Technical Report—Child Passenger Safety

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abstract

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Despite significant reductions in the number of children killed in motor vehicle crashes over the past decade, crashes continue to be the leading cause of death for children 4 years and older. Therefore, the American Academy of Pediatrics continues to recommend inclusion of child passenger safety anticipatory guidance at every health-supervision visit. This technical report provides a summary of the evidence in support of 5 recommendations for best practices to optimize safety in passenger vehicles for children from birth through adolescence that all pediatricians should know and promote in their routine practice. These recommendations are presented in the revised policy statement on child passenger safety in the form of an algorithm that is intended to facilitate their implementation by pediatricians with their patients and families. The algorithm is designed to cover the majority of situations that pediatricians will encounter in practice. In addition, a summary of evidence on a number of additional issues that affect the safety of children in motor vehicles, including the proper use and installation of child restraints, exposure to air bags, travel in pickup trucks, children left in or around vehicles, and the importance of restraint laws, is provided. Finally, this technical report provides pediatricians with a number of resources for additional information to use when providing anticipatory guidance to families. *Pediatrics* 2011;127:e1050–e1066

KEY WORDS
car safety seat, booster seat, child restraint system, air bag, child passenger safety, motor vehicle crash

ABBREVIATIONS

NHTSA—National Highway Traffic Safety Administration
CSS—car safety seat
AAP—American Academy of Pediatrics
LATCH—lower anchors and tethers for children
OR—odds ratio
CI—confidence interval
FARS—Fatality Analysis Reporting System
RR—relative risk
FMVSS—Federal Motor Vehicle Safety Standard
FAA—Federal Aviation Administration

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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INTRODUCTION: MAGNITUDE OF THE PROBLEM OF MOTOR VEHICLE CRASHES

Motor vehicle crashes represent the leading cause of death for children and youth older than 3 years in the United States.[1] Each year, more than 5000 children and adolescents under the age of 21 years die in crashes, which represents approximately 15% of people killed each year in crashes.[2] Fatalities represent only the tip of the motor vehicle crash problem for children and youth. For every fatality, approximately 18 children are hospitalized and more than 400 receive medical treatment for injuries sustained in a crash.[1] Current estimates of injuries and fatalities are updated annually and can be found in the Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System at www.cdc.gov/injury/wisqars.

In the United States, motor vehicle traffic-related mortality rates are highest for black and American Indian/Alaskan Native children, lowest among Asian/Pacific Islander children, and intermediate for Hispanic and white children.[3] Examining trends over a 20-year period through 2003 reveals significantly declining rates for child occupant deaths among all race and ethnic groups examined. However, among infants (aged 0–12 months), improvements in mortality rates among black children have slowed more recently. Occupant mortality rates among children 1 to 4 years of age showed a tendency toward increased mortality in black, Hispanic, and American Indian/Alaskan Native children. Although there were significant declines in total motor vehicle mortality rates across all racial groups, improvement in occupant injury was greater for white children, and disparities actually widened for both black and American Indian/Alaskan Native children compared with white children.

The racial/ethnic disparities in motor vehicle occupant death rates are likely explained in large part by lower use of restraints, including child restraint systems, by people of racial minorities. Seat belt and child restraint use among black adults and children are lower than the national average.[4,5] Similarly, seat belt use among Hispanic (85%) and non-Hispanic black (80%) adults traveling with children was lower than that for white (96%) adults traveling with children.[6] The reasons for these disparities in restraint use are not completely known but may be related to a lack of knowledge as well as a lack of culturally appropriate messages from generalized public education intervention programs.[7] More culturally sensitive intervention programs designed to increase child restraint use among minority populations have resulted in significant increases in restraint use among target populations.[8]

Through the early 1990s, child occupant fatality rates remained relatively stagnant at approximately 3.5 deaths per 100 000 population.[9] Beginning in 1995, when children killed by deploying passenger air bags were first reported clinically, attention began to focus on the unique needs of children in automotive safety. Subsequently, in the United States, the number of motor vehicle fatalities and serious injuries has been reduced through a combination of increased attention to age-appropriate restraint use and rear seating position[10–15] as well as enhanced child restraint laws and enforcement of these laws.[16,17] In the 10 years from 1999 to 2008, the number of children younger than 15 years who died in motor vehicle crashes in the United States declined by 45%.[2] Annual updates on the number of children killed in motor vehicle crashes can be obtained from the National Highway Traffic Safety Administration (NHTSA) at www-fars.nhtsa.dot.gov/Main/index.aspx.

Although significant progress has been made in reducing the number of children killed in crashes, the exposure of children to motor vehicle travel and, thus, to potential crashes is great. Children younger than 16 years travel nearly as much as adults (average of 3.4 trips per day and 45 to 50 minutes/day spent in a vehicle), which emphasizes the importance of age-appropriate restraint on every trip.[18]

THE IMPORTANCE OF AGE-APPROPRIATE RESTRAINT USE

Mechanism of Action of Restraint Systems

Restraint systems are designed to reduce risk of ejection during a crash, better distribute the energy load of the crash through structurally stronger bones rather than soft tissues, limit the crash forces experienced by the vehicle occupant by prolonging the time of deceleration, and limit the contact of the occupant with interior vehicle structures. Optimal performance of restraint systems depends on an adequate fit between the restraint system and the occupant at the time of the crash. Restraint systems can be generally categorized as vehicle restraints—air bags and seat belts—or add-on restraints specifically made for children—child restraint systems. Child restraint systems include infant-only car safety seats (CSSs), convertible and combination CSSs, integrated seats, travel vests, and belt-positioning booster seats. A description of each type of restraint is provided below as well as in Table 1 of the accompanying policy statement.[19]

Age-Specific Prevalence of Restraint Use

In large part because of the increased attention paid to the needs of children in motor vehicle safety beginning in the mid-1990s, large increases in restraint use (including CSSs and booster seats) by children have been observed over the past decade. Data from the National Occupant Protection Use Survey and the National Survey of the Use of Booster Seats indicate that restraint use for children in the United States in 2008 stood at 99% among infants younger than 1 year, 92% among 1- to 3-year-olds, and 89% among 4- to 7-year-olds.[20] Restraint use for children driven by a belted driver was significantly higher (92%) than for those driven by an unbelted driver (54%). It is important to note that although child restraint use is high among the youngest children, improper use of the restraint may limit the effectiveness of the system. Among children either younger than 1 year or who weighed less than 20 lb, a group that has traditionally been recommended to ride in a rear-facing CSS, 21% were not compliant with these recommendations.[21] Similarly, although overall restraint use among older children is relatively high, nearly half of children 12 years and younger who are under 54 inches in height are not using a CSS or booster seat, which is their recommended form of optimal restraint.[21] Although the prevalence of use according to race and ethnicity varied somewhat among age groups, use rates tended to be higher among white and Asian non-Hispanic children (at least 90% for all age groups) and lower among black non-Hispanic children (ranging from 72% for 8- to 12-year-olds to 94% for infants younger than 1 year).[22] It should be noted that child restraint use among black children 4 to 7 years of age increased from 73% in 2007 to 84% in 2008.

Among children 8 years and younger in crashes, overall reported use of child restraint systems has increased nearly threefold since 1999 to 80% of children in a large sample of children in crashes by 2007.[23] The largest relative increase in child restraint use among children in crashes was among 6- to 8-year-olds, yet 57% of these children continued to be inappropriately restrained in 2007. Forward-facing CSSs were primarily used by children 3 years and younger, whereas belt-positioning booster seats have become the most common restraints for 4- to 5-year-olds.[24]

Pediatric obesity has become a major public health concern in the United States as the prevalence of being overweight among children tripled over the past 2 decades.[25] Currently, 34% of children are categorized as being "overweight" (BMI $\geq$ 95th percentile) or "at risk for overweight" (BMI $\geq$ 85th to $<$95th percentile).[26] Childhood obesity has significant implications for child passenger safety, because young children who are overweight may not fit properly in CSSs or booster seats that would otherwise be appropriate for their age.[27] It is fortunate that, over the past several years, increasing numbers of CSSs and booster seats with higher weight and height limits have been introduced into the market in response to this challenge. Among currently available products listed in the American Academy of Pediatrics (AAP) pamphlet "2011 Car Safety Seats: A Guide for Families" (available at www.healthychildren.org/carseatlist), nearly half (14 of 29) of infant-only seats can accommodate children to 30 lb or more, which represents at least the 75th percentile for girls and boys at 24 months of age. Nearly all (30 of 35) currently available convertible CSSs can accommodate children to 35 lb or more when used rear-facing, a weight that exceeds the 95th percentile for boys and girls at 24 months of age. Similarly, for children 2 to 8 years of age, 34 of 53 currently available forward-facing seats used with a harness can accommodate children to at least 50 lb, which exceeds the 95th percentile for boys and girls younger than 5 years. Therefore, there are sufficient products available to consumers to accommodate larger children in the correct restraint. Limited data exist on the risk of injury to overweight children in motor vehicle crashes but suggest that overweight children may be at an increased risk of particular types of injuries, particularly lower-extremity fractures, compared with children of normal weight.[28–30] Further research is needed to establish motor vehicle safety as yet another public health burden imposed by childhood obesity and to ensure that overweight children are properly protected in motor vehicles.

Seat belt use among all front-seat occupants (drivers and front passenger-seat occupants) in the United States increased to 84% in 2009.[31] Among older children, restraint use in any seating location in the vehicle in 2008 was 85% among 8- to 12-year-olds and 83% among 13- to 15-year-olds.[6,20] Seat belt use anywhere in the vehicle among 13- to 15-year-olds varied according to race and ethnicity; white adolescents had higher seat belt use rates (89%) than either Hispanic (82%) or black non-Hispanic (46%) youth.

It is important to note that CSSs were designed as occupant safety devices in motor vehicles, not as general child seating devices. A recent study that used data from the National Electronic Injury Surveillance System operated by the US Consumer Product Safety Commission estimated that more than 8000 infants younger than 1 year are evaluated in hospital emergency departments each year for car seat–related (non–motor vehicle crash) injuries suffered when the car seats were used improperly or for unintended purposes.[32] The majority (85%) of injuries were related to falls, either infants falling out of car seats or car seats falling from elevated surfaces such as countertops and tables. Nearly half of the injuries occurred at home, and head and neck injuries accounted for 84% of the injuries to infants. Prolonged use of CSSs by young infants for positioning also contributes to the increased incidence of plagiocephaly, exacerbates gastroesophageal reflux, and increases risk of respiratory compromise.[33] Families should be encouraged to use CSSs only as occupant-protection devices for travel as they were intended.

Installation of Child Restraint Systems

CSSs must be installed tightly to derive the optimum benefit of both the crashworthiness of the vehicle (eg, crumple zones that dissipate the energy of the crash and prolong the time of deceleration of the vehicle) and the design of the seat itself. As a general rule, if a CSS can be moved more than 1 inch from side to side or front to back when grasped at the bottom of the seat near the belt or lower anchors and tethers for children (LATCH) attachment points, it is not installed tightly enough. Improper installation of a CSS may result in an increased likelihood of excessive movement of the child in the event of a crash, thus increasing the child's risk of injury.

The most recent estimates of CSS misuse are derived from an observational study of more than 5000 children in which 72.6% of CSSs were observed to have some form of misuse.[34,35] The most common critical misuses were loose harness straps and a loose attachment of the CSS to the vehicle when using the seat belt. Results of several studies have indicated that misused CSSs may increase a child's risk of serious injury in a crash.[13,14,36,37]

An issue specific to installing rear-facing CSSs relates to the recline angle of the seat. Proper installation results in a semireclined angle of approximately 45°, which enables the infant's head to lie against the back of the CSS, as opposed to potentially falling forward, which compromises the infant's airway, if the seat is angled too upright. Preterm infants are particularly vulnerable to an increased risk of oxygen desaturation, apnea, and/or bradycardia, especially when placed in a semireclined position in CSSs.[38–41] Therefore, CSS monitoring in the infant's own CSS before discharge from the hospital should be considered for any infant who was less than 37 weeks' gestation at birth to determine if the infant is physiologically mature and has stable cardiorespiratory function. More specific information on car seat testing of preterm newborn infants and recommendations based on results of testing are available in an AAP clinical report on the subject.[33]

A relatively new way by which CSSs can be installed in passenger vehicles, known as LATCH, was designed to reduce the difficulty associated with installing CSSs. This system uses dedicated attachment points in the vehicle rather than using the vehicle seat belt for CSS installation. All vehicles and child restraints manufactured and sold in the United States after September 2002 are required to have this anchoring system. For rear-facing CSSs, there are 2 points of attachment at the base of the CSS. For forward-facing CSSs, a third dedicated attachment point near the top of the CSS is used for a top tether to attach to a separate anchor point in the vehicle (see Fig 1).

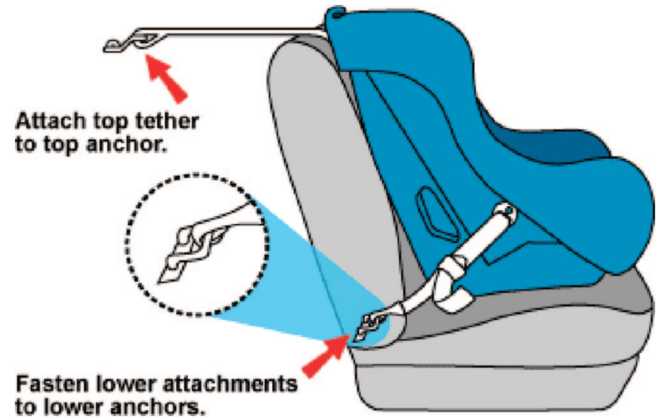

FIGURE 1
Schematic of the LATCH system.

Previous research has evaluated the performance of LATCH (or its European counterpart, ISOFIX) in laboratory sled-test environments[42–44] and demonstrated improved kinematics and reduced injury measures on crash test dummies, in particular with use of the top tether, when compared with using a seat belt to attach the CSS. To date, there are no real-world data from evaluations of the performance of LATCH, although its theoretical advantages in ensuring proper installation suggest that families should use it when available.

Arbogast and Jermakian have reviewed cases of CSSs attached by using LATCH and illustrated examples of LATCH misuse.[45] In 2005, a large-scale observation study that examined LATCH use and misuse in the United States was conducted at 66 sites across 7 states.[46] The study results indicated that many parents who purchased newer vehicles did not update their CSS to take advantage of the available LATCH attachment system. Approximately one-fifth of CSSs in vehicles equipped with LATCH did not have tether straps, and one-sixth did not have lower attachments. Even when their CSSs were LATCH equipped, approximately one-third of the drivers with LATCH-equipped vehicles stated that they could not use LATCH because there were no anchors in their vehicles. Much of the nonuse of lower anchors in this study related to the fact that the vehicle safety belt was the only method available in the center rear-seating position for installing a CSS. The rear seats of most passenger vehicles typically are equipped with lower LATCH anchors only in the outboard seating positions. When parents had experience attaching CSSs by using the safety belt and LATCH system, three-quarters reported a preference for LATCH, because they found it easier to use and obtained a tighter fit, and they felt that the child was more secure.

EVIDENCE FOR BEST-PRACTICE RECOMMENDATIONS

The following section of this technical report will provide a summary of the evidence in support of each of the best-practice recommendations included in the accompanying policy statement.

Children with certain physical and behavioral conditions may require specialized restraint systems and other considerations. Relevant conditions may include prematurity, cerebral palsy, the presence of a tracheostomy, muscle tone abnormalities, skeletal abnormalities, and certain behavioral or emotional conditions as well as temporary conditions such as fractures that require spica casts. Therefore, the AAP has developed a separate policy statement that reviews important considerations for transporting children with special health care needs and provides current guidelines for the protection of children with specific health care needs, including those transported in wheelchairs.[47]

1. Best-Practice Recommendation: All Infants and Toddlers Should Ride in a Rear-Facing CSS Until They Are 2 Years of Age or Until They Reach the Highest Weight or Height Allowed by the Manufacturer of Their CSS

This best practice results from the need to support the young child's posterior torso, neck, head, and pelvis and to distribute crash forces over the entire body. Developmental considerations, including incomplete vertebral ossification, more horizontally oriented spinal facet joints, and excessive ligamentous laxity put young children at risk of head and spinal cord injury. Rear-facing CSSs address this risk by supporting the child's head and preventing the relatively large head from moving independently of the proportionately smaller neck.

In the United States, although the majority of children use rear-facing CSSs during the first year of life, 21% of infants who are either younger than 1 year or weigh less than 20 lb have been turned forward-facing.[21] In Sweden, many children remain rear-facing up to the age of 4 years and transition directly from the rear-facing CSS to a booster seat. Swedish researchers have reported that rear-facing CSSs reduce the risk of significant injuries (those with an Abbreviated Injury Scale score of ≥2) by 90% relative to unrestrained children, which reinforces their policy of children remaining in a rear-facing CSS up to the age of 4 years.[48,49]

Henary et al[50] reviewed US crash data to calculate the relative effectiveness of rear-facing CSSs compared with forward-facing CSSs for children 0 through 23 months of age in crashes from 1988 to 2003. The authors reported that children in forward-facing CSSs were significantly more likely to be seriously injured when compared with children restrained in rear-facing CSSs in all crash types (odds ratio [OR]: 1.76 [95% confidence interval [CI]: 1.40–2.20]). When considering frontal crashes alone, children in forward-facing CSSs were more likely to be seriously injured, although this finding was not statistically significant (OR: 1.23 [95% CI: 0.95–1.59]). In side-impact crashes, however, children in forward-facing CSSs were much more likely to be injured (OR: 5.53 [95% CI: 3.74–8.18]). When children 12 to 23 months of age were analyzed separately, those who were restrained in forward-facing CSSs were also more likely to be seriously injured (OR: 5.32 [95% CI: 3.43–8.24]). These authors concluded that for children through 23 months of age, rear-facing CSSs provided optimal protection. The lack of meaningful numbers of children 24 months or older in rear-facing CSSs in US databases has prevented extension of these analyses to even older age groups of children, such as those studied in Sweden.

2. Best-Practice Recommendation: All Children 2 Years or Older, or Those Younger Than 2 Years Who Have Outgrown the Rear-Facing Weight or Height Limit for Their CSS, Should Use a Forward-Facing CSS With a Harness for as Long as Possible, up to the Highest Weight or Height Allowed by the Manufacturer of Their CSS

The recommendation for forward-facing CSSs has been based, in part, on an analysis by Kahane[51] of laboratory sled tests, observational studies, and police-reported crash data from the early 1980s that estimated that correctly used forward-facing CSSs reduce the risk of death and injury by approximately 71% compared with unrestrained children. The engineering tests documented the biomechanical benefits of the CSS in spreading the crash forces over the shoulders and hips and controlling the excursion of the head during a crash. Kahane further estimated the effectiveness of a partially misused CSS as providing a 45% reduction in risk of fatality and serious injury. Using Fatality Analysis Reporting System (FARS) data from 1988 to 1994, NHTSA found that, among children between 1 and 4 years of age in passenger cars, those in forward-facing CSSs had a 54% reduction in risk of death compared with unrestrained children.[52] Given the currently high rates of restraint use among children in the United States, it is no longer meaningful to quote effectiveness estimates in comparison to unrestrained children.

Estimates of the effectiveness of forward-facing CSSs in comparison with children using seat belts, on the basis of real-world crash data, vary depending on the source of data used, the time period studied, and the analytical approach taken. Estimating effectiveness of child restraint systems through analysis of crash databases is challenging because of the association between how passengers are restrained in a given crash and whether that crash will be in a specific database. For example, the FARS, operated by the NHTSA, is a census of vehicle crashes in the United States in which at least 1 person died. The FARS has a sufficient number of outcomes of fatal child injuries for analyses but has a biased selection of crashes in that inclusion of crashes is associated with the outcome of interest (ie, mortality). Several different analytic techniques, described hereafter, have been developed to minimize the effects of this bias.

The results of most studies to date have indicated that forward-facing CSSs are effective at preventing nonfatal injuries when compared with seat belts; effectiveness estimates have ranged from 71% to 82% reduction in serious injury risk.[13,53] Elliott et al[14] compared the effectiveness of child restraints to seat belts in preventing fatal injuries to 2- to 6-year-old children in crashes by combining data from the FARS with data from the National Automotive Sampling System–Crashworthiness Data System. The combined data set, in theory, overcame several of the known limitations of using either data source alone. Compared with seat belts, child restraints, when not seriously misused (eg, unattached restraint, child restraint system harness not used) were associated with a 28% reduction in risk of death (relative risk [RR]: 0.72 [95% CI: 0.54–0.97]) after adjusting for seating position, vehicle type, model year, driver and passenger ages, and driver survival status. When including cases of serious misuse, the effectiveness estimate was slightly lower (21%) and not statistically significant (RR: 0.79 [95% CI: 0.59–1.05]).

In a controversial analysis, Levitt[54] used FARS data from 1975 to 2003 and, by various methods, directly compared the mortality rates for child restraints and for seat belts for children aged 2 to 6 years and could not demonstrate a difference in effectiveness. Levitt restricted the FARS data set to 2-vehicle crashes in which someone in the other vehicle (ie, the vehicle without the index child occupant) died, under the assumption that the distribution of restraint use among children in potentially fatal crashes is independent of whether someone in the other vehicle dies, after adjusting for various crash-related characteristics. In a subsequent study in which a marginal-structural-model-type estimator was used in an attempt to explore the relationship between various biases inherent in data sources and the estimates of CSS restraint effectiveness, Elliott et al[55] suggested a 17% reduction in fatality risk for children 2 through 6 years of age in child restraint systems relative to seat belts. This reduction is estimated at 22% when severe misuse of the restraint is excluded.

3. Best-Practice Recommendation: All Children Whose Weight or Height Is Above the Forward-Facing Limit for Their CSS Should Use a Belt-Positioning Booster Seat Until the Vehicle Lap-and-Shoulder Seat Belt Fits Properly, Typically When They Have Reached 4 Feet 9 Inches in Height and Are Between 8 and 12 Years of Age

Children who have outgrown a forward-facing CSS (based on the height or weight limit of the seat) should be restrained in belt-positioning booster seats by using the lap-and-shoulder belts in the back seat of a vehicle. Booster seats position the child so that the lap-and-shoulder belt fits properly. Correct fit of the belt is defined as follows:

- The shoulder belt lies across the middle of the chest and shoulder, not the neck or face.
- The lap belt is low across the hips and pelvis, not the abdomen.
- The child is tall enough to sit against the vehicle seat back with his or her knees bent without slouching and can stay in this position comfortably throughout the trip.

Although seat belt geometry varies from vehicle to vehicle depending on the depth of the seat bottom and placement of the upper and lower anchor points of the belt, most vehicle seat belts will not fit correctly until a child reaches approximately 4 feet 9 inches in height and is between 8 and 12 years of age. This height threshold was derived from a study of 155 children 6 to 12 years of age who were assessed for the fit of the vehicle seat belt in 3 different types of vehicles in 1993.[56] The minimum height of a child who could fit properly in the vehicle seat belts was 148 cm (58 inches). It is important to note that this study is nearly 20 years old, and significant changes have been made to the vehicle fleet during this time.

Cases of serious cervical and lumbar spinal cord injury, as well as intraabdominal injuries, to children in motor vehicle crashes resulting from poorly fitting seat belts have been described for many years and are known as the "seat belt syndrome."[57] First described by Kulowski and Rost in 1956,[58] the term "seat belt syndrome" was coined by Garrett and Braunstein in 1962[59] to describe a distinctive pattern of injuries associated with lap seat belts in serious crashes. Two predominant factors have been hypothesized to explain this constellation of injuries: the immaturity of the pediatric pelvis to properly anchor the lap portion of the belt and the tendency of children to scoot forward in the seat so that their knees bend at the edge of the vehicle seat. From this position, in a rapid deceleration, the belt can directly compress abdominal organs against the spinal column, and the child's body may "jack-knife" around the belt, putting high tension forces on the lumbar spine, which may lead to distraction injuries of the posterior elements of the spine, such as Chance-type fractures.

Durbin et al[12] published results of the first real-world evaluation of the performance of booster seats compared with seat belts for young children. These authors determined that the risk of injury after adjusting for child, crash, driver, and vehicle characteristics was 59% lower for 4- to 7-year-olds in belt-positioning booster seats than those using only seat belts. Applying these results to Wisconsin state data from 1998 to 2002, Corden[60] determined that there would be an approximate 57% reduction in deaths and hospitalizations if all 4- to 7-year-olds were in booster seats. A recent updated analysis of booster effectiveness in preventing nonfatal injuries was able to examine a greater percentage of older children using booster seats; 37% of the more recent study sample using booster seats were 6 to 8 years of age.[24] In this study, children 4 to 8 years of age using belt-positioning booster seats were 45% (95% CI: 4%–68%) less likely to sustain nonfatal injuries than children of similar ages using the vehicle seat belt. Among children restrained in belt-positioning booster seats, there was no detectable difference in the risk of injury between the children in backless versus high-back boosters.

Rice et al[61] extended the data on booster seat performance by estimating the effectiveness of booster seats in reducing the risk of fatal injuries to children 4 to 8 years of age. Using a matched cohort analysis of data from the FARS, Rice et al determined that booster seats reduced the risk of fatal injuries by 67% for 4- to 5-year-olds and 55% for 6- to 8-year-olds compared with unrestrained adults and children. They also determined that seat belts alone reduced the risk of fatal injury by approximately 62% for 4- to 8-year-olds compared with unrestrained adults and children. They did not demonstrate a significant difference in fatality risk reduction for booster seats when compared with seat belts (RR: 0.92 [95% CI: 0.79–1.08]). The authors postulated that although booster seats, which improve seat belt fit, may reduce the risk of nonfatal injuries (some of which may be attributable to improperly fitting seat belts), they may not improve the likelihood that children will survive a severe crash with major occupant compartment intrusion or during rollovers. It may be that properly fitting seat belts are no better than poorly fitting seat belts at preventing fatal injuries in these severe crashes.

Although most newer vehicles include lap-and-shoulder belts in all rear-seating positions, many older vehicles still in use may have only lap belts available in some seating positions, typically in the center of the rear seat. Laboratory tests have revealed increased head excursions when booster seats are used with lap belts compared with when only lap belts are used.[62,63] Other research results have indicated that booster-aged children using only lap belts are likely to strike their heads on vehicle seat backs or other interior components in front of them, even without booster seats.[64,65] Results of a recent study that used 2 real-world data sources suggested that children restrained in booster seats with lap belts had a lower injury risk when compared with children restrained in lap belts only, although the possibility of no difference could not be excluded.[66] For families faced with frequently transporting booster-aged children in lap-belt-only seating positions, there are other restraint options (eg, forward-facing CSSs with higher weight limits and safety vests) that, although typically more expensive than booster seats, are more likely to provide optimal protection if children ride regularly in these seating positions. It should be noted that the number of children in this scenario will decrease over time as vehicles equipped with lap-belt-only restraints in rear seats are phased out of the US vehicle fleet.

4. Best-Practice Recommendation: When Children Are Old Enough and Large Enough to Use the Vehicle Seat Belt Alone, They Should Always Use Lap-and-Shoulder Seat Belts for Optimal Protection

Lap-and-shoulder belts have been required in rear outboard positions of vehicles since 1989. However, it was not until 2005 that lap-and-shoulder belts were required in the center rear-seat position. Many manufacturers introduced center rear lap-and-shoulder belts in advance of this requirement, and by model year 2001, most vehicles provided them as standard equipment.[67] Arbogast et al[68] determined that the presence of a shoulder belt reduced the risk of injury by 81% for children seated in the center rear in seat belts, and the primary benefit is seen in reductions in abdominal injuries. Parenteau et al[69] had previously documented a similar shift in the pattern of injury to children in lap-only belt restraints to lap-and-shoulder belts. Their study, however, examined the rear seat as a whole and did not separate the rear seating positions.

Using data from the FARS, the NHTSA has evaluated the performance of lap-and-shoulder belts in the rear rows and found them to be effective (compared with unrestrained occupants) in all crash directions for children and adult occupants 5 years and older. The estimated fatality reduction, compared with unrestrained occupants, was 77% in rollover crashes, 42% in side impacts, 29% in frontal impacts, and 31% in rear impacts and other crashes.[70] Two studies have evaluated seat belt effectiveness specifically for children. Chipman et al,[71] using a database of fatal crashes in Ontario, Canada, estimated that seat belts reduced the risk of serious injury or death by 40% for children 4 to 14 years of age. Data from Wisconsin suggested that 100% seat belt use by children 8 to 15 years of age (compared with current 72% use) would result in reductions of 45% and 32% for deaths and hospitalizations, respectively.[60]

5. Best-Practice Recommendation: All Children Younger Than 13 Years Should Be Restrained in the Rear Seats of Vehicles for Optimal Protection

In large part because of the attention resulting from the tragedy of children killed by passenger air bags, significant declines in front seating of children in vehicles have occurred since the mid-1990s. By 2008, 95% of infants, 98% of children 1 to 3 years of age, and 88% of children 4 to 7 years of age rode in the rear seat.[20] These rates compare with rates of 85%, 90%, and 71%, respectively, in 2002, the first year from which these data were available from direct observation studies.[72] It should be noted that rear seating does not seem to vary on the basis of whether there is a state law requiring children to ride in the rear. In 2008, 92% of children who lived in states in which such a law existed rode in the rear, versus 93% of children from states in which no such law exists.[20] Children using child restraint systems were more likely to sit in the rear (≥93%) than were those in seat belts (89%) or riding unrestrained (84%). In a study of children involved in nonfatal crashes, children were more likely to be seated in the front if the vehicle was driven by a male or by someone other than the child's parent or if the vehicle was not equipped with a passenger air bag.[73] Among children younger than 4 years in CSSs who have been in crashes, there seems to be a preference for placing the CSS in the right outboard seating position in the rear row (41%) compared with the center rear (31%) or left outboard (28%),[74] which likely has to do with the increased ability for the driver to directly observe the child more easily when in the right outboard rear seating position.

Several studies have documented the benefits of rear seating for children. Estimates of the elevated risk of injury for children in the front seat compared with children in the rear have ranged from 40% to 70% depending on the time period and characteristics of the group studied.[10,75,76] The authors of 1 of these studies specifically noted that the beneficial effects of the rear seat were no longer seen for children 13 years and older.[10] Thus, the AAP continues to recommend that all children younger than 13 years ride in the rear seat. It is interesting to note that the benefits of rear seating for child occupants extend to side impacts as well; children seated in the rear are 62% less likely to sustain an injury.[77] Not only is the overall risk higher, but the severity of injury is also greater in the front seat. An analysis of crashes identified through the Crash Injury Research and Engineering Network (CIREN) revealed that child occupants in the front seat sustained more severe injuries than those seated in the rear rows as measured by an injury severity score higher than 16.[78]

Two recent studies specifically evaluated the potential incremental benefits of the center rear seating position compared with the rear outboard positions. Lund[79] used data from the National Automotive Sampling System–General Estimates System system from 1992 to 2000 to evaluate the effect of seating position on the risk of injury for children in child restraints. Lund reported that children in the center rear seat had a similar risk of injury to children in the outboard rear seats. In contrast, Kallan et al[74] used data from the Partners for Child Passenger Safety project, a large, child-focused crash-surveillance system, from 1998 to 2006 and found that children restrained in forward-facing CSSs and seated in the center rear had an injury risk 43% lower than similarly restrained children in either of the rear outboard positions (adjusted OR: 0.57 [95% CI: 0.38–0.86]). These contrasting findings are likely attributable to how injuries were defined in the 2 studies. Lund defined injury as any police-reported injury, which included those of a relatively minor nature. The threshold for injury was higher in the Kallan et al analysis, which included only injuries involving internal organs and fractures of the extremities.

CHILDREN AND AIR BAGS

In November 1995, an article in the *Morbidity and Mortality Weekly Report* of the Centers for Disease Control and Prevention described 8 deaths of child occupants involving air-bag deployment that were of special concern, because they involved low-speed crashes in which the children otherwise should have survived.[80] As passenger air bags diffused into the market, numerous case reports began appearing in the medical literature describing brain and skull injuries sustained by children in rear-facing CSSs and brain and cervical spine injuries sustained by older children who were often unrestrained or restrained in seat belts inappropriately for their age.[81–85]

Several researchers reviewed case series of children exposed to deploying passenger air bags to elucidate the mechanisms of injury.[86–90] For children killed in a rear-facing CSSs, the air bag typically deployed into the rear surface of the child restraint near the child's head and caused fatal skull and brain injuries. For older children who were either unrestrained or restrained in seat belts inappropriate for their age, braking before impact caused the child to pitch forward so that they were in the path of the air bag as it deployed. On deployment, the air bag caused a spectrum of injuries to the brain and cervical spine, including atlanto-occipital fractures, brainstem injuries, and diffuse axonal injury. Case series of other less serious injuries to child occupants associated with air-bag deployment continue to appear in the literature, including injuries to the eye[91] and upper extremities[92] as well as respiratory and hearing problems related to the sound wave and cloud of fine particulate matter released during an air-bag deployment.[93]

Several population-based estimates of the effects of air bags on young children in crashes have consistently indicated an increased risk of fatal and nonfatal injuries to both restrained and unrestrained child occupants.[11,12,94–98] Exposure to passenger air bags increased the risk of both minor injuries, including facial and chest abrasions, and moderate and more serious injuries, particularly head injuries and upper-extremity fractures.

On the basis of this evidence, the NHTSA initiated a 2-pronged program of education and regulation in response to the initial reports of deaths and serious injuries to children from air bags. First, the NHTSA, joined by many national organizations including the AAP, recommended that all child passengers younger than 13 years sit in the rear seats of vehicles. Second, in 1997, the NHTSA enacted a substantial regulatory change to Federal Motor Vehicle Safety Standard (FMVSS) 208, the safety standard that governs the protection of motor vehicle occupants in frontal impact crashes. Because frontal air bags are designed to primarily protect occupants in frontal impact crashes, their performance is certified through FMVSS 208. The change provided automakers a choice in the type of test that could be used to certify frontal crash performance for unbelted adults.[99] This change in the standard resulted in the redesign of frontal air bags to reduce the force with which they deploy. These new air bags are often referred to as "second-generation air bags" and were generally present in all vehicles beginning with model year 1998.

Several studies have examined the effect of these design changes on child occupants in real-world crashes. Olson[100] found that second-generation air bags reduced the risk of death among right-front-seated children 6 to 12 years of age by 29% compared with no air bag. For children younger than 6 years, both first- and second-generation air bags increased the risk of death compared with no air bag; however, the increased risk of death was less for second-generation air bags (10%) compared with first-generation air bags (66%). Arbogast et al[101] quantified the risk of serious nonfatal injuries in frontal crashes among belted children in the front seat of vehicles in which second- versus first-generation passenger air bags deployed. Serious injuries were reported in 14.9% in the first-generation group versus 9.9% in the second-generation group. In particular, children in the second-generation group sustained fewer head injuries, including concussions and other serious brain injuries, than in the first-generation group.

Braver et al[102] examined federal crash data to determine the effect of second- versus first-generation air bags on the risk of fatal injuries to children in the right-front seat. Right-front passengers younger than 10 years in vehicles with second-generation air bags had statistically significant reductions in risk of dying in frontal collisions compared with children of similar ages in vehicles with first-generation air bags, including a 65% reduced risk among children 0 to 4 years of age (RR: 0.35 [95% CI: 0.21–0.60]). Nonsignificant decreases in risk of death were observed among children 10 to 14 years of age.

Kuppa et al[103] evaluated the influence of the air bag on the effectiveness of rear seating by using a double-pair comparison study of frontal impact crashes identified in the FARS. Two pairs were analyzed: the first group consisted of fatal crashes in which a driver and front outboard seat passenger were present and at least 1 of them was killed; the second group consisted of fatal crashes in which a driver and a rear outboard seat passenger were present and at least 1 of them was killed. This analysis examined vehicles with and without a passenger air bag separately. For restrained children 5 years or younger, the presence of a passenger air bag increased the benefit, in terms of reduced fatalities, associated with rear seating. For restrained child occupants older than 8 years, the rear seat was still associated with a lower risk of death than the front, but its benefit was less in vehicles with a passenger air bag than in vehicles without a passenger air bag.

Air bags continue to undergo significant redesigns in an effort to optimize their effectiveness in serious crashes while minimizing their risk of adverse injuries in minor crashes. In 2001, additional revisions were made to FMVSS 208, which now requires the testing of air-bag systems for all sizes of occupants, including children. At this time, no studies have evaluated the benefits of these designs, often termed "certified advanced compliant air bags," for child occupants.

There have been limited studies that have attempted to examine age-specific effects of air bags on risk of injury to children. Newgard and Lewis[97] used data from the National Automotive Sampling System–Crashworthiness Data System to evaluate specific cutoff points for age, height, and weight as effect modifiers of the association between the presence of a passenger air bag and serious injury among children involved in motor vehicle crashes. The time period studied (1995–2002) preceded the time when second-generation air bags were generally available in the vehicle fleet. Newgard and Lewis found that children 0 to 14 years of age involved in frontal collisions seemed to be at increased risk of serious injury from air-bag presence (OR: 2.66 [95% CI: 0.23–30.9]) and deployment (OR: 6.13 [95% CI: 0.30–126]), although these values did not reach statistical significance. Among children 15 to 18 years of age involved in frontal collisions, there was a protective effect on injury from both air-bag presence (OR: 0.19 [95% CI: 0.05–0.75]) and deployment (OR: 0.31 [95% CI: 0.09–0.99]). A similar analysis has not been replicated to determine if different age cutoffs might be identified with children in vehicles equipped with second-generation air bags. Therefore, the AAP continues to strongly recommend that all children younger than 13 years sit in the rear seat. In vehicles with only a single row of seats, such as compact pickup trucks, the frontal air bag can be deactivated, or an on/off switch can be installed, to prevent its deployment in the event of a crash, thus allowing either the installation of a CSS in the front seat or the ability of a child younger than 13 years to ride in the front if necessary.[104]

Side air bags were introduced in the mid-1990s as a safety strategy to reduce serious injuries and fatalities occurring in side-impact crashes. Initial crash tests that involved vehicles equipped with so-called torso side air bags in the front seats revealed that the head was still at risk of serious injury in side-impact crashes.[105,106] To maximize protection of the head for adult front and rear-seat occupants of a variety of statures and seating postures, the roof-rail or head curtain air bag was developed and has become the preferred head-protection system for side-impact crashes. These systems, frequently accompanied by a separate torso side air bag, provide more extensive coverage of the upper vehicle side interior and often extend the entire length of the vehicle, including the rear rows. Side air bags have become a common safety technology in the vehicle; 79% of model-year 2006 vehicles have some type of side air bag either as standard or optional equipment.[107] The NHTSA recently conducted an analysis of side-impact protection with a focus on side air-bag technology[108] and determined that side air bags resulted in a reduction in struck-side fatality risk of 18% in multivehicle crashes and substantial improvement in a thoracic injury metric, the Thoracic Trauma Index, in laboratory assessments. Benefits were greater for head side air bags than those with torso side air bags alone. However, these analyses were primarily focused on protection of adult drivers and front-seat occupants. Arbogast and Kallan[109] used the Partners for Child Passenger Safety (PCPS) database to estimate the prevalence of side air-bag exposure to children in crashes and to provide estimates of injury risk among those exposed. In the study sample, 2.7% of children in crashes were exposed to a deployed side air bag. More than 75% of these children were seated in the rear seat, and 65% of those exposed were younger than 9 years. Of those exposed, 10.6% sustained an Abbreviated Injury Scale 2 injury to the head or upper extremity, a rate similar to that of children exposed to second-generation frontal air bags. These limited field data on the performance of side air bags with respect to child occupant protection suggest that, although a significant number of children are exposed to side air-bag deployments, there is no evidence that these air bags pose a particular risk of serious or fatal injuries to children.

SPECIAL CONSIDERATIONS

The Safety of Children Left in or Around Vehicles

Children should never be left unattended in or around parked cars. Among the safety risks that have been described, being backed over when the vehicle is set in motion, hyperthermia, and strangulation from entrapment in power windows are among the most serious and preventable injuries. In 2008, Kids and Cars, a safety advocacy group dedicated to the prevention of such injuries, amassed reports of a wide range of safety incidents that involved nearly 1000 children and resulted in more than 200 deaths.[110] In response to the Cameron Gulbransen Kids Transportation Safety Act of 2007 (Pub L No. 110-189), the NHTSA created a virtual database called the Not in Traffic Surveillance (NiTS) system to ascertain population-based estimates of the prevalence of noncrash deaths and injuries. NiTS data indicate that approximately 35 to 40 occupants (primarily children) die of hyperthermia and 5 die of power-window strangulation each year, which highlights the importance of never leaving children unsupervised in or around cars.[111]

The Safety of Children in Pickup Trucks

Pickup trucks are popular vehicles in the United States and accounted for approximately 13% of new vehicle sales in 2008.[112] Although many have only a single row of seats, extended-cab models have a second row of seats and may be viewed as family vehicles by parents who want to follow safety recommendations that children be placed in the rear seat. Compact extended-cab pickup trucks, which typically have a smaller rear-seat compartment, sometimes with side-facing, fold-down seats, present a particular safety hazard to children. Winston et al[113] found that children in the rear seat of compact extended-cab pickup trucks were more than 4 times as likely to be injured (adjusted OR: 4.69 [95% CI: 2.44–9.01]) as were rear-row–seated children in other vehicles. A substantial portion of the increased risk was mediated by contact with the vehicle interior during the crash, because the rear-seat compartment in these trucks is typically not as well padded as in other vehicles. It is important to note that full-size extended-cab pickup trucks, which typically have a rear-seat compartment similar in size and configuration to other vehicles, were found to have injury risks similar to those of other passenger vehicles.

Of particular concern regarding the safety of pickup trucks for children is the use of the cargo area of pickup trucks for the transport of children and youth. Because the cargo area is not intended for passenger use, it is neither required nor designed to meet occupant safety standards applicable to passenger locations. The fatality risk to children in the cargo area of pickup trucks has been well described.[114,115] The most significant hazard of travel in the cargo area of a pickup truck is ejection of a passenger in a crash or noncrash event (eg, sudden stop, turn, swerve, or loss of balance, as well as intentional or unintentional jumps and falls). It is fortunate that the number of children and adolescents younger than 18 years killed as passengers in the cargo area of pickup trucks has declined by more than 50% over the past decade, from more than 40 per year to less than 20 per year more recently.[2] The most effective prevention strategies for reducing the number of deaths and injuries to children in pickup trucks are the prohibition of travel in the cargo area and age-appropriate restraint use in an appropriate rear-seat location in the cab.

The Safety of Children on Commercial Airlines

Currently, the Federal Aviation Administration (FAA) exempts children younger than 2 years from the requirement that all aircraft passengers occupy a seat with a separate safety belt.[116] The FAA and NHTSA agreed on a single government performance standard, FMVSS 213, that would satisfy both aviation and highway safety requirements for child restraint systems.[117] The FAA has also approved a harness-type restraint appropriate for children who weigh between 22 and 44 lb. This type of device provides an alternative to using a hard-backed seat and is approved only for use on aircraft. It is not approved for use in motor vehicles.[118] Newman et al[119] examined the potential impact and costs of a requirement for use of child restraint systems by young children on aircraft. The potential impact of such a regulation requires a number of assumptions, primarily regarding the effectiveness of child restraint systems in survivable aircraft crashes and the proportion of families who would switch from air to ground travel if required to assume the added cost of an additional aircraft seat and the child restraint system for their children younger than 2 years. Using available data on the risk of fatalities from air travel and the survivability of crashes and reasonable assumptions for RRs of death for restrained and unrestrained young children involved in crashes, Newman et al found that the number of deaths that could be prevented in the United States with mandatory child restraint system use in commercial aircraft is small: less than 1 per year. The number of deaths that could be prevented by mandatory child restraint system use is limited, because the number of deaths of unrestrained young children in survivable aircraft crashes is already low. Newman et al suggested that a policy of requiring child restraint system use for airplane travel is likely to lead to a net increase in deaths caused by increased motor vehicle travel if the proportion of families switching to automobile travel exceeds approximately 5% to 10%. This threshold varied with the estimated number of lives saved by child restraint system use on airplanes, the average length of the added round trips by car, and the risk profile of the drivers but was unlikely to exceed 15%. The National Transportation Safety Board disputed the "diversion" claim made by Newman et al and others and suggested that available data did not indicate that diversion to road travel has previously occurred when circumstances made it likely (eg, immediately after the terrorist attacks on September 11, 2001).[120]

An alternative approach supported by the FAA is to encourage families to inquire about the availability of open seats on less crowded flights so that parents could put their child in a child restraint system in a seat next to them without needing to buy a ticket and without revenue loss to the airline. This approach was also advocated by Bishai[121] in an editorial that accompanied the Newman et al study. If open seats are not available, families would be required to check the CSS as luggage. In 2008, the Department of Federal Affairs surveyed all major US airlines on their baggage policies and learned that with 1 exception, airlines have adopted policies that do not count CSSs toward checked baggage allowances.[122]

Data fundamental to creating an evidence-based policy, including information on the number of children younger than 2 years of age who currently fly unrestrained, as well as data on the number of children who sustain injuries in turbulence, are not available. Until data systems are created and used to provide evidence to inform the policy debate and ticket-pricing policies and security screening procedures are enhanced to make it easier for families to follow best-practice recommendations for correct child restraint use during commercial airline travel, and to have their own CSS or booster seat available to them after airline travel, the current situation of allowing young children to travel in a manner inconsistent with best-practice recommendations is likely to continue.

CHILD RESTRAINT LAWS

The first state child occupant restraint law was passed in Tennessee in 1978, primarily attributable to the efforts of pediatrician Robert Sanders. By 1985, all 50 states and the District of Columbia had passed laws requiring child restraints for young children. However, these initial child passenger safety laws were generally inconsistent with best-practice recommendations at the time, which created several gaps in coverage of children and resulted in poor compliance with the provisions of the laws.[123] Recognizing the importance of laws in both changing restraint behavior and educating the public about recommended restraint practices, most states have recently enhanced their child occupant restraint laws through the enactment of booster seat use provisions for older children. Current information on all child restraint laws in the United States is updated by the Insurance Institute for Highway Safety and can be found at www.iihs.org/laws/ChildRestraint.aspx. Although the laws aim to ensure the appropriate use of all forms of child restraints (eg, CSSs and belt-positioning booster seats), the revised laws generally became known as "booster seat laws." Results of subsequent study of the association of a booster seat provision in a state child restraint law with changes in child restraint use in that state indicated that booster seat provisions that cover children from 4 through 7 years of age increase the use of child restraints by 39% among children in this age range.[16] Children 4 to 5 years of age in states with booster seat laws were 23% more likely to be reported as appropriately restrained than were children in other states, and those 6 to 7 years of age were twice as likely to be reported as appropriately restrained. For 6- to 7-year-olds, the effect was much stronger when the law included children through 7 years of age than when it included only those 4 to 5 years of age.

A focus-group study of violators of California's child restraint law revealed that multiple complex factors influence consistent use of a CSS.[124] At the time of the study, the California law required children younger than 4 years and weighing less than 40 lb to be properly secured in a CSS that meets federal standards. Parents who violated the law described a number of factors, including unreliable access to a vehicle, the trip circumstances, parenting style, and child refusal, that affected the use of a CSS at the time of the citation. Among parents who had been ticketed for not restraining their children, participation in a class in which child passenger safety information was provided demonstrated some benefit in their subsequent knowledge of child passenger safety issues, compared with a fine alone.

Seat belt laws have played a critical role in increasing seat belt use by 83% of front-seat occupants by 2008.[125] However, seat belt use continues to be lower—at 80% in 2008—among drivers and front-seat occupants 16 to 24 years of age. There are 2 different types of enforcement of seat belt laws: primary and secondary enforcement. Primary-enforcement laws allow a citation to be issued whenever a law enforcement officer observes an unbelted driver or passenger. Secondary enforcement seat belt laws require the officer to stop a violator for another traffic infraction before being able to issue a citation for not using a seat belt. Previous studies have demonstrated that, on average, the effects of primary-enforcement laws are larger and more consistent than secondary-enforcement laws in increasing seat belt use and decreasing injuries among adult drivers and passengers.[126–129]

Gaps between adult seat belt laws and child restraint laws result in lack of coverage for many older children (5–15 years of age) in all seating positions. For example, in some states, a 15-year-old can ride legally in the back seat without a restraint, because the laws in those states apply only to front-seat occupants. To gain insight on the potential effect of primary-enforcement safety belt laws on older child passengers, Durbin et al[130] compared reported use of seat belts among 13- to 15-year-old passengers in crashes in states with a primary-enforcement seat belt law versus states with a secondary-enforcement law. Restraint use was 7.2% (95% CI: 4.3%–10.1%) higher among 13- to 15-year-olds in primary-enforcement states versus those in secondary-enforcement states. Restraint use among 13- to 15-year-olds was significantly lower in secondary-enforcement versus primary-enforcement states, particularly when the driver was unrestrained. For 13- to 15-year-olds in a secondary state with an unrestrained driver, 65.8% were unrestrained compared with 22.8% in a primary-enforcement state (adjusted RR: 3.0 [95% CI: 1.5–15.7]). After adjusting for both driver age and restraint use, a 13- to 15-year-old was more than twice as likely to be unrestrained in a secondary-enforcement state compared with a primary-enforcement state (RR: 2.2 [95% CI: 1.4–3.5]). The authors concluded that primary-enforcement laws were associated with higher rates of seat belt use compared with secondary-enforcement laws among children 13 to 15 years of age, a group not generally covered by restraint laws.

RESOURCES FOR PEDIATRICIANS AND FAMILIES

The NHTSA began a standardized child passenger safety training and certification program in 1998. Since then, tens of thousands of people have been certified as child passenger safety technicians.[131] These people participate in community-based child safety seat clinics and are a source of information for families on appropriate use and installation of all types of CSSs and booster seats. Although the algorithm to guide implementation of best-practice recommendations by pediatricians provided in the policy statement is designed to cover the majority of situations that pediatricians will encounter in practice, pediatricians should consider child passenger safety technicians as sources of information when atypical circumstances may be encountered that are not adequately managed by the algorithm. In most communities, technicians work at formal inspection stations; a list of these stations is available at www.seatcheck.org. If your community does not have an inspection station, you can find a technician in your area via the National Child Passenger Safety Certification Web site (http://cert.safekids.org) or the NHTSA child safety seat inspection station locator (www.nhtsa.dot.gov/cps/cpsfitting/index.cfm). Technicians with enhanced training in restraining children with special health needs, as well as those with Spanish-language proficiency, can be identified at these sites. Car seat checkup events are updated at www.safekidsweb.org/events/events.asp. In addition, additional resources for pediatricians and families can be found at www.aap.org and www.healthychildren.org.

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