Booster seat use by children aged 4–11 years: evidence of the need to revise current Australasian standards to accommodate overweight children

Michael P Fitzharris, Judith Charlton, Megan Bohensky, Sjaanie Koppel and Brian Fildes

ABSTRACT

Objective: To examine the relationship between child weight and vehicle booster seat usage in the context of current Australasian booster seat standards.

Design, setting and participants: Questionnaire survey conducted between February and April 2005. A convenience sample of parents with children aged 4–11 years in New South Wales and Victoria completed a questionnaire, reporting on the height and weight of their children and the nature of restraint devices used in the family vehicle.

Main outcome measures: Proportion of children meeting standard-specified weight and height criteria who are not restrained in booster seats; proportion of children who meet the specified height criteria but whose weight exceeds the specified weight.

Results: 699 of 3959 questionnaires were returned (response rate, 18%), of which seven lacked essential details. The remaining 692 responses provided information on 1500 children. Of these children, 633 aged 4–11 years fell within the recommended height range for using booster seats, but only 29% were typically restrained in booster seats, the majority (70%) being restrained in normal seatbelts. A key finding was that 37% of the children who met the recommended height criteria exceeded the maximum weight for booster seats stipulated by the current Australasian safety standard.

Conclusion: In view of increasing rates of overweight and obesity in children, it is important to reassess current Australasian standards for child restraints in vehicles. A concerted parental education campaign is also needed to raise awareness of which restraint types are appropriate for children of various heights and weights.

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With 461 passengers under 12 years old killed in traffic crashes between 1996 and 2005 in Australia,[1] the safe transport of children has received considerable attention from researchers[2-5] and policymakers.[6-7] The premature graduation of children from booster seats to normal (adult) seatbelts is well documented, as is the increased injury risk associated with children incorrectly restrained in the event of a crash.[2,8-11] (For a summary of the types of child restraint devices in vehicles, see the Australian Transport Safety Bureau website.[6]) A recent study in the United States estimated that about 283 000 children aged 1–6 years are unable to be restrained correctly, given the range of available child restraints and the large number of overweight children.[12] This may be of similar concern in Australasia, given that the 2004 Australia/New Zealand child restraint standard (AS/NZS 1754)[13] stipulates a considerably lower maximum child weight for booster seats (26 kg) than is the case in the US, where restraints recommended for children of up to 36 kg are available.[14]

With substantial increases in childhood overweight and obesity rates being observed in the past few decades,[15,16] and in view of the fact that weight is used as the basis of child restraint recommendations,[4,5] the link between the safety of children in vehicles and childhood obesity is of significant public health interest. Given the limited success of preventive efforts and weight loss strategies in reducing population obesity levels, coupled with historical trends in weight gain globally,[15] it is likely that the number of Australian parents who will have difficulty ensuring the correct and safe transport of their children will increase. A recent review of child restraint laws in Australia indicated significant deficiencies relative to other countries,[5] and stated that changes to current standards[13] are required to enhance the safety of children travelling in vehicles.

It is within this context that we re-examined previously reported data[3,8] to investigate the relationship between child weight and height, body mass index (BMI), and booster seat usage. This is timely, given the review of child restraint guidelines currently being undertaken by the Australian Government.[7,13]

METHODS

Participants and setting

Our study was conducted between February and April 2005. Participants were parents holding a valid drivers licence with a child aged 4–11 years residing in New South Wales or Victoria. Participation was voluntary and no payment was offered. We used a convenience sample of parents with school-aged children.

Recruitment

In NSW, regional school directors, on behalf of our research team, contacted school principals via email with details of the research project. In Victoria, schools were randomly selected and school principals were sent a letter of invitation to participate. After this initial contact, interested school principals contacted us directly and provided the number of pupils enrolled in the school. Unaddressed research packs were sent to each participating school, where principals distributed the packs to parents via the child, accompanying the school newsletter. Each research pack contained a letter of invitation for parents and a self-report questionnaire. A total of 3959 questionnaires were distributed to 32 primary schools (25 in NSW, seven in Victoria).

Questionnaire

The questionnaire examined restraint use, child and parent characteristics, travel patterns, and a range of knowledge and attitude statements designed to elucidate reasons for parental restraint choices. Using one questionnaire per household, parents were asked to report on all children, regardless of age, and were requested to accurately measure the height and weight of each child. Full details of the questionnaire items are reported elsewhere.[3,8]

Analysis

The booster seat child height corridor used in our study (100–145 cm) was defined by

1 Child age, sex, BMI, weight category and typical restraint characteristics (all values except age are percentages)

					Restraint type*						
			BMI (IOTF defined and adjusted[17])		Forward-facing child restraint	Booster seat			Seatbelt		
Age (years)	Sample ($n = 633$)	Girls	25–29.9 kg/m^2	⩾ 30 kg/m^2	14–26 kg	< 14 kg	14–26 kg	> 26 kg	< 14 kg	14–26 kg	> 26 kg
4	5.7	38.9	16.7	0	11.1	0	75.0	2.8	0	11.1	0
5	22.9	51.7	16.6	9.7	1.4	0.7	52.4	1.4	0.7	40.0	3.4
6	20.1	48.0	15.0	4.7	1.6	0	34.6	5.5	0	45.7	12.6
7	17.7	46.4	16.1	10.7	0	0	6.3	4.5	0	45.5	43.8
8	17.7	53.6	11.6	8.0	0	0	5.4	1.8	0	32.1	60.7
9	8.8	60.7	12.5	5.4	0	0	1.8	1.8	0	23.2	73.2
10	4.9	48.4	22.6	3.2	0	0	3.2	3.2	0	16.1	77.4
11	2.2	35.7	14.3	21.4	0	0	Nil	Nil	0	7.1	92.9
Total	*100*	*49.9*	*15.2*	*7.6*	*1.2*	*0.2*	*25.6*	*3.0*	*0.2*	*35.7*	*34.1*

BMI = body mass index. IOTF = International Obesity Taskforce. * Rows sum to 100%. ◆

the upper recommended child height for forward-facing child restraints (100 cm) and a commonly accepted "seatbelt transition height" (145 cm), above which the child is considered tall enough for a normal seatbelt.[3,4] Booster seat child weight threshold values (14–26 kg) were based on the current AS/NZS 1754.[13] Using International Obesity Taskforce (IOTF) age and sex tables, children were classified as being normal weight (BMI < 25 kg/m^2), overweight (BMI 25–29.9 kg/m^2) or obese (BMI ⩾ 30 kg/m^2).[17]

Univariate analysis was performed where appropriate (using t tests and χ^2 tests), and odds ratios (ORs) were calculated to assess the relationship between BMI and restraint use.[18] Analysis was performed using Stata software, release 8.0 (StataCorp, College Station, Tex, USA).

Ethics approval

Our study was approved by the Monash University Standing Committee on Ethics in Research Involving Humans, the NSW Department of Education and Training and the Department of Education and Early Childhood Development, Victoria.

RESULTS

Response rate and demographic characteristics of respondents

Of the 3959 questionnaires distributed, 699 were returned (response rate, 18%). The response rate was higher in NSW (19%) than Victoria (15%). Because of privacy laws, no follow-up of non-responders was possible.

Compared with Australian census data of parents with a child aged 4–11 years in NSW and Victoria,[19] respondents were more likely to be women (sample [88%] v census [55%]), less likely to reside in urban areas (36% v 66%), and more likely to have completed secondary education or a university qualification (76% v 45%). The sample was otherwise matched with census data on household income (< $40 000: 25% v 32%; $40 000–$75 999: 33% v 38%; ⩾ $76 000: 42% v 27%), age (18–30 years: 9% v 11%; 31–45 years: 83% v 76%; > 46 years: 9% v 13%), and marital status (married or with partner) (86% v 81%).

Characteristics of children and restraint devices

Of the 699 parents returning the questionnaire, seven failed to provide details of their children and were excluded from further consideration. The remaining 692 parents reported on the seating patterns and characteristics of a total of 1500 children ranging from 1 month to 20 years of age. Our study reports on the 633 children whose height fell within the defined booster seat corridor (100–145 cm), details of which were provided by 452 parent respondents. Of these parents, 287 (63.5%) had one child, 149 (32.9%) had two children and 16 (3.5%) had three children. Parents reported that their children were always restrained in the restraint type noted when travelling in the vehicle.

Child demographic factors and typical restraint characteristics are presented in Box 1. Half of the 633 children were girls (316 [49.9%]). The mean age was 7.2 years (SD, 1.6) for girls and 7.1 years (SD, 1.6) for boys (median age for both sexes, 7.0 years). There was no difference in age distribution between boys and girls ($P = 0.4$). Using IOTF age- and sex-adjusted cut-off points, 15.2% of children were overweight (BMI 25–29.9 kg/m^2 equivalent) and 7.6% were obese (BMI ⩾ 30 kg/m^2 equivalent). By comparison, 20% of Australian boys (including 4.7% classified as obese) and 21.5% of girls (including 5.5% classified as obese) aged 7–15 years were classified as overweight in 1995.[20]

Few children (1.2%) aged 4–11 years were reported to be restrained in a forward-facing child restraint, 28.8% were restrained in a booster seat, and 70.0% were reported to be restrained in a seatbelt (95% lap/sash; 5% lap only). None of the children were reported to be restrained in a child harness, which can accommodate children weighing up to 32 kg. Key observations were as follows (Box 1):

- 3% of children were restrained in booster seats despite weighing over 26 kg;
- 25.6% of children falling within the height and weight range for booster seats were appropriately restrained in a booster;
- 35.7% of children, despite falling within height and weight range for booster seats, were restrained in seatbelts;
- 34.1% of children exceeded the upper weight limit of 26 kg for booster seats and were restrained in seatbelts;
- Increasing age was associated with an increasing proportion of children exceeding the 26 kg booster seat threshold. As age

2 Restraint type used for children aged 4–11 years in the height range 100–145 cm, by BMI*

Restraint type and booster seat weight criteria	BMI (IOTF defined and adjusted[17])			
	< 25 kg/m²	25–29.9 kg/m²	⩾ 30 kg/m²	Total
Restrained in booster (total)	*148 (81.3)*	*26 (14.3)*	*8 (4.4)*	*182 (100)*
Below booster weight	1 (100)	0	0	1 (100)
Within booster weight	137 (84.6)	21 (13.0)	4 (2.5)	162 (100)
Above booster weight	10 (52.6)	5 (26.3)	4 (21.1)	19 (100)
Restrained in seatbelt (total)	*333 (75.2)*	*70 (15.8)*	*40 (9.0)*	*443 (100)*
Below booster weight	1 (100)	0	0	1 (100)
Within booster weight	194 (85.8)	24 (10.6)	8 (3.5)	226 (100)
Above booster weight	138 (63.9)	46 (21.3)	32 (14.8)	216 (100)
Total	*489 (77.3)*	*96 (15.2)*	*48 (7.6)*	*633 (100)†*

BMI = body mass index. IOTF = International Obesity Taskforce. * Figures represent number (%). † Eight children (1.3%) within the weight range for booster seats were seated in a forward-facing child restraint (all had BMI < 25 kg/m²). ◆

increased, so too did the proportion of children restrained in seatbelts despite not having reached the seatbelt transition height.

Characteristics of children falling within the recommended height range for booster seats (100–145 cm) but having a BMI of 25–29.9 kg/m² or ⩾ 30 kg/m² (age-and sex-adjusted, using IOTF criteria[17]) are included in Box 2. About 19% of children restrained in booster seats and about 25% of children restrained in seatbelts were classified as being overweight or obese. Overweight and obese children, as a group, were no more likely to be restrained in a seatbelt than a booster seat (OR, 1.44; 95% CI, 0.93–2.2; $P = 0.1$); however, obese children were more likely to be restrained in a seatbelt than a booster seat, even if they were below the seatbelt transition height (OR, 2.2; 95% CI, 1.0–4.6; $P = 0.048$). The fact that 15.5% of children restrained in boosters are classified as overweight or obese demonstrates that current weight guidelines do include, to some extent, overweight children. Children with a BMI > 25 kg/m² were significantly more likely (OR, 3.4; 95% CI, 2.5–5.0; $P < 0.001$) to exceed the booster seat weight threshold than those with a BMI < 25 kg/m².

DISCUSSION

Our study reports on children whose height fell within the defined booster seat corridor, and, by that criterion, all should ideally have been restrained in a booster seat. However, the finding that a proportion of children exceed the recommended upper weight limit for booster seats stipulated by AS/NZS 1754,[13] yet fail to meet the seatbelt transition height, highlights the difficulty faced by parents in ensuring optimal seating for their children. This appears to be a significant issue for children aged 7 years and older in particular, and despite such children not meeting the minimum recommended height, seatbelts appear to be the preferred mode of restraint for these children. While seatbelts are better than no restraint, the use of booster seats is associated with a significantly lower risk of head and spinal injuries, internal organ injury and lower extremity fractures than the use of seatbelts for children aged 4–7 years.[21]

As we used a convenience sample, the limitations of our findings relate to non-response bias; parental reporting bias of weight, height and restraint type; and assumptions concerning restraint use. As the response rate for our survey was low, those who responded may not be representative of the wider population. Moreover, participants in research about behaviours that are not socially acceptable have been shown to minimise the extent of their negative behaviours when responding to surveys.[22] Parents may have over-reported the use of an appropriate child restraint, leading to an underestimation of the extent of seatbelt misuse. While parents were requested to measure and weigh their child, it is acknowledged that parents may have simply estimated these parameters without measuring them. Such estimates may not be reliable, especially if the child is overweight or obese.[23] On the other hand, recent research has shown that, in a sample of parents presenting their children to a hospital emergency department, estimates of their child's weight were accurate to within 10% on 78% of occasions.[24] Allowing for this degree of error, the proportion of children exceeding the weight maximum for booster seats could therefore range from 32% to 51% (±5%), with the point estimate being 37% in this sample. A large-scale research program, in which height and weight are directly measured and the make and model of the restraint device are recorded, would be required to overcome this limitation.

CONCLUSION

We recommend that consideration be given to increasing the maximum child weight limit for booster seats, as defined by AS/NZS 1754.[13] If this standard were to stipulate that booster seats accommodate children weighing up to 36 kg, the proportion of children in our sample exceeding the weight criteria would be reduced from 37.1% to 4.3%. On a further policy level, age-based guidelines have been suggested as an alternative to the current standard.[4] However, given the current range of available booster seats, our data show that a proportion of children would be inadequately seated if guidelines based on age alone were used. Simply providing booster seats designed to accommodate heavier children will be insufficient to ensure the safe carriage of children, given the high proportion of children who are placed into seatbelts despite meeting height and weight criteria for using booster seats. We recommend a community-based education campaign, coupled with a change in booster seat minimum design standards, to facilitate the optimal protection of children in vehicles.

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COMPETING INTERESTS

None identified.

AUTHOR DETAILS

Michael P Fitzharris, BA, BSc(Hons), PhD, Senior Research Fellow[1]
Judith Charlton, BEd, MSc, PhD, Senior Research Fellow[2]

Megan Bohensky, BA, MPH, Research Fellow[2]
Sjaanie Koppel, BAppSc(Hons), PhD, Research Fellow[2]
Brian Fildes, BSc(Hons), PhD, Professor and Chair of Road Safety[2]

1 Critical Care and Trauma, The George Institute for International Health, Sydney, NSW.

2 Accident Research Centre, Monash University, Melbourne, VIC.

Correspondence: **mfitzharris@george.org.au**

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