic crashes has focused on professional driving, there is limited information on the impact of fatigue during commuting. Some of the available evidence suggests that working hours play an important role in drivers fatigue with shiftworkers more likely to be tired and to fall as asleep behind the wheel on the drive between their workplace and home than non-shiftworkers (Rogers et al., 2001). It is possible that the underlying factors contributing to fatigue may differ between on duty and commuting crashes. The issue needs to be investigated further.

While illegal alcohol levels did not play a major role in work-related crashes, males were more likely to have illegal alcohol readings than females particularly during commuting. Unsafe speed was also more prevalent in men, particularly for traffic crashes occurring while on duty. The overall pattern of major impact of fatigue and relatively low alcohol levels in occupational compared to non-occupational motor vehicle crashes was also found in an American study of fatal traffic crashes (Bunn and Struttmann, 2003).

As expected commuting crashes occurred more often during peak hours which coincide in Australia with between

0700–0900 and 1500–1900 h. Similar results were found elsewhere (Harrison et al., 1993; Salminen, 2003).

It is important to note that cases identified by data record linkage in this study might underestimate the number of work traffic crashes as the NSW Workers Compensation Database does not cover all work-related injuries, particularly the self-employed workers who comprise 15–20% of the workforce (Macaskall and Driscoll, 1998), and because not all eligible workers make workers compensation claims. Previous research indicated that some groups in particular, such as young workers, are less likely to make claims (Boufous and Williamson, 2003). An Australian study which compared coroners' death files to compensation data systems found that the latter covers 65% of on duty traffic crashes and 53% of those occurring during commuting (Driscoll et al., 2003). Similarly, police crash data does not include all traffic crashes as not all are reported to the police. In addition, during the probabilistic record linkage process, we adopted a relatively conservative approach when deciding on which record pairs were true matches, particularly for paired records identified as possible links. When trade-offs were required between the number of false positives and false negatives, as is always the case in probabilistic record linkage projects, our strategy was to sacrifice the sensitivity (and incur more possible false negatives or missed matches) but maintain a high specificity (and incur few false positives or incorrect links).

Despite these limitations, the similarities between our findings, particularly in terms of fatalities and the involvement of heavy truck drivers, and those of other studies using different methodology point to the soundness of the data linkage process used in this study. The data linkage approach provided an opportunity to investigate the characteristics and circumstances of work-related crashes involving vehicle controllers by making use of information contained in the two most widely used datasets to examine the issue of work-related crashes. To maximise the benefits of such an approach in the future, it will be useful to link datasets examined in this study, using similar techniques, to other injury outcomes data such as emergency and hospitalisation collections in order to provide a more complete picture of the nature, circumstances and the burden of work-related traffic injury.

5. Conclusions

Developing prevention strategies aimed at reducing the burden of work-related traffic crashes requires sound knowledge of areas related to environmental, behavioural and organisational factors that contribute this type of injury. However, current knowledge of these issues is fragmented mainly due the nature and limitations of the various administrative databases which contain information on occupational traffic crashes. The current study demonstrated that it is possible to address this problem by merging data, using record linkage techniques, from workers compensation and police road crashes datasets in order to provide a more complete picture of the circumstances of occupational road traffic crashes. The findings highlighted the vulnerability of males, transport workers and particularly heavy vehicle drivers to work-related traffic crashes. The results also pointed to the role played by fatigue and speeding in this type of occupational crashes. The study also saw the collaboration of both road safety and occupation safety professionals which is vital to improving the effectiveness of measures aimed at preventing work-related traffic crashes.

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References

Adams-Guppy, J., 2003. Truck driver fatigue risk assessment and management: a multinational survey. Ergonomics 46 (8), 763–779.

Akerstedt, T., 2000. Consensus statement: fatigue and crashes in transport operations. J. Sleep Res. 9, 395.

Australian Bureau of Statistics, November 1999. Labour Force NSW and ACT. ABS, Canberra.

Boufous, S., Williamson, A., 2003. Work-related injury in New South Wales Hospitalisation and Worker's Compensation datasets: a comparative analysis. Aust. NZ J. Public Health 27 (3), 352–357.

Bunn, T.L., Struttmann, T.W., 2003. Characterization of fatal occupational versus non-occupational motor vehicle collisions in Kentucky (1998–2000). Traffic Injury Prev. 4 (3), 270–275.

Bylund, P.O., Bjornstig, U., Larsson, T.J., 1997. Occupational road trauma and permanent medical impairment. Safety Sci. 26 (3), 187–200.

Charbotel, B., Chiron, M., Martin, J.L., Bergeret, A., 2001. Work-related road crashes in France. Eur. J. Epidemiol. 17 (8), 773–778.

Charbotel, B., Martin, J.L., Gadegbeku, B., Chiron, M., 2003. Severity factors for truck drivers' injuries. Am. J. Epidemiol. 158 (8), 753–759.

Clark, D.E., 2004. Practical introduction to record linkage for injury research. Injury Prev. 10, 186–191.

Driscoll, T., Mitchell, R., Mandryk, J., Healey, S., Hendrie, L., Hull, B., 1989. Work-related fatalities in Australia 1989 to 1992: an overview. J. Occup. Health Safety: Aust. NZ 17 (1), 45–66.

Driscoll, T., Mitchell, R., Mandryk, J., Healey, S., Hendrie, L., Hull, B., 2003. Coverage of work related fatalities in Australia by compensation and occupational health and safety agencies. Occup. Environ. Med. 60 (3), 195–200.

Hakkanen, H., Summala, H., 2000. Sleepiness at work among commercial truck drivers. Sleep 23 (1), 49–57.

Harrison, J.E., Mandryk, J.A., Frommer, M.S., 1993. Work-related road fatalities in Australia, 1982–1984. Accid. Anal. Prev. 25 (4), 443–451.

LinkageWiz, 2002. Record Linkage Software, Version 3.04. LinkageWiz Inc., Adelaide.

Loomis, D.P., Richardson, D.B., Wolf, S.H., Runyan, C.W., Butts, J.D., 1997. Fatal occupational injuries in a Southern state. Am. J. Epidemiol. 145 (12), 1089–1099.

Macaskall, P., Driscoll, T., 1998. National occupational injury statistics: what can the data tell us? In: Feyer, A.-M., Williamson, A. (Eds.), Occupational Injury: Risk, Prevention, Intervention. Taylor & Francis, London.

National Occupational Health and Safety Commission, 1999. National Data Set for Compensation-based Statistics, 2nd ed. National occupational health and Safety Commission, Canberra.

Newcombe, H.B., 1998. Handbook of Record Linkage: Methods for Health and Statistical Studies, Administration, and Business. Oxford University Press, London.

Pratt, S.G., 2003. Work-Related Roadway Crashes. Challenges and Opportunities for Prevention. The National Institute for Occupational Safety and Health, Cincinnati.

Road and Traffic Authority, 2003. Traffic Accident Database System Data Manual. RTA, Sydney.

Rogers, A., Holmes, S., Spencer, M., 2001. The effect of shiftwork on driving to and from work. J. Human Ergol. 30 (1/2), 131–136.

Rossignol, M., Pineault, M., 1988. Fatal occupational injury rates: Quebec 1981 through 1988. Am. J. Public Health 83 (11), 1563–1566.

Salminen, S., 2003. Seriousness of traffic crashes during work and commuting. Percept. Motor Skills 97 (1), 147–150.

SAS, 2000. SAS: Statistical Software, Version 8.02. SAS Institute Inc., Cary, NC.

Stutts, J.C., Wilkins, J.W., Osberg, J., Vaughn, B.V., 2003. Driver risk factors for sleep-related crashes. Accid. Anal. Prev. 35 (3), 321–331.

Thiffault, P., Bergeron, J., 2003. Monotony of road environment and driver fatigue: a simulator study. Accid. Anal. Prev. 35 (3), 381–391.

Toscano, G., Windau, J., 1994. The changing character of fatal work injuries. Monthly Labour Rev., 17–28.

Williamson, A.M., Feyer, A.M., Friswell, R., 1996. The impact of work practices on fatigue in long distance truck drivers. Accid. Anal. Prev. 28 (6), 709–719.