A CROSS SECTIONAL OBSERVATIONAL STUDY OF CHILD RESTRAINT USE IN QUEENSLAND FOLLOWING CHANGES IN LEGISLATION

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ABSTRACT

As part of an evaluation of the 2010 legislation for child vehicle occupants in Queensland, road-side observations of private passenger vehicles were used to estimate the proportions of children 0-under 7 years travelling in each of the 5 different restraint types (eg. forward facing child restraint). Data was collected in 4 major population centres: Brisbane, Sunshine Coast, Mackay and Townsville. Almost all children were restrained (95.1%, 95% CI 94.3-95.9%), with only 3.3% (95% CI 2.6-4.0%) clearly unrestrained and 44 (1.6%, 95% CI 1.1-2.1%) for whom restraint status could not be determined ('unknown'). However, around 24.0% (95 CI 21.8-26.2%) of the target-aged children were deemed inappropriately restrained, primarily comprised of 3-6 year olds in seatbelts (18.7% of the 0-6 year olds, 95% CI 16.3-21.1%) or unrestrained (3.7% of the 0-6 year olds, 95% CI 2.5-4.9%) instead of booster seats. In addition, compliance appeared significantly lower for some regional locations where the proportion of children observed as completely unrestrained was relatively high and of concern.

INTRODUCTION

Surveys of restraint use in Australia have shown consistently high levels of compliance over the past three decades, with recent figures indicating that compliance is in the order of 95-99% for all occupants. However, prior to 2010, legislation for children's restraint only specified the type of restraint that should be worn for infants under 12 months of age: these children were required to use an Australian Standards approved (AS/NZS1754) restraint [1]. For children of this age, approved restraints incorporate a 6-point internal harness and are secured to the vehicle by both an adult seatbelt passed through the frame of the restraint and a top tether attached to an anchor point, generally located in the rear of the vehicle (Australian Design Rules govern where these anchor points may be located). For newborn babies, restraints face rearwards until the child outgrows the specification for the restraint (approximately corresponding to 6-12 months old depending on the restraint). Once this occurs, and the baby can support his or her head reliably, a forward-facing restraint can be used.

Before amendments to the pre-2010 legislation, it was perfectly legal for a child of 12 months old or more to be restrained in an adult seatbelt. However, research has consistently demonstrated that restraints specifically designed for children are very effective in reducing injury and death [1-7] and that children are better protected when they wear these restraints rather than adult seatbelts [8-11]. Fortunately, even though not mandated at the time, it was common practice in Australia for children 3 years and under to be restrained in child restraints [12-14]. Once past this age, studies in NSW, South Australia, Victoria and Queensland suggested that a large proportion of children were restrained in adult belts rather than dedicated restraints [12-17].

In recognition of this gap between the legislation and optimal protection, the National Transport Commission (NTC) amended the Australian Road Rules in 2009 to specify that child restraints should be used until children are at least 7 years old. Moreover, the type of restraint required and the seating row was also specified according to age in these new rules. From late 2009 to the end of 2010 all States and Territories in Australia, with the exception of the Northern Territory, enacted legislation that incorporated these new child restraint requirements. For Queensland all child passengers have been required to use a dedicated child restraint until at least age 7 years old since March 2010. Table 1 sets out the types of restraints required for each child age. As can be seen, after children outgrow the rear-facing infant restraint, the next type of restraint is a forward facing child seat. Children must use these until at least 4 years old, at which time booster seats become the age-appropriate restraint. Booster seats are required until children are at least 7 years old, when seatbelts can then be used. Rear seating is also required until children are aged 7 years, although in situations where the rear seats are all occupied by other children under 7 years, a child can travel in the front seat if aged at least 4 years old. The legislation recognises that a very small proportion of children may be too big for the age-appropriate restraint and in these circumstances, a child can be restrained in the next-sized restraint.

In order to assess the extent to which parents were complying with the new legislation as well as to gauge the level of parental understanding of the purpose for the changes and support for these, an outcome evaluation was conducted approximately 18 months after the new laws were in place. The evaluation consisted of three studies, including the observational study to determine the level of compliance with the new legislation. This paper focuses primarily on the results from this observational study. Results of a second study using parent intercept interviews is reported in [19] and the interested reader is referred to this.

METHOD

Road-side observations of vehicles carrying child passengers were carried out in four major population centres of Queensland. These were Brisbane, the Sunshine Coast, Mackay and Townsville. Brisbane was divided into north and south for the purposes of ensuring that observations included a wider spread of the city. Suitable suburbs within each population centre were identified based on Australian Bureau of Statistics (2006) census data relating to two criteria: couple family income ≤ AUD$1400 per week; and at least 15% of residents aged under 15 years old. As the design of the evaluation included parent intercept interviews, and it was desirable for these to be conducted in the same suburbs as those for the observations, a third criterion was whether medium-large shopping centres in these suburbs were willing to grant permission for the researchers to approach parents within their precincts. Hence, while a fairly large pool of potential suburbs was generated for Brisbane North, Brisbane South, and the Sunshine Coast, in practice, consent to the study was only granted by a few shopping centre managers, thus limiting which suburbs were eventually included in the study. Table 2 details those suburbs where observations were carried out.

Observation sites were chosen close to primary schools and medium-large shopping centres as these were deemed likely to have high volumes of child-related travel and thus be cost-effective for data collection. Specific schools within or close to the selected suburbs were chosen on the basis of enrolments levels (≥ 200 students) as indicated by the Queensland Schools Directory on the website for Education Queensland. For the Sunshine Coast and Mackay, due to there being fewer schools with sufficient enrolments, some of the schools chosen were located 10-15 minutes drive from the shopping areas where the interviews were conducted. In addition, for Mackay, a single data collection session was conducted in Sarina, a town of approximately 3200 people, located about 35 kilometres south of Mackay. This was because the demographic information from parents participating in the interview study in Mackay revealed that a proportion were residents of Sarina who regularly travel to Mackay to shop.

Table 1: Rules for persons travelling in or on vehicles (as specified in Transport Operations (Road Use Management-Road Rules) Regulation 2009 Part 16: Rule No. 266: Wearing of seatbelts by passengers under 16 years old) [18]

Rules for the types of restraints to be worn (according to the child's age)	
< 6 months	child must be restrained in a suitable and properly fastened and adjusted rearward facing approved child restraint
6 months – < 4 years	child must be restrained in a suitable and properly fastened and adjusted: rearward facing approved child restraint; or forward-facing approved child restraint that has an inbuilt harness
4 years – < 7 years	child must be: restrained in a suitable and properly fastened and adjusted forward-facing approved child restraint that has an inbuilt harness; or be placed on a properly positioned approved booster seat and be restrained by a seatbelt that is properly adjusted and fastened
Seating positions rules	
< 4 years	child must not be in the front row of a motor vehicle that has 2 or more rows of seats
4 years –< 7 years	child must not be in the front row of a motor vehicle that has 2 or more rows of seats unless all of the other seats in the row or rows behind the front row are occupied by passengers who are also under 7 years old

Trained observers worked in pairs and stationed themselves on the footpath at places where traffic was forced to slow down (e.g. corners) or stop (e.g. traffic lights) and where they could clearly see into the vehicles. In order to reduce the possibility of counting vehicles more than once around schools, an assumption was made that parents would use the same pick-up/drop-off point for their children each day and thus data was only collected for each school entrance only once. Sessions were conducted around schools at the typical school day commencement and closing times, 8:15-9am and 2:30-3:30pm. Around shopping areas, sessions were carried out between 9am and 10:30am when child passenger traffic is highest. Observers were instructed to include only private passenger vehicles (i.e. no taxis, buses, mini-buses or vans) with a rear seat (not utilities/pick-up trucks) and carrying child passengers. In order to ensure that drivers were free to choose where the child was seated, only vehicles with no adult front seat passenger were included. For sites where vehicles were moving, both observers collected data on each vehicle and verbally verified the details with each other for each observation. Where vehicles had more than one row of rear seats, one observer collected the data for the front and middle row, while the other collected data for the subsequent row(s). Where the observers disagreed about what they had observed, the vehicle was excluded from the collection. For situations where traffic was forced to stop, observers were able to collect data on separate vehicles (e.g. standing on opposite sides of the road and observing traffic in opposing directions of travel) by walking up and down past the stationary vehicles. In practice, due to the high prevalence of vehicles with very darkly tinted windows or window 'socks', and the difficulty of making accurate observations when these vehicles were moving, the majority of observations were taken where traffic was forced to stop. Thus observers could spend more time on each observation and be reasonably certain that the data captured was accurate.

Data was recorded for each child passenger's seating position (front, rear), estimated age (based on baby length or child's seated height, ≤ 6 mths, 7 mths-2 years, 3-6 years, 7-12 years), and the type of restraint worn. Restraint types were categorised as rear-facing infant restraint, forward facing child seat, high-backed booster seat, seatbelt, 'unknown', or unrestrained. Children were only categorised as 'unrestrained' where the observer could clearly see that the child was not wearing a restraint (e.g. the child was standing up, sitting on an adult's lap, sitting in the middle of the two front bucket seats). Where the observer could not see the restraint (e.g. a child sitting in the middle rear position in a lap-only belt), but could not clearly see that the child was unrestrained, the category 'unknown' was used to denote this. As the legislation specifies that 3 year old children should be restrained in a forward-facing child seat until they are at least 4 years old, it would have been ideal for the age groupings match these requirements. However, though in practice it was fairly easy to distinguish between a child under 2 years and those 3 years and over, it was too difficult for observers to distinguish between a 3 year old and a 4 year old child with a high degree of confidence. Accordingly, they were instructed to use the 3-6 year age grouping instead of 4-6 years.

Table 2: Cities and suburbs selected for collection of the observations (children's restraints and seating positions)

City	Suburbs	Number of vehicles observed (number of child passengers observed)
Brisbane North	Aspley Bald Hills Bracken Ridge Brookside Keperra Mitchelton	293 (419)
Brisbane South	Acacia Ridge Algester Calamvale Inala Forest Lake	512 (713)
Sunshine Coast	Maroochydore Mudjimba Moolooaba	462 (668)
Mackay	West Mackay Sarina	354 (526)
Townsville	Heatley Vincent	294 (458)
	Total	1915 (2784)

RESULTS

Across the four cities, a total of 1,915 vehicles carrying 2,783 child passengers were observed. Almost two thirds (62.7%) of the vehicles carried only 1 child passenger, with 30.8% carrying two children and 6.5% carrying 3 or more. About half the sample of children were estimated as aged 6 years and under (1,419, 51%) and the remaining children as aged 7-12 years (1,364, 49%). Around one third (611, 31.9%) of the observed vehicles had a child passenger in the front seat. The majority

of these were estimated as aged 7-12 years (542, 88.1%), though there were 69 children estimated as aged 3-6 years, and 3 children estimated as aged under 2 years, seated in the front seat.

Almost all children were restrained (2644, 95.1%, 95% CI 94.3-95.9%), with only 93 (3.3%, 95% CI 2.6-4.0%) children clearly unrestrained and 44 (1.6%, 95% CI 1.1-2.1%) for whom restraint status could not be determined ('unknown'). Consistent with similar studies, the most common type of restraint used was an adult seatbelt, with more than half of the 0-12 year old children (1470, 52.8%) restrained in these regardless of seating position.

Overall, 22.0% (615/2783) of the children were seated in the front seat, with 543 of these aged 7-12 years (39.8% of the children in this age group, 95% CI 37.2-42.4%), and 72 aged 0-6 years (5.1% of this age group, 95% CI 4.0-6.2%). As might be expected, almost all of the children seated in the front seat were restrained in seatbelts, though there were 13 children observed using dedicated child restraints. For children seated in the rear seat, more than half wore dedicated child restraints (1161, 53.6%) with the most common being forward facing child seats (639, 29.5%) followed by booster seats (470, 21.7%) and rear-facing infant restraints (41, 1.9%), with a few children (11, 0.5%) restrained in a child H harness (4-point restraint). For 42 (1.9%) children the type of restraint could not be determined and a larger proportion (82, 3.8%) were clearly unrestrained. Table 3 summarises these results.

Table 3: Types of restraints worn and seating positions by estimated age group of child

	Child's estimated age				
Restraint type	0-6 mths	7 mths-2 yrs	3-6 yrs	7-12 yrs	Totals
Front seat					
Rear-facing infant restraint	1	-	-	-	1
Forward facing child seat	-	-	2	-	2
Booster seat	-	-	7	3	10
Seatbelt	-	1	55	531	587
Unknown	-	-	3	1	4
Unrestrained	1	-	2	8	11
					Total 615
Rear seat					
Rear-facing infant restraint	38	3	-	-	41
Forward facing child seat	8	367	263	1	639
Booster seat	1	5	356	108	470
H harness	-	-	7	4	11
Seatbelt	-	1	211	671	883
Unknown	-	3	32	7	42
Unrestrained		1	51	30	82
					Total 2168
Totals	49	381	989	1364	2783

Children under 7 years

As the legislation applies to the types of restraints for children under 7 years, the remainder of the analyses will refer only to the children in this age group. For these children, most were seated in the rear seat (1347, 94.9%, 95% CI 93.5-95.9%). A primary interest was whether children were restrained in the type of restraint specified for age under the legislation, and seated in the rear seat as required. Accordingly, each observed child estimated as aged 0-6 years (n = 1419) was given a code of 'Appropriate' or 'Inappropriate' based on the combination of observed restraint type and seating position. Thus infants estimated as aged 0-6 months were deemed appropriately restrained if they were in the rear seat and using a rear-facing infant restraint or capsule. Children estimated as aged 7 months to 2 years were deemed appropriately restrained if they were in the rear seat and using a forward-facing child seat, or a rear-facing child restraint. Children estimated as aged 3-6 years were deemed appropriately restrained if they were sitting in the rear seat and using either a forward-facing child seat, a booster seat or an H harness. The legislation allows for children aged 4-7 years to occupy front seats if all rear seats are already occupied by other children aged under 7 years. Only 7 vehicles in this study carried 4 or more child passengers, and thus may have necessitated a child seated in the front seat. However, all had more than two rows of seats and none were observed with a child seated in the front row.

Overall, 1041 (73.3%, 95% CI 71.0-75.6%) of the under 7 year old children were categorised as 'Appropriately' restrained, while 340 (24.0%, 95 CI 21.8-26.2%) were deemed 'Inappropriately' restrained and for 35 (2.7%, 95% CI 1.9-3.5%) children restraint status could not be determined. Chi square analyses revealed that the number of children in the vehicle (1-2 children versus 3 or more children) did not appear to affect whether a 0-6 year old child was seated in the front seat χ^2 (1) = 1.52, p = .218 (data not shown). Similarly, no statistically significant differences were found between the different locations for whether a child aged 0-6 years was seated in the front seat (χ^2 (4) = 7.12, p = .130), with over 90% of vehicles in each location not carrying a child of this age in the front seat (data not shown). The mean proportion of vehicles with a child aged 0-6 in the front seat was 5.6% (range 3.6% in Townsville, to 8.5% in Mackay).

However, differences were found for location in terms of the number of child passengers in the vehicle. Children aged 0-6 years that were observed in Mackay were more likely to be travelling in a vehicle carrying three or more children, while children observed in Brisbane South were less likely to be travelling in vehicles with three or more children (see Table 4).

Table 4: Number of vehicles (%) carrying either 1 or 2 children, or 3 or more children (0-6 years only) by location

Location	1 or 2 child passengers n vehicles (%)	3 or more child passengers n vehicles (%)	
Brisbane North	204 (90.3)	22 (9.7)	
Brisbane South	381 (91.1)	37 (8.9)[a]	
Sunshine Coast	302 (84.4)	56 (15.6)	
Townsville	193 (86.2)	31 (13.8)	
Mackay	159 (80.7)	38 (19.3)[a]	χ^2 (4) = 7.12[b], p = .002, φ_c = .11[c],

[a] These cells had a major contribution to the chi-square result (standardised residuals +/- 1.96)
[b] Significant > .05
[c] φ_c = Cramer's V for effect size (Small = .1; Medium = .3; Large > .5)

Due to the very small numbers of children using a dedicated child restraint in the front seat, as well as the relatively small numbers of children aged 0-6 occupying front seats, only the data for children in the rear seat was included in more detailed analyses on restraint type and appropriateness. In addition, for these analyses, H harnesses were combined with booster seats, and the 'unknown' restraint category (35 children) was excluded.

Table 5: Number of child passengers in the vehicle by restraint type (0-6 year olds, rear seat only)[a]

	Number of child passengers in the vehicle			
Restraint type	1or 2 children n (%)	3 or more children n (%)	Totals	
Rear-facing infant restraint	40 (3.5)	1 (0.6)	41	
Forward facing child seat	573 (50.1)	65 (38.5)	638	
Booster seat	329(28.8)	39 (23.1)	368	
Seatbelt	153 (13.4)[b]	59 (34.9)[b]	212	
Unrestrained	48 (4.3)	4 (3.0)	52	$\chi^2(4) = 52.70$, $p < .001$, $\varphi_c = .20$[c]
Totals	1143	168	1311	

[a] For number of child passengers in the vehicle, the figures in the table refer only to the 0-6 year olds but the vehicles may have had one or more child passengers aged 7-12 making up the total count of children in the vehicle. 'Unknown' restraint type was excluded; H harnesses combined with booster seats
[b] These cells had a major contribution to the chi-square result (standardised residuals +/- 1.96)
[c] φ_c = Cramer's V for effect size (Small = .1; Medium = .3; Large > .5)

As can be seen in Table 5, the most popular type of restraint for children 0-6 years was a forward-facing child seat (48.7% overall), followed by booster seats (28.1% overall) and seatbelts (16.2% overall). However, the number of children in the vehicle appeared to influence the type of restraint worn, with children in vehicles with 3 or more child passengers more likely to be wearing a seatbelt than children in the vehicles with only one or two child passengers (see Table 5). Consistent with this result, children in vehicles with greater numbers of children were also more likely to be deemed to be inappropriately restrained (37.9%) than children in vehicles with fewer child passengers (18.2%) as displayed in Table 6.

Table 6: Number of child passengers in the vehicle by appropriateness of the type of restraint worn (0-6 year olds, rear seat only)

	Restraint status		
Number of child passengers in the vehicle	Inappropriate n children (%)	Appropriate n children (%)	
1 or 2 children	208 (18.2)	936 (81.8)	
3 or more children	64 (37.9)[a]	105 (62.1)[a]	$\chi^2(1) = 34.75$, $p < .001$, $\varphi_c = .16$[b]

[a] These cells had a major contribution to the chi-square result (standardised residuals +/- 1.96)
[b] φ_c = Cramer's V for effect size (Small = .1; Medium = .3; Large > .5)

Results of comparisons of restraint type and appropriateness for location revealed that children observed in Mackay were more likely to be restrained in a seatbelt (26.8%, 95% CI 20.2-33.2%) or to be unrestrained (7.8%, 95% CI 3.9-11.7%) compared to children who were observed in the other locations χ^2 (16) = 55.29, $p < .001$, $\varphi_c = .21$ (φ_c = Cramer's V for effect size (Small = .1; Medium = .3; Large > .5, see Table 7). Results for appropriateness of the restraint type for age were similar, with children observed in Mackay (34.6%, 95% CI 27.6-41.6%) more likely to be deemed inappropriately restrained than children observed in the other locations (see Table 8).

Table 7: Number of children restrained in each type of restraint by location (0-6 year olds, rear seat only)

	Restraint type				
Location	Rear facing n (%)	Forward-facing child seat n (%)	Booster seat n (%)	Seatbelt n (%)	None n (%)
Brisbane North	6 (3.0)	107 (53.8)	47 (23.6)	37 (18.6)	2 (1.0)[a]
Brisbane South	14 (3.6)	194 (50.0)	96 (24.7)	69 (17.8)	15 (3.9)
Sunshine Coast	15 (4.5)	160 (47.9)	108 (32.3)	39 (11.7)	12 (3.6)
Townsville	4 (1.9)	106 (49.8)	73 (34.3)	19 (8.9)[a]	11 (5.2)
Mackay	2 (1.1)	71 (39.7)	44 (24.6)	48 (26.8)[a]	14 (7.8)[a]

[a]These cells had a major contribution to the chi-square result (standardised residuals +/- 1.96)

Table 8: Appropriateness of children's restraints for age by location and number of children in the vehicle (0-6 year olds, rear seat only)

	Appropriateness of restraint for age		
	Overall[b]	1 or 2 child passenger vehicles[c]	3 or more child passenger vehicles[d]
	Appropriate n (%)	Appropriate n (%)	Appropriate n (%)
Brisbane North	158 (79.4)	143 (79.9)	15 (75.0)
Brisbane South	303 (78.1)	287 (80.4)	16 (51.6)
Sunshine Coast	281 (84.1)	240 (86.0)	41 (75.0)
Townsville	182 (85.4)	163 (88.1)	19 (67.9)
Mackay	117 (65.4)[a]	103 (71.5)	14 (40.0)[a]

[a] These cells had a major contribution to the chi-square result (standardised residuals +/- 1.96)
[b]χ^2 (4) = 31.16, $p < .001$, $\varphi_c = .15$
[c]χ^2 (1) = 19.42, p=.001, $\varphi_c = .13$
[d]χ^2 (1) = 14.14, p=.007, $\varphi_c = .29$
where φ_c = Cramer's V for effect size (Small = .1; Medium = .3; Large > .5)

Figures are available from an earlier observational study conducted in Brisbane by the author [14] in 2005. Methods for this earlier study were similar, being road-side observations (made by trained observers) of children's seating positions and types of restraints. Types of vehicles included were the same, and estimates of children's ages were also based on seated height. Categories of restraint were slightly different in the earlier study. In the 2005 study the observed vehicles were not always stationary, and hence distinctions between a forward facing child seat and a high-backed booster seat could not always be made reliably. As a result, these restraint types were collapsed into a single category. Thus it is not possible to make a direct comparison between the two studies in the proportions of children in appropriate restraints. Moreover, the previous study was confined to

Brisbane rather than including other cities. However, the extent to which children 0-6 years were seated in the front seat use and the proportions of these children restrained in dedicated child restraints may be compared. Accordingly, the data for Brisbane children aged 0-6 years were extracted and compared with the figures from 2005.

For the current study, 5.5% (95% CI 3.8-7.2%) of children observed in Brisbane and estimated as aged 0-6 years were observed occupying front seats. In the earlier study this figure was 8.4% (95% CI 6.3-10.5%). Recategorising restraint type for both front and rear seated children into 'dedicated restraint' versus 'not dedicated restraint' for each study yielded 74.8% (95% CI 71.5-78.3%) of the of the 0-6 year old children observed in Brisbane in the current wearing dedicated restraints while for the 2005 study, this figure was 69.7% (95% CI 63.0-73.4%). As can be seen, these results suggest a movement in the desired direction in the current study for both front seating and dedicated restraint use in this age group. However, this difference is not statistically significant.

DISCUSSION

Most of children (0-12 years) observed in this study were deemed to be wearing the restraint required under the legislation for children of their age (84.7%. 95% CI 83.4-86.0%), based on seated height as a proxy for child age, suggesting high levels of compliance with the legislation overall. Consistent with other Australian studies on children's restraint use, [4, 9, 12-14] restraint use for this sample of children was high (95.1%, 95% CI 94.3-95.9%), with only 93 (3.3%, 95% CI 2.7-4.0%) children clearly unrestrained and 46 (1.6%) for whom restraint status could not be determined. Only 22.1% of the 2783 children observed were travelling in the front seat, and most of these (88%) were estimated as aged 7-12 years.

Considering only those children in the age range targeted by the legislation (under 7 years) the results were somewhat less encouraging. Only 73.3% (95% CI 71.0-75.6%)of children estimated as aged 0-6 years were deemed appropriately restrained according to the requirements of the legislation, with 24.0% (95 CI 21.8-26.2%)deemed inappropriately restrained, and 2.7% (95% CI 1.9-3.5%) for whom this could not be determined. While almost all of these children were seated in the rear seat (94.7%, 95% CI 93.5-95.9%), there was a large proportion of 3-6 year olds wearing seatbelts (18.7% of the 0-6 year olds, 95% CI 16.3-21.1%) or unrestrained (3.7% of the 0-6 year olds, 95% CI 2.5-4.9%) instead of using an age-appropriate restraint.

This study does not provide any information about parental reasons for non-compliance with the changes in the legislation more generally. It may be that parents are unaware that changes have been put in place, or they may be misinformed about what the requirements are for children of their own child(ren)'s age(s). It may also be that parents do not regard the changes as applicable to them, or are unconvinced that there is any additional benefit from using a particular type of restraint rather than another type. One explanation for the higher proportion of children aged 3-6 years using adult belts is that parents may believe the child has outgrown the booster seat and can legitimately be moved into a seatbelt. Indeed, an additional possibility is that parents are basing their decisions about the appropriateness of booster seats and transition times on the weight limits specified for this type of restraint under the previous Australian Standard (AS/NZS1754:2004). These specify a weight range of 14-26kg for booster seats, which would lead parents to believe that they *must* progress a child from the booster once he/she reaches 26 kg. As this weight is based on the 50th percentile weight for boys of 7 years given in the Centres for Disease Control US growth charts of 2001 [26], it is likely that, with increasing body mass and prevalence of obesity, many Australian children may exceed this weight earlier than 7 years old. The age basis of the requirements under the new legislation and Standard (AS/NZS1754:2010) targeted this issue. However, if this reason underlies parental behaviour then the problem is likely to persist until the complete phasing out of restraints that comply with the previous Standard (AS/NZS1754:2004).

CONCLUSIONS

Taken as a whole, these results suggest that the legislation may have improved both the extent to which children aged 0-6 years travel in the rear seat and the extent to which they are restrained appropriately for their ages when in the rear seat (though as highlighted previously, in the current study the observations may have overestimated the extent to which 3 year olds were using age-appropriate restraints due to the way that age was estimated for these children). However, in relation to the use of dedicated restraints these improvements might be regarded as modest, amounting to safer travel for an estimated 7-10% of children in the 0-6 years age range targeted by the legislation: one in four children of this age still appears to be inappropriately restrained while travelling in a passenger car.

One concern from these results is that there may be differences in the level of safe travel for younger children depending on the number of children in the car and where children live. Though it affected only a small proportion of the children in this study, the benefits of the legislation appear to be diminished where there are three or more child passengers, with 0-6 year olds much more likely to be restrained in a seatbelt under these circumstances than children who were sole passengers or had only one other child in the car. The proportions of 0-6 year olds deemed to be inappropriately restrained were significantly higher for Mackay compared to the other cities in this study, and this was particularly marked for children observed as completely unrestrained. This non-use of restraints in children may be reflective of the tendency towards lower rates of restraint use among rural populations (compared with urban ones) that has been reported previously [20-21]. The level of children completely unrestrained is of particular concern since previous research in South Australia, Western Australia and Queensland consistently demonstrates that rural and remote crashes are characterized by lower rates of seatbelt use [20-24]. Thus the current results suggest that children in these locations would seem especially at risk. Moreover, in international studies, the driver's use of a restraint has been found to be predictive of whether children are restrained and this pattern is likely to be relevant in Queensland [25]. Accordingly, interventions to improve the rates at which children are restrained may be more effective if they address adult use as well, particularly if the underlying reasons for non-use are identified and targeted. Though it is not possible from observation alone to determine the reasons for the observed differences in patterns of restraint use, the results suggest that further exploration of the factors influencing the restraint of child passengers in Mackay and other more rural locations is urgently needed in order to inform such interventions.

Limitations

Several factors may need to be considered in relation to determining the representativeness of the results reported here. As described above, selection of sites for the observations was dependent to some extent on the availability of shopping centres willing to allow conduct of the interviews for the second study. We cannot be sure what level of bias this may have introduced, as it may be that shopping centres servicing predominantly more disadvantaged families, or with higher proportions of families with larger numbers of children in the target age range, were more cooperative than those in more advantaged areas. The type of travel represented by the sites chosen for the observations (schools and shopping precincts) may also not be representative of other types of travel for children. An additional limitation was the physical difficulties in being able to see the restraints children were wearing. A more careful and expert inspection of children's restraints and their actual use would have been desirable, though clearly much more expensive and difficult to undertake. More careful inspection would also allow conclusions about whether restraints are being used in a safe manner, an issue that has been highlighted as critical in other studies [27-28].

The calculation of proportions of appropriately restrained children in each age group depended heavily on the estimations of age made by observers. As already noted in relation to 3 and 4 year olds, such estimations can be difficult, though observers undertook several practice sessions prior to collecting

data. The level of error introduced by use of this method is also not able to be determined without a more objective measure of age, such as parental report for each child.

Lastly, the figures used for comparative purposes in determining the effectiveness of the legislation were based on observations carried out in Brisbane only. There are no available figures that can act as a baseline for the other population centres used for data collection. Thus for population centres such as Mackay, where compliance levels may be significantly lower than for other locations, it is difficult to tell what the precise effect of the legislation has been since there is no way of determining what the pre-legislation levels of restraint use were. Moreover, the changes may have resulted from other influences rather than form the amendments to the legislation. These points need to be borne in mind when interpreting the findings and their meaning.

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