

Results from an observational survey of restraint and child restraint use, 2009

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Abstract

On-road observational surveys of restraint use provide a valuable means of obtaining information on the current level of restraint use and on the characteristics (vehicle, occupant, location) of non-use of restraints. Very few observational restraint use surveys have been conducted in Australian jurisdictions in recent years and the last observational survey undertaken in South Australia was in 2002. This paper presents the results of a new observational survey, undertaken in March 2009, to monitor the levels of restraint use by occupants of passenger vehicles in areas previously surveyed in South Australia: metropolitan Adelaide and five rural regions. Trained field observers recorded the vehicle type, plates displayed on the vehicle, and the seating position, gender and restraint use of vehicle occupants including the uses and types of any child restraints. For the first time in this series of surveys, restraint use was observed on weekends in addition to weekdays. Observed rates of restraint wearing were relatively high, ranging from 98.9% in Murray Bridge (weekend) to 96.8% in Clare (weekday). Rear seat passengers had the lowest observed rates of restraint wearing. Adult males wore seat belts less often than adult females. Child restraint use varied by region but was relatively high. Findings from this survey might assist in the development of restraint use publicity campaigns and the monitoring of their effectiveness.

Keywords

Seat belt use, Child restraints, Observational survey

Introduction

Vehicle occupant restraints or seat belts have been the single most effective technology for reducing injury severity in the event of a crash [1, 2]. It has been estimated that the use of three-point restraints reduces the risk of fatality by 45 to 60%, dependent on the vehicle type [3]. Despite this, approximately a third of all vehicle occupants killed on South Australian roads each year are not wearing a seat belt at the time of the crash [e.g. 4]. Information on current levels of restraint use, and on the characteristics of those occupants, vehicles and locations associated with non-restraint use, may assist in developing strategies to further increase compliance with restraint use laws. On-road observational surveys of restraint use provide a means of obtaining such information and can also assist in monitoring the effectiveness of seat belt publicity campaigns.

Observational studies also provide an opportunity to monitor the use of appropriate child restraints. New Australian Road Rules, expected to be introduced in late 2009, will require children up to the age of seven to be appropriately restrained based on their age. Children up to the age of six months will be required to be restrained in a rearward facing child restraint (e.g. infant capsule). From six months until the age of four, children must be restrained in either a rearward or forward facing child restraint (e.g. child safety seat). From four years until the age of seven, children must be restrained in either a forward facing child restraint or booster seat restrained by a correctly adjusted and fastened restraint or child safety harness. In addition, children up to four years must be restrained in the rear of the vehicle where a vehicle has two or more rows of seats. Children aged four to seven years are not permitted to sit in the front seat of a vehicle unless children aged less than seven years occupy all other rear seats.

During the last decade there have been very few publications providing results from observational surveys of passenger vehicle restraint use in Australia. The most recent observational survey of restraint usage in an Australian jurisdiction was conducted in Western Australia during 2005 [5]. The study reported an average rate of correct restraint usage (i.e. age appropriate restraint correctly fitted and fastened) across Western Australia of 96.3% and an overall restraint usage rate of 97.4% [6]. Several observational surveys of restraint use in passenger vehicles have been conducted in South Australia from

1998 to 2002. The last survey in 2002 reported that restraint usage was at least 95% in both metropolitan Adelaide and the five selected rural areas [7].

This paper presents the results of a new on-road observational survey undertaken in South Australia during March 2009, the first observational restraint use survey undertaken in an Australian jurisdiction since 2005. The motivation was to determine if restraint use has been sustained at the high levels observed previously. Restraint use was observed on weekends and weekdays (the previous surveys only included weekday observations.)

Method

The observational methods and the observation sites used in this survey were consistent with previous surveys to allow comparisons to be made. The observational method was adapted from a New South Wales observational survey by Preece, Johansen and Norrish [8].

Data on restraint use was collected by direct observation by trained staff working at 61 sites in metropolitan Adelaide and in five rural centres: Mount Gambier, the Riverland, Whyalla, Murray Bridge, and Clare. The sites were originally selected to include all vehicles leaving or entering the city and towns in all directions and to capture a range of occupant types (e.g. local traffic, people travelling to and from work). In the present survey, some of the observation positions at intersections had to be altered because of footpath obstructions (i.e. café dining) or changes to the road geometry since the last survey.

Consistent with previous surveys, the majority of surveys were conducted on weekdays within two three-hour periods: 7.00am to 10.00am and 3.00pm to 6.00pm. These times were originally chosen to include times of heavy traffic so as to minimise observation time and with the intention of including a wide range of road users. Restraint use was also observed for one weekend in the Adelaide metropolitan area and one weekend in Murray Bridge. Observations were conducted between 10am and 2pm on Saturdays and between 11am and 2pm on Sundays, times when traffic volumes were highest. The observation days did not include school or public holidays.

In order to observe stationary or slowed traffic, only intersections controlled by traffic lights, stop signs, give way signs and large roundabouts were chosen. At observation sites located at traffic lights, the observers waited until vehicles were stationary at a red light. The observers then recorded details for each stationary vehicle in the line of traffic until traffic began to move off. At intersections controlled by stop signs, give way signs or roundabouts, details of vehicles that slowed were recorded. Vehicles in the lane closest to the observer were selected, usually the left kerbside lane, and an attempt was made to record all relevant details, regardless of the difficulty of the observation. Two observers spent approximately one hour at each site.

Prior to data collection, training sessions were held in which the observers were briefed on the observational procedures, types of child restraints and data sheets. A pilot observation period was also conducted at an intersection in metropolitan Adelaide. During the on-road testing, the observational procedures of observers were monitored and any problems with observations were addressed during the following debriefing session.

The survey was restricted to cars and car derivatives. This included any car, station wagon, four-wheel-drive, utility, van, or taxi used for private or commercial purposes. Service vehicles such as police cars, ambulances or fire vehicles were excluded in addition to wedding cars and limousines. The details of each vehicle were recorded on an observation sheet specifically developed for this survey. Vehicle details included the type of vehicle (taxi or not), any learner or provisional plates displayed and the number of occupants. The number plate of each vehicle was also recorded to ensure that details for each vehicle were not recorded multiple times during each observation session. (Exclusions were determined later, after data had been entered into a database.)

The following details were recorded for each occupant in a vehicle: seating position, gender (if adult), estimated age (if child), restraint type (if child), and wearing of restraint. For children, two age group categories (Preschool - 0 to 4 years, Primary school - 5 to 12 years) were used.

In previous surveys, a distinction was made between 'correct' and 'incorrect' usage (e.g. twisted, not worn over shoulder) of restraints. However, these surveys found it difficult to consistently ascertain the 'correct usage' of restraints, particularly by passengers in the middle rear-seat. For this reason, the current survey did not attempt to make a distinction. The data is simply recorded in terms of whether or not a restraint is being 'used'.

The survey results are summarised in this paper using frequencies and cross tabulation. If any observation omitted to record a variable, that observation was excluded from the tabulation of the variable. Initially, a statistical analysis (chi-square) was performed to ensure that restraint use levels at individual sites in each region did not differ significantly from the mean for the region. The results indicated that restraint use at sites within a region did not vary from the region's mean by any more than what would be expected by chance. Consequently, the results of sites were aggregated into regional results. Levels of restraint use were then compared between regions, between seating positions, between weekdays and weekends, and over time using the chi-square test for independence. Note that this method does not account for clustering effects. Results are reported for separate bivariate comparisons between pairs.

Results

Restraint use could be determined for 16,657 vehicle occupants (13,964 on weekdays in six regions and 2,693 on a weekend in two regions). The results are presented separately for each region and for weekdays and weekends. With respect to the characteristics of the vehicles and vehicle occupants observed, the vehicles observed on the weekend (relative to vehicles observed during the week) tended to have more occupants, and drivers with restricted licences were more prevalent. Vehicles in rural regions tended to have more children on board. Less than 1% of the vehicles observed were taxis.

The distribution of restraint use is tabulated by region and seating position for weekdays and weekends in Table 1. Standard errors for the proportions not wearing restraints are also given in the Table. The survey results for weekdays indicate that restraint-wearing rates for all vehicle occupants was relatively high ranging from 98.4% in the Adelaide metropolitan area to 96.8% in Clare. Results from chi-square analyses comparing restraint use for all vehicle occupants (worn – not worn) between the regions indicated that overall, the level of restraint use in metropolitan Adelaide was higher than in the Riverland ($\chi^2(1)=5.08, p<.05$), Murray Bridge ($\chi^2(1)=4.68, p<.05$), and Clare ($\chi^2(1)=11.49, p<.01$) by a statistically significant margin. The difference between the rates observed in Mount Gambier and Clare was also statistically significant ($\chi^2(1)=9.77, p<.01$).

Table 1: Summary of restraint use (% , SE) by region and seating position

Seating position	Weekdays						Weekend	
	Adelaide	Whyalla	Riverland	Mount Gambier	Murray Bridge	Clare	Adelaide	Murray Bridge
Driver	98.7 (0.3)	98.0 (0.3)	97.8 (0.4)	98.6 (0.3)	97.9 (0.4)	96.3 (0.5)	99.0 (0.3)	98.6 (0.5)
Front passenger	98.5 (0.7)	96.8 (0.8)	97.6 (0.7)	96.8 (0.8)	97.4 (0.7)	98.1 (0.8)	98.5 (0.6)	99.4 (0.4)
Rear passenger	95.8 (1.7)	97.4 (1.0)	95.1 (1.4)	98.2 (0.8)	94.8 (1.5)	97.5 (1.0)	95.7 (1.5)	99.0 (0.7)
All occupants	98.4 (0.3)	97.7 (0.3)	97.5 (0.3)	98.2 (0.3)	97.5 (0.3)	96.8 (0.4)	98.5 (0.3)	98.9 (0.3)
Total no. vehicle occupants	2052	2503	2458	2804	2375	1772	1510	1183

The pattern of restraint use observed for drivers by region was similar to that for all vehicle occupants. For front seat passengers, the highest rate of restraint use was recorded in Adelaide (98.5%) and the lowest rate was observed in Whyalla and Mount Gambier (96.8%). Front seat passengers were less likely to be restrained than drivers in Mount Gambier ($\chi^2(1)=7.84, p<.01$). Rear seat passenger compliance rates were generally lower than for other seating positions, ranging from 98.2% in Mount Gambier to 94.8% in Murray Bridge. Statistical analyses of the differences in restraint use between seating positions within each region found that in Adelaide ($\chi^2(1)=7.12, p<.01$), the Riverland ($\chi^2(1)=6.20, p<.05$), and Murray Bridge ($\chi^2(1)=8.18, p<.01$), rear seat passengers were less likely to be restrained than drivers. There was

also a trend for rear seat passenger compliance rates to be lower than that for front seat passengers in these locations.

Restraint use on weekends

Compared to weekdays, restraint use on weekends (see Table 1) was similar in Adelaide but higher in Murray Bridge by a statistically significant margin ($\chi^2(1)=7.64, p<.01$). Examination by seating position shows that restraint use in Murray Bridge was higher on the weekend than on weekdays for front seat passengers ($\chi^2(1)=4.78, p<.05$) and rear seat passengers ($\chi^2(1)=5.53, p<.05$). Analysis of weekend compliance rates by seating position within metropolitan Adelaide indicates that the rate for rear seat passengers was lower than the rate for drivers ($\chi^2(1)=11.60, p<.01$), and front seat passengers ($\chi^2(1)=4.01, p<.05$).

Restraint use by sex/age

Table 2 shows the survey results disaggregated according to the sex of the occupant (if over 12) or by age group (if child). Sex was not recorded for children estimated to be aged 12 years or less. Restraint use was generally higher among adult females than adult males and relatively consistent across regions at around 98 to 99%. There was greater variation in adult male restraint use with levels ranging from 98.6% in metropolitan Adelaide to 94.6% in Clare. Due to small numbers, restraint use levels for children are difficult to interpret and they tend to vary by region. Nevertheless, child restraint use appears to be relatively high in most regions, particularly Mount Gambier, Whyalla, and Clare. Of interest, in metropolitan Adelaide restraint use levels for children (when combining two age groups, 96.6% on weekdays and 97.4% on weekends) are lower than those for adult males and adult females.

Table 2: Restraint use (% , SE) by sex of adult and age of child for all seating positions

Sex / age	Weekday						Total (N)	Weekend		
	Adelaide	Whyalla	Riverland	Mount Gambier	Murray Bridge	Clare		Adelaide	Murray Bridge	Total (N)
Adult female	98.7 (0.4)	98.5 (0.4)	98.5 (0.4)	98.3 (0.4)	98.6 (0.4)	98.4 (0.5)	6089	98.5 (0.5)	99.4 (0.3)	1182
Adult male	98.5 (0.4)	97.0 (0.5)	96.5 (0.6)	97.9 (0.4)	96.6 (0.5)	94.6 (0.8)	6459	98.6 (0.4)	98.4 (0.5)	1270
Child 0-4yrs	95.6 (3.1)	98.2 (1.3)	96.9 (2.2)	100.0 (-)	98.4 (1.6)	98.6 (1.4)	463	100.0 (-)	98.0 (2.0)	95
Child 5-12yrs	97.3 (1.9)	98.0 (1.0)	97.0 (1.2)	99.2 (0.8)	97.1 (1.3)	98.3 (1.0)	953	95.7 (2.4)	100.0 (-)	146

Child restraints

In anticipation of new child restraint laws requiring children up to the age of seven to be appropriately restrained based on their age, an examination of child restraint usage rates, where children were sitting when restrained and unrestrained, and whether children were wearing age appropriate restraints was conducted. The number of children (0-12 years) observed in some regions was small so child restraint data from all of the regions on weekdays were aggregated. Consequently, the distribution of child restraint use is not representative of restraint use over all surveyed regions as the sample is biased toward regional areas. Two per cent ($n=29$) of the surveyed children aged 12 years and under were unrestrained, 4% ($n=21$) of children aged 0 to 4 years were sitting in the front seat, and 10% of children ($n=46$) aged 0 to 4 years were restrained in adult seat belts alone.

Change in restraint use over time

Prior to the present survey, four on-road observational restraint use surveys were conducted in South Australia from 1998 to 2002. The current survey used the same methodology as previous surveys and was conducted predominantly at the same sites in metropolitan Adelaide and in a number of rural regions. Levels of restraint use by seating position for all regions surveyed from 1998 to 2009 are presented in Table 3. The results from statistical analyses comparing wearing rates for the last restraint use survey in 2002 and the current survey in 2009 are also presented in Table 3.

For all vehicle occupants, restraint use levels in 2009 were the highest observed since surveys began in 1998. Current restraint use levels in metropolitan Adelaide, the Riverland, Murray Bridge and Clare were statistically significantly higher than in the previous survey in 2002. A similar result was found for drivers in these regions. There were no statistically significant changes in restraint use for front or rear seat passengers from 2002 to 2009 in any of the regions.

Table 3: Restraint use by seating position, region and survey year

	Year of survey										χ^2 ^b	P value
	Feb 1998		March 1999		May 2000		May 2002		March 2009 ^a			
	%	N	%	N	%	N	%	N	%	N		
<i>Driver</i>												
Adelaide	92.9	2500	91.4	2348	96.0	1872	96.4	2228	98.7	1564	18.59	**
Whyalla	86.1	1941	93.4	2342	97.9	1741	97.2	1555	98.0	1694	2.23	NS
Riverland	88.6	2073	90.8	2214	96.5	1474	95.2	1403	97.8	1709	16.21	**
Mt Gambier	88.1	2401	90.5	2243	96.7	1804	98.3	2439	98.6	1972	0.62	NS
Murray Bridge	-	-	-	-	96.2	1292	96.7	1625	97.9	1609	5.02	*
Clare	-	-	-	-	92.1	796	94.2	736	96.3	1173	4.73	*
<i>Front passenger</i>												
Adelaide	93.3	531	94.3	581	96.0	396	96.9	438	98.5	320	1.93	NS
Whyalla	82.6	490	92.5	630	99.0	482	97.5	311	96.8	488	0.31	NS
Riverland	84.7	542	90.5	599	95.8	424	95.2	377	97.6	455	3.79	NS
Mt Gambier	86.3	597	92.0	648	96.6	475	97.2	590	96.8	513	0.16	NS
Murray Bridge	-	-	-	-	98.7	317	96.9	464	97.4	487	0.25	NS
Clare	-	-	-	-	90.2	225	95.7	202	98.1	304	2.44	NS
<i>Rear passenger</i>												
Adelaide	81.5	207	89.7	236	94.1	522	94.5	120	95.8	136	0.24	NS
Whyalla	73.2	213	89.4	344	99.2	635	97.1	68	97.4	264	0.02	NS
Riverland	75.7	202	83.0	289	93.5	613	92.7	164	95.1	232	1.08	NS
Mt Gambier	80.5	269	89.9	358	94.8	753	95.8	254	98.2	269	2.53	NS
Murray Bridge	-	-	-	-	97.1	384	93.5	157	94.8	220	0.34	NS
Clare	-	-	-	-	89.6	366	99.0	100	97.5	238	0.78	NS
<i>All occupants</i>												
Adelaide	92.1	3239	91.8	3165	95.6	2399	96.4	2805	98.4	2020	18.82	**
Whyalla	84.1	2646	92.8	3316	98.3	2380	97.3	1937	97.7	2446	0.87	NS
Riverland	86.7	2817	89.9	3104	95.6	2158	95.0	2000	97.5	2396	19.55	**
Mt Gambier	87.1	3267	90.7	3250	96.2	2572	97.9	3295	98.2	2754	0.71	NS
Murray Bridge	-	-	-	-	96.5	1723	96.5	2254	97.5	2316	4.27	*
Clare	-	-	-	-	91.2	1177	95.0	1039	96.8	1715	5.91	*
Total Worn (N)	11,969		12,835		12,409		13,330		13,647			

Notes: Observational surveys in Murray Bridge and Clare were conducted from May 2000. Excludes cases for which restraint use was unknown. N = total number of occupants wearing restraints.

^a Data for 2009 includes weekday data only.

^b Chi-square analysis results compares 2002 and 2009 restraint use.

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

Discussion

The findings from the observational restraint use survey described in this paper provide the most current indication of restraint use levels in an Australian jurisdiction. The 2009 survey results indicated that overall rates of restraint use were relatively high. Observed rates ranged from 98.9% in Murray Bridge (on a weekend) to 96.8% in Clare (on a weekday). This level of restraint use is consistent with a large state wide observational survey conducted in Western Australia in 2005 that reported an overall wearing rate of 97.4% [6]. Like the current survey, the Western Australian survey covered both metropolitan and regional areas but also included sites in more remote areas and observed a greater number of vehicle occupants (approximately 55,000) across all times of day and night.

The observational methods and the observation sites used in this survey were consistent with previous surveys so that trends in restraint use over time could be examined. Findings from the current survey indicate that the levels of restraint use in South Australia at the surveyed locations have increased substantially over the last decade, with the highest levels recorded since surveys began in 1998. Of note, wearing rates were initially quite low in rural regions but are now catching up to rates for the Adelaide metropolitan area. Since the last survey in 2002, observed restraint use has increased significantly in metropolitan Adelaide, the Riverland, Murray Bridge and Clare and the main contribution to the increase has been a rise in restraint use by drivers.

The rate of restraint use on weekdays was higher in metropolitan Adelaide than in the rural regions of Murray Bridge, the Riverland and Clare by a statistically significant margin. Drivers in Clare had lower rates of restraint use than drivers in the other regions. The finding that wearing rates are higher in the metropolitan area than in rural regions is consistent with the recent Western Australian observational survey (98% correct wearing of restraints in metropolitan WA, 90% in rural WA; [6]). However, the difference is not as pronounced in the South Australian survey, most likely because the current survey did not include any remote locations where restraint use is likely to be lower.

Consistent with previous surveys, the lowest rates of restraint wearing were observed for rear seat passengers, specifically in Murray Bridge, the Riverland and Adelaide (weekdays and weekends). These findings suggest that future campaigns aiming to increase restraint use should consider targeting rear seat passengers as this is where the greatest general increases in restraint use might be achieved. Restraint use in Murray Bridge was significantly higher on the weekend than on weekdays for both front and rear seat passengers, while in Adelaide, restraint use was similar on both weekdays and weekends.

Restraint use was higher among adult females (ranging from 98% to 99%) than adult males (ranging from 95% to 99%) at all survey locations. Interestingly, while previous surveys in South Australia have consistently found male restraint use to be lower than female restraint use, the Western Australian survey found little difference by sex [6]. The level of restraint use by children varied by region but was generally higher than the level of use by adult males. The apparent rate of child restraint use was lowest in Adelaide on weekdays (96.6%). Moreover, child restraint use was lower than for adults in Adelaide on both weekdays and weekends. Any future campaigns aiming to increase restraint use among children should consider targeting children and parents in metropolitan Adelaide.

While it is acknowledged that there may be considerable variation in the size and weight of children of the same age, current research recommends children aged 0 to 4 years are restrained in either a baby capsule (up to 6 months) or a child seat (6 months to 4th birthday) while children aged four to seven years should be restrained in a booster seat [see 9]. These age-based recommendations will be introduced as new child restraint laws later in 2009. It is somewhat concerning that 10% of children ($n=46$) estimated to be aged 0 to 4 years were restrained in adult seat belts. None of these children were travelling in a taxi (children are not required to use a child restraint in a taxi if one is not available). Four per cent ($n=21$) of children estimated to be aged 0 to 4 years were sitting in the front seat. If a vehicle has two or more rows of seats, the new national child restraint laws will require children under the age of four years to be restrained in the rear of the vehicle. Children aged four to seven years will also not be allowed to sit in the front seat of a vehicle unless children aged less than seven years occupy all other rear seats. The findings from this survey suggest that the new national child restraint laws need further promotion amongst parents.

An important consideration is that the results from the current survey represent restraint use at only the times and places where surveys were undertaken (i.e. day time, in town/city centres, at intersections, in lower speed limit zones). Observation sites have heavy traffic and contain a wide range of vehicle types and occupants. The passenger vehicle traffic at these observation sites are unlikely to be a representative sample of all passenger vehicles in South Australia, and may not capture the vehicle occupants that are most likely not to be wearing a seatbelt. Since restraint use at these sites is now very high, it may be time to think of alternative survey designs that are more likely to characterise low restraint use, and particularly high-risk low restraint use. For example, consideration could be given to conducting future restraint use surveys on different types of roads (i.e. 80/100km/h rural roads, residential 'back' streets) and at different times to those in the current survey. Observational studies from the United States have found that restraint use varies by situational factors, with restraint use lower on local roads than freeways [10], and at night [11]. Evidence from police-reported crashes in Queensland and the United States as well as crash data collected from rural crashes in Queensland suggest a link between night time driving, rural location, and the involvement of drivers not using restraints in crashes [12]. While it would be interesting to explore whether restraint use is lower at night, evidence from the Western Australian observational survey suggests that such surveys at night are not worthwhile. Roberts et al. [6] found no major difference in restraint use by time of day/night and noted that the accuracy of observations at night may be compromised due to the intrinsic problem of poor visibility. Night vision goggles and handheld infrared spotlights might assist in overcoming visibility problems [see 11].

The latest restraint survey results suggest around 2 to 4% of vehicle occupants do not wear restraints. But crash data indicates that around 30% of fatally injured vehicle occupants in South Australia are recorded as not wearing restraints [e.g. 4]. The discrepancy between these two rates is only partly explained by the increased likelihood of injury for non-restrained vehicle occupants in crashes. The crude ratio of the odds of dying between unrestrained and restrained occupants in crashes is around 3.5 to 4 [13]. If the non-wearing rate amongst the population at risk was indeed 3% and the odds ratio of being killed is indeed 4 for unrestrained occupants compared to restrained occupants, then we would expect to see $(3\% \times 4) / (97\% \times 1 + 3\% \times 4) = 11\%$ of occupant fatalities unrestrained. Affecting this relationship will be uncertainties in all of the related quantities, however it is probable, as mentioned above, that the times and places at which the survey was taken do not capture the wearing rates of the population at risk of being killed in a crash.

In conclusion, the present survey has presented useful results on the general compliance with restraint use laws in South Australia, and in particular has shown a positive trend in wearing rates compared with previous surveys. Less clear are trends in, and levels of, restraint use for the population at risk of being killed in a crash – to elucidate restraint use amongst this population would require a different, logistically difficult survey design, possibly at the locations and times at which serious crashes have occurred.

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