Seatbelts and the law: how well do we protect Australian children?

Katie N Reeve, Yvonne A Zurynski, Elizabeth J Elliott and Lynne Bilston

ABSTRACT

- About a thousand Australian children are seriously injured in motor vehicle accidents each year, despite 92% using seatbelts or child restraints.
- Premature graduation of children to adult seatbelts, misuse of seatbelts and use of lap-only belts increase the risk of injury or death.
- In Australia, use of a child restraint or booster seat is not mandatory for children aged > 1 year, while other countries mandate their use for children up to 5–12 years old.
- Australian parents are confused about the safest restraint and seating position, particularly for children aged > 2 years.
- Australian child restraint legislation needs to be reviewed to increase the rate of optimal restraint use.

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In Australia in 2005, 72 child passengers under the age of 16 years were killed in motor vehicle accidents, accounting for about two-thirds of all road user deaths in this age group.[1] About a thousand children are seriously injured as vehicle occupants on Australian roads each year.[2] Car accidents are the most common cause of injury and death for Australian children aged 1–14 years and account for about 40% of all injury-related deaths.[3]

The rate of child restraint and seatbelt use in Australia is high, at over 92%.[4-7] Although more frequent when children are unrestrained, serious injuries and deaths also occur among restrained children. The "seatbelt syndrome" is a specific pattern of serious injury to the lumbar and cervical spine, and to abdominal organs, including contusions, tears, and perforations.[8-11] These injuries are associated with premature graduation of young children to adult seatbelts, misuse of seatbelts, or use of lap-only belts.[4-6,12-17]

In this review, we summarise current evidence for child restraint use, existing restraint legislation and policy, and parents' knowledge and attitudes towards child restraints.

Methods and results of literature search

We searched MEDLINE, the Cochrane Library, and government, legal and other road-safety-related websites to extract information on child restraint legislation, policy, types and incidence of injuries, and knowledge and use of restraints by parents and carers.

MEDLINE was searched via Ovid for the period January 2000 – March 2007. We found 181 titles using the search terms "seat belt AND injuries" (limits: child 0–16 years, English language) and 103 titles using "lap belt". Our search focused on injuries associated with seatbelt and child restraint use and/or seating position for passengers aged up to 16 years travelling in motor vehicles. Of 124 abstracts identified, 26 articles were relevant for this review. Randomised controlled trials of restraints as intervention are not ethical and none were identified. We found one literature review and one Cochrane systematic review of the effectiveness of interventions to increase optimal restraint use. We excluded articles if there was no focus on type of restraint used or misuse of restraint; there was a lack of description of the types of injuries sustained; or it was a case report only.

We conducted an Internet search using the terms: seat belt legislation/law, Australian Road Rules, booster seat, child restraint, safety belt, road fatalities, crash statistics, child deaths, and child injuries. We reviewed 10 papers and 36 websites.

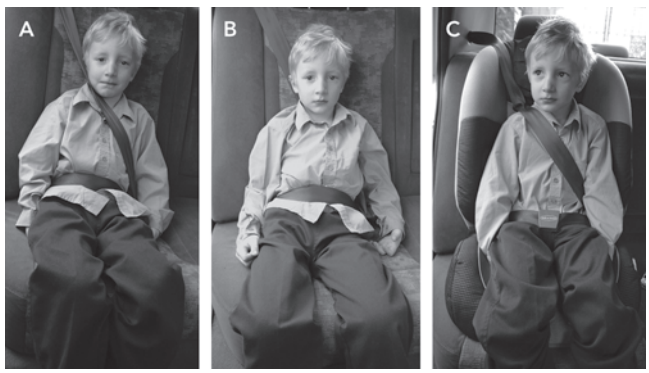
Most evidence in support of the use of child restraints meets National Health and Medical Research Council (NHMRC) evidence level III or IV and comes from simulated crash tests (some controlled), cross-sectional studies, case series, case–control studies and observational studies that assessed restraint-use behaviour, or crash and injury surveillance data.

Optimal use versus misuse of restraints

Adult seatbelts and car seats are designed to protect adult passengers. Children are shorter than adults, have relatively larger heads, and underdeveloped iliac crests. As a result, the sash portion of an adult seatbelt tends to lie across a child's face or neck (Box 1A) and the lap portion rides up across the abdomen (Box 1, A and B).[15,18-20] Poor fit is exacerbated by the "slouch factor", as children tend to sit slumped in their seats. As the seatbelt is uncomfortable, children are likely to misuse it by placing the sash portion under the arm or behind the back, effectively converting a lap-sash belt into a lap-only belt.[11,13,14,21] In an accident, incorrect seatbelt positioning or misuse increases the risk of intestinal perforation and mesenteric disruption due to "jackknife" forces on the lap portion of the belt, and head injuries due to excessive head excursion, allowing the head to make contact with the child's lower limbs or the vehicle's interior.[11,21,22]

Child restraints reduce the risk of injury and death in a car crash by minimising contact with the vehicle's interior, reducing impact forces and spreading forces onto less vulnerable parts of the body.[12,15,21] In Australia, restraints must comply with stringent Australian Standards (AS 1754). Current Australian child restraint guidelines recommend use of a dedicated child restraint — a rear-facing infant capsule or a forward-facing child seat or booster seat with high back and wings — until children are at least 145 cm tall (Box 2).[23,24] Use of a booster seat improves the fit of an adult seatbelt (Box 1C).

1 Uses of an adult seatbelt on a 6-year-old child



A: Incorrect fit. B: Misuse. C: Improved fit using a booster seat. ◆

2 Australian child restraint guidelines[23]

Size	Age	Best-choice restraint	When to move to the next restraint
Birth to 8 kg	0 to ~ 6–9 months	Rear-facing infant capsule	> 8 kg and/or > 70 cm length
8–18 kg	6 months to ~ 5 years	Forward-facing child seat	> 18 kg and/or eye level is above the back of the child seat
⩾ 18 kg or eye level above back of child seat	~ 5 years +	Booster seat with high back and wings	Child's legs long enough to have his/her back against the back of the car seat and knees bent over edge of seat cushion; lap portion of seatbelt fits across the hip bones, not abdomen; and sash portion passes on outer shoulder, not on neck; usually when child is > 145 cm tall
> 145 cm	~ 11 years	Adult seatbelt	◆

3 Child restraint legislation in Australia and other English-speaking countries

Country	Current laws for child restraint use
Australia[31]	• Child restraints mandatory for children up to 1 year of age • Adult seatbelt or child restraint mandatory for children 1–16 years of age
New Zealand[32]	• Child restraints mandatory for children up to 5 years of age • Adult seatbelt or child restraint mandatory for children 5–16 years of age
United Kingdom[33]	• Child restraints mandatory for children up to 12 years of age or height 135 cm • Adult seatbelt mandatory for children > 12 years of age or height > 135 cm
United States[34,35]	• Variation among states: child restraint laws require children to travel in approved child restraint devices, and some permit or require older children to use adult seatbelts. The age at which seatbelts can be used instead of child restraints differs among the states; 38 states have booster seat laws (all have age limits, additionally some have height and weight limits)
Canada[36]	• Variation among provinces: all have child restraint laws, including three with booster seat laws covering children up to 8 years and/or 36 kg and/or 145 cm ◆

4 Australian child restraint resources

Child Restraint Evaluation Program buyer's guide (free copy) (http://www.racv.com.au)
KidSafe (http://www.kidsafe.com.au)
Australian Transport Safety Bureau (http://www.atsb.gov.au)

New South Wales
Motor Accidents Authority (http://www.maa.nsw.gov.au)
Roads and Traffic Authority (http://www.rta.nsw.gov.au)
NRMA (http://www.mynrma.com.au)

Victoria
VicRoads (http://www.vicroads.vic.gov.au)
RACV (http://www.racv.com.au)

Queensland
Queensland Transport (http://www.roadsafety.qld.gov.au)
RACQ (http://www.racq.com.au)

South Australia
Department for Transport, Energy and Infrastructure (http://www.transport.sa.gov.au)

Western Australia
Office of Road Safety (http://www.officeofroadsafety.wa.gov.au)

Tasmania
RACT (http://www.ract.com.au)

Northern Territory
Department of Planning and Infrastructure (http://www.ipe.nt.gov.au)

Australian Capital Territory
Department of Territory and Municipal Services (http://www.tams.act.gov.au) ◆

In a car crash, restrained children fare better than unrestrained children, even when using inappropriate restraints for their age or size.[8,15-17,21,22] Two studies reported that seatbelts were equally effective in preventing injuries among adults and children aged > 4 years, however, these studies did not distinguish between the use of child restraints and adult seatbelts by the injured children.[25,26] While adult seatbelts are safer than no restraint, they offer suboptimal protection to children.[15-17,21,22] Severe injuries resulting in paraplegia and death have been associated with the use of lap belts.[9] Children aged 2–5 years wearing an adult seatbelt are 3.5 times more likely to suffer a significant injury and 4.2 times more likely to sustain a head injury than those using a dedicated child restraint.[16] Data from the United States showed a 28% reduction in risk of death for children aged 2–6 years using child restraints.[15] Children aged 4–7 years using booster seats had a 59% reduction in risk of injury compared with adult seatbelts.[21] Children using adult seatbelts were 2.7 times more likely to suffer a severe injury compared with similarly restrained adults.[27] Furthermore, children using adult seatbelts had significantly more injuries to all body parts, including injuries consistent with seatbelt syndrome, compared with children in booster seats.[17] In Australia, a crash investigation study found that for children < 14 years of age, dedicated child restraints performed best in terms of safety, followed by lap-sash belts, then lap-only belts.[12] More recently, a case–control study of 152 children aged 2–8 years found no serious or fatal injuries among optimally restrained children, while 30% of suboptimally restrained children sustained serious or fatal injuries.[13,14]

It is recommended that children graduate to an adult seatbelt without a booster seat when a good fit is achieved, usually once children are 145 cm tall (about 11 years old).[20,23,24] However, many children move to an adult seatbelt too early.[6,13,14,28] In New South Wales and Victoria, the mean age of transition to a seatbelt is 5.6 years (range, 3–9 years).[4] A recent New Zealand study found that only 40% of children requiring a booster seat were using one, and in the 5–8-years age group, 93% required a booster seat but only 30% were using one.[29] In one Australian study, only 18% of children aged 2–8 years injured in car crashes were optimally restrained.[13,14] Other studies have shown that suboptimal restraint is highest among children aged 2–8 years.[6,8,16-18]

Front or rear seat — which is safest?

Five recent cross-sectional studies assessing the effect of seating position on injuries all concluded that the rear seat is the safest place for children.[8,12,14,25,30] Children < 16 years old are at 40% greater risk of injury when travelling in the front seat.[8] In Australia, children aged 2–8 years injured in car crashes when seated in the rear sustained significantly fewer severe injuries than

children in the front seat.[13] The association between serious injury and deployment of airbags adds to the evidence that children are safer in the rear seat.[30] Despite this evidence, and the recommendation that children < 12 years should travel in the rear seat,[23] only one of Australia's states and territories prohibits the use of child restraints in the front seat.[31]

Child restraint legislation

Current Australian legislation requires infants up to the age of 1 year to travel in a properly fitted, Australian Standards-approved child restraint. Children aged 1–16 years must travel in either a child restraint or a seatbelt.[31] Australian child restraint laws lag behind those of other countries, many of which have legislation making child restraints compulsory for children aged > 1 year (Box 3). In 2006, the United Kingdom and 12 other countries in the European Union introduced child restraint laws for children up to 12 years of age (or 135 cm tall).[33,37] Canada and the US are gradually making booster seats mandatory for children < 145 cm tall.[34-36]

A recent longitudinal study from the US found that children in states with laws requiring booster seats up to age 7 years were 39% more likely to be appropriately restrained.[38] Evidence from a systematic review showed that legislation coupled with education campaigns successfully increases the use of optimal restraints.[39] Since the introduction of mandatory child restraints law in NZ for children up to 5 years of age,[32] the use of dedicated child restraints increased by 15% to reach 89% in 2005 in this age group.[28] The number of injuries decreased by 44%, and deaths decreased by 46% (Stephen Evans, Research and Statistics, NZ Ministry of Transport, personal communication).

Parents rely on the law to guide them in restraint choice and feel that if a restraint type is legally valid, it must be safe.[40] The National Transport Commission recently proposed changes to the Australian Road Rules that would require all children < 6 months to use a rear-facing restraint, then a forward-facing restraint with in-built harness or rear-facing restraint up to age 4 years, then a booster seat or forward-facing restraint up to age 7. Children < 7 years would also have to sit in the rear seat. If adopted, these changes will need to be enacted by each state for legislative effect. Such laws may be introduced as early as the end of 2007. Further changes to enhance protection for 7–10-year olds will require upgrades to the Australian Standards for child restraints.

What do parents know about child restraints?

We found six Australian studies assessing parents' knowledge about child restraints, which showed uncertainty about optimal restraint choice, correct installation, and the safest seating position for children.[4-7,41,42] These studies included two surveys with small self-selected samples and low response rates,[4,42] three observational studies coupled with interviews of the drivers,[5,6,41] and one purely observational study[7] (looking through car windows) to observe restraint use and to estimate the size or age of the child. Study quality varied, highlighting the methodological challenges in performing this kind of research.

A recent NZ study that matched actual behaviour to survey responses showed that although drivers were confident about restraint use in children < 8 years old, 64% made at least one error.[43] Similarly, Australian parents/carers were confident about their knowledge of child restraints, but most were not aware of the recommendations for choosing the optimum restraint according to the child's age and size and when to progress to adult seatbelts.[4,5,12,42] Parents/carers were also confused about restraint legislation — only 44% had some knowledge of child restraint legislation and 6% were not aware of any laws.[6] The most common reason for not using a booster seat was parents' beliefs that their child was "too big" for a child restraint once they had outgrown their forward-facing child seat.[4,6,40,42] Other barriers included a lack of understanding of risks associated with seatbelt use in children, failure to perceive booster seats as safe, and inability to get a child to use a booster seat.[40] Price was an issue for only 10% of Australian parents/carers and most believed restraints were worth the money.[42]

Australian parents believe child restraint installation is easy, however more than 20% of restraints are fitted incorrectly (eg, top-tether strap not connected, seatbelt incorrectly threaded or not buckled, anchorage point used incorrectly).[5,41] About two-thirds of parents consider using licensed restraint-fitting stations.[42]

Although current guidelines recommend that children < 12 years old sit in the rear seat,[23] at least a quarter of Australian parents feel it is safe for a child aged 7 years to travel in the front seat.[7,42]

There are many information resources for parents on child restraints (Box 4). However, 40% of parents in Australia purchased their child restraint with inadequate or no sales advice.[6,42] Parents feel the best means of promoting restraint use is through advertising and children's stories on television, and pamphlets at day care centres, hospitals, and schools.[42] Initiatives to increase booster seat use are effective; schemes that provide free or discounted booster seats with education on their use have the most benefit, although education-only schemes are also successful.[39,44] Child health practitioners are an important advocacy group and well placed to provide information to families.[45]

5 Key recommendations and levels of evidence*

- Children are safest travelling in dedicated child restraints (III-3)
- Children are safest travelling in the rear seat of a vehicle (III-3)
- Size is more important than age in deciding when to graduate to another restraint type. Graduation to an adult seatbelt should only occur when a child is 145 cm tall (III-3)
- Appropriate legislation, education and awareness campaigns are needed to improve the use of optimal restraints (I)
- Health professionals are well placed to provide information on child restraints and advocate for changes in legislation (IV)

* National Health and Medical Research Council. A guide to the development, evaluation and implementation of clinical practice guidelines. Canberra: NHMRC, 1999. ◆

Conclusion

High levels of overall restraint use in Australia indicate that parents are motivated to protect their children, yet inadequate knowledge of what constitutes optimal restraint is placing children at unnecessary risk. Education campaigns, strong advocacy, and legislation play important roles in injury prevention. The safety benefits of child restraint use should be reflected in adequately disseminated policy. Key recommendations are shown in Box 5.

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Competing interests

None identified.

Author details

Katie N Reeve, MB BS(Hons), MRCPCH, MRCP, Research Officer[1]
Yvonne A Zurynski, BAppSc, MAppSc, PhD, Assistant Director,[1] Senior Lecturer[2]
Elizabeth J Elliott, MD, FRACP, FRCPCH, Director and NHMRC Practitioner Fellow,[1] Professor[2]
Lynne Bilston, BE(Mech)(Hons), MSE, PhD, NHMRC Senior Research Fellow, Prince of Wales Medical Research Institute; Associate Professor, Faculty of Medicine[3]

1 Australian Paediatric Surveillance Unit, The Children's Hospital at Westmead, Sydney, NSW.
2 Discipline of Paediatrics and Child Health, University of Sydney, Sydney, NSW.
3 University of New South Wales, Sydney, NSW.
Correspondence: apsu@chw.edu.au

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