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Nighttime seatbelt non-use in serious crashes: A comparison of contributing factors in rural and urban areas of the United States and Queensland

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Abstract. The level of restraint wearing among the Australian driving population as a whole is consistently noted as being very high in relation to comparable nations such as the United States which do not uniformly have primary enforcable seatbelt legislation. Recent research from the U.S. has however noted differential restraint wearing rates on the basis of time of day and rurality, which are reflected strongly in increased representation in fatal road crashes. The current paper presents evidence from police-reported crashes in the U.S. and Queensland as well as data collected as part of the CARRS-Q Rural and Remote Road Safety Study that suggests a strong link between nighttime driving, rural location, and the involvement of drivers not using restraints in crashes. Narrative crash details collected as part of study participant interviews are used to provide additional information as to why injured persons chose not to use a restraint. Particular attention is given to those crashes in which it is known that occupants did not to wear a restraint while driving a short distance. The results are discussed in terms of suggested interventions to target increased seatbelt usage and to maximise the effect of limited available enforcement in rural areas.

Introduction

Seatbelts were introduced in Australia in 1970, prior to any state of the United States or European nation (Rivara, Thompson, & Cummings, 1999). The levels of seatbelt usage in Australia among the general public are noted as approaching 100% (Royal Automobile Club of Western Australia, 2007), with the benefits of high use regularly reiterated in research findings since their introduction (see Milne, 1985, for a review of early findings in Australia; Cummings, Wells, & Rivara, 2003; Evans, 1986; States et al., 1990). High levels of restraint use may however be offset by the 'selective recruitment hypothesis' which suggests that those who are most likely to be a belt user are also those who have the least likelihood of taking part in risky behaviours and crashing. Thus, the rate of uptake of seatbelt wearing is not necessarily equivalent to the crash rates where someone is unbuckled (Graham, 1993).

In an investigation of international changes in seatbelt laws including findings sourced from Queensland, New South Wales and South Australia, the introduction of primary seatbelt laws (those where someone can be issued a citation for not wearing a belt, without the presence of another offence) were found to be associated with a reduced relative risk of fatality between 0.54 and 0.97 (Rivara et al., 1999). Cummings et al (2003) undertook a

matched-pairs study using data from the U.S. FARS database, which compared the risks of death for adult, front seat passengers in crashes in which either one of the driver or right-side passenger was killed. They estimated the relative risk of death of belted to unbelted occupants at 0.39, that is the risk of death unbelted to belted is 2.56 times (Cummings et al., 2003).

Nighttime Wearing of Restraints

Recent research from the United States has noted differential rates of restraint wearing on the basis of time of day which are reflected in increased representation of nighttime non-wearers in fatal road crashes. Chaudhary and Preusser (2006) showed that the main effect of time of day was significant, with nighttime belt use being substantially lower than daytime use. Also, it was found that there was an interaction between location and time of day, with the proportional drop in wearing rates in nighttime crashes being larger in urban as opposed to rural areas. McCartt and Northrup (2004) likewise noted that non-use of restraints was associated with late night crashes; single vehicle crashes and those crashes occurring on rural roadways.

Other Factors Associated with Seatbelt Non-Use

A number of other psychological and social factors have also been linked with seatbelt use. The results of a campaign on seatbelt wearing in New York showed that those who had not heeded the advice and continued to not wear a restraint were more likely to be male, to have a greater history of involvement in injury crashes and of traffic violations, and to report a greater propensity towards risk taking (Preusser, Williams, & Lund, 1991). Likewise, an analysis of serious injury crash cases in Hawaii for the years 1986 to 1995 demonstrated that those that were unbelted were also more likely to be male, young, driving while alcohol impaired and to be using heavier vehicles such as pickups and trucks as compared to passenger vehicles or vans (Kim & Kim, 2003).

Nighttime driving and the presence of alcohol are factors which have been shown to be related to decreased seatbelt use regardless of age (Williams & Shabanova, 2002). However, the addition of passengers to a vehicle has been shown to have a differential effect on seatbelt use depending on the age of the driver. The addition of young passengers to a vehicle controlled by a young driver has been found to be associated with decreased seatbelt use. However, seatbelt use did not decrease if the young driver's passengers were over 30 years of age. Likewise, seatbelt use does not decrease in a vehicle controlled by an older adult driver with the addition of passengers (Williams & Shabanova, 2002). Thus, the social influence of peers on young driver and passenger wearing rates along with youth related factors such as impulsiveness should be considered.

Across a wide sample of European countries (Belgium, England, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, the Netherlands, Poland, Portugal, and Spain), seatbelt wearing was found to increase with the introduction of laws (Steptoe et al., 2002). Other research has found that perceived risk of being ticketed was a significant predictor of whether someone always wore their belt or not, an effect that persisted even after taking into account other significant predictors of belt use such as income, age and gender (Chaudhary, Solomon, & Cosgrove, 2004).

Non-use of seatbelts was also positively associated with alcohol-impaired driving in the previous 12 months and not driving regularly within the speed limit (Steptoe et al., 2002). “Another item noted is that 27.9% of drivers who had consumed drugs alone, 37.6% who had consumed alcohol and 48% who had consumed a combination of alcohol and drugs were not wearing their seatbelt at the time of the accident, compared to 15.9% of test-negative drivers. The rate of failure to wear a seatbelt is less than 10% in Quebec among the general driving population” (Bouchard & Brault, 2004, p3).

Aims

The current study aimed to investigate seatbelt use in crash data sourced from both the United States and Queensland with a focus on its relationship with the time of day of the crash and other crash circumstance factors. The results of this investigation will provide a means to identify at risk driver types and situations which can in turn be used to guide targeted programs of enforcement or intervention.

Method

A number of datasets with differing inclusion criteria were analysed in the current paper, sourced from Queensland and United States road crash databases.

Scope

Crashes investigated in the current study are those which occurred on public roads. That is, this analysis considers only police-reported crashes which occurred on state and local authority controlled roads. Analysis for both datasets was completed at the level of casualty data. That is, looking at the characteristics of each vehicle occupant that was either killed or injured in one of the involved vehicles. A number of data fields are common to both sources of data, such as crash time and the age and gender of casualties.

Queensland

Crash data sourced from Queensland Transport's WebCrash2 online database provides details from police-reported crashes occurring on public roads where either a person was killed or injured, $2500 of damage occurred to property other than vehicles, or where a vehicle was towed. Only casualties from 'serious crashes' are used in the current analyses, referring to a crash where a fatality or a hospitalisation was recorded as the most serious injury by any involved occupant or road user.

Queensland crash reports for seatbelt use have five possibilities, fitted – worn, fitted – not worn, fitted – unknown if worn, unknown and not applicable. For the purposes of the current study, unknown and not applicable have been excluded from the analysis so that only those cases where a clear decision could be made are presented.

United States

The U.S. FARS database contains data on fatal traffic crashes occurring in all 50 states as well as Puerto Rico. As in Australia, a fatality for purposes of inclusion in this database refers to an occupant or other road user dying within 30 days of the crash. The U.S. database provides an indication of both the type of belt and its use. The categories are: seatbelt worn (shoulder, lap, lap + shoulder, child safety seat, restraint used - type unknown), used improperly (safety belt, child safety seat), not worn, unknown and missing. A summary of the variables used for selection of data for the current study are presented below in Table 1.

Table 1. *Summary of data criteria for use in current analyses*

Variable	Queensland	United States
Time	2001-2005	2005
Road user types	Driver/Passenger	Driver/Passenger
Vehicle types	Car/Truck & Derivatives	Car/Truck & Derivatives
Crash severity	Fatal Hospitalisation	Fatal
Casualty severity	Minor Injury Medical Treatment Hospitalised Fatal	Possible Injury Non-incapacitating Evident Injury Incapacitating Injury Fatal Injury
Rural Indicator	Geographical classification of SLA by RRAMA Code[1] of 3-7 for "Rural" and 1-2 for "Urban"	Classification by "roadway function type" comparing "Rural" and "Urban" groups
Level of analysis	Casualty	Casualty

[1] - SLA = Statistical Local Area, RRAMA = Rural, Remote and Metropolitan Areas Classification

Thus, there are some notable differences between the U.S. and Queensland data. While only one year of U.S. data was used, 5 years of Queensland data were used to ensure sufficient sample size to detect trends. For the same reason, crashes where the most seriously injured person was either hospitalised or fatally injured were selected for the Queensland data, compared to only crashes resulting in a fatality for U.S. data. All injured casualties involved in these crashes, regardless of their own severity, were included in the analyses. As no information is available in the Queensland database regarding the characteristics of those occupants not injured in the vehicle, the "no injury" occupants were excluded from the U.S. FARS data.

Results

To provide a general overview of seatbelt wearing rates in crashes, Table 2 presents the proportion of Queensland and U.S. crashes according to restraint use.

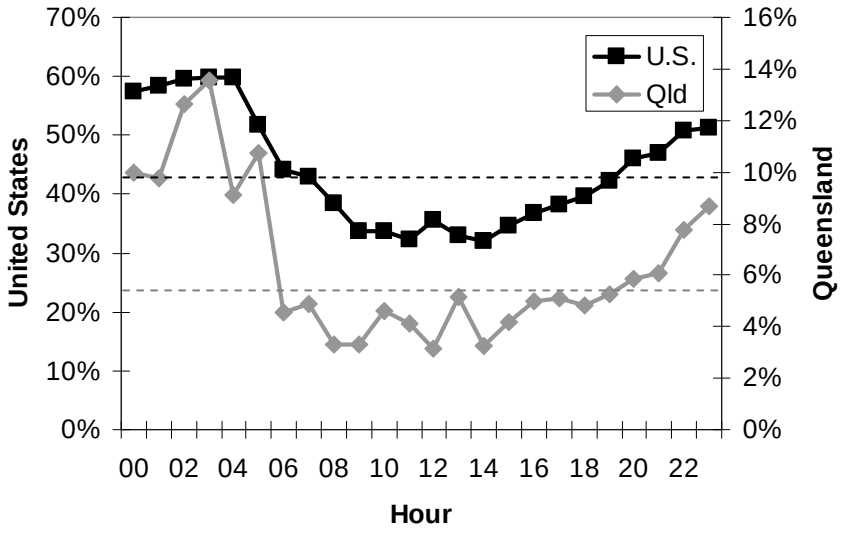
Table 2. *Restraint Use for Queensland and United States Casualty Data*

Restraint Use	No.	%
Queensland (2001 - 2005)		
Fitted - Worn	21245	75.9
Fitted - Not worn	1511	5.4
Not fitted	514	1.8
Unknown	2331	8.3
Fitted - Unknown if worn	2250	8.0
Not applicable[1]	143	0.5
Total	**27994**	**100.0**
United States (2005)		
Worn	34881	56.8
None used/not applicable[1]	26364	42.9
Improperly Used	204	0.3
Total	**61449**	**100.0**

[1] - Motorcycles and other vehicles which would not normally have seatbelt's fitted are not included in these 'Not applicable' totals

Source: FARS Database (National Highway Traffic Safety Administration, 2006); WebCrash2 (Queensland Transport, 2007)

When the rates of non-wearing (ie - number not wearing / total number of casualties excluding unknown and not applicable) are plotted against hour of day, definite trends emerge. Figure 1 below presents this information graphically.



Source: FARS Database (National Highway Traffic Safety Administration, 2006); WebCrash2 (Queensland Transport, 2007)

Figure 1. Proportion of driver and passenger casualties known to not be wearing a seatbelt by hour of day, Queensland and United States.

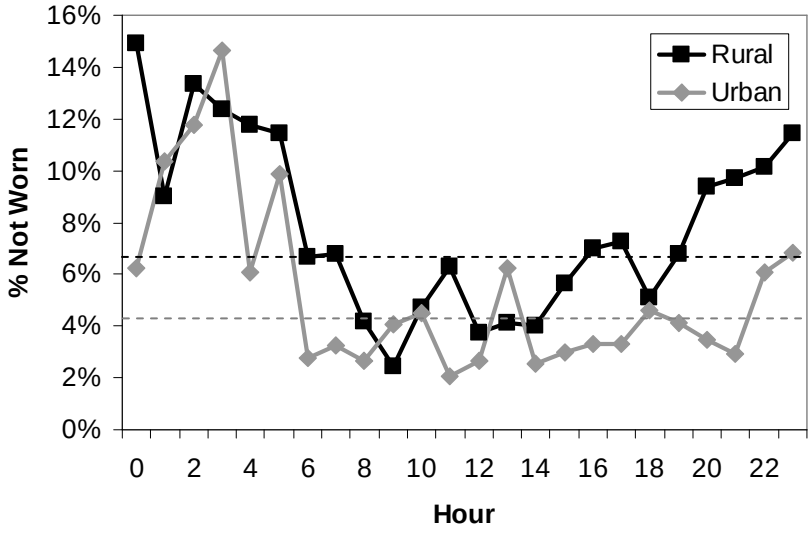
As can be seen in Figure 1, there is a greater proportional representation of non-wearers in nighttime and early morning serious crashes. Although the absolute percentages in the U.S. and Queensland data are markedly different, the pattern is very similar in both jurisdictions. As previous research had identified that this time of day effect varied considerably between rural and urban areas, these results from both jurisdictions were broken further to identify the degree of this effect in the current statistics. Table 3 below provides a summary of restraint use levels by the rural and urban indicators listed in Table 2.

Table 3. *Restraint Use for Queensland and United States Casualty Data by Rurality*

Jurisdiction		Not Worn	Total	% Not Worn
Queensland (2001 - 2005)				
	Urban	648	15115	4.2
	Rural	863	12879	6.7
	Total	**1511**	**27994**	**5.4**
United States (2005)				
	Urban	8616	22099	38.9
	Rural	16544	36789	44.9
	Total	**25160**	**58888**	**42.7**

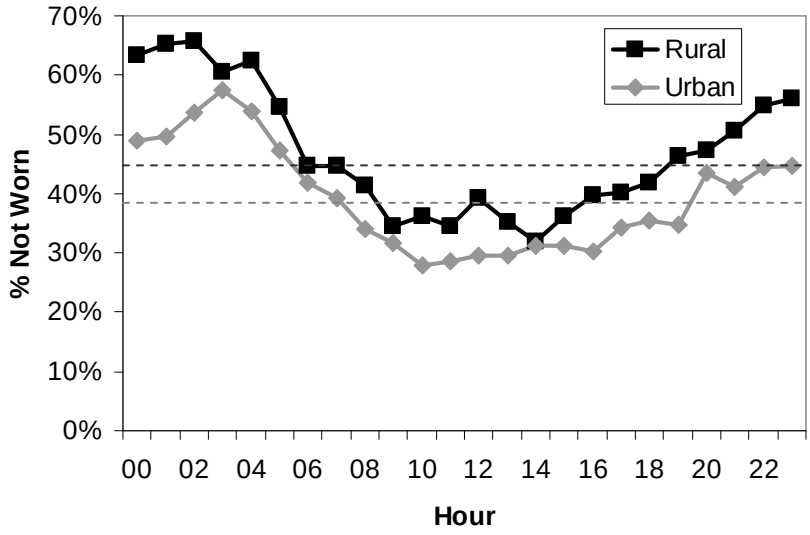
Source: FARS Database (National Highway Traffic Safety Administration, 2006), WebCrash2 (Queensland Transport, 2007)

There was a trend in both jurisdictions that rates of non-use of restraints were higher in rural locations. To examine this trend further, Figures 2 and 3 below present the proportions of casualties wearing and not-wearing a seatbelt by hour of day and rurality for Queensland and the U.S. respectively.



Source: WebCrash2 (Queensland Transport, 2007)

Figure 2. Proportion of driver and passenger casualties known to not be wearing a seatbelt by hour of day and rurality, Queensland, 2001-2005.

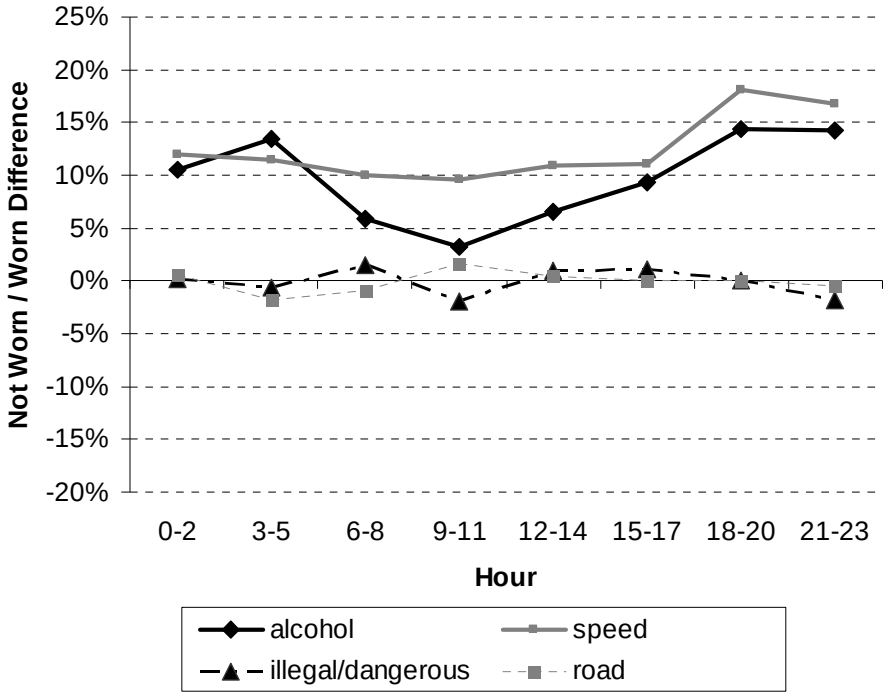


Source: FARS Database (National Highway Traffic Safety Administration, 2006)

Figure 3. Proportion of driver and passenger casualties known to not be wearing a seatbelt by hour of day and rurality, United States, 2005.

As can be seen in both the above figures, the trend towards an overrepresentation of non-wearers is typically higher for the rural areas in all hours, though this overrepresentation is more pronounced in the nighttime hours. To further investigate the characteristics of those people not wearing seatbelts, the related contributing circumstances grouped by “alcohol”, “speed”, “illegal/dangerous” (ie - other road rule breaking or reckless driving) and “road” were investigated for wearers and non-wearers of seatbelts. For the Queensland data, these corresponded respectively to the police-recorded crash groupings of “alcohol-related”; “speed related”; a grouping of all illegal behaviours (eg: red light running, ignoring give-way signs) together with “dangerous driving” and “reckless driving”, and all road-related factors (eg: “road surface”, “road quality” factors). Comparable driver-related factors under the groupings of “alcohol”, “speeding”, a grouping of the same traffic breaches and environmental factors were used for the U.S. FARS data.

The graphs below present the proportional difference between non-wearers and wearers in the representation of each circumstance for each time period. That is, a circumstance line that is consistently above “0” shows this circumstance as being more represented in non-wearers then in wearers. A circumstance line falling near the “0” point shows no difference, while a line below “0” shows a greater representation in those casualties wearing a seatbelt.

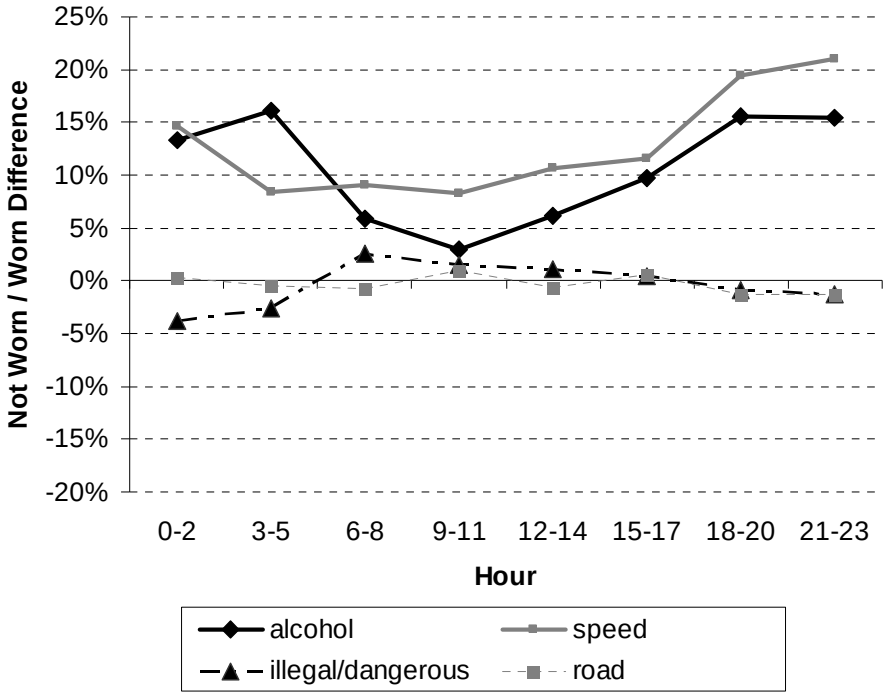


Source: FARS Database (National Highway Traffic Safety Administration, 2006)

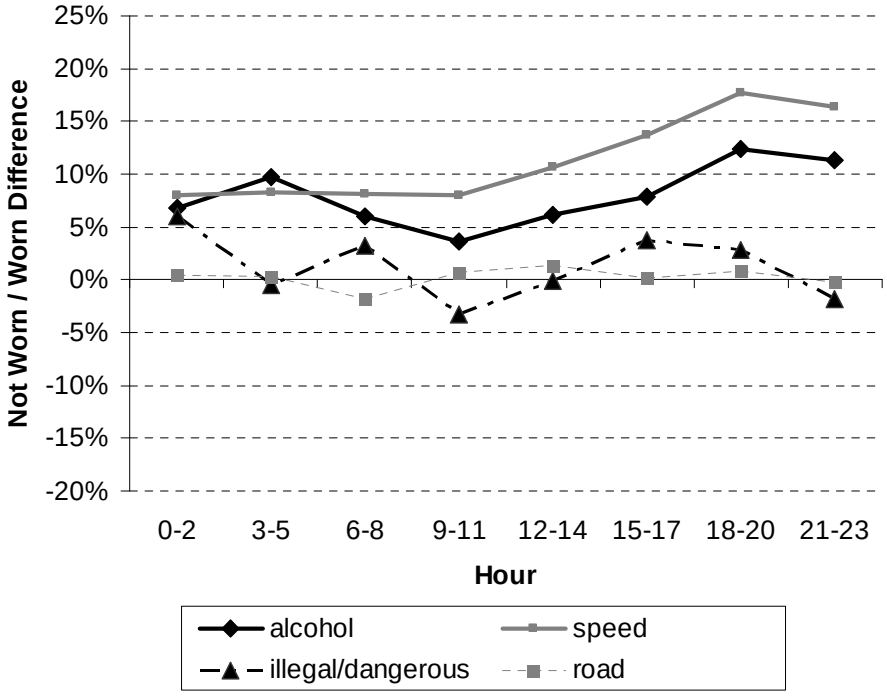
Figure 4. Differences between worn and not worn U.S. drivers in terms of driver contributing circumstances.

These results show alcohol and speed were more highly represented among non-wearers, and that this difference was greatest in the late night and early morning hours. The nighttime difference between wearers and non-wearers was more pronounced for the representation of alcohol. No consistent over-representation was shown in the illegal/dangerous and road condition contributing factors.

Rural



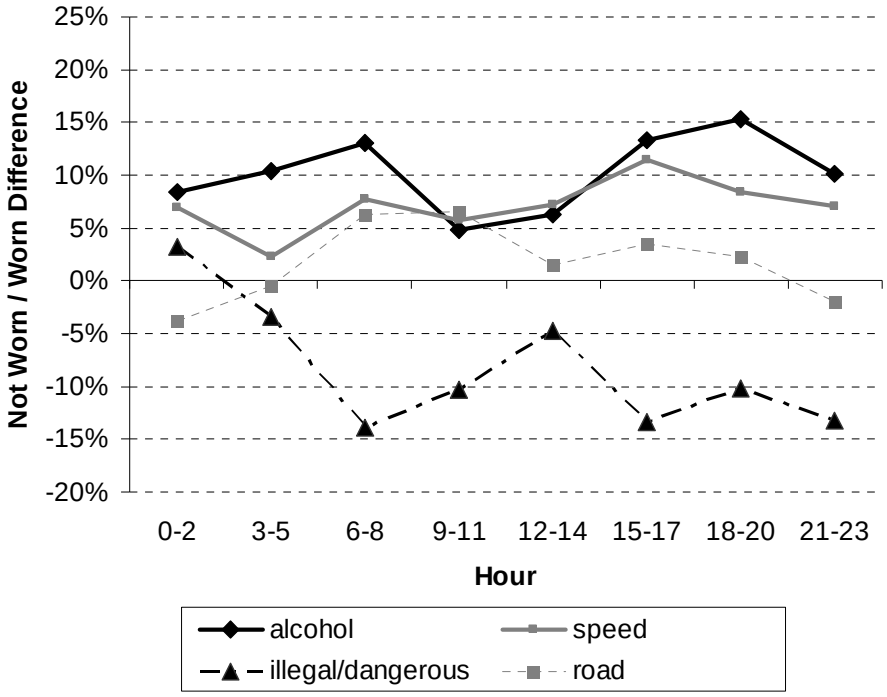
Urban



Source: FARS Database (National Highway Traffic Safety Administration, 2006)

Figure 5. Differences between worn and not worn U.S. drivers in terms of driver contributing circumstances, by rural and urban status.

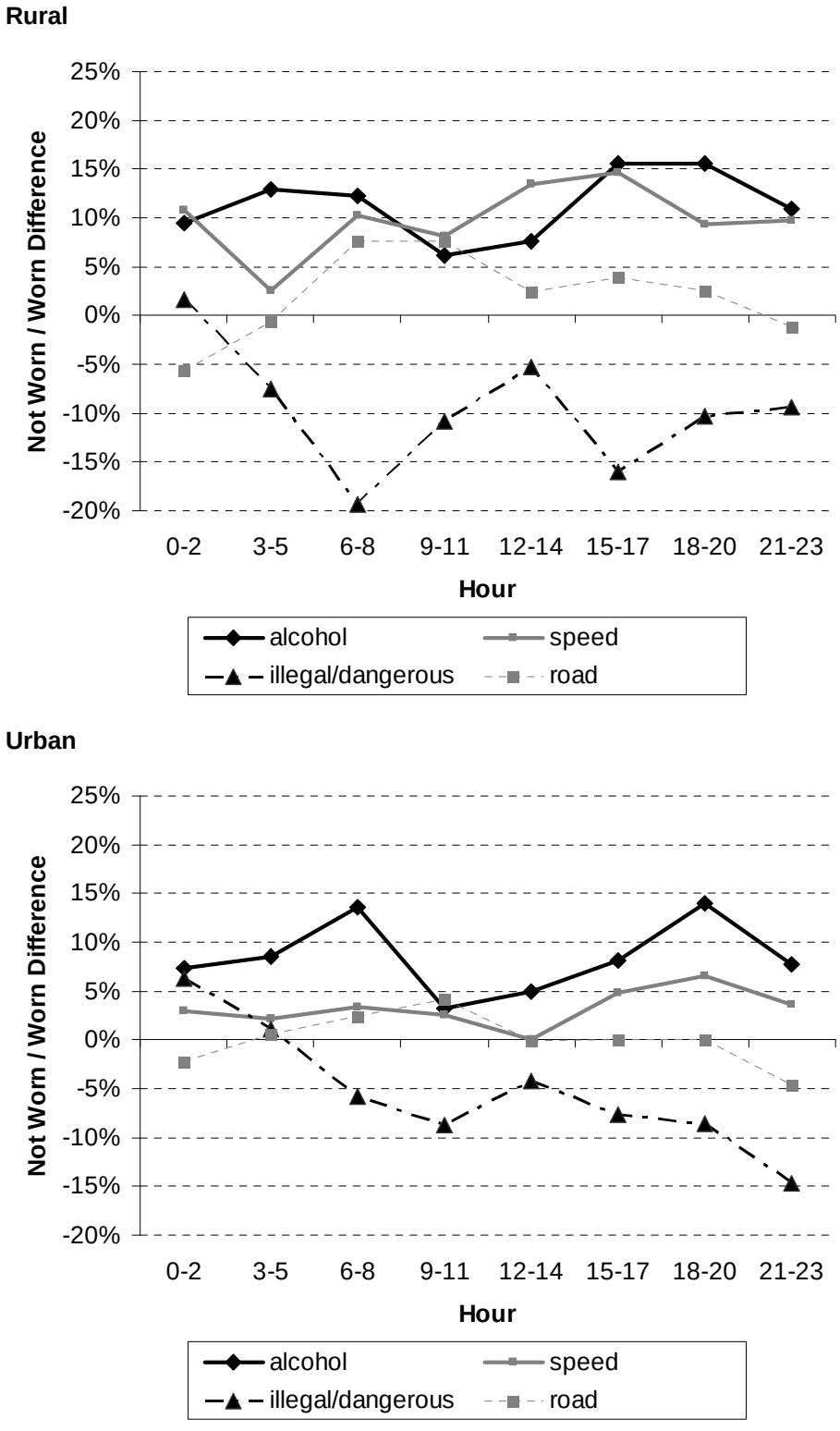
A similar pattern was present among casualties of crashes for both rural and urban areas within the U.S. It should however be noted that the greater involvement of alcohol and speed were more pronounced in the early morning times in the rural compared to the urban areas, where a difference was particularly notable in the late night hours between 9pm and midnight. The results of similar analyses were completed for Queensland.



Source: WebCrash2 (Queensland Transport, 2007)

Figure 6. Differences between worn and not worn Queensland casualties in terms of crash contributing circumstances.

Although both alcohol and speed were again more often associated with those not wearing seatbelts, there was not a trend towards these circumstances being particularly over-represented during nighttime hours. Illegal and dangerous activities and road-related circumstances did not show a consistent trend towards over-representation. In fact, the data suggests that those crash involved drivers engaged in illegal or dangerous driving are more likely to be wearing a seatbelt than those not attributed such a crash circumstance.



Source: WebCrash2 (Queensland Transport, 2007)

Figure 7. Differences between worn and not worn Queensland casualties in terms of crash contributing circumstances, by rural and urban status.

When considering rural and urban areas separately, the distribution of circumstances between those wearing and not wearing a seatbelt were very similar to the overall distribution. The trends were largely the same also when comparing the distribution of circumstances, though the illegal/dangerous circumstance trend was more pronounced in terms of greater proportional wearing in rural areas.

Additional Evidence from the CARRS-Q Rural and Remote Study Crash Narratives

Detailed narrative crash descriptions collected as part of the CARRS-Q Rural and Remote Road Safety Study being conducted in North Queensland provide some interesting indications of co-occurrences with non-use of seatbelts in rural areas. Several of the drivers commented that they were driving between rural stations on minor routes at the time of crashing. One participant in particular noted that they commonly drank alcohol while working, but had previously incurred no issues driving these short distances. Another particular case noted not wearing a seatbelt as a result of getting in and out of a vehicle for work purposes while driving along a dirt road. These cases should also be taken in light of findings from focus groups conducted with rural North Queensland drivers which identified attitudes among some participants that the wearing of seatbelts is not required for short trips or those over rough terrain, to facilitate quickly exiting the vehicle in case of rollover (Sticher, 2005). The low probability of enforcement of seatbelt usage in these areas over short distances may also be a related factor. Further analysis of the seatbelt wearing data

Discussion

The current study sought to identify co-occurring factors among crash involved casualties who were known not to be wearing a seatbelt, by examining crash data sourced from both the United States and the Australian state of Queensland. Specifically, time of day of crash, whether the area was rural or urban, and groups of co-occurring crash contributing factors were examined.

Results showed that despite differences in overall seatbelt use rates between Queensland and U.S. figures, there was agreement in that non-use of seatbelts was particularly high during late night and early morning hours. In fact, the relationship across each hour of the day was very similar. This supports the findings of Chaudhary and Preusser's (2006) analysis of U.S. data, suggesting such an effect may be present across similarly motorised countries. Further analyses also identified seatbelt use rates among those crashing to be lower in rural areas, with this effect also proportionally greater in nighttime hours. These results were similar for both Queensland and the U.S. data. This finding is however at odds with Chaudhary and Preusser's finding that seatbelt wearing among those on the road (as opposed to those crashing) dropped at a greater rate in urban as compared to rural areas of Connecticut. It should be however noted that the current study took into account

crashes across the entire area of the U.S. and Queensland and may thus be more representative than a sample at a few particular sites. Further research should examine this relationship.

The distribution of crash circumstances most clearly demonstrated that those not wearing a seatbelt were more likely to have alcohol and speeding attributed as a contributing factor in the crash. This finding was present for both rural and urban areas of the U.S. and Queensland. This is in line with Graham's (1993) 'selective recruitment hypothesis' that suggests that those not wearing a seatbelt are also more likely to be taking part in risky driving behaviours. In contrast however, the current investigation did not show this same consistent overrepresentation for the general grouping of illegal and dangerous driving behaviours. This could be attributed to certain risky driving behaviours like speeding and drink driving being more likely to co-occur among some drivers. This 'clustering' of driver types and related behaviour has been noted in young drivers (Deery & Fildes, 1999). An alternate explanation is that the greater priority in enforcement given to speeding and drink driving offences, which are regularly included in publicity such as Queensland's 'Fatal Four' campaign (which target speeding, drink driving, fatigue and seatbelt use), may indicate these circumstances are more readily attributed to crashes than more general road rule breaking.

In terms of the differences in crash circumstance representation, there was a trend in the U.S. towards these being larger during nighttime hours. This effect was more pronounced for alcohol as a contributing factor, with a clear increase between 6pm and 5am. Speeding was more limited in its relationship, with this increase focused around 6pm to midnight, with only a slight increase shown in the early morning hours of midnight to 5am. While these patterns persisted for both rural and urban areas, a much larger proportion of non-wearers as opposed to wearers were associated with alcohol and speeding in rural areas. This may be linked to the lesser availability of alternative travel choices for those drinking in rural areas, particularly during late night hours when public transport and other options may not be as readily available as during the day (Doherty & Roche, 2003; Loxley, Homel, Berger, & Snortum, 1989; Toohey, 2001).

Analysis of Queensland data showed a similar pattern again in regards to the overrepresentation of alcohol and speed in crashes with casualties not wearing seatbelts. However, a greater overrepresentation of alcohol compared to speeding in nighttime crashes for non-wearers was noted. Where this trend towards overrepresentaion of speeding was present, it was focused mostly on the early evening and did not extend throughout the night and into the early morning hours.This may possibly be due to speeding being a behaviour that occurs at all hours, while alcohol consumption tends to focused moreso around the nighttime hours. Interestingly though, no differences were evident in the trend of contributing factors between rural and urban areas of Queensland. This may possibly be related to differences between the comparative characteristics of rural areas in Queensland as opposed to the United States as a whole.

Future Research

The current paper has identified a number of trends related to the non-use of seatbelts. Specifically, higher levels of non-wearing of seatbelts in rural areas is of concern, given that many crashes in rural areas involve higher speeds and are likely to lead to greater injury outcomes. While the policing of rural areas is potentially far more labour-intensive than processes existing in urban areas, there is a scope that a greater vigilance towards increasing seatbelt use may provide several positive outcomes. It can firstly serve as a means of enforcement for the potential detection of co-existing risky behaviours such as alcohol use. Secondly, the protective nature of seatbelts should be highlighted to those groups of drivers most likely to speed and drink drive. Positive results have been noted for publicity programs put in place in drinking establishments in the U.S. to encourage seatbelt wearing (Malenfant & Van Houten, 1988). However, further research is still required to identify how seatbelt use may differ, considering several other variables in conjunction with those discussed in this paper.

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