Lessons and Results from the Observational Study of Motor Vehicle Restraint Use in Western Australia

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ABSTRACT

While many US states regularly make use of methodologically sophisticated restraint use surveys, few such surveys are, or have been conducted in Australia. This is a problem because, particularly in Western Australia, there is little reliable objective information on which to base campaigns and interventions. In 2005 the Western Australian Office of Road Safety commissioned ARRB Group to conduct an observational survey of restraint use across the state of Western Australia. A reliable and valid observational method was developed equivalent to world's best practice. This paper reports on the lessons learned in developing this methodology and conducting the survey. The results of the survey highlight a number of concerns. In particular, it was found that although the overall rate of restraint use in Western Australia is very high at this point in time (96%), there are nevertheless major areas of concern. In particular, some regional areas had very low rates of restraint use (as low as 56%) and would undoubtedly benefit from some kind of intervention designed to increase usage rates. In addition, children, especially in the 1 to 4 year old age group were frequently not correctly restrained. Only 63% of 1 – 4 year olds were correctly restrained. For 5 – 11 year olds it was 83% and for 12 – 16 year olds it was 91%. This suggests that there would be enormous value in exploring the restraint usage of children in more depth, perhaps in a survey that contained an interview component.

1 INTRODUCTION

Despite the safety benefits of motor vehicle restraint use being well known and widely accepted throughout the world, all countries experience a significant level of non-use. This is true even in countries like Australia where seat belt wearing has been mandatory since the early 1970's. In Western Australia the restraint wearing rate was thought to be somewhere around 95% in urban areas, but it was recognized that it may be significantly lower in country areas. However, non use rates of even a few percent are of concern because of the high rate of death and injury that is associated with restraint non use in motor vehicle accidents. For example, in a recent study in Western Australia in 2001, 29% of vehicle occupants who were killed in a police-attended road crash were known not to be wearing a seat belt (Legge, Gavin and Cercarelli, 2004).

Hence, there is considerable value in continuing to attempt to increase restraint use. In order to achieve such a goal however it is important to have an accurate picture of the current levels of restraint use and the characteristics of vehicle occupants, vehicles and geographical factors associated with non use. This information could be used to target the specific groups most in need of remedial action. Furthermore, regular monitoring along these lines would allow evaluation of the effectiveness of any campaigns or other interventions designed to increase restraint use.

For this reason the Office of Road Safety's "Arriving Safely 2003-2007" road safety strategy recommends that an annual restraints observational study be conducted in Western Australia. Consequently, the Office of Road Safety commissioned Data Analysis Australia Pty Ltd and ARRB Group to develop the methodology and conduct such a study. This report presents the results of the observational study of restraint use conducted around Western Australia by ARRB Group in 2005.

2 METHODOLOGY

The study utilised a purely observational methodology. That is, vehicle occupants were observed in their vehicles by research assistants in the field, who recorded the time, vehicle type, if and how restraints were used, and the gender, age and seating position of the occupants.

Observations were made at a number of locations around the metropolitan area and in regional areas across Western Australia.

Not all vehicle types were observed. Eligible vehicle categories were: normal passenger cars (sedans/station wagons/panel vans), four wheel drives, taxis, vans (non commercial people-movers capable of seating up to 9 people) and utilities.

The survey was conducted both during the school term and for an equivalent period during the immediately following school holidays.

Observers were thoroughly trained in the observational methodology prior to data collection.

2.1 Training Programme

The training programme consisted of two phases.

2.1.1 Phase 1

Firstly, approximately 130 digital photographs were taken of adults and children in stationary vehicles posed wearing various kinds of restraints, both correctly and incorrectly as well as not at all. These photographic subjects were recruited at a local university and at various childcare centres. Subjects were paid $10 per vehicle for their participation. These photographs provided the basic training material for the observers. Approximately half of these photographs (64) were randomly selected and copied into a PowerPoint presentation. Interleaved between each photograph was a slide of the record form to be used by observers in the field, with the correct responses filled in. This allowed the observers to obtain feedback on the correct response to the immediately preceding slide. The PowerPoint presentation also contained a number of links to web sites that explained in detail the criteria for judging correct restraint use, especially for children.

Observers attended a training session where the nature of the survey and the training programme was explained. They were given a CD containing the PowerPoint presentation described above and asked to spend at least several hours studying the information on the websites and practicing categorising the photographs and recording their responses on record forms.

2.1.2 Phase 2

Approximately one week later the observers returned to the ARRB offices. They were then exposed to the remaining (64) previously unseen photographs presented at a rate of two per minute and asked to fill out record forms in the appropriate manner for each photograph.

The results of the phase 2 test are shown in table 1.

Table 1 Observer Accuracy

Observer number	Accuracy (% correct)		
	Restraint use	Sex	Age
1	98.4	100	93.8
2	100	100	92.2
3	95.3	100	96.9
4	96.9	100	90.6
5	65.6	96.9	70.3
6	100	98.4	85.9
7	95.3	100	84.4
8	98.4	100	81.3
9	96.9	98.4	93.8
10	68.8	93.8	75.0
11	100	100	82.8
12	96.9	100	89.1
13	96.9	98.4	87.5
14	100	98.4	93.8

Of the 12 potential observers who attended the phase 2 session, 10 exceeded the criterion of 95% accuracy for the restraint use category. The two who did not achieve this criterion (observers 5 and 10) had scores well below 95% (68% and 65%). As a consequence they were asked if they would prefer to participate in a different study, which they accepted.

Unfortunately, but not unexpectedly, while responses in the *restraint use* and *sex* category were highly accurate, responses in the *age* category were less accurate, dropping to around 70% in some cases. Despite the fact that this accuracy level was well below that which was considered desirable it was decided not to attempt any ameliorative action at this stage for several reasons. Firstly, it was obvious that errors in this category were, almost universally, the result of responding with an adjacent age category. Secondly, the errors were consistent across observers. For this reason it was decided to test the reliability of responding in the field before any decision was made to institute remedial strategies.

2.2 Field Pilot

Following successful completion of phase 2 the observers were taken out into the field in groups of four for the field pilot. Initially each group conducted observations of vehicles exiting a car park feeder road onto a main road during daylight hours (between 3.30 and 5pm). Observations of eighty vehicles were conducted. Observations were recorded and carefully numbered so that responses could be compared across observers.

Following the daytime task observers paired up and repeated the procedure during the hours of darkness at a convenient location. Three sites were utilised: the intersection of South Street and Murdoch Drive in Murdoch, the entry to the Kardinya Park shopping centre on South Street in Kardinya, and the entry to the Caltex service station on Vincent Street in Leederville. Two pairs of observers were assigned to each site.

Before conducting the field pilot a job safety analysis was conducted and the issues raised discussed in detail with the observers. Issues discussed included appropriate attire, personal safety and how to choose a safe vantage point for observation.

A field manual was also produced and distributed to all observers to peruse well in advance of the field pilot. This provided background information on the study and covered practical methodological issues and protocols to be followed in the field.

2.2.1 Field Pilot Results

Inter-rater reliability was assessed by calculating agreement across observers. Any disagreement on any of the observation dimensions for any occupant in any vehicle was counted as a disagreement and hence resulted in a reduction in the amount of agreement between observers.

Daytime Results

Two measures were calculated. Firstly, the agreement across all pairs in each group of four observers was calculated. In all cases the pair-wise agreement exceeded 85%, varying between 87% and 95%, depending on the pair of observers being compared. Secondly, the agreement across all four observers in a group was calculated. For all three groups the agreement exceeded 85%. The average level of four-way agreement was 86.7%. The pair-wise agreement for each pair of observers within each group is shown in table 2 below.

Table 2 Pair-wise Comparisons within each Group

Observer group	Pair-wise comparison (% agreement)					
	1	2	3	4	5	6
1	95.3	95.3	92.2	93.8	93.8	92.2
2	87.5	90.1	95.3	89.1	89.1	87.5
3	90.1	90.1	92.2	90.1	93.8	92.2

Night time Results

The agreement between each pair of observers at each of the three sites is shown in table 3 below.

Table 3 Observer agreement at each of the night time sites

Site	Agreement (%)	
	Pair 1	Pair 2
Murdoch Drv, South St	43.5	46.9
Kardinya Park	64.1	62.5
Caltex, Leederville	71.9	70.3

Observations after dark proved to be substantially less reliable than daytime observations. In some situations with standard street lighting it proved very difficult to observe the relevant variables. Agreement under these circumstances dropped as low as 43% for one pair of observers at one site (Murdoch Drive and South Street intersection). For this reason observers conducted observations at service stations and similar locations that had much greater levels of illumination. Agreement under these circumstances varied between 63% and 72%, with an average of 67%. It was noted by observers (and apparent in the data) that the rear passenger on the driver's side was particularly difficult to see at night.

2.3 Survey Methodology

Trained observers arrived at a site in time to follow the observation schedule for that site. Observers were equipped with pencils, clip boards, stopwatches, maps and schedules and record forms.

They stood on the side of the road observing oncoming traffic in the lane closest to themselves as it approached a traffic light or stop sign or entered a car park or service station.

Observers recorded information in half-hour blocks that began and ended on the hour or half-hour. If there was more traffic passing the observation point than could be dealt with, observers spent the first 5 minutes of each half-hour block simply counting the number of vehicles passing the observation point. In the remaining 25 minutes observers observed vehicles at a rate that allowed all the relevant variables for each vehicle to be recorded. If it was possible to record all the required information for every vehicle passing the observation point then observers observed and recorded information for every vehicle for 25 minutes. Time, date and location information was also recorded for each half-hour block.

Seven restraint usage categories were employed: 1 Correctly used; 2 Incorrectly used (including incorrect restraint type for age/size); 3 Available, not used; 4 Available, unsure whether used; 5 Not available; 6 Unsure if available, not used; 7 Unsure if available, unsure if used. The criteria for assignment to these categories was explained in the training sessions and is derived from advice provided on the following websites:

http://www.afp.gov.au/afp/page/Prevention/RoadTrafficSafety/RoadSafety/SafetyRestraintsKids.htm

http://www.roadsafety.qld.gov.au/qt/LTASinfo.nsf/index/rs_restraints_choosing

http://www.atsb.gov.au/public/pdf/child_restraints.pdf

http://motoring.racv.com.au/peacemind/safety/children/step4.cfm

While seven categories were employed during the observations, in practice it was found that 3 categories accounted for almost all observations. Briefly, **1 Correctly used**, meant age appropriate restraint correctly fitted and fastened; **2 Incorrectly used**, meant incorrectly fastened or age inappropriate restraint; and **3 Available, not used**, meant that no restraint was used, despite some kind of restraint being available. It should be noted that a category 2 assignment for a child is not necessarily equivalent to a violation of the road traffic code as the code does not require that an age-appropriate restraint be used unless the child is under 12 months old.

Random unannounced spot checks were regularly made on metropolitan observers by the survey supervisor during the course of the survey. These occurred frequently early on in the survey (usually once per day) but declined in frequency as the survey progressed. This allowed any problems or misunderstandings to be identified early on. Indeed, only a few minor misunderstandings were evident (mostly about where to stand at particular sites) and there was no evidence of any major misunderstandings or failure by observers to attend the survey sites during the course of the survey.

Because of the remote locations involved it was not possible to provide such spot checks on regional observers. However regular phone contact was maintained with regional observers and they usually received a phone call from the survey supervisor once per day. Furthermore, regional observers were supplied with an ‘all-hours’ number to contact the survey supervisor so that any problems could be resolved immediately without compromising the integrity of the observation schedule. In fact, few problems occurred, with most of the issues revolving around the suitability of observation sites, as noted earlier. These problems were resolved rapidly and satisfactorily, prior to the scheduled observation times.

3 RESULTS

3.1 Preliminary Data Processing

As discussed previously, at sites where the rate of traffic flow exceeded the ability of observers to record the data for each and every vehicle a simple count of eligible vehicle numbers was made for the first 5 minutes of each half-hour observation period. This information was utilised to estimate the actual (rather than observed) numbers of instances of the different categories of information at that site during the observation period.

Essentially, the five-minute count at each of these sites was used to estimate the traffic flow and number of occupants in each category by multiplying the five-minute count by 5 (i.e. to obtain an estimate of the 25-minute numbers). This product was then divided by the actual numbers of vehicles observed at each site to produce a weighting factor for that site. The weighting factor was then multiplied by the actual numbers in each category of observation to yield the weighted N (number of occupants) for those variables at that site.

3.2 Overall Restraint Use

A total of 35,713 vehicles and 55,913 occupants were observed during the course of the survey. When appropriately weighted, in the manner outlined above, this produced an estimate of 61,623 vehicles and 97,118 occupants passing the observation points during the course of the survey. All subsequent analyses are based on the weighted numbers.

The overall rate of correct restraint usage, calculated over all locations and observation periods, was 96.28%.

3.3 Location

Data from all locations were grouped according to the Main Roads Regions. These results are shown in Figure 1 below.

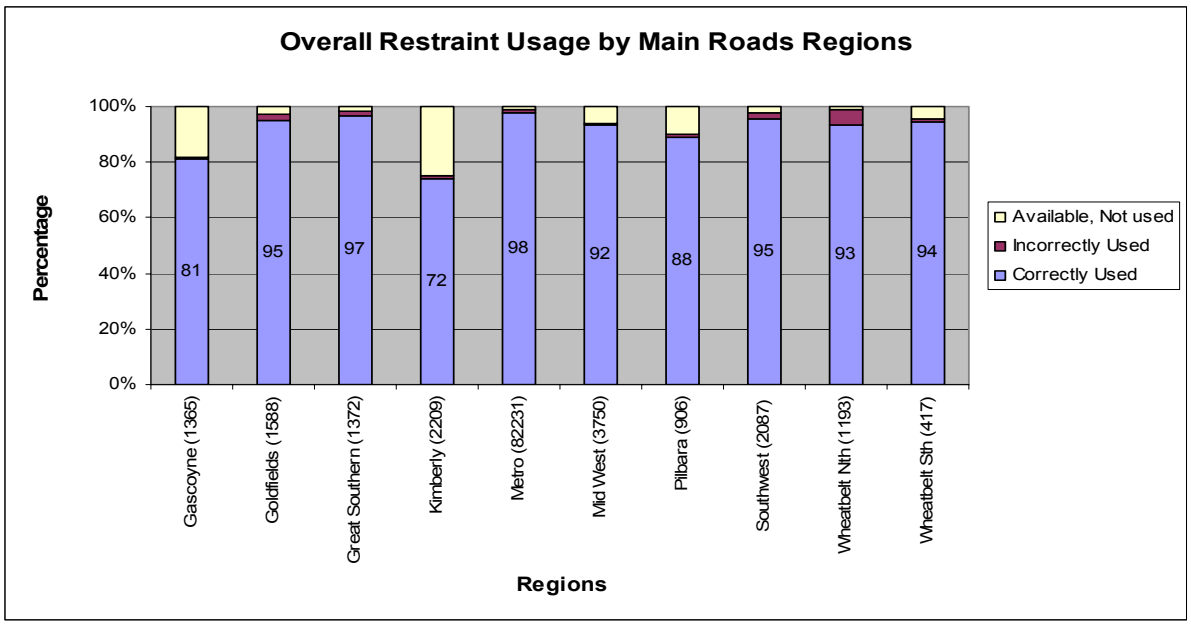

Figure 1 Restraint usage in each of the Main Roads regions (N's in parentheses)

As can be seen, although the overall rate of correct restraint usage in Western Australia is high (i.e. around 96%), in some regions of the state the rate is considerably lower. Indeed, in the Kimberly region the rate of correct usage is only 72%. Interestingly, this low rate of correct usage appears not to be a consequence of incorrect use or the unavailability of restraints in vehicles in this region, but rather a genuine disregard for, or lack of awareness of the road traffic code, in that the balance of observations indicated non usage of restraints even when appropriate restraints were available.

3.4 Age

Usage rates for the different age categories are shown in Figure 2 below. As can be seen, there is a very low rate of correct restraint usage for ages 1 to 4 and ages 5 to 11.

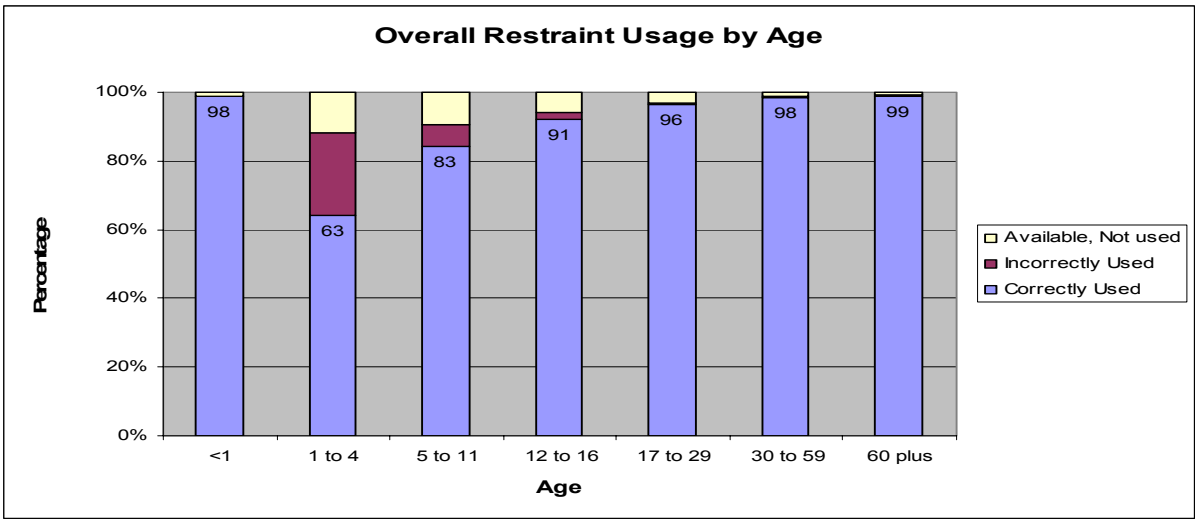

Figure 2 Overall restraint usage rates for different age groups

Interestingly, while the general pattern of age related restraint use remains the same across both the school term and school holiday periods, as can be seen from Figure 3, the rate of correct restraint usage appears to improve for some ages in the school holiday period compared to the non school holiday period. This is particularly marked for the 1 to 4 age range which showed a 7% increase in correct usage in the school holiday period, more than twice the increase of any other age category.

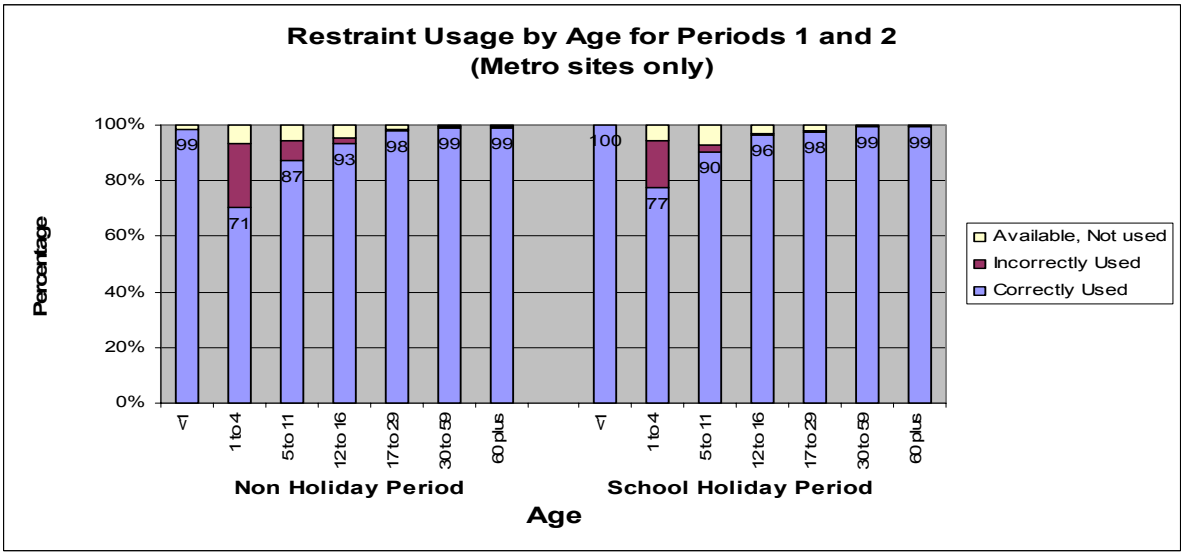

Figure 3 Restraint usage for different age groups across periods 1 and 2

3.5 Age and Gender

As can be seen from

Table 4 below there are some differences between males and females for particular age groups.

Table 4 Restraint usage for males versus females by age group

Age	Gender	Restraint Usage (%)		
		Correctly Used	Incorrectly Used	Available, Not used
<1	Male	99.42	0	0.58
	Female	98.64	0	1.35
1 to 4	Male	58.44	24.79	16.76
	Female	68.62	23.57	7.81
5 to 11	Male	81.99	7.42	10.58
	Female	86.29	5.89	7.81
12 to 16	Male	91.39	1.91	6.71
	Female	93.21	1.59	5.19
17 to 29	Male	95.86	0.58	3.56
	Female	96.89	0.62	2.49
30 to 59	Male	98.34	0.25	1.41
	Female	98.83	0.29	0.87
60 plus	Male	98.83	0.06	1.11
	Female	98.67	0.71	0.61

This is most dramatic for the 1 to 4 age group with correct wearing rates for boys being approximately 10% lower than for girls of the same age.

3.6 Occupant Contingencies

The current study shows an effect of the drivers restraint use on passenger restraint use. When the driver failed to use an appropriate restraint the probability of at least one passenger also failing to use an appropriate restraint was 0.67. On the other hand, when at least one passenger failed to use an appropriate restraint the probability of the driver also failing to use an appropriate restraint was only 0.24. Hence, driver non-use was a good predictor of passenger non-use, but not vice versa.

This effect appears to be modified by the gender of the driver. While the probability of at least one passenger failing to use an appropriate restraint when the driver failed to use an appropriate restraint is 0.64 when the diver is male, it jumps to 0.78 when the driver is female. Hence, driver non-use was a stronger predictor of passenger non-use when the driver was female than when the driver was male.

One explanation for this gender difference may be that the passengers in a vehicle are more likely to be children when the driver is female. Presumably children are less likely to be able to make the decision to employ appropriate restraints and thus should be more likely to be affected by the attitude and restraint usage of the adult driver. Consistent with this speculation, in those cases where both the driver and at least one passenger were not appropriately restrained, 54% of the passengers were children (0 to 16) when the driver was female, but only 26% were children when the driver was male.

4 DISCUSSION

The overall rate of correct restraint usage across Western Australia is estimated to be 96.28%. This appears to be somewhat higher than the previous most recent estimate of state-wide restraint use (Roadwise, 2000) which provided an overall wearing rate estimate of 92%.

It is not clear whether true wearing rates have actually changed from 2000 to the present as the Roadwise study was based on a much smaller and less representative sample (1,332 occupants in total) than the current study. In addition, observers in that study may not have been as rigorously trained as those in the current study. As a consequence those results may not have been as accurate an estimate of state-wide restraint use at that time.

A state-wide observational survey in Queensland in 1997 also provided an overall estimate of correct restraint wearing of 92% (RACQ, 1998). This survey was much larger (around 14,000 occupants) and hence would be expected to be more reliable than the Roadwise survey in Western Australia in 2000. An observational survey by the Monash University Accident Research Centre in 2001 (MUARC, 2003) found a correct restraint usage rate of around 92%.

This survey was based on approximately 6,500 occupants but was restricted to only five sites in Melbourne. Finally, a state-wide observational study in NSW in 2003 yielded a correct restraint use rate estimate of 96.7% (RTA, 2003). Like the current survey this study covered both metropolitan and regional centres and consisted of observations of a large number of vehicle occupants (47,273).

It is unclear from these findings whether the estimated usage rate in Western Australia deriving from the current study reflects an increase in correct restraint usage over the past 5 years. What is clear is that the overall correct restraint usage rate in Western Australia at this time is very high. Less certain, but probable is that it is higher than it has ever been, and perhaps higher than Queensland and Victoria, and similar to NSW. It is certainly well above the usage rates observed in the United States. The most recent survey in Michigan, for example, yielded an estimate of overall correct restraint usage of around 84% (UMTRI, 2003). This relatively low rate exists despite the (recent) change permitting primary enforcement of restraint use in that state.

In the current study only 63% of 1 – 4 year olds were correctly restrained. For 5 – 11 year olds it was 83% and for 12 – 16 year olds it was 91%. In very few cases were these low usage rates a consequence of the unavailability of appropriate restraints. Most frequently lack of correct restraint use was observed to be incorrect use, but it was also surprisingly frequently a case of non use even when a restraint of some kind was available. This non use despite availability was most striking for 1 – 4 year old boys who had non usage (Available, Not used) rates of 16%, double that for girls in this age category. One likely explanation for this gender difference is that boys are more likely to resist or subvert correct restraint usage. If correct this suggests that there are important issues of parental control involved in increasing appropriate child restraint usage, particularly with boys. Interestingly, the rate of correct restraint usage for children increased substantially during the school holiday period, especially for this 1 – 4 year old age group. Again, this focuses attention on parental control issues. During school holidays parents may be less likely to be working and hence less rushed and perhaps more aware and more focused on their children.

A second area of concern is the low rate of correct restraint usage in some regional locations. The Kimberly region had the lowest rate of correct restraint usage at 72%, around 15% lower than the state average. Also notable for the low rate of correct restraint usage was the Gascoyne (81%) and the Pilbara (87%). Some regional towns had very low rates of correct restraint usage. Marble Bar had a correct restraint usage rate of 53%, Halls Creek 56% and Fitzroy Crossing 63%.

In conclusion, while the overall rate of restraint use in Western Australia is very high at this point in time, there are major areas of concern. In particular, some regional areas have very low rates of restraint use. While these areas are currently targeted by mass media campaigns it appears that they could benefit from additional interventions designed to increase usage rates. In addition, there may also be value in conducting additional surveys and interviews that attempt to understand the reasons why restraint usage rates are so low in some regional areas. Children, especially in the 1 to 4 year old age group are disturbingly frequently not correctly restrained. This suggests that there would be

enormous value in exploring the restraint usage of children in more depth, perhaps in a survey that contained an interview component. This could provide valuable lessons as to how and why children are so frequently incorrectly restrained and inform interventions and campaigns designed to increase child restraint use.

REFERENCES

Legge M., Gavin A., Cercarelli R. (2004). Reported Road Crashes in Western Australia 2001. Road Safety Council of Western Australia.

Roadwise (2000) Vehicle Occupant Restraints Taskforce restraint use study.

RACQ (1998) Seatbelt wearing survey. Traffic and Safety Department.

MUARC (2003) Establishing a benchmark of safety on Melbourne roads during 2001. Monash University Accident Research centre. Report No. 198.

RTA (2003) Seatbelt and child restraint usage in NSW July 2003. for the Roads and Traffic Authority, by Tavener Research Company.