

INSURANCE INSTITUTE FOR HIGHWAY SAFETY

September 27, 2001

Jeffrey W. Runge, M.D.
Administrator
National Highway Traffic Safety Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

**Request for Comments to Obtain the Views of the Public
on the Use and Effectiveness of Booster Seats
Docket No. NHTSA 2001-10359**

Dear Dr. Runge:

The National Highway Traffic Safety Administration (NHTSA) has requested comments on the use and effectiveness of booster seats for improving the fit of adult seat belts for children, in particular the advantages and disadvantages associated with their use. The Insurance Institute for Highway Safety welcomes this opportunity to comment on an issue that could become confusing for parents and legislators.

There is widespread agreement that children graduating from forward-facing seats may be too small to be adequately protected by adult seat belts. Although adult belts can and do prevent injuries among these children, they often do not provide optimal protection. A lap belt may ride too high, which increases the risk of abdominal injury in a crash. Or a shoulder belt may ride across a child's neck, which encourages a child to position the belt behind the back. Nevertheless, the safety community should continue to recognize that the bigger problem is children who ride unrestrained. It would be unfortunate if parents, as a result of their concern about injuries that might result from adult belts, decide not to use these belts in the event that booster seats are unavailable. In this regard, NHTSA's website currently does not do an effective job of advising parents of the importance of restraint use at all times, even if the available restraint is not ideal. As NHTSA develops materials to inform parents about the benefits of booster seats, it also should advise parents that an adult belt alone still is much better than no restraint at all.

The Institute also is concerned that NHTSA's public recommendations for booster seats are getting ahead of science and regulations for child passenger safety. For example, the agency recommends that all children weighing 40-80 pounds and less than 57 inches in height

should ride in belt-positioning booster seats (www.nhtsa.dot.gov/people/injury/childps/boosterseat/CPS_Week.pdf). As a result, child safety advocates around the country are promulgating these guidelines, and many states now are passing laws. These recommendations, however, are based on a fairly limited study conducted in the early 1990s in which seat belt fit was evaluated for about 150 children ages 7-12 positioned in the rear seats of three different vehicles. Belt fit was evaluated with the seat belt alone and with three different booster seat models. Although this study provided an important demonstration of the potential for adult belts to be poorly positioned, by itself it does not support these global recommendations and laws.

The principal problem is that there is no definition of what constitutes a booster seat for most of the children covered by the recommendations. Current federal standards require dynamic testing of all restraints designed for children weighing 50 pounds or less (Federal Motor Vehicle Safety Standard 213). However, there are no design or test requirements for child seats or boosters for children weighing more than 50 pounds, even though the recommendations extend to 80 pounds. As a result, if states require that children weighing up to 80 pounds be restrained in a federally approved device, they are requiring parents to obtain a device that does not exist. More importantly, parents have no objective basis for concluding that any commercially available booster is any better or worse than positioning a child on a phone book or pillows or, indeed, is any better or worse than seating the child with the adult belts alone.

This is not a trivial issue. Children differ in physique, and car seats themselves differ greatly. These factors can affect how well booster seats reposition the adult belt. To get a better understanding of how currently available booster seats affect belt fit, the Institute conducted a small-scale photographic study of seat belt fit among children ages 4-7. Belt fit was evaluated with and without boosters in the rear seats of three different vehicles chosen to represent a variety of seats (1998 Honda Accord, 2001 Dodge Caravan, 2001 Hyundai Elantra). Three children participated, and six booster seat models were evaluated (see Table 1 for details of the booster seats used and the children's ages, heights, and weights). In addition, a 6-year-old child Hybrid III dummy was used to evaluate fit with more than 25 booster seats currently on the market.

Along with guidelines about the weight and height thresholds for booster seat use, NHTSA's website provides guidelines for the proper fit of a vehicle belt when used with a booster. The most important of these guidelines is that the lap portion should rest on top of the upper thighs. This helps to prevent instances of submarining and abdominal injury. The photographic evidence in the Institute's study

Table 1
Institute Booster Seat Study

3 children and 6-year-old child Hybrid III dummy	Alexander: 4 years, 39 inches tall, 39 pounds Cameron: 5 years 4 months, 45 inches tall, 42 pounds Laura: 6 years 11 months, 52 inches tall, 62 pounds 6-year-old child dummy: 45 inches tall, 52 pounds
3 vehicles	2001 Dodge Caravan 2001 Hyundai Elantra 1998 Honda Accord
6 trials in booster seats, 1 without booster seat	LaRoche Brothers Grizzly Bear Safeline Mission Control Evenflo Right Fit Jupiter Komfort Rider GTX Britax Starriser Fisher Price Safe Embrace

indicates that some boosters improved belt fit for all the children in the study. However, other booster seats did not improve belt fit, and some actually worsened the fit of the lap belt. In its evaluation of more than 25 booster seats currently on the market using the 6-year-old child dummy as a surrogate, the Institute found that only a small number of these boosters routed the lap belt properly. In some instances the booster seat routed the lap portion of the belt directly over the child's (dummy's) abdomen. The attached photos illustrate the variable performance of boosters in repositioning adult seat belts for children of different sizes.

There were other concerns than just seat belt fit. For example, some of the booster seats with guides to reposition shoulder belts could introduce slack in the belt, thus compromising protection in a crash (see also *Consumer Reports*, July 2001, for a discussion of this issue). Another concern is that some booster seats do not keep the belts reliably in place; for example, the "arms" or "horns" on some boosters are too short to retain the proper position of the shoulder belt as children wriggle in the seat (see attachment).

These observations highlight the need for NHTSA to develop scientific and regulatory information to support its recommendation that children weighing up to 80 pounds be in booster seats. The Institute recognizes that one reason for the current gap in child restraint standards for this age group is the lack of a suitable dummy for NHTSA's dynamic test paradigm. The largest certified child dummy, which represents a 6 year-old, weighs 52 pounds. The Institute therefore supports the development of a larger, heavier dummy to assess whether booster seats perform adequately for children weighing more than 50 pounds, and we urge NHTSA to expedite the update of

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Federal Motor Vehicle Safety Standard 213 to include a dynamic performance test using these heavier dummies. One of the primary measures in the dynamic test, dummy excursion, should help to ensure that booster seats do not introduce too much slack into the shoulder belt.

However, development of a new test dummy will take time, and the Institute is concerned that a dynamic test may not be the best test of certain issues. For example, a dynamic test will not replicate some critical occupant kinematics and injury patterns of real children in real crashes. No dummies or tests are currently available to assess abdominal injury risk from lap belts improperly positioned on children, which is the primary safety concern when children are restrained in adult belts. This remains a concern with many of the boosters studied by the Institute. As a result, poorly fitting lap belts positioned high on the abdomen (not across a child's thighs) may result in high forces that could not be discerned from dynamic tests. Even if a new dummy includes instrumentation to measure abdominal loads, it is unlikely that the rigid spine and molded hips of the 6-year-old child dummy will imitate the kinematics of a child in a crash. For example, a dummy is unlikely to submarine under a lap belt that is poorly positioned. Thus, it may be possible to design a booster seat that will position belts properly on a 6-year-old child dummy or a 10-year-old child dummy but not do a very good job of protecting a child of the same size in a crash.

New dummies and new dynamic tests may not be necessary to begin to solve this problem. The purpose of booster seats is not to restrain children -- the adult belts do this. If it can be demonstrated that a booster seat can provide a proper fit of the adult belt then it ought to provide optimal protection in a crash. For this reason, we recommend that NHTSA develop a procedure to measure how well seat belts fit with booster seats, perhaps building on the belt routing observations already contained on the agency's website. The Institute photographic study described earlier indicates that the 6-year-old child dummy may provide a good proxy for assessing fit, although a more detailed study is needed to confirm this finding.

In summary, the Institute supports NHTSA's efforts to improve the occupant protection afforded children who are outgrowing their approved child restraints. We believe the agency's number one priority should be to ensure that every parent understands that the primary threat to their child's safety is the failure to restrain their children, and that it is imperative that children be restrained by the seat belts available in every vehicle. However, because adult lap and shoulder belts do not fit some of these children optimally, especially the smaller ones, the agency also needs to quickly

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promulgate rulemaking to guide the development of effective booster seats that can reposition adult belts to more effectively protect these children. Finally, the agency needs to develop new dummies and new test procedures to better assess the protection that children are receiving from adult belts and booster seats. These dynamic test procedures are needed to ensure that booster seats are strong enough to support the recommended weights of their occupants and that they do not exacerbate the excursion of children's heads by introducing too much slack in shoulder belts. Because the development of dummies and new dynamic tests will take time, the Institute suggests that NHTSA first concentrate on the issue of belt positioning in defining appropriate booster seats, with dynamic performance to follow when test procedures are adequately defined.

Sincerely,

A handwritten signature in black ink that reads "Susan A. Ferguson". The signature is written in a cursive, flowing style.

Susan A. Ferguson, Ph.D.
Senior Vice President, Research

cc: Docket No. NHTSA 2001-10359

Attachment

ATTACHMENT

For a Small Child, a Booster Can Improve Belt Fit

4 years, 39 inches, 39 pounds

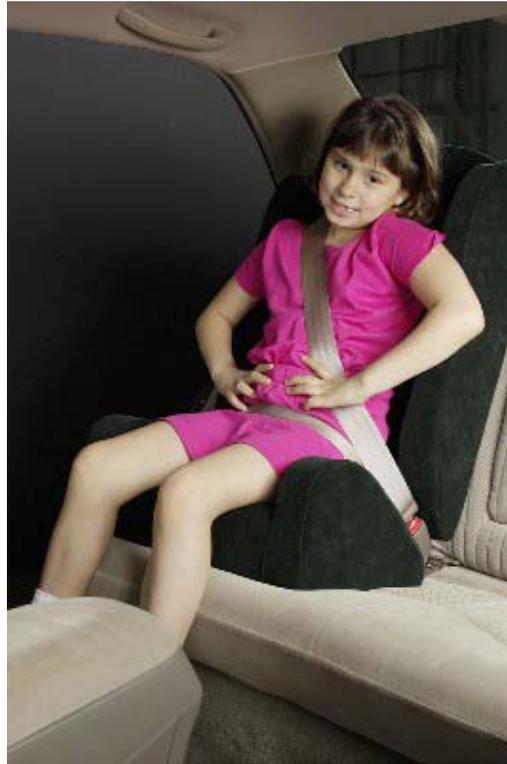


5 years 4 months, 45 inches, 42 pounds



A Booster Can Improve Belt Fit, Keep it the Same, or Make it Worse

6 years 11 months, 52 inches, 62 pounds



Poor Fit in the Same Booster Seat with Occupants of Different Sizes

4 years,
39 inches, 39 pounds



5 years 4 months,
45 inches, 42 pounds



6 years 11 months,
52 inches, 62 pounds



Good Fit in the Same Booster Seat with Occupants of Different Sizes

4 years,
39 inches, 39 pounds



5 years 4 months,
45 inches, 42 pounds



6 years 11 months,
52 inches, 62 pounds



Booster Seats with Arms Generally Improve Fit

They keep the lap belt routed low on the hips or on top of the thighs

5 years 4 months,
45 inches, 42 pounds



6 years 11 months,
52 inches, 62 pounds



Some Booster Seat Arms Are Too Small to Hold the Shoulder Belt in Position

6-year-old child
Hybrid III dummy



6-year-old child
Hybrid III dummy



6 years 11 months,
52 inches, 62 pounds

