Too Small for a Seatbelt: Predictors of Booster Seat Use by Child Passengers

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ABSTRACT. Objectives. Motor vehicle injury is the leading cause of injury death for children 4 to 8 years of age. Although booster seat use in this age group substantially reduces the risk of injury, most children are currently restrained by seatbelts designed for adults. The objective of this study was to measure booster seat use directly, determine factors predictive of proper child restraint, and assess parental reasons for booster use and nonuse.

Methods. We conducted a cross-sectional, observational study in Seattle, Washington, Spokane, Washington, and Portland, Oregon, from February to April 2000. Drivers were surveyed in their vehicles after picking up children from schools and child care centers. Trained observers recorded child age, weight, and height and directly observed restraint use. Observed restraint use was compared with the recommended restraint method based on the child's weight and age. Data were analyzed using multivariate logistic regression, adjusted for clustering by car and site.

Results. We observed 2880 children traveling in cars, 1539 of whom were eligible for booster seat use. Eighty-eight percent of drivers agreed to respond to our survey. Only 16.5% of children for whom a booster seat was recommended were properly restrained, compared with 80% of younger children for whom a child safety seat was recommended and 55% of children for whom an adult seatbelt was recommended. Relative to a 4-year-old booster-eligible child, a 6-year-old was only half as likely to use a booster seat (odds ratio [OR]: 0.47; 95% confidence interval [CI]: 0.31–0.71) and an 8-year-old almost never used a booster seat (OR: 0.04; 95% CI: 0.01–0.19). Booster use was more common when the driver wore a seatbelt (OR: 3.1; 95% CI: 1.8–5.4). Parents whose children were using booster seat cited “safety” (61%) and “child comfort and visibility” (12%) as their primary concerns. When a child was not using a booster seat, parents most often believed that their child was “too big for a car seat” (56%), reported that the seat was in another vehicle (9%), or stated that they “had not heard” of booster seats (8%).

Conclusions. Many parents still incorrectly believe that children are safe in a seatbelt and have outgrown the need for a car seat. These results demonstrate the need for public education campaigns to educate parents about booster seat use. Pediatrics 2003;111:e323–e327. URL: http://www.pediatrics.org/cgi/content/full/111/4/e323; injuries, motor vehicles, booster seats, seat belts.

ABBREVIATIONS. SD, standard deviation; OR, odds ratio; CI, confidence interval.

Motor vehicle crashes remain the leading cause of death for children 4 to 8 years of age.1 These children do not yet fit well into the adult lap and shoulder belt, and so belt-positioning booster seats are recommended for children under 4’9”, generally between 4 and 8 years of age, or 40 to 80 pounds.2,3 Nonetheless, most parents still do not know that a seatbelt does not offer optimal protection for their booster-aged child.4 As a consequence, few children between 4 and 8 years of age use a booster seat, with national estimates ranging between 6% and 19% booster use.5–7

We sought to measure observed booster seat use among child passengers. The study had 3 objectives: 1) to estimate the prevalence of booster seat use, 2) to identify factors associated with booster seat use and nonuse, and 3) to assess parental reasons for restraint choice.

METHODS

Study Design

From February to April 2000, we conducted a cross-sectional observational study on booster seat use. We conducted our survey in the cities of Seattle, Washington; Spokane, Washington; and Portland, Oregon. In each city, we surveyed booster seat use in 4 different neighborhoods, or 12 neighborhoods total. Neighborhoods selected had distinct geographic boundaries and represented a range of income and poverty levels (Table 1).

Observations were conducted at 83 child care centers and elementary schools. The 83 sites were those in the respective neighborhoods that had agreed to participate in the study. Verbal consent was obtained from all participating drivers, and the goals of the study were explained. Centers were asked to withhold information to the parents about the scheduling of the survey, so as not to alter routine behavior. The study was approved by the University of Washington Human Subjects Division.

Observation Methods

A pilot study was conducted to determine the feasibility of the observational study and brief survey. Observers were recruited from local colleges and communities and underwent a standard training program to explain the aims of the study and observation.
methods. Practice observations were conducted under supervision before data collection. Teams of 2 or more observers visited each site. Observers surveyed drivers as children were picked up at the end of the day, as drivers were less rushed and pickup times were more extended than drop-off times. The survey team approached all available cars leaving the child care center or school during the specified pick-up period, typically between 3 and 6 PM. Cars leaving with only a nonambulatory child were excluded from the survey. Cars were approached in the parking lot only after the driver had an opportunity to secure any children in the vehicle and to fasten his or her own seatbelt.

Drivers were asked whether they were willing to participate in a brief interview. They were asked to describe their child’s age, weight, and height and to estimate the distance from home. Trained observers looked into the car to assess restraint use by the driver and all occupants. Drivers were queried about reasons for restraint choice, and their responses were recorded verbatim. The open-ended responses were then coded by 1 of the researchers and an assistant. All drivers received information about the study and a pamphlet describing booster seat use.

Data Analysis

For the purposes of our study, we defined a child who should use an infant or child seat as any child <40 pounds, or under 4 years of age. Observers were not asked to differentiate between rear-facing infant harness seats and forward-facing child harness seats. As most drivers in our survey were unable to report a child height, we chose to use only age and weight criteria to define recommended booster seat use. We defined a child who should use a booster seat as any child between 40 and 80 pounds and between 4 to 8 years old, or a child between 4 and 8 years old when weight data were not available. Three-year-old children weighing 40 pounds were also characterized as being booster seat-eligible, because the majority of child harness seats have a top weight limit of 40 pounds. Children who were over 80 pounds or over 8 years of age were considered to be big enough for the adult lap and shoulder belt. Data were analyzed in STATA Version 7.0 using logistic regression, where the dependent variable was booster seat use. We used a generalized estimating equations method to account for clustering by car and site.

RESULTS

Participation of Study Sites and Study Participants

Ninety-five percent of child care centers and schools contacted gave permission for us to survey parents leaving their facility parking lot. Directors were asked to estimate the number of 4 to 8-year-old children at their facility, and sites with >20 enrolled 4- to 8-year-old children were selected. Of the 116 sites that agreed to participate, surveyors visited 83 sites. Those sites whose directors refused cited perceived dangerous parking situations prone to congestion or prohibitive corporate policy as the reasons for refusal.

Eighty-eight percent of drivers approached agreed to participate in our survey. We recorded information on 2880 children, traveling in 2212 cars. A total of 1539 children met criteria for booster seat use. The mean age of all children observed was 4.9 years (standard deviation [SD]: 2.2 years), mean weight was 46 pounds (SD: 17 pounds), and mean height when known was 43 inches (SD: 8 inches; Table 2).

However, fewer than one third of drivers were able to report a child height. Children were most commonly in the rear outboard seats; however, 24% of children were front-seat passengers. Eighty-three percent of drivers wore a seatbelt, and 70% of all drivers were female. Drivers were an average of 12 minutes from home.

Restraint Use

Overall, 21.3% of booster-eligible children were using booster seats, although only 16.5% were using booster seats properly with a lap and shoulder belt. Figure 1 shows the percentage of children who were correctly restrained, according to the recommended child restraint device for their stated age and weight. For children who were optimally restrained in an infant or child seat, 80% were properly restrained. For children who were optimally restrained in a booster seat, only 16% were properly restrained. Among older children who were able to use an adult lap-shoulder restraint system, 55% were properly restrained.

Although younger children were generally correctly restrained in child harness seats, the use of child seats began to decrease at 3 years of age (Fig 2), as some of these children were prematurely graduated to booster seats or adult seatbelts. The use of booster seats was very low among children 4 to 6 years of age. Proper restraint use began to increase slowly at 7 to 8 years, primarily because some of these children exceeded the weight requirements for booster seats and were using adult seatbelts. Seatbelt
use remained between 60% and 70% for children older than 8 years. Among children surveyed, 9% were completely unrestrained in the car.

Restraint Misuse
For booster-aged children who were not using booster seats properly, more than two thirds of restraint misuse was attributable to premature graduation to adult seatbelts (Table 3). Thirty-seven percent of the booster-eligible children who had prematurely graduated to the use of an adult seatbelt had moved the shoulder belt behind the back or arm before leaving the parking lot. Eleven percent of booster-eligible children were seated in passenger positions when only a lap belt was present. Another 11% were still using child harness seats despite exceeding recommended weight limits. Improper booster seat use accounted for 4.8% of restraint misuse, including the use of booster seats without the shoulder belt and the use of shield boosters with the shield on, which are no longer recommended for this age group. Of note, nearly half of the low-back booster seat users (44%) were using the booster seat inappropriately with a lap belt only or with the shoulder belt placed behind the shoulder or back.

Predictors of Booster Seat Use
Logistic regression was performed to identify factors associated with booster seat use among children of appropriate age and weight for a booster seat.

| TABLE 3. Misuse of Restraint Devices Among Booster-Eligible Children Not in Booster Seats (n = 1789) |
|-------------------------------------------------|---------------------------------|
| Child Restraint Device                          | Percentage Use |
| Properly restrained in booster seat             |                   |
| Low-back booster                                | 3.8%              |
| High-back booster                               | 12.7%             |
| Total properly restrained                       | 16.5%             |
| Improperly restrained                           |                   |
| Unrestrained                                    | 8.9%              |
| Child harness seat, despite exceeding weight requirements | 11.1% |
| Improper booster seat use                       |                   |
| Low-back booster without shoulder belt          | 2.9%              |
| High-back booster without shoulder belt         | 1.0%              |
| Shield booster using shield                     | 0.9%              |
| Total improper booster seat use                 | 4.8%              |
| Premature adult seat belt use                   |                   |
| Adult seat belt with lap and shoulder belt      | 28.7%             |
| Adult seat belt with shoulder belt behind back or arm | 17.0% |
| Lap belt only                                   | 11.3%             |
| Total premature adult seat belt use             | 57.0%             |
| No booster, other                               | 1.6%              |
| Total improperly restrained                     | 83.5%             |
(Table 4). A lower odds ratio (OR) suggested a lower likelihood of being in a booster seat. For each additional year of age, the likelihood of being properly restrained by a booster seat decreased. Relative to a 4-year-old booster-eligible child, a 6-year-old was only half as likely to use a booster seat (OR: 0.47; 95% confidence interval [CI]: 0.31–0.71), and an 8-year-old booster-eligible child very rarely used a booster seat (OR: 0.04; 95% CI: 0.01–0.19). Three-year-old children were nearly twice as likely to use booster seats as were 4-year-olds (OR: 1.92; 95% CI: 1.09–3.39). Driver seatbelt use was strongly associated with correct booster seat use (OR: 3.1; 95% CI: 1.82–5.39). Booster use was not significantly associated with the length of the trip, city of residence, or the gender of child or driver.

Parental Reasons for Booster Seat Use or Nonuse

The parents of children in booster seats were asked, “Why have you chosen to use a booster seat for your child?” The most commonly stated reason (61%) was “to keep him or her safe.” Other reasons mentioned included a better fit (9%), more comfortable seat (6%), and better view (6%). The parents of booster-eligible children were also surveyed as to the reasons they chose not to use a booster seat. The majority believed that their child was “too big” and did not need a booster seat (56%). Nine percent said that they had a booster seat but it was in a different car or at home; 8% stated they had not heard of booster seats; and 5% identified child resistance as an important factor. Only 3% identified “cost” as a concern.

DISCUSSION

Children who are <80 pounds or <4’9” tall are inadequately restrained by adult seatbelts, increasing the risk of injury in an automobile crash.10,11 The positioning of adult belts on young children can cause life-threatening spinal or abdominal injury, the so-called “seatbelt syndrome.”12 The evidence for a protective effect of booster seats is no longer theoretical. One recent study that reviewed automobile insurance data found that compared with children who were ages 2 to 5 and using child restraint systems, children who were restrained with seatbelts were 3.5 times more likely to incur a significant injury and 4.2 times more likely to have significant head trauma.13

Our study found that among children who ought to have been using a booster seat, 83.5% were improperly restrained. Two thirds of these children had prematurely graduated to an adult seatbelt. One third of these seatbelt users had already moved the shoulder belt behind the back or arm by the time the parent was ready to leave the parking lot, providing direct evidence of poor belt fit.

It should also be noted that 40% of the children whom we observed to be using a low-back booster seat did not use a shoulder belt. We suspect that many parents are using these seats in lap-belt-only positions in the mistaken belief that low-back boosters do not require the presence of a shoulder belt. At present, there are few inexpensive options for safely securing children when shoulder belts are not available, and this is an area that will require additional study.

Children aged 6 years and older were considerably less likely to use a booster seat than were children between 4 and 5 years of age. Our study also found that children were more likely to be using a booster seat when the driver was using a seatbelt. Parental restraint use has consistently been a strong predictor of child restraint use, which may be both a proxy for a parental belief structures and a powerful example for both younger and older children.4,14,15

Our finding of 16.5% booster use is similar to those from a recent national restraint use observational study, reporting booster seat use to be 19% (Cody et al, personal communication).7 Another recent study of the drivers of newer vehicles who filed a vehicle insurance claim found booster seat use to be 13% among children 4 to 8 years of age, although these data were based on self-report rather than direct observation.6

One of the challenges of promoting booster seat use is the need to consider the child’s attitudes toward using a booster seat. Our study found that younger children were considerably more likely to be using a booster seat than older children, and many parents incorrectly believed that their child had outgrown the need for a booster seat. Our previous focus group study suggested that parents believed that it would be extremely difficult to convince the child to move back to a booster seat.4 Although crash test data suggest that booster seats will have a protective effect for children under 4’9” tall, children in the United States are unfamiliar with the seats and perceive that they are for “babies.”4 It may be wise, therefore, for public health efforts to focus on encouraging booster use among younger children who are outgrowing their child harness seats; for them, a booster seat is a “step up” toward a “grown-up” seatbelt. We anticipate that as demand for booster seats increases, companies will also begin to market more aggressively to children and will make more attractive, acceptable products, similar to the transition in bicycle helmet production.

Drivers whose children were using booster seats reported being primarily motivated about their child’s safety, although many mentioned child comfort, better visibility, and child containment as additional advantages. Parents whose children did not
use booster seats incorrectly believed that their child was big enough to be safely restrained with a seatbelt. When considered together with parents who had not heard anything about booster seats, nearly two thirds of all parents surveyed did not know that their booster-age child was inadequately protected by an adult seatbelt. Previous focus group studies also identified a knowledge barrier to booster seat use.4,16,17 A smaller group of parents identified other barriers, such as the inconvenience of moving seats between multiple vehicles and child resistance. Cost has variably been reported as a deterrent in previous focus group studies.4,17 Very few drivers in this study mentioned cost as a barrier, although this may become more important as knowledge about seats increases and use increases among lower income families. At the time of this study, retail prices for booster seats ranged from $25 to >$100. The barriers identified by these parents helped guide a subsequent community intervention campaign.

There are a number of limitations to this study. Because this was an observational survey, there are potentially other unmeasured confounders. Observers also measured child restraint use but not correct use or installation. We relied on drivers to state child age and weight and did not independently validate their report by directly measuring the child’s weight. Our study was conducted at child care centers and schools. Booster seat use by children who attend these sites may differ from use by other children who are cared for at home or who ride a bus to school. The response of drivers to the open-ended questions in the study may have been limited by the brevity of the interview or potentially a social desirability bias. Finally, because the study was conducted in 3 cities in the Northwest, results may not be generalizable to other sites.

After the collection of our study data in 2000, Washington and then Oregon passed laws requiring booster seats for children <60 pounds or younger than 6 years. There was little widespread state media attention about booster seats before the enactment of these laws, both of which came into effect in 2002. Therefore, we do not believe that the subsequent passage of the legislation had a substantial impact on our findings.

This study highlights the ongoing need for public information campaigns to educate parents about booster seat use. Booster campaigns should clearly state age and weight requirements as parents are widely misinformed. Although child height is likely a better predictor of booster seat use than either age or weight, more than two thirds of drivers were unable to report a height for their child. These results suggest that a public health campaign to increase booster seat use ought not focus solely on child height.

Nearly half of booster-eligible children who were using an adult lap and shoulder belt had placed the shoulder belt behind the back or arm. Although this behavior may place the child at added risk of seatbelt syndrome injuries in a crash, it also is a clear indication to the parent that the adult seatbelt does not fit the child properly and as such may be incorporated into public health messages. Parents who use their own seatbelts are also more likely to use booster seats with their children. Community health education campaigns may work synergistically with ongoing efforts to cover booster-aged children under state and national child restraint laws.

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