

Results and Implications of a Survey of Child Restraint Use in South Australia

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ABSTRACT

A survey has been conducted of child restraint use (infant capsules, child safety seats and booster seats) in motor vehicles in the Adelaide metropolitan area. Driver knowledge concerning child restraint use was also studied. A random sample of 31 pre-schools and primary schools was selected. Researchers visited sites on mornings in August 2004, and surveyed 357 drivers who were transporting children aged 0-10 years. Based on common age recommendations, 82% of children were using an appropriate restraint, but based on the weight of the child (a better metric of correct restraint choice), we estimate that the rate of appropriate restraint selection was between 64% and 72%. The rate of inappropriate restraint selection was due largely to children progressing prematurely to an adult seat belt. Children were rarely unrestrained. We conclude that guidelines on child restraint selection need to be clarified. Higher rates of appropriate restraint use may be achieved by carefully reconsidering the weight ranges for each kind of restraint, specified in the Australian and New Zealand Standard, so that age may be successfully used to guide restraint choice.

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INTRODUCTION

The benefits of using child restraints for young children have been documented in the research literature. For example, Winston, Durbin, Kallan and Moll (2000) analysed crash data from insurance companies in the US and telephoned the drivers and parents of child occupants involved in the crashes. Booster seat use for children aged between four and eight years was inadequate. Less than 1% of children greater than five years of age were using a booster seat. Winston et al. concluded that young children were more likely to be injured if wearing an adult belt compared to a child restraint, with an elevated risk for head injury. Furthermore, abdominal injuries (albeit low in frequency) only occurred for children using adult seatbelts. In a later study, Durbin, Elliot and Winston (2003) showed that booster seats were effective in reducing injuries to children in the 4 to 7 year age range. They demonstrated a reduction in abdominal injury and overall, the odds of being injured in a crash for children in a booster seat were estimated to be 56% lower than those restrained by an adult seatbelt alone. It was not clear from the study how injuries of different severity were affected.

Generally, studies have found that a higher proportion of infants are restrained appropriately (in infant capsules) than are older children (in child safety seats or booster seats). As the child ages, compliance with the recommended progression of child safety restraints lessens (Smith and Drummond, 1988). A common finding is that younger children (three years of age) use booster seats more frequently than older children who are an appropriate age to use booster seats (four years and greater) (e.g., Apsler, Formica, Rosenthal and Robinson, 2003; Winston et al., 2000). Ramsey, Simpson and Rivara (2000) found that a common reason that parents did not use booster seats was because they believed that their child (in the three to eight years age range) was too big for them. Of those children in the booster seat age range, only 28% were using booster seats. Parents commonly believed that their child was not in need of a booster seat as the adult seatbelt provided adequate safety. Previous observations of child restraint use have revealed that a high proportion of children are inadequately restrained in South Australia too (Simons and O'Dea 1995; Simons, 1991; Simons, 2000).

The South Australian Department of Transport, Energy and Infrastructure (2000), non government bodies and manufacturers do provide parents with advice on choosing appropriate restraints and this advice is based on the relevant Australian Standard: AS 1754:2004 "Child restraint systems for use in motor vehicles".

The standard defines specific restraint devices and the suitable weight ranges (and for some restraints, length) for each. The normal translation of the Standard into advice suitable for parents takes the form of the weight range for each seat and then, often, a corresponding age range as supplementary advice. These recommendations are summarised in Table 1. Advice often also mentions the size and/or age from which an adult seat belt may be used although this is not dealt with explicitly by the Standard.

Table 1 Australian and New Zealand Standard child restraint specifications and ages often recommended for the restraint

Restraint type	AS/NZS 1754		Age group often associated with restraint
	Weight	Length	
Infant restraint	< 9 kg	< 70cm	Birth - 6 months
Forward facing child seat	8-18 kg		6 m - < 5 y
Booster seat	14-26 kg		3 – < 6 / 8 years (age varies by source)
Harness (only with booster if <26kg)	14-32 kg		

Note: The Department of Transport, Energy and Infrastructure suggests that booster seat use can cease at “about 6 years”, but alternative advice (e.g. leading manufacturer) mentions booster seat use to 7 years. The Royal Automobile Association of South Australia does not make any age-based recommendations at all.

METHOD

The present study attempted to estimate rates of appropriate child restraint selection and child restraint knowledge among drivers in the Adelaide metropolitan area.

The survey was designed to assess the frequency of child restraint use, with a focus on the use of booster seats. Children aged from birth to 10 years were observed arriving by car at pre-schools and primary schools in the Adelaide metropolitan area. After they had been observed, the vehicle driver was asked for some personal details and information about the children that they were transporting, and a few questions about their knowledge and perceptions of child restraints. Full details of the method and the contents of the survey may be found in Edwards, Anderson and Hutchinson (2006).

Approval for this study was granted by the University of Adelaide’s Human Research Ethics Committee, the Department of Education and Children’s Services (DECS) and the Catholic Education Office. Thirty-one sites were randomly selected and attended by CASR research officers during August 2004. The sites consisted of 16 pre-schools or child parent centres, and 15 junior primary or primary schools. CASR research officers approached 427 drivers of vehicles arriving at the designated sites, if the vehicles were carrying at least one child (judged visually to be) 10 years of age or less. In total, 357 interviews were conducted, a response rate of 84%.

The observations and interviews were undertaken on school days, over a four-week period during August 2004. Sites were randomly allocated to a date for data collection, with some exceptions to account for closure days and days when a higher-than-usual influx of arrivals was expected by the school. Data were only collected during arrival times, not when children were being collected, to minimise any situation in which drivers could alter their behaviour as a consequence of being observed. Research officers attended primary schools from approximately 8:15 a.m. and pre-schools from 8:15 a.m. and 11:30 a.m. (to cover both sessions).

Between two and four observers collected the data, depending on the number of children enrolled at the school. The survey was conducted openly, and research officers wore CASR vests to show their affiliation. It was assumed that overt data collection was adequate as those not using child restraints could not alter their behaviour prior to the observations.

The survey covered each driver's knowledge about appropriate transitions from one restraint type to another. Photographs of restraint types were used to avoid any confusion about restraint types being referred to. Responses were recorded word for word. The driver was asked to identify demographic and restraint details for themselves and all children being transported. The driver was asked for the weight and height of children and whether the child was a member of their household and whether they normally transported the child to school.

Each driver was asked questions related to beliefs and attitudes to restraint use and his or her knowledge of the applicable law.

The research officer noted the restraint use of the children and the seatbelt use of the driver as the vehicle approached. The research officer introduced herself or himself, and informed the driver that they were conducting a survey on travelling with children in cars. Drivers who escorted their child into the school or preschool before answering questions were interviewed upon return. Sometimes, it was impossible to observe actual seatbelt use due to height of the vehicle or tinted windows, and restraint and seatbelt use were reported by the participants. Whether occupied or unoccupied, child restraints were directly observed in the vehicles. Drivers who declined participation were noted.

The 357 driver interviews contained information on a total of 586 children in the target age range (birth to 10 years). Observation of restraint use proved to be difficult when vehicles had tinted windows, were high and thus difficult to see into, and when children had removed their restraints, ready to alight from the vehicle. In such instances, there was the need to rely on driver's report of restraint use. Sometimes, self-reported data were corroborated by observation. Of the 586 children, the restraint type available to the child and its actual use was observed in 74% of cases, were reported in 16% of cases, and in the remaining 10% of cases, restraint type was noted but use of the restraint was reported (as the child had already removed it before the observation).

RESULTS

Table 2 shows the percentages of children using each method of restraint, for each of 12 age groups. Table 2 also shows with boxes the age brackets that approximately correspond to weight specifications in AS/NZS 1754:2004. These boxes are based the 50th percentile weights of children of particular ages, and whether or not that weight falls into the specification of the restraint type.

Within each age group we would expect to see a distribution of weight, and consequently a distribution of restraint types. Therefore, the numbers falling within the boxes shown in Table 2 may or may not indicate the extent of appropriate restraint in each age group. Nevertheless, a cursory examination of Table 2 suggests that premature progression to restraints unsuited to the children's age is a characteristic of every age group, and is most prevalent amongst children of late pre-school age and early primary school age. Sizeable proportions of children in each age category were wearing an adult seatbelt only. However, relatively few children in the sample were unrestrained (2% of the sample).

As we have mentioned, age is often used as supplementary advice for restraint selection. However, as will be seen, age was the criterion most often cited by drivers for restraint transition in our survey. In South Australia supplementary age criteria suggest that from birth to 0.5 years, an infant restraint should be used; from 0.5 to less than 5 years of age a forward facing child seat is appropriate; and from greater than 3 to less than 8 years of age (considering advice from manufacturers), a booster seat is appropriate. Some advice could be interpreted as recommending, as appropriate, adult belt use from 6 years of age. As we collected age information in our survey, we can report rates of restraint selection against these age criteria. The result of such a comparison will be shown in Table 4.

Table 2 Percentages within each age group using each method of restraint (N=586).

Age group	Infant capsule	Child seat	Booster seat	Adult belt	None	Count
0-<.5 years	82	18	0	0	0	11
.5-<1 year	0	100	0	0	0	13
1-<2 years	0	84	5	11	0	19
2-<3 years	0	68	29	3	0	38
3-<4 years	0	38	43	17	2	42
4-<5 years	0	9	54	35	2	162
5-<6 years	0	2	32	65	1	91
6-<7 years	0	2	20	75	3	64
7-<8 years	0	0	18	82	0	56
8-<9 years	0	0	4	91	4	45
9-<10 years	0	0	3	97	0	31
10-<11 years	0	0	0	100	0	14
Total %	2	16	29	52	2	
Count	9	91	172	304	10	586

Five children were using a harness in conjunction with an adult seatbelt.

Boxes indicate age-appropriate restraints based on 50th percentile weights for each age, and weights specified in AS/NZS 1754:2004.

Child's weight

For the purposes of this study, we wanted to consider a restraint selection as appropriate, if the child's weight fell within the limits specified by AS 1754. Drivers were asked what were the weights and heights of the children they were transporting. We did not weigh children and only (rarely) measured their height when the driver was unable to offer an answer when questioned.

On examination of the survey data, we concluded that the responses from drivers about the weight and height of their children were too inaccurate to be of use. There were many "outliers" and the distributions at each age did not appear credible. So we used alternative means to estimate rates of weight-appropriate restraint use.

The age of a child can be considered a proxy for the child's weight: by consulting human growth data, we calculated the relative proportions of children in each age category that satisfy the weight criteria in AS 1754. Consequently we were able to estimate the proportion of children at each age for whom each type of restraint is suitable.

To do this, we consulted U.S. growth data from the Centers for Disease Control and Prevention (Kuczmarski, Ogden, Guo, et al., 2000). We assumed that these data were applicable to Australian children. This data is used in Australia as a reference for normal growth patterns in Australian children (Department of Human Services, State Government of Victoria, 2006). Kuczmarski et al. (2000) tabulate growth data by age and sex, and the tabulated values for the mean and standard deviation for children's weight were pooled to provide mean and standard deviations for our age categories. Male and female data were also pooled. Then, for each age group, the expected proportion of each age category falling within the weight ranges specified by the Australian Standard was estimated by assuming a normal distribution of weights, and using standard Z-scores.

For example, an analysis of the Centers for Disease Control and Prevention (CDC) growth tables suggest that approximately 100% of all 2 - < 3 year old children's weights are greater than 8 kg and less than 18kg and thus, all 2 - < 3 year old children are suitable for restraint in a forward facing child seat. Thirty-four percent of children in the same age range weigh 14 kg – 26 kg, and are therefore suitably restrained using a booster seat. Our analysis of the CDC growth tables in conjunction with AS/NZS 1754:2004 is shown in Table 3.

Table 3 Proportion of all children in the weight categories defined in AS/NZS 1754:2004, by age, based on CDC growth charts (Kuczmarski et al., 2000).

Age group	Birth – 9 kg (Infant capsule)	8 kg – 18 kg (Child seat)	14 kg – 26 kg (Booster seat)	>26 kg (Adult belt)
0-<.5 years	n.a. ¹	n.a. ²	0%	0%
.5-<1 year	44%	84%	0%	0%
1-<2 years	6%	99%	8%	0%
2-<3 years	0%	100%	34%	0%
3-<4 years	0%	88%	74%	0%
4-<5 years	0%	58%	90%	0%
5-<6 years	0%	29%	93%	3%
6-<7 years	0%	14%	85%	13%
7-<8 years	0%	6%	63%	37%
8-<9 years	0%	4%	38%	61%
9-<10 years	0%	3%	21%	78%
10-<11 years	0%	1%	12%	88%

¹ Tabulated CDC data are only available for birth weights and weights of children over 2 months. However, this proportion is greater than 94%

² Similarly, this proportion is less than 31%

Assuming that our sample of children is typical, and similar to the population used to create the CDC growth charts, we can estimate the rate of weight-inappropriate restraint use in each age group in the sample. Some assumption needs to be about the method of restraint selection for each individual child in the sample.

Optimistically, we can assume that, where the proportion of children using a particular restraint (Table 2) is less than the maximum proportion that we would expect (Table 3), that all children were in a correct restraint for their weight. For example, Table 3 shows that no more than 34% of 2 - < 3 year-old children are sufficiently heavy for a booster seat. Referring to Table 2, 29% of 2 - < 3 year-olds in our sample were restrained in a booster seat, which is less than the maximum, and therefore we can estimate optimistically that all of the 29% of the 2 - < 3 year-olds in booster seats were appropriately restrained for their weight.

Alternatively, we can assume that children were “randomly allocated” to their restraint, with no regard for their weight. For example, referring to Table 3, we estimate that, in our sample, only 88% of 3 - < 4 year-olds in child seats and only 74% in booster seats are within the correct weight range for their restraint. This gives a more pessimistic estimate of weight-appropriate restraint use.

Note that AS/NZS 1754:2004 does not specify a weight for the commencement of an adult belt. We have made the assumption that once a child exceeds 26 kg, a booster seat is unsuitable, and it is therefore preferable that they be restrained by an adult belt. This assumption strongly influences our results for children 5 years and older. The results of our analysis along these three lines are shown in Table 4.

Table 4 Estimated rates of inappropriate restraints based on alternative definitions

Age group	Defined by age	Defined by weight		Unrestrained
		optimistic	pessimistic	
0-<.5 years	18%	0%	17%	0%
.5-<1 year	0%	16%	16%	0%
1-<2 years	16%	16%	17%	0%
2-<3 years	32%	3%	22%	0%
3-<4 years	19%	17%	32%	2%
4-<5 years	37%	35%	44%	2%
5-<6 years	68%	62%	65%	1%
6-<7 years	5%	62%	68%	3%
7-<8 years	0%	46%	59%	0%
8-<9 years	9%	30%	38%	4%
9-<10 years	3%	19%	24%	0%
10-<11 years	0%	12%	12%	0%
Weighted mean	18%	28%	36%	1%

The estimated rate of unrestrained child occupants was low – 1% (mean, weighted by age interval). We have listed rates of unrestrained child occupants separately from the rates of inappropriate restraint in Table 4, as an unrestrained child is at significantly greater risk of injury in a crash than a restrained child, irrespective of a non-ideal restraint selection. Inappropriate restraint selection in the context of this survey is about choosing a less-than-ideal restraint for the child. Therefore, when interpreting Table 4, it should be borne in mind that even an inappropriate restraint, in this context, provides some level of protection.

A notable aspect of Table 4 is the fact that, at ages 6 and over, the numbers of children that are probably in the wrong restraint for their weight is not indicated by those in “age-inappropriate” restraints.

DRIVERS’ KNOWLEDGE OF CHILD RESTRAINTS

Drivers were asked several questions to assess their knowledge of child restraints. Specifically, questions related to knowledge of when to begin using an infant capsule, when to begin using a child safety seat, when to begin using a booster seat, when to cease use of a booster seat, and of the relevant law.

Drivers’ knowledge of appropriate restraint selection

Information on the staged use of child restraints is somewhat ambiguous, consisting of overlapping weight-range guidelines and, sometimes, imprecise supplementary age advice. We therefore have coded as correct, answers that are consistent with the Australian and New Zealand Standard 1754:1995 as well as age guidelines typically used in South Australia. It will be seen that most drivers’ responses were made using aged-based criteria.

Concerning the baby capsule, 98% of participants correctly identified this as being appropriate from birth. Of more interest are the transitions to forward facing child restraint, booster seat, and the cessation of booster seat use. A participant’s knowledge was rated as good if their response accorded with at least one criterion in Table 5, and no part of their response was inconsistent with the criteria. The result of the survey is summarised in Table 6.

Table 5 Criteria for assessing “good” knowledge

Transition	Good knowledge
Commence forward facing child restraint use	6 m, 70 cm, or 8-9 kg
Commence booster seat use	3, 4, or 5 y, 14 -18 kg
Cease booster seat use	6, 7 or 8 y, 26 kg

Table 6 Driver knowledge of when to begin child safety seat use

Transition	Good knowledge	Age given as response	Modal age response
Commence forward facing child restraint use	29%	90%	6 months
Commence booster seat use	69%	86%	3 or 4 years
Cease booster seat use	33%	69%	5 years

Despite a generous definition of “good” knowledge, a significant proportion of respondents displayed poor or incomplete knowledge of child restraint transition. It should be borne in mind that some interviewees were transporting older children and may have forgotten or had no prior experience of the transition from infant capsules to child seats. It should be noted that a majority of drivers responded to questions relating to transition by nominating an age. Very few participants nominated the correct upper weight for booster seat use: only two of 344 responses included the correct weight criterion, 26 kg. (A further five responses were within a couple of kilograms of the correct weight.)

Drivers’ knowledge of the law

Participants were asked “As far as you’re aware, are there any current laws on restraining children in cars?” If they said yes, they were asked to describe the laws in an open-ended format. For ease of analysis, participant responses were coded as showing good knowledge if the law was specified correctly (whether partially or entirely), or otherwise as poor knowledge. The majority, 56%, had poor knowledge, 6% stating that no law existed to mandate the use of restraints while travelling with children in vehicles. While 44% had good knowledge of the law, only 3% were able to state all elements of it.

DISCUSSION

The present study investigated the frequency of child restraint use in the Adelaide metropolitan area by observing usage during trips to school/preschool. The size of the sample was 586 children aged up to 10 years. Data were collected at 31 preschools and primary schools. Approximately 82% of all child occupants were appropriately restrained given supplementary age recommendations for child restraints published by DTEI, and only 1% (weighted) were completely unrestrained. However, we estimate that the true rate of appropriate restraint, based on the child’s weight, is lower: between 64% and 72%.

In the 5 - <7 years age range, over 60% of children were not using a restraint appropriate for their weight, chiefly because they had progressed to an adult seatbelt too soon. This may increase the risk of being injured and the seriousness of the injury should their vehicle be involved in a crash (Winston et al., 2000).

To make these estimates, we relied on a technique that used the ages of the children and growth charts. This was because the weights of children were either not known to the driver, or unreliably reported.

Child restraint selection and knowledge

The use of forward-facing child seats is more common than the use of booster seats. Children will generally need to be moved to a forward-facing child seat before the age of 12 months, and therefore the continued use of the seat beyond 12 months is not surprising, given that, at this stage, there is little incentive to cease use. Forward-facing child seats may be regarded as both safe *and* practical when the child is younger, whereas, by school age, any perceived safety benefit may be outweighed by other factors that make parents perceive booster seats as impractical or unnecessary. These factors may include the attitude of the child, the small but added effort needed when using a booster seat, and the restraint use habits of the child's peers.

When asked about the criteria for progressing from one type of restraint to the next, the majority of participants responded with an age. These age responses were inconsistent, but the modal response for the transition from child seat to booster seat was in the correct range. The modal response for cessation of booster seat use was 5 years of age, which is lower than any recommendation promoted in South Australia and substantially underestimates the likely age at which a child will be too large for a booster seat: about half of all children on their 8th birthday would still be suitably restrained by a booster seat. It was surprising and noteworthy that only two participants correctly responded that the use of a booster seat should cease when the child is 26 kg.

Implications of the survey results

It is clear that drivers display, both in knowledge and actual use, a poor understanding of criteria for correct restraint selection. Furthermore, drivers do not know the weight criteria, nor the weights of their children. The most obvious response to this state of affairs is to suggest more education/promotion. However, careful consideration should be given to the kind of education and promotion that is provided. Survey respondents had a high rate of personal seatbelt wearing compliance, and very few children were unrestrained, and so it is arguable that the high rate of mis-selection of restraint is not due to casual attitudes to restraint use in general.

The aim of public health messages on child restraints is to ensure that children are in the correct restraint for their weight. Current practice is to quote the Australian Standard 1754 verbatim. Where age is mentioned, it is almost always done so as a supplement, but rarely is it recommended that age be relied upon. Contrast this with the responses given in this survey: a majority of responses included reference to the child's age. It is worth reflecting on the nature of the specifications of the Australian Standard. The standard is notable amongst similar standards globally in that there are considerable weight overlaps between types of restraint, and between the forward facing child seat and booster seat in particular. The purpose of introducing this was to cater for the children whose weight was in the tails of the distribution, while still allowing recommendations to be provided on the basis of age (Henderson, personal communication, 2005).

In this light, the implications of the Standard for promotion might be rather different than it has turned out: the intent of the Standard might be seen as allowing all children to graduate to a restraint at a similar age, with the lower and upper end of the weight range chosen to cater for the smallest and largest children graduating to that restraint. A consequence of promoting restraint use on the basis of age, in conjunction with a coordinated design standard, should be that very few children at the low or high end of each weight range should be using any particular class of restraint, and even fewer outside the weight range. Current public health messages fail to recognise the intent of the Standard in this regard. However, the extent to which the Standard successfully achieves this is debatable, and we intend to evaluate this more thoroughly in the future.

As it is, the transition between child seat and booster seat is handled reasonably well in the Australian and New Zealand Standard, with a large proportion of 3 and 4 year olds appropriately restrained with either device; it is likely that an age recommendation of child seat use until the 4th birthday is satisfactory.

Irrespective of the kind of promotion that is used, there would be merit in removing inconsistencies within promotional messages, and between promotional efforts by different organisations. For example, supplementary age advice from the South Australian Department of Transport, Energy, and Infrastructure mentions that booster seat use is suitable until the child is greater than 26 kg, or about 6 years of age (DTEI, 2000). However, as 26 kg is the 50th percentile weight of children on their 8th birthday, the advice might be altered for consistency. Child growth data is readily available, and should be used to provide consistent information where age criteria are promoted alongside weight.

One further point should be made. Increasingly, promotional messages on restraints appear to be seen as being consequential to the Standard, rather than a consideration in the setting of the Standard. This seems sensible given the requirements of the Standard are engineering ones, and manufacturers must ensure that their products can adequately protect children of the relevant sizes. However, an alternative view might be that, in the case of child restraints, correct selection and use relies heavily on the ability of parents to make the correct choice, and that should be pivotal in the setting of the Standard. Parents would clearly benefit from the simplest advice possible. If simple advice based on age were used, then the Standard could subsequently be modified to ensure that the fewest possible children would be in the wrong restraint for their weight, when the restraint is selected based on age.

Regulation

South Australian law appears to not mandate the use of child seats beyond 12 months of age, nor the use of booster seats. Once the child is greater than 12 months of age, the only legal minimum requirement for transporting them in a vehicle is to use an “appropriate restraint” or “suitable seatbelt” where one is available. This is widely interpreted as meaning an adult seatbelt for children above 12 months is sufficient to satisfy the regulation. Thus drivers may not feel compelled to provide appropriate seats for the children they are transporting.

As current regulation does not appear to encourage appropriate restraint use beyond 12 months, further developments in this area might be considered, in coordination with appropriate promotion, as a means of increasing the rate of appropriate restraint selection.

Limitations of this study

A limitation of this study lies in our use of concepts of appropriate restraint. While we have been able to estimate rates of weight-appropriate restraint in each age group, we cannot estimate weight-appropriate restraint for individual children in our sample, limiting our ability to determine the predictors of inappropriate restraint selection. The other point that should be mentioned is the obvious one that this survey was confined to journeys to school or pre-school. It is quite possible that for other journeys, patterns of restraint use would be different.

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