Trends in Booster Seat Use Among Young Children in Crashes

Dennis R. Durbin, MD, MSCE*‡; Michael J. Kallan, MS‡; and Flaura K. Winston, MD, PhD*

ABSTRACT. *Introduction.* **Booster seat use in the United States is extremely low among 4- to 8-year-old children, the group targeted for their use. However, more recent attention has been paid to the role of booster seats for children who have outgrown their forward-facing child safety seat. In particular, several states are currently considering upgrades to their child restraint laws to include the use of booster seats for children over 4 years of age.**

Objective. **To examine recent trends in booster seat use among children involved in automobile crashes in 3 large regions of the United States.**

Design. **This study was performed as part of the Partners for Child Passenger Safety project, an ongoing, child-specific crash surveillance system that links insurance claims data to telephone survey and crash investigation data. All crashes occurring between December 1, 1998, and November 30, 2000, involving a child occupant between 2 to 8 years of age riding in a model year 1990 or newer vehicle reported to State Farm Insurance Companies from 15 states and Washington, DC, were eligible for this study. A probability sample of eligible crashes was selected for a telephone survey with the driver of the vehicle using a previously validated instrument. The study sample was weighted according to each subject's probability of selection, with analyses conducted on the weighted sample.**

Results. **The weighted study sample consisted of 53 834 children between 2 to 8 years old, 11.5% of whom were using a booster seat at the time of the crash. Booster seat use peaked at age 3 and dropped dramatically after age 4. Over the period of study, booster seat use among 4- to 8-year-olds increased from 4% to 13%. Among 4-year-olds specifically, booster use increased from 14% to 34%. Among children using booster seats, approximately half used shield boosters and half used belt-positioning boosters.**

Conclusion. **Although overall booster seat use among the targeted population of 4- to 8-year-old children remains low, significant increases have been noted among specific age groups of children over the past 2 years. These data may be useful to pediatricians, legislators, and educators in efforts to target interventions designed to increase appropriate booster seat use in these children.** *Pediatrics* **2001;108(6). URL: http://www.pediatrics.org/cgi/content/full/108/6/e109;** ***booster seat, child passenger safety, automobile crashes.***

From the *Department of Pediatrics, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania; and the ‡Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania.

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Reprint requests to (D.R.D.) Center for Clinical Epidemiology and Biostatistics, Room 711 Blockley Hall, 423 Guardian Dr, Philadelphia, PA 19104. E-mail: ddurbin@cceb.med.upenn.edu

ABBREVIATIONS. NHTSA, National Highway Traffic Safety Administration; CHOP/Penn, Children's Hospital of Philadelphia and University of Pennsylvania; CI, confidence interval.

Motor vehicle crashes remain the leading cause of death for children over age 1 in the United States.[1] Despite significant increases in restraint use for children over the past 25 years,[2] many children are not restrained properly for their age.[3] This problem is particularly prevalent among children 4 to 8 years old. These children have typically outgrown a forward-facing convertible child restraint, yet are not big enough to use the vehicle seat belt properly. Current guidelines from the American Academy of Pediatrics[4] and the National Highway Traffic Safety Administration (NHTSA)[5] recommend that children from 40 to 80 lbs and up to 57 inches in height should use a belt-positioning booster seat. Recent data have documented that young children in seat belts are over 3 times more likely to be injured in a crash than children in age-appropriate restraints.[3]

In response to this problem, the NHTSA and other organizations have begun to emphasize the importance of booster seats in public education campaigns.[6] In addition, several states (WA, CA, AR) have recently passed upgraded child restraint laws that require the use of booster seats for children over age 4. Many other states are actively considering similar upgrades to their child restraint laws.

In light of this recent activity to promote and/or legislate booster seat use, the objective of this study was to assess current trends in booster seat use in 3 large regions of the United States. This information would be of use to public health professionals and policy makers to justify or target efforts to increase booster seat use.

METHODS

This study was conducted as part of the Partners for Child Passenger Safety Project. Detailed descriptions of the study population and methods involved in data collection and analysis have been previously published.[7] Briefly, the project consists of an ongoing, large scale, child-specific crash surveillance system created by linking electronic insurance claims data at State Farm Insurance Companies (Bloomington, IL) to telephone survey and crash investigation data. The insurance claims function as the source of cases, with the telephone survey and onsite crash investigations serving as the primary sources of data.

Crashes qualifying for inclusion in the surveillance system are those involving at least 1 child occupant ≤15 years of age riding in a model year 1990 or newer State Farm-insured vehicle. Qualifying crashes are limited to those that occur in 15 states and the District of Columbia, representing 3 large regions of the United States (East: NY, NJ, PA, DE, MD, VA, WV, NC, DC; Midwest: OH, MI, IN, IL; West: CA, NV, AZ). On a daily basis, data from

qualifying and consenting claims are transferred electronically from all involved State Farm field offices to researchers at the Children's Hospital of Philadelphia and University of Pennsylvania (CHOP/Penn). Data in this initial transfer include contact information for the insured, the ages and genders of all child occupants, and a coded variable describing the medical treatment received by all child occupants.

The data are then subjected to an automated sampling algorithm to select a representative sample of claims to be included in the surveillance system. Crashes involving children who were treated in emergency departments, physician's offices, or admitted to the hospital are oversampled to ensure the capture of all injured children while maintaining a representative sample of all crashes. Sampled claims are then transferred electronically on a daily basis to Roper Starch, Worldwide, Inc (Princeton, NJ) for the conduct of a telephone survey with the driver of the vehicle and parent(s) of the involved children. The survey was designed to ascertain information on the circumstances of the crash, including the type of restraint system used by each child, as well as injuries to all child occupants, and has been previously validated.[8] Parents were asked a serious of questions requiring them to describe the type of restraint used by their child (eg, the presence of a harness) and whether or not the seat belt was used to secure the seat. In this way, we could distinguish booster seats from child safety seats.

Separate verbal consent is obtained from eligible participants for the transfer of claim information from State Farm to CHOP/Penn, for the conduct of the telephone survey, and for the conduct of a crash investigation. The study protocol was reviewed and approved by the institutional review boards of CHOP/Penn.

Because study participants are sampled with different probabilities depending on their medical treatment received after the crash, the study sample was weighted with weights inversely proportional to their probability of selection. All analyses were then conducted on the weighted population to reduce the effects of bias introduced by the sampling procedure. Descriptive statistics, consisting of frequencies for categorical variables, were determined. Changes in booster seat use over time were assessed with logistic regression analysis using the date of the crash as the independent variable and booster use as the dependent variable. Separate models were created for each year of age as well as for the overall 4- to 8-year-old population. Results are expressed as probabilities of booster use (with associated 95% confidence intervals [CI]) at the beginning and end of the time period, as well as the annual average percent change in booster seat use. Trends in booster seat use were examined for yearly age groups of children to identify evidence for changes in the age at which parents used booster seats over the time period of study.

RESULTS

Between December 1, 1998, and November 30, 2000, completed survey data were obtained on 11 643 children who were then weighted to represent 113 387 children from 0 to 15 years of age involved in 73 382 crashes. In the overall population, booster seat use was confined to children between 2 to 8 years of age. There were 53 834 children in this age group, representing 47% of the entire population. Table 1 provides descriptive information on these children.

Overall reported restraint use was 97% among 2- to 8-year-olds. Figure 1 shows the type of restraint used by children at each age, averaged over the 2-year time period. Booster seat use peaked at age 3 (30%), declined dramatically beginning at age 5, and was virtually nonexistent over 6 years old. Among the 6171 children using booster seats, 3219 (52%) were using a shield booster seat and 2952 (48%) were using a belt-positioning booster seat. The type of booster seat used varied with age, with younger children more likely to use shield boosters (67% of 2- to 3-year-olds vs 39% of 4- to 6-year-olds). Because younger children were less likely to use boosters

TABLE 1. Descriptive Statistics on the Study Sample

Variable Name	Weighted Number (%) N = 53 834
Gender	
Male	27 489 (51%)
Female	26 345 (49%)
Seat position	
Front seat	6976 (13%)
Rear seats	46 858 (87%)
Vehicle type	
Passenger car	21 717 (53%)
Passenger van (minivan)	9407 (23%)
Sport utility vehicle	6506 (16%)
Pick-up truck	2267 (6%)
Large van	1057 (2%)
Crash location	
East region	29 335 (55%)
Midwest region	15 627 (29%)
West region	8872 (16%)
Driver age (n = 40 940 drivers)	
16–20 y	846 (2%)
21–25 y	2961 (7%)
26–35 y	19 329 (47%)
36–45 y	13 181 (32%)
>45 y	4532 (11%)
Unknown	91 (<1%)

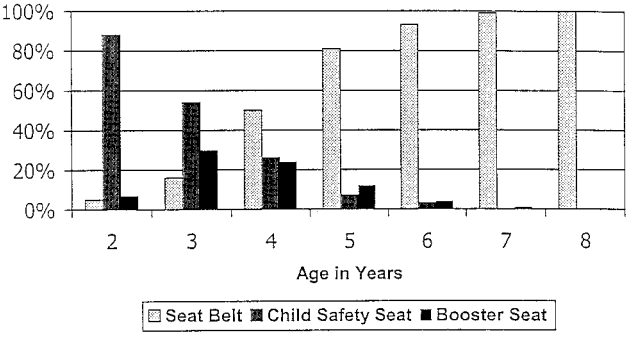

Fig 1. Type of restraint used by year of age.

over time, belt-positioning booster seats accounted for an increasing proportion of boosters over time.

Figure 2 shows trends in booster seat use over the time period of the study for specific ages of children. Booster seat use among 4- to 8-year-old children, the targeted population for their use, increased significantly from 4.6% to 13% over the time period of study, representing an annual increase of 74% (95% CI: 20%–150%). The greatest age-specific increase in use occurred among 4-year-olds, rising from 14% to 34% over the 2-year period, representing an annual increase of 80% (95% CI: 10%–190%). Booster seat use among 3-year-olds demonstrated a declining trend over time, although this trend was not statistically significant (annual average: 10%, 95% CI: −40%–50%). This trend was offset by a similar trend demonstrating increasing use of child safety seats among 3-year-olds over time (not shown).

When analyses were restricted to the use of belt-positioning booster seats, the type currently recommended, a significant increase in use was seen among all 4- to 8-year-olds, from 3% at the outset to nearly 9% at the completion of the time period (annual average increase: 90%, 95% CI: 10%–220%).

Figure 3 demonstrates the proportion of 4- to

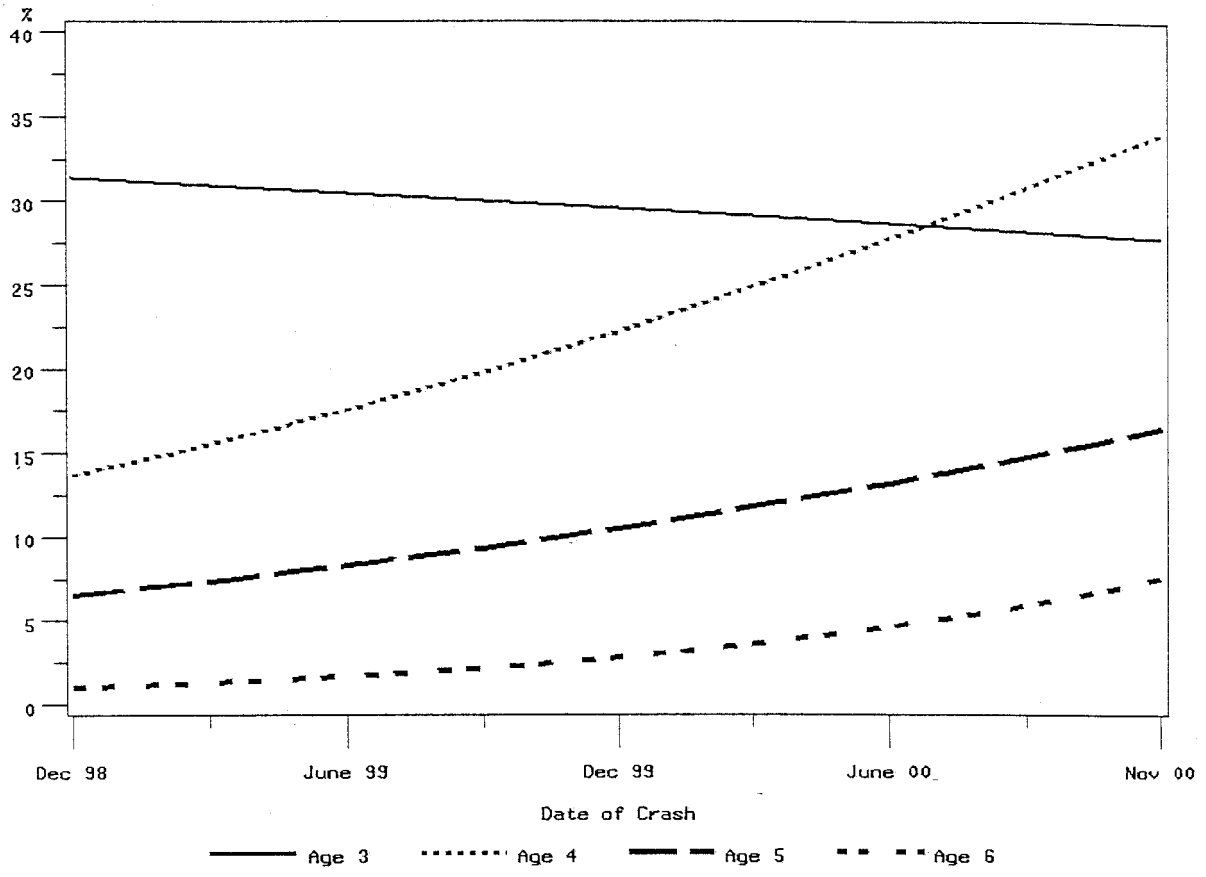

Fig 2. Probability of booster seat use over time, by age of child.

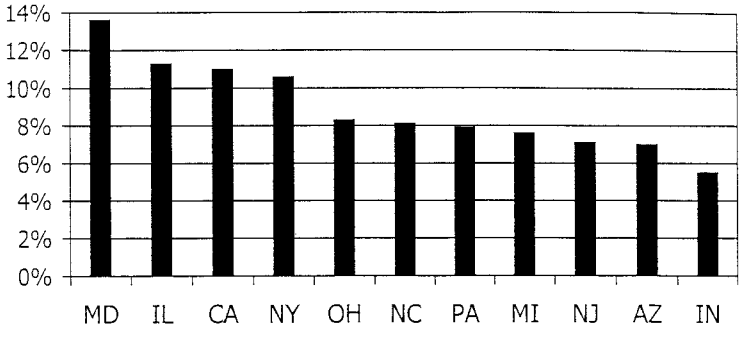

Fig 3. Two-year average booster seat use among 4- to 8-year-olds by state.

8-year-old children using booster seats, averaged over the 2-year time period, by state, for those states with at least 100 weighted booster seat users. There was a 2.5-fold difference in use between the highest (MD) and lowest (IN) state. Only 4 states (MD, IL, CA, NY) had use rates over 10% in the targeted population.

DISCUSSION

Results of this study show that, although overall booster seat use remains low among the population of children targeted for their use, there have been significant increases in use noted among 4- to 6-year-olds during the 2-year time period of this study. In particular, results demonstrating a trend toward maintaining 3-year-olds in child safety seats, with a large increase in booster use by 4-year-olds, suggests that a greater proportion of children are remaining in a forward-facing child seat up to age 4 and then transitioning to a booster seat, which is consistent with current recommendations. Data demonstrating essentially no use of booster seats among 7- and 8-year-olds suggests that parents of these children must also be counseled regarding current best practice recommendations.

It is important to highlight that, based on current recommendations for optimal restraint of children, many children using shield booster seats were not, in fact, restrained optimally. Shield booster seats have been decertified by the NHTSA for all children except those weighing between 30 and 40 lbs. Even in this weight group, the American Academy of Pediatrics recommends the use of a full harness child restraint as current best practice. Pediatricians

should counsel parents to keep children in full harness child safety seats until approximately 4 years of age or 40 lbs, at which time children should use belt-positioning booster seats.

The NHTSA began a standardized child passenger safety training and certification program in March 1998. Since then, over 16 000 individuals have been certified as child passenger safety technicians (personal communication, Lori Miller, NHTSA, June 11, 2001). These individuals have participated in thousands of community-based child safety seat clinics and have been a source of information on appropriate restraint guidelines, including the use of booster seats. In addition, several government- and industry-sponsored initiatives have drawn significant media attention to the importance of booster seats. The NHTSA made booster seats the focus of its Child Passenger Safety Week educational campaign in February 2000. State Farm Insurance Companies has conducted a nationwide education campaign of its 35 million policyholders via a mass mailing of information on booster seats. Ford Motor Company, through its BoostAmerica campaign, has also increased the public's awareness of the need for booster seats, and is distributing 1 million booster seats across the country.

Our study suggests that these public education efforts have been effective in increasing booster seat use, particularly among 4-year-old children. A recent survey, conducted in December 2000 (the end of the time period of the current study) suggests that parental knowledge of booster seats has increased over the time period of this study.[9]

At the present time, 3 states (WA, CA, AR) have passed legislation upgrading child restraint laws to include the appropriate restraint of children age 4 and over in booster seats. Several other states have also recently drafted upgraded child restraint laws to include the use of booster seats. At the current time, federal legislation is being drafted to encourage states to upgrade their child restraint laws to include the use of booster seats for children 4 years of age and over.[10] Our results may assist state and federal policymakers by demonstrating the current level of interest on the part of parents to optimally restrain their older children.

Nearly all of the data for this study was obtained via telephone interview with the driver/parent of the child and is potentially subject to bias, specifically, the parent/driver overreporting of restraint use. Ongoing comparison of parent-reported restraint use to evidence from onsite crash investigations has demonstrated excellent accuracy (83% agreement) of the parent report. In addition, given the manner in which parents were asked to describe features of the seat and how it was used, it is unlikely that parents would report use of a booster seat when they were not, in fact, using it.

The Partners for Child Passenger Safety surveillance system is limited to children occupying model year 1990 and newer vehicles in crashes in 15 states and the District of Columbia. Results of this study may, therefore, not be generalizable to children occupying older or uninsured vehicles, or to children residing in nonstudy states.

CONCLUSION

Although significant increases in booster seat use among 4- to 8-year-old children were seen over the 2-year study, overall booster use, particularly among children over age 4, remains very low. Given that data now exist to document the additional safety benefits of booster seats over seat belts alone,[3] it is imperative that efforts to upgrade child restraint laws and educational efforts directed to parents and children include language about the importance of booster seats. Pediatricians can play an important role in advocating for these legislative and educational efforts to improve the safety of children in cars.

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REFERENCES

1. US Department of Transportation, National Highway Traffic Safety Administration. *Research Note: 2000 Motor Vehicle Traffic Crashes, Injury and Fatality Estimates: Early Assessment, March 2001*. Washington, DC: National Center for Statistics and Analysis; 2001
2. National Highway Traffic Safety Administration. *Traffic Safety Facts 1999*. Washington, DC: National Center for Statistics and Analysis, Department of Transportation; December 2000
3. Winston FK, Durbin DR, Kallan MJ, Moll ED. The danger of premature graduation to seat belts for young children. *Pediatrics*. 2000;105: 1179–1183
4. American Academy of Pediatrics. Selecting and Using the Most Appropriate Car Safety Seats for Growing Children: Guidelines for Counseling Parents (RE9618); 1996. Available at: http://www.aap.org/family/01352.htm. Accessed June 1, 2001
5. National Highway Traffic Safety Administration, Emergency Nurses Association, American College of Emergency Physicians. Protect your kids in the car. 1997. Available at: http. //www.nhtsa.dot.gov/people/injury/childps/rxFlyer/rxflyer4.html. Accessed June 1, 2001
6. We must get kids into booster seats. http://www.nhtsa.dot.gov/people/injury/childps/boosterseat/booster.html. Accessed June 5, 2001
7. Durbin DR, Bhatia E, Holmes JH, et al. Partners for child passenger safety: a unique child-specific crash surveillance system. *Accid Anal Prev*. 2001;33:407–412
8. Durbin DR, Winston FK, Applegate SM, Moll EK, Holmes JH. Development and validation of ISAS/PR: a new injury severity assessment survey. *Arch Pediatr Adolesc Med*. 1999;153:404–408
9. Survey of booster seat usage and awareness in 50 states. McLean, VA: Wirthlin Worldwide; 2001
10. Child Passenger Protection Act of 2001. S. 980, 107th Congress §2

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