

**Title:** Direct observations of child restraint use to evaluate a preschool based education and restraint distribution program

**Authors:** Lisa Keay<sup>1</sup>, Julie Brown<sup>2</sup>, Kate Hunter<sup>1</sup>, Lynne E Bilston<sup>2</sup>, Judy M Simpson<sup>3</sup>, Maureen Elliott,<sup>4</sup> Katrina Thistlethwaite<sup>1</sup>, Rebecca Q Ivers<sup>1</sup> and the Buckle-Up Safety Team

1. The George Institute for Global Health, The University of Sydney
2. Neuroscience Research Australia; University of New South Wales
3. School of Public Health, The University of Sydney
4. NSW Roads and Traffic Authority

## Contact Author

Lisa Keay

### **The George Institute for Global Health | AUSTRALIA**

Level 7, 341 George St | Sydney NSW 2000 Australia

Postal Address: PO Box M201 | Missenden Rd | NSW 2050 Australia

T +61 2 9657 0335 | F +61 2 9657 0301

E lkeay@georgeinstitute.org.au | W www.georgeinstitute.org.au

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## **Abstract:**

**Background and aims:** Programs to increase the use of child restraints have showed promise, however reliable tools are required to evaluate these programs. Here we describe self report and observation of child restraints as outcome measures in a cluster RCT evaluating the *Buckle-Up Safely Program*, an education and restraint distribution program.

**Methods:** We interviewed a parent or carer and observed children aged 2-5 years upon arrival at one of 27 early childhood services during September-December 2010. The interview related to their journey to the early childhood service and the child was observed in the car. Self-reported was compared to observed restraint use.

**Results:** 736 parents or carers and their children, aged 2-5 years, were evaluated and 725 had both the interview and observations (98.5%). While 20 children aged 2-5 years were observed seated in the front seat, 18 children were reported by parents to have travelled in the front seat. One third of the children observed in seatbelts (14/57, 35%) were reported by parents to sit in a child restraint or booster seat. Concordance was higher between observation and self report for booster seats (91%) than forward facing child restraints (86%). Overall agreement between self report and direct observation was good for seat position (Kappa statistic 63%, 95% confidence interval 48-78%) and type of restraint (Kappa statistic 79%, 95% confidence interval 74-83%).

**Conclusions:** Self report slightly over-reported child restraint use and rear seating for preschool aged children in this evaluation. While self report gave an indication of appropriate restraint for age, observations allowed full characterisation of the appropriate restraint and correct use.

## **Introduction**

Age appropriate child restraints are a proven, effective measure to reduce the risk of serious injury and death amongst child passengers in motor vehicle crashes. [1] Crash investigation studies consistently find the highest risk of severe injuries for unrestrained children in the front seat and lowest risk for appropriately restrained children in the rear seat.[2-4] Furthermore, the level of protection afforded by a restraint system is degraded by errors in securing the child in the restraint or installation of the restraint into the vehicle.[3]

Despite the clear safety benefits, age appropriate restraint use is low in Australia, particularly amongst preschool aged children[5] and a significant proportion of child restraints are not used correctly.[6, 7] Until July 2010 the only legal requirement was for a child up to one year to be restrained in an approved child restraint. New legislation regulated type of restraint for age up to 7 years and seating location for child passengers.[8] The Buckle-Up Safely Program was developed to increase both age-

appropriate restraint use and decrease incorrect restraint use in preschool aged children and a rigorous evaluation of this program was planned.[9]

A range of approaches have been used in previous studies to assess child restraint practices. Telephone surveys have the advantage of being able to reach a broader population, and are less resource intensive.[5, 10, 11] This approach has been favoured when the primary objective is measuring knowledge rather than definitive assessment of restraint use, as a detailed technical assessment is not possible during telephone surveys. Surveys are also favored in settings where direct observation of the child restraint is difficult such as in studies of restraint use in emergency departments or health clinic populations.[12, 13] Direct observations are feasible in settings where children frequently arrive in cars, including shopping centre or clinic car parks and educational services.[14, 15] There is a trend to use direct observations where possible to accurately measure child restraint use in the community[15] and to evaluate interventions.[16, 17]

The purpose of this manuscript is to describe the methods for comprehensively assessing child restraint use including restraint type for age and presence of installation and securing errors. We compare self report to observed restraint use.

## **Methods**

A total of 27 pre-schools and long daycare centres in western and south-western Sydney were involved in the Buckle-Up Safely cluster randomised trial. For measurement of the trial outcome, parents or carers arriving to drop a child at a participating centre were invited to participate in an evaluation of child restraint use. This included an interview with parent or carer and simultaneous observation of the child in the vehicle. Consistent with the sample size calculation for the cluster randomised trial, our target for enrolment was at least 20 children aged 3-5 years from each centre. Research assistants attended the centres over a period of approximately 2 hours at the drop-off times on consecutive days over a 1 week period. When the enrolment target was reached or over 70% of eligible children at that centre had been included, recruitment was ceased. If enrolment targets were not met, researchers attended the centre for up to 3 days the following week. The duration of recruitment was limited as the presence of the researchers may serve to change how people restrain their children in cars on subsequent days.

Informed consent was gained from participating parents or carers for their involvement and the involvement of their child. Ethics approval was granted from the University of Sydney Human Research Ethics Committee and ratified by the University of New South Wales Human Research Ethics Committee. All interviews and observations were conducted between September and December 2010.

The study survey was administered as an interview with the parent or carer about how each child was restrained for the current journey. We asked for information on type of

restraint (forward facing child restraint, booster seat, seat belt or other), seating position (rear or front), for all children up to age 10 in the car today. Laminated A4 sized photographs were used to help respondents identify the different types of seats. Bilingual research assistants were employed with fluency in community languages. Where able, the respondents scribed their own responses for income, education and other demographic information. Translated versions of the consent form and interview were also available in Chinese, Vietnamese, Arabic, Hindi, Turkish and Dinka languages.

One child was selected from each vehicle as the child of interest, preferentially in the age range of 3-5 years. If there was more than one child in this age range, the child with the next birthday was selected. At the same time as the interview was being conducted, a second research assistant observed the child of interest in situ, noting the type of seat and how the child was secured. After the child had left the vehicle, the installation of the restraint was checked. Training of research assistants conducting technical assessments has been recommended[15] and the research assistants completing the observations were authorized restraint fitters or had completed a short course in restraint fitting.

The observation methodology has been used previously in a population-referenced observational survey in New South Wales[18]. As in the earlier study [17], errors in restraint use and installation were assessed by observing the general features of the restraint and anchorage system as shown in Figure 1. Errors were classified as minor or moderate /severe (major error) which is based on the likely degradation in restraint performance introduced by that single error. [17] A total error score for each child observed was created by summing all errors including minor errors. An appropriate restraint for age was defined as a forward facing child restraint for children up to at least 4 years and a forward facing seat or booster seat up to age 7 years which was consistent with new Australian legislation relating to child passengers.[8] The child was considered to be in an appropriate or inappropriate seat for age, based on the observed/self reported restraint system and the child age as reported by the parent or carer. For descriptive purposes, the appropriate seat for age and presence of errors were combined to give four categories:

- Optimal (appropriate restraint for age and no major errors)
- Incorrect only (appropriate restraint for age with at least 1 major error in use)
- Inappropriate only (inappropriate restraint for age and no major errors)
- Incorrect and inappropriate (inappropriate restraint for age with at least 1 major error in use)

## Analysis

We used the vehicle arriving at the centre as the analytic unit and selected one child from each vehicle for analysis. This approach was favoured as other children in the same vehicle could not be considered as independent observations. The observation data for the type of restraint and seating position was considered the gold standard. The agreement between self report and observation for type of restraint and seating

position was estimated using Kappa statistics. Distributions of optimal, inappropriate and incorrect restraint use were described for each age as patterns in restraint practices have been shown to be age-specific.[7]

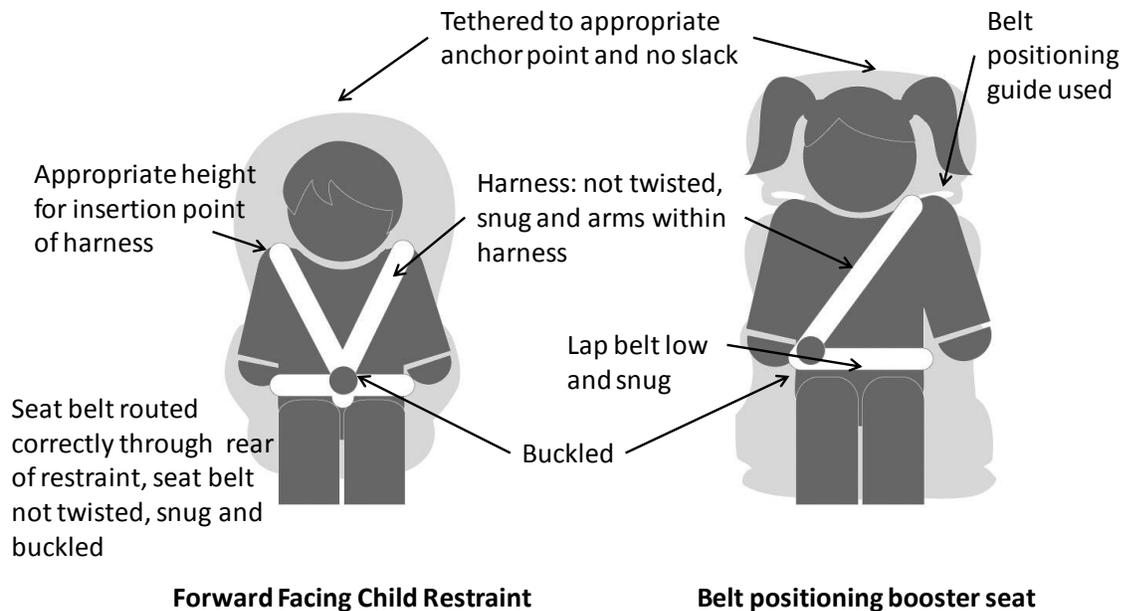


Figure 1: Assessment of child restraint systems

## Results

We met our enrolment target of at least 20 children aged 3-5 years at 24/27 centres. The centres that did not meet enrolment targets were small. The primary reason for non-participation was lack of time (92%) but there were opportunities to participate on another day. The observations were conducted over 4-8 days with median data collection time of 5 days. A total of 736 adults and their children travelling with them to the preschool or long daycare centre participated in the study. Data excluded from subsequent analysis were four instances where observation of the child in situ was not undertaken and one occasion when the type of restraint was not recorded. There were an additional 6 self-report surveys where the type of restraint was not given. Our analytic dataset for comparing the self reported and observed restraint use therefore comprised 725 children. There were more missing data for seating position for which comparisons were possible for 684 children. The characteristics of the carers and their children are summarized in Table 1.

There were twenty preschool aged children observed to be sitting in the front seat of the car which was 2.9% of the total sample (Table 2). The information on front seating location given by the parent or carer was in agreement for 18/20 (90%). The vast majority of children were in the rear seat and correct reporting of rear seating in the self report survey was 646/664, 97%. Hence the greatest inaccuracies in self report of seating location were misreporting of travel in the front seat which occurred for 10%.

The kappa statistic was 63% (95% confidence interval 48-78%) for agreement on rear seating between observed and self report.

**Table 1: Characteristics of children and survey respondents (n=725)**

<b>Child observed in situ</b>	
Male, n (%)	380 (47.8)
Age of child, n (%)	
1-2 years	66 (10.0)
3 years	203 (27.8)
4 years	307 (42.1)
5-6 years	154 (21.1)
<b>Parent or carer</b>	
Relationship to child	
Mother*	497 (70.5)
Father*	156 (22.1)
Grandparent	39 (5.5)
Other	16 (2.3)
Annual family Income in Australian \$, n (%)	
<\$20,000	70 (11.5)
\$20-40,000	89 (14.6)
\$40-60,000	108 (17.7)
\$60-80,000	87 (14.2)
\$80-100,000	108 (17.7)
\$100-150,000	106 (17.4)
>150,000	43 (7.0)
Language other than English spoken in home, n (%)	129 (18.7)
Parent or carer age (years), mean±SD [range]	36±8 [18-75]
Children in family under 18 years of age, mean±SD [range]	2.4±1.1 [0-7]
Education, n (%)	
None, primary or some secondary school	112 (13.2)
Completed secondary school	133 (19.5)
Some University or TAFE	226 (33.4)
University Graduate	170 (25.0)
Post Graduate degree	62 (9.0)

\* Three interviews were completed with both the mother and father together so percentages add up to more than 100%

# Other languages spoken at home were Chinese (21, 17%), Arabic (30, 24%), south-east Asian (39, 21%), Indo-Aryan languages (12, 9%), Turkish (11, 9%), African languages (7, 6%), European (7, 6%) and Pacific Island languages (2, 2%). Two families spoke both Chinese and Vietnamese at home so percentages add up to more than 100%. Language not specified for 2.

**Table 2: Agreement between observed seating position and self reported seating position (n=684)**

<b>Self reported:</b>	<b>Observed seating position</b>	
	<b>n (%)</b>	
	Front	Back
Front	<b>18 (2.6)</b>	18 (2.6)
Back	2 (0.3)	<b>646 (94.4)</b>

\*bold text indicates agreement

There was agreement in 87% of cases between the observed restraint system type and that reported by the carer. The largest source of disagreement was between booster seats and forward facing child restraints and incorrect reporting was found in 10% of cases. The direction of the disagreement was evenly distributed rather than representing a specific bias in reporting (Table 3).

A significant proportion of the 57 children who were observed to be using a seat belt alone were reported by their carer to travel in a forward facing child restraint (n=4), a booster seat (n=9) or no restraint (n=1). This was 14/57 of those observed to be using a seat belt (25%). There were an additional 7 respondents who reported that their child travelled in a restraint when they were observed to be unrestrained. Those respondents who indicated a more appropriate system when they used a seatbelt alone or were unrestrained were 3.3% of the total sample. In contrast just 3 (0.3%) reported seat belt or no restraint use when their child was observed in a child restraint or booster.

The kappa statistic for agreement between self report and observed restraint system was 79% (95% confidence interval 74-83%). The children were in the appropriate restraint for age in 569/725 (78%) of cases.

Table 3: Agreement between observed and self-reported restraint system (n=725)

<b>Observed restraint system:</b>				
<b>Self reported restraint system:</b>	Forward facing child restraint	Booster Seat	Seat Belt	Unrestrained
Forward facing child restraint	<b>236 (32.6)</b>	34 (4.7)	4 (0.6)	0 (-)
Booster seat	36 (5.0)	<b>350 (48.3)</b>	9 (1.2)	3 (0.4)
Seat belt	1 (0.1)	1 (0.1)	<b>43 (5.9)</b>	4 (0.6)
No restraint	0 (-)	1 (0.1)	1 (0.1)	<b>2 (0.3)</b>

\*bold text indicates agreement

The observations documented errors in either installation of the child restraint or the way the child was secured in the system in 330/725 (46%) of cases. Securing errors such as having arms outside of the harness or seat belt and loose or twisted webbing were present in 40% of cases. Installation errors were less prevalent (17%). A forward facing child restraint has more opportunities for error than a booster seat (12 vs 5) and the observed rate of errors reflected this difference. Errors per restraint ranged from 0-4 in booster seats and 0-7 in forward facing child restraints and the distribution of error scores varied between restraint systems (chi-squared test, p<0.001). The combinations of the two measures of restraint practice (i.e. appropriate and incorrect), for each age group, are summarized in Figure 2. More child restraints were incorrectly used in the younger age groups where restraint systems are more complex (Chi Squared test p<0.001).

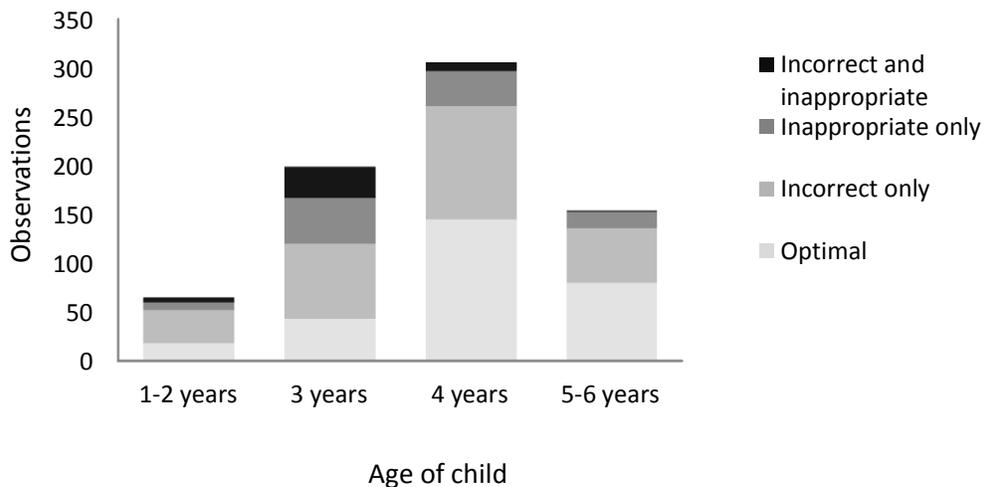


Figure 2: Number of observations where an appropriate restraint for age was used and any installation or securing errors by age (n=724). For one observation, the age of the child was not recorded so appropriate restraint for age could not be assessed

If we relied on self report, we would misclassify compliance based on age in sixteen 4-5 year olds (3.6%) which was predominantly over-reporting use of booster seats and child restraints (2.9%). The self-report data misclassify 23 children under 4 years of age (8.4%), though these were both under-reporting (4.0%) and over-reporting (4.4%) of use of forward facing child restraints. The kappa statistic for agreement in appropriate restraint for age was 84% (95% confidence interval 79-89%).

## Discussion

Direct observation has been used to evaluate child restraint use in a large group of preschool aged children.[9] Completion of these observations was quite resource intensive with teams of research assistants attending each centre over a number of days. Using this approach, however, we are able to present a full characterisation of restraint use. These are the first data collected since new legislation in NSW and show trends towards greater use of appropriate restraints, particularly in children aged 4 years and older.[7] Our experiences from this setting highlighted the need for photographs or diagrams to define different types of restraints and the capacity to conduct interviews in community languages.

We had the opportunity in this evaluation to compare self reported use to ‘gold standard’ observed restraint use. There were some small differences in the results, which lends support for the use of direct observation to measure child restraint use most accurately, although the greater cost of this approach is acknowledged.[19] Specifically, correct restraint use would be over-reported by 3.6% in 4-5 year olds and both under (4.0%) and over reported (4.4%) in 2-3 year olds. Overall, the level of agreement can be

considered good and self report is a viable option for determining type of restraint used if resources are limited. However, through direct observation a detailed assessment of installation errors and securing errors is possible. Others have explored the accuracy gathering this type of information from parent survey alone and while the specificity was >80% for many individual errors, parents tended to mis-report the snug fit for the harness.[20]

It appears that there may be confusion differentiating booster seats from forward facing child restraints. This was present, even though research assistants who administered the interviews had photographs of seats to help parents and carers make an accurate response. Future use of self report of restraint type should pay particular attention to differentiation between a forward facing child restraint and booster seat. The proportion of respondents (10%) who did not accurately identify the type of seat indicates that there is significant confusion in the community. This has implications for research study design but also for enforcement of the new legislation which mandates a minimum age of 4 years for transition from a forward facing child restraint to booster seat.[8] An understanding of the differences in restraint types and different mode of use for convertible restraints is needed to achieve compliance to this aspect of the legislation.

A common criticism of self report data is the possibility of social desirability bias whereby respondents over-report best practice behaviours. We found a small number of respondents who over-reported best practice in seating position, i.e. they were reported as rear seated when the child was observed in the front seat (<1%) or they reported that they used a restraint when the child was actually in a seat belt or unrestrained (3%). Bias has been demonstrated in comparison of self report and direct observation of booster seat use in 4-8 year old Latino children in the US but was as high as 24%.[14] The larger effect may be due to greater susceptibility for social desirability bias in the Latino population and the lower baseline use of booster seats (52%) in this community. Our methods also differed, and concealed observation of the child on departure, as used in the US, may have better captured this bias. In our approach, carers were informed that an observation of the child was planned and the bias in a stand-alone self report survey may be greater. Previous experience of field observations[18] and telephone survey[5], though not in the same population, have suggested over-reporting of best practice restraint use of about 5% in self report.

Through direct observation, we have successfully characterised the use of restraints in our target population. By being able to assess the combination of appropriate seat use with quality of use of the restraint, an informative assessment of the likely level of protection can be made. This approach is robust and should contribute high level evidence for the effectiveness of programs to increase restraint use. Comparison of the self reported data to direct assessment suggests that there is only a small upward bias in self reporting. In addition, parents and carers may not be sufficiently familiar with different seat types to distinguish reliably between booster seats and forward facing child restraints.

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