U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

NHTSA
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DOT HS 808 440

January 1996

Final Report

Patterns of Misuse of Child Safety Seats

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 808 440		

4. Title and Subtitle

PATTERNS OF MISUSE OF CHILD SAFETY SEATS

5. Report Date
January 1996

6. Performing Organization Code

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8. Performing Organization Report No.

9. Performing Organization Name and Address
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10. Work Unit No. (TRAIS)

11. Contract or Grant No.
DTNH22-93-C-05014

12. Sponsoring Agency Name and Address
National Highway Traffic Safety Administration
Office of Program Development and Evaluation
400 Seventh Street, SW
Washington, DC 20590

13. Type of Report and Period Covered
Final Report
October 1993 - December 1995

14. Sponsoring Agency Code

15. Supplementary Notes
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16. Abstract

This project addressed the patterns of child safety seat (CSS) misuse in the nation and reported on the most appropriate techniques to accurately and efficiently collect this data. CSS use and misuse observations were collected for about 5,900 target young children (under 60 pounds) in over 4,000 vehicles in the following four states: Mississippi, Missouri, Pennsylvania, and Washington.

Results showed overall restraint use for target children was 87.2%. CSS and safety belt use was 50.6% and 36.6%, respectively. The remainder of target children were unrestrained (12.8%). Correct CSS use was defined as proper use of all of the following CSS elements: seat direction, vehicle safety belt routing, harness buckle and harness strap, harness retainer (chest) clip, and locking clip (on safety belt, if needed). Overall correct CSS use was 20.5%. For infants (children under 20 pounds), 96.6% were in a CSS and 20.6% of the CSSs were correctly used. For toddlers (children between 20 and 40 pounds), 67.5% were in a CSS and 18.9% of the CSSs were correctly used. For pre-school, booster seat weight children (between 40 and 60 pounds), 6.1% were in a CSS and 50% of the CSSs were correctly used. The strongest positive relationship between target child restraint use and CSS proper use was for drivers using safety belts. Other positive relationships were found for the vehicle having air bags, the driver being a family member, the child in the middle back seat position, and CSS infrequently removed from the vehicle.

Recommendations are provided for data-collection techniques and promoting CSS use and proper use. Data collection should include: local support; "train-the-trainer" and local workshops; comprehensive classroom and field instruction and supervision; and demonstrations using several CSS makes and types. To improve CSS use and proper use the following is recommended: continue local programs; promote stronger state laws and restraint law enforcement; provide easy to read and understand instructions with CSSs; and conduct periodic CSS misuse surveys. Consideration should be given to modify CSS and vehicle restraint system designs that arise from CSS misuse. Research should be conducted to quantify the impact of CSS misuse on children involved in motor vehicle crashes.

17. Key Words	18. Distribution Statement
Child Safety Seat Use, Misuse, Safety Belt Use, Proper Use, Infant Seat, Convertible Seat, Booster Seat, Driver Relationships	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

PREFACE

This project identified the types and degrees of misuse of child safety seats (CSSs), examined the characteristics that distinguished CSS misusers from correct users of CSSs, and identified the most appropriate techniques for collecting CSS misuse data, as well as the most suitable types of sites at which to collect this data.

The authors wish to thank many individuals and organizations for their time and effort. The authors would first like to express their appreciation to the regional coordinators who were responsible for field operations. They include Juli C. McGreevy (Pennsylvania consultant), Kathryn P. Kruger (Washington Safety Restraint Coalition), Cynthia Huff and Kay Brodbeck (Mississippi Safety Services), and Jerald L. Miller (Safety Council of Greater St. Louis).

Thanks go to Lorrie Walker and Kathy Strotmeyer (Pennsylvania Traffic Injury Prevention Project) for assistance in training and field operations, as well as other regional staff, Terri Anthony (Washington County, Pennsylvania, Regional Comprehensive Highway Safety Program), Sherry Miller and Linda Doty (South Central Pennsylvania Highway Safety Program), and Dianna Reed (Manager of Comprehensive Programs), supported by the Pennsylvania Department of Transportation Center for Highway Safety. The authors also wish to thank the many individuals who collected the data and who represented state, regional, and community organizations that cooperated with the effort.

Thanks are in order to Dave Roberts and Bob Hathaway at Calspan Corporation (Buffalo, New York) for assisting in the train-the-trainer workshop, reviewing data, and providing suggestions for recommendations and future research. In addition, thanks go to Doreen Wolpert of Canada Market Research Ltd. (Ontario, Canada) for providing suggestions learned from her research in the field.

Thanks are in order to the Society of Automotive Engineer's (SAE) Children's Restraint Systems Task Force for their assistance in reviewing the test plan and providing suggestions during the study.

Thanks are also in order to Cheryl A. Kim and Stephanie Tombrello of SafetyBeltSafe U.S.A. for providing suggestions during the final draft versions.

Final thanks to Julee Shuck for editing and producing the final manuscript and graphic illustrations.

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EXECUTIVE SUMMARY

The purpose of this study was to address the patterns of child safety seat (CSS) misuse in the nation and develop the methodology to accurately and efficiently collect this data. The project objectives included the following:

- Identify CSS misuse by type of misuse characteristic;
- Examine the relationship of driver characteristics that distinguish CSS misusers from correct CSS users;
- Examine the problems associated with correct installation of CSSs and current vehicle occupant protection systems; and
- Identify the most effective data collection methods and techniques to optimize the collection of CSS misuse data.

Previous CSS misuse studies varied widely in definition, scope of effort, and techniques used to measure CSS misuse, resulting in a wide range of reported CSS misuse rates. There was also a lack of information about how improvements in CSS design and variations in safety belt design, along with other vehicle occupant protection safety devices, affect CSS misuse. With these factors in mind, there was a need for a study to improve the understanding of the CSS misuse problem in the nation.

RESEARCH METHODOLOGY AND DATA COLLECTION

Four states (Mississippi, Missouri, Pennsylvania, and Washington) were selected to participate in the data collection effort, based on geographic representation, state support, and willingness to participate in the project. Local coordinators from each state were selected based on their expertise in CSS issues, experience in conducting CSS inspection clinics and other highway safety programs in their communities, and their ability: to solicit site cooperation; recruit and train data collectors; and supervise data collection efforts. Coordinators selected sites, which were located in the suburban areas of Jackson (Mississippi), St. Louis (Missouri), Harrisburg/Washington (Pennsylvania), and Seattle (Washington). Sites were selected based on the cooperation of proprietors and shopping center managers, the volume of target group traffic, and safety. Sites were primarily community shopping centers, malls, fast food restaurants, parks, and other recreational facilities. Sites were not selected on the basis of inferring statistical representation across the nation.

The data collection consisted of interviewing drivers with young children (under 60 pounds or 27 kg) and making observations of occupant and target child restraint use and CSS misuse. Two phases of training occurred:

1. Coordinators participated in a "train-the-trainer" workshop hosted by project staff, the COTR, and national experts in CSS misuse and other occupant protection issues; and

2. Each coordinator trained the field staff in their state.

CSS misuse characteristics and the criteria for misuse were identified during the first phase of training by the project team and CSS experts that attended the workshop. The SAE Children's Restraint Systems Task Force also reviewed the misuse criteria. It is important to note that the selection of misuse criteria was not weighted by criticality of the misuse characteristic in terms of severity of possible injuries associated with that misuse type, but based on the key misuse characteristics that are commonly reported and that can be identified through the observation methods used for the study.

Training of data collectors involved 3 days of classroom instruction, followed by 3 to 5 days of training and supervision in the field. Training topics included:

- Instruction on child development;
- CSS seat types;
- Age and weight characteristics;
- CSS misuse characteristics;
- Demonstrations with various CSS makes and types;
- Instructions on data collection techniques; and
- Actual data collection practice.

Teams of two collectors were required to collect the data for each vehicle. The team consisted of an interviewer and an observer who used separate interview and observation forms. Three categories of data were collected:

- Site and driver-reported demographics;
- Observed target child and driver/other occupant restraint use and CSS misuse characteristics (e.g., seat direction, safety belt, locking clip use on safety belt, harness connection, harness straps, and harness retainer (chest) clip);

- Seat type (infant, convertible, or booster);
- Seat manufacturer and make and type; and
- Driver-reported behavioral characteristics related to CSS acquisition, installation, and placement of child in CSS.

The data were checked and verified in the field and sent to project staff for data entry and analysis. The coordinators also reported on their experiences in the field relating to site and staff recruitment, training, data collection, and other related project issues.

RESULTS

Data collection took place from mid-Spring to mid-Summer of 1995. A total of 4,019 drivers in target vehicles were stopped for the survey; and 5,865 target children were observed for restraint use and CSS misuse. Drivers were mostly under age 40, female, and the parent of the target children. Most of the drivers were local residents, within a 15-mile (24-kilometer) distance and 30-minute ride from the observation site. The vehicles driven were primarily sedan/coupes, passenger/mini-vans, and station wagons. About one-third of the vehicles had driver-side airbags and about one tenth of the vehicles had passenger-side airbags.

The majority of drivers reported that the vehicle they were driving was the one they regularly drove. The majority of drivers also reported that the CSSs were acquired new. Parents were the primary person installing the CSS in the vehicle and securing the child in the CSS. About 40% of the drivers regularly remove CSSs from the vehicle. Over 70% of drivers reported that their knowledge on how to *install the CSS in the vehicle* came from reading the instructions on the box or on the CSS. However, only about 50% of the drivers reported that their knowledge on how to *secure the child in CSS* was from reading the instructions on the box or on the CSS. A good percentage (30%) of drivers learned how to secure the child in the CSS on their own.

Observational data were obtained for driver and target children in the four states. Overall driver safety belt use was 81.6%. For target-weight children (under 60 pounds or 27 kg), the overall restraint use was 87.2%; CSS use in all four states was 50.6%, safety belt use was 36.6%, and no restraint use was 12.8%. Three of the four states were fairly consistent in their results. Mississippi was much lower for target child CSS use (26.9%) and safety belt use (25.5%) and had a large proportion of unrestrained target children (47.6%). For infants (target children under 20 pounds or 9 kg), CSS use was 96.6%, safety belt use was 0.5%, and no restraint use was 2.8%. For toddlers (target children between 20 and 40 pounds or 9 to 18 kg), CSS use was 67.5%, safety belt use was 21.4%, and no restraint use was 11.1%. For pre-school,

booster seat weight children (weight between 40 and 60 pounds or 18 to 27 kg), CSS use was 6.1%, safety belt use was 75.3%, and no restraint use was 18.6%. Mississippi showed much lower CSS use for infants and toddlers than the other three states.

CSS misuse included observing one or more CSS misuse criteria defined as critical elements in CSS safety. For target children, the overall percentage of proper use of CSSs was 20.5%. The overall percentage of CSS misuse was 79.5%. Observed misuse of CSSs by each misuse criteria element was as follows:

- locking clip misuse or no use when necessary	72.0%
- harness retainer (chest) clip misuse or not used	58.8%
- harness strap misuse or not used	45.8%
- vehicle safety belt misuse or not attached to CSS	16.9%
- CSS direction incorrect	9.6%
- harness not connected (buckled) to crotchplate	3.3%

Specific incorrect uses by each misuse element by type of CSS (infant, convertible, or pre-schooler, booster) is summarized in Table i.

On issues relating to vehicle restraint, other occupant protection systems, and vehicle seat design, it was found that there was a slightly higher correct CSS use with 2-point lap belts than 3-point lap/shoulder belts; only about 6% of CSS installation misuse was affected by belts that were anchored forward of the bight (crease where the upper and lower cushion meet). In addition, built-in CSSs did contribute to higher CSS proper use than conventional seats. Drivers were also able to handle very slanted seats somewhat better in terms of CSS correct use, as opposed to other special seat conditions (e.g., deeply contoured, center curved, and narrow rear seat).

For target children who were secured only in safety belts instead of convertible or booster seats, the misuse of safety belts was 67.6%. The highest safety belt misuse was attributed to lap belts being too high (across the abdomen) and the belts being too loose. Almost one half of the shoulder belt misuse involved the child not using the shoulder belt when it was present. Most of the other remaining shoulder belt misuse was related to the belt being too high on the child (near or on the neck).

Despite the fact that infant CSS use (96.6%) was much higher than toddler CSS use (67.5%), CSS misuse rates for both weight group categories were similar (infant misuse was 79.4% and toddler misuse was 81.1%). In addition, toddler CSS use was much higher than that of children of booster seat weight. However, when booster seat weight children were in a CSS, the misuse rate was only 50%.

Table i. Child Safety Seat Correct/Incorrect Use by Misuse Element

	Infant Seats		Convertible Seats		Booster Seats		Totals	
Seat Direction	n	%	n	%	n	%	n	%
Correct	375	75.9%	1,601	94.6%	--		1,976	90.4%
Incorrect	119	24.1%	92	5.4%	--		211	9.6%
Total	494	100%	1,693	100%	--		2,187	100%
Safety Belt Use:								
Correct	408	80.3%	1,450	82.2%	535	88.3%	2,393	83.1%
Unbuckled/ Disconnected	10	2.0%	33	1.9%	12	2.0%		
Misrouted	17	3.3%	42	2.4%	6	1.0%		
Improper Use/Fit	73	14.4%	239	13.5%	53	8.7%	485	16.9%
Total	508	100%	1,764	100%	606	100%	2,878	100%
Locking Clip Use:*								
Correct	72	27.6%	183	27.0%	61	32.4%	316	28.0%
Not Used	164	62.8%	439	64.6%	108	57.5%		
Improper Use/Fit	25	9.6%	57	8.4%	19	10.1%	812	72.0%
Total	261	100%	679	100%	188	100%	1,128	100%
Harness Connection (Buckle Use):								
Correct	476	94.6%	1,737	97.3%	--		2,213	96.7%
Unbuckled/ Disconnected	27	5.4%	48	2.7%	--		75	3.3%
Total	503	100%	1,785	100%	--		2,288	100%
Harness Strap Use:								
Correct	245	48.2%	1,005	55.9%	--		1,250	54.2%
Misrouted	68	13.5%	72	4.0%	--			
Not Used	19	3.7%	52	2.9%	--			
Improper Use/Fit	176	34.6%	668	37.2%	--		1,055	45.8%
Total	508	100%	1,797	100%	--		2,305	100%
Harness Retainer (Chest) Clip Use:*								
Correct	231	51.1%	492	37.8%	--		723	41.2%
Not Used	69	15.3%	287	22.1%	--			
Improper Use/Fit	152	33.6%	522	40.1%	--		1,030	58.8%
Total	452	100%	1,301	100%	--		1,753	100%

* Cases where the locking clip or harness retainer (chest) clip were not required have not been included in the correct/incorrect use statistics. The total cases where the locking clip was not required were: 221 for infant seats, 1,040 for convertible seats, and 299 for booster seats. The total cases where the harness retainer (chest) clip was not required were: 48 for infant seats and 454 for convertible seats.

When the driver was restrained in a safety belt, CSS use and proper use was higher than when the driver was unrestrained. However, the most dramatic difference

between the restrained and unrestrained drivers was the difference in children not restrained by either a CSS or safety belt. Drivers restrained in safety belts only had 5.4% of the unrestrained target children; however, when the driver was unrestrained almost half of the target children (47.3%) were also unrestrained. Results also showed that when the vehicle had a driver-side airbag or both driver- and passenger-side airbags, CSS use was slightly higher, but misuse was similar. Results showed no specific relationships between vehicle or license plates and CSS use or misuse.

Results showed a higher percent of target children unrestrained in the front middle and third row of seats (such as in mini-vans) than any other position. The middle seat of the second row or back seat of many vehicles had the highest rate of CSS use and proper use. CSS misuse rates were similar across the different number of vehicle occupants and target children occupants. However, it was observed as the number of occupants and target children increased in the vehicle, the number of unrestrained target children increased, most likely due to not having more than one CSS in the vehicle.

There was no particular relationship between driver age or gender and CSS use or misuse rates. In addition, when the driver was a parent or grandparent, restraint use or CSS misuse was very similar. However, it was observed that if the driver was a friend or another relative, there was a higher percentage of unrestrained target children. Results showed little difference among the driver's distance and time from last stop and CSS use and misuse. There was also very little difference in CSS misuse as a function of whether or not the vehicle was the one regularly driven.

There was very little difference between how the CSS was obtained and the frequency of misuse. There was only slightly higher correct CSS use when the person who installed the CSS in the vehicle or secured the child in the CSS was the parent or relative. There was very little difference in CSS misuse based on the methods used to learn how to install the CSS in the vehicle or how to secure the child in the CSS. When the driver learned on his/her own, CSS misuse was slightly higher for both CSS installation and child placement in CSS. In addition, when CSSs were frequently removed from the vehicle, CSS misuse was slightly higher than when the CSS was only occasionally or never removed from the vehicle.

CSS manufacturers were identified for 96% of the CSSs observed. However, only 50% of make and types were identified. This report presents the CSS misuse results for the most common make and type infant, convertible, and pre-schooler, booster seats identified. However, the sample size for even the more common CSSs identified was not large enough to report on the specific make and type misuse rates.

SUMMARY AND RECOMMENDATIONS

Based on observations of approximately 5,900 children of CSS weight (under 60 pounds or 27 kg), the level of CSS use for infants (under 20 pounds or 9 kg), toddlers

(20 to 40 pounds or 9 to 18 kg), and pre-schooler, booster-weight children (41 to 60 pounds or 18.5 to 27 kg) was 96.5%, 67.5%, and 6.1%, respectively. CSS correct use was 20.5% for all target children combined. The study findings suggest that child weight, family relationship, driver restraint use, and vehicle passive occupant protection systems were related to CSS use and levels of CSS misuse.

It is important to note that the study is not nationally representative and conclusions drawn from it should be viewed with the limitations of the sample in mind.

The success of the study's field operations is attributed to the experienced coordinators from the four states, the cooperative site owners, the high family traffic volume sites selected, the dedicated and dependable staff, the extensive train-the-trainer and field training workshops, the comprehensive training materials, and availability of a wide variety of CSS makes and types.

Coordinators had extensive experience in CSS and other highway safety issues and were employed by state and state safety associations and governments. The most productive sites were community shopping centers with family-type stores with limited entrances. The best approach for obtaining site permission involved using known community contacts and assistance from local police. The data collectors were people with diverse backgrounds and experience. Training included 3 days of classroom and practice field work, followed by a week of on-site "live" data collection. The target vehicles were spotted at entrance locations, safely stopped, asked to participate in the survey, and directed to a designated parking area. The interview and observation lasted about 5 minutes and was conducted by two data collectors.

For CSS misuse data-collection, the following is recommended:

- Survey sites should offer a high volume of family traffic and safe designated areas in which to conduct the survey;
- Several teams should be used at each qualified site during the length of the survey;
- Data collectors should be well trained, highly motivated, personable, and conduct themselves in a professional manner;
- Training of the data collectors should involve comprehensive classroom and field instruction, supported by training materials and demonstrations with a large selection of CSS makes and types; and
- Data-collection forms should be designed for simple coding in the field.

The following is recommended for CSS programs and future research to improve CSS use and proper use:

- Conduct research to quantify the impact of CSS misuse on children involved in motor vehicle crashes;
- Promote stronger CSS laws that increase the maximum weight limit of CSS use, especially toddler and pre-school children in the 40 to 60 pound (18 to 27 kg) group;
- Focus CSS program messages on the importance of reading instructions that come with CSSs and vehicle owner manuals;
- Provide instructions that are easy to read and follow for proper CSS installation and use;
- Involve local government, business and the police in child passenger safety programs and data collection efforts;
- Encourage continued police enforcement of occupant restraint laws;
- Encourage healthcare and community safety groups to continue providing information on proper CSS use and CSS restraint compatibility with vehicle seat design;
- Periodically collect national CSS misuse data; and
- Investigate the reasons why some states have much lower occupant restraint use rates than others.

Other considerations need to be given to CSS and vehicle restraint system design issues that arise from CSS misuses.

This research effort confirmed the concerns of government officials, industry specialists, safety and health care professionals, and child passenger safety advocates that the misuse of CSSs is highly evident among young children passengers in motor vehicles. This was especially true for toddlers (20 to 40 pounds or 9 to 18 kg) and even more so for booster seat children (40 to 60 pounds or 18 to 27 kg), where only a very small percentage of children were in a CSS.

The study finds that many young children who are placed in CSSs could be at risk *of not attaining the full benefits of the CSS* because the CSS is not being used properly, not installed according to manufacturer's recommendations, or that the child is being moved to safety belts too soon. *Child restraints, as currently used, are very effective in reducing injuries and fatalities, but are more effective when used properly.* The study found a high percentage of CSS misuse among target weight children, but did not identify the impact of the type of misuse in terms of the injury potential to this target group.

1.0 INTRODUCTION

This chapter presents background information on the purpose for this study, characteristics of child safety seats (CSSs), historical data on CSS use and misuse rates, and the factors that have influenced CSS use/misuse in the past. The project objectives and scope of work are then summarized.

1.1 BACKGROUND

The estimated national child safety seat use rate for children under five was over 80% when this decade began (NHTSA, 1991). However, many young children are still unrestrained and riding in motor vehicles without properly installed or used CSSs. Of the approximately 600 young children passengers (under 5 years of age) who lose their life each year in traffic crashes, approximately 250 of these children die because they were not in CSSs or not secured in them properly. It is likely that additional young children would have been killed or injured more seriously if they had not been restrained, however, some of these injuries were likely the result of misuse of the CSS (NHTSA, 1992).

CSS manufacturers have improved the design of CSSs by eliminating the need for tethers, increasing the convenience of the harness systems, and reducing the likelihood of misrouting the vehicle's safety belts through the CSS. However, current variations in safety belt design and other vehicle occupant protection safety devices, such as passenger-side air bags, have again complicated the installation and proper use of CSSs.

With the estimated misuse of CSSs reducing the safety effectiveness against severe and fatal injuries by about half, the National Highway Traffic Safety Administration (NHTSA) was interested in identifying the current patterns of CSS misuse in the nation. This study sought detailed information on the types and patterns of CSS misuse, with particular focus on newer CSS design and CSS compatibility issues with vehicle seat design and occupant protection systems.

Characteristics of Child Safety Seats

There are currently three basic types of CSSs: infant, convertible, and booster seats. A few years back, the toddler seat was also manufactured.

The **infant seat** is designed to be used from birth to 20 pounds (9 kg). Infant seats are typically one-piece, protective molded shells. The seat comes equipped with a snap-in pad and slots for the vehicle's safety belt. The infant is secured in the carrier with a harness and, in most cases, a harness retainer (chest) clip to hold the child's head and shoulders in the harness system. Whether it is placed on the back seat or in the front seat (except when there is a front passenger air bag), the carrier must face the rear of the

vehicle, with the exception of car beds. All infant seats include up to three sets of slots in the back of the seat to allow for harness adjustment to accommodate an increase in the infant's height and weight. These seats have a three-point harness that consists of two straps over the shoulder connecting in a "V" shape at the buckle or to a small hip pad that attaches to the buckle. Some infant seats also serve as a car bed which allows an infant to lie flat and perpendicular to the direction of vehicle travel with the head towards the center of the vehicle. Figure 1-1 illustrates properly installed infant seats (shell type and car bed) in vehicles with infants properly placed in the seats.

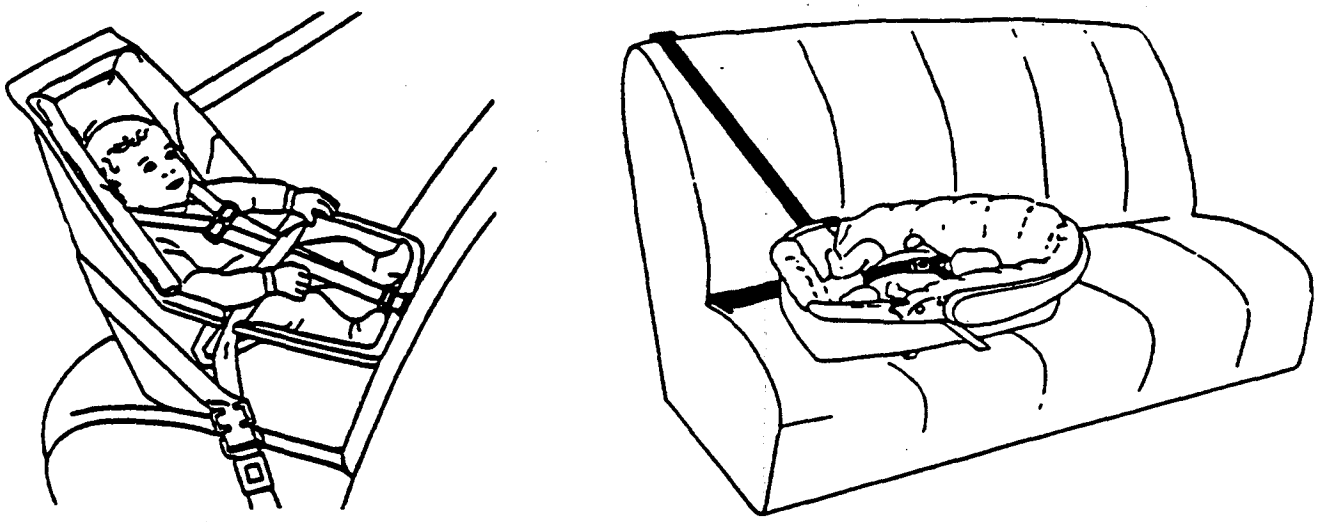


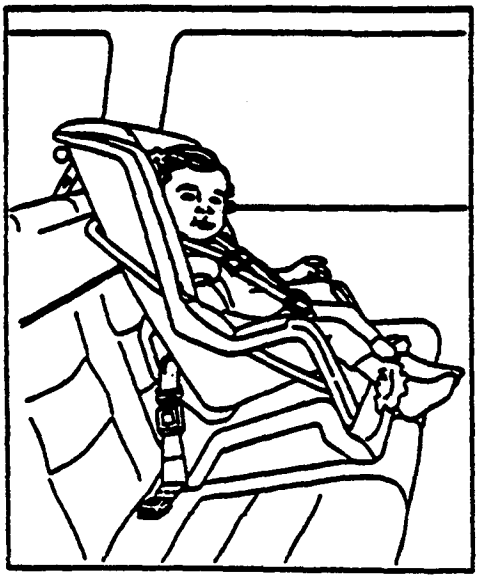
Figure 1-1. Infant Seats

(Illustrations from NHTSA's *Child Passenger Safety Resource Manual*, 1992 and Canada Market Research's *Interviewer/Observer Training Manual*, 1992)

The **convertible seat** is designed to be used from birth to 40 pounds (18 kg). The seat incorporates features to allow use for infants as well as toddlers. Initially, the seat is used in a rear-facing position until the infant is about 20 pounds (9 kg) and approximately 1 year of age. Placed in a forward-facing position, the convertible seat then carries the young child until 40 pounds (18 kg) and approximately 4 years of age. A distinguishing feature among convertible seats is the harness system. Convertible seats have either a five-point harness or a three-point harness with a T-bar or abdominal shield. The five-point harness system consists of two shoulder straps, two hip straps and a crotch snap, all joined together with a buckle. They usually have padded arm rests. For three-point harnesses with abdominal shields, the shoulder straps are attached to the abdominal shield which buckles into a crotch strap. A design refinement of the three-point harness includes retractable shoulder straps attached to a pliable plastic T-bar. The T-bar locks into a buckle in the crotch area. All convertible seat harness systems can be adjusted as the child grows. There are harness slots that accommodate changing the harness straps from the lowest slot position for an infant to the upper slots for toddlers. Most of the harness systems require a harness retainer (chest) clip, placed at the armpit level of the child, which

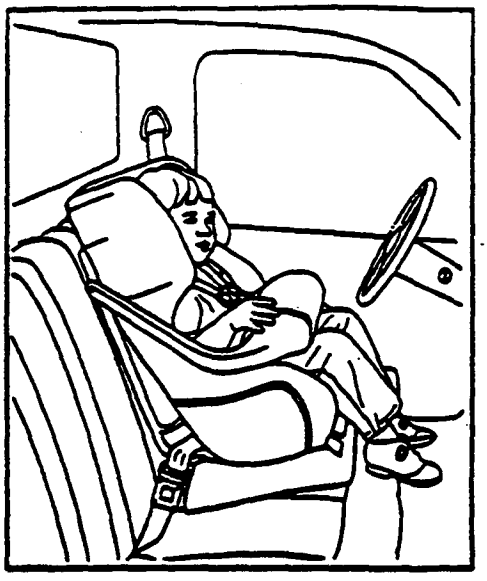
keeps the two restraint straps over the shoulder. Convertible seats also have a reclining mechanism. This apparatus allows an infant to sleep at an acceptable reclining angle while facing the rear, and a toddler to sit more upright while facing forward. Figure 1-2 illustrates the types of convertible seats.

Five-point Harness



Harness With T-Shield

Harness With Tray Shield



Convertible Seat in Rear-facing Position

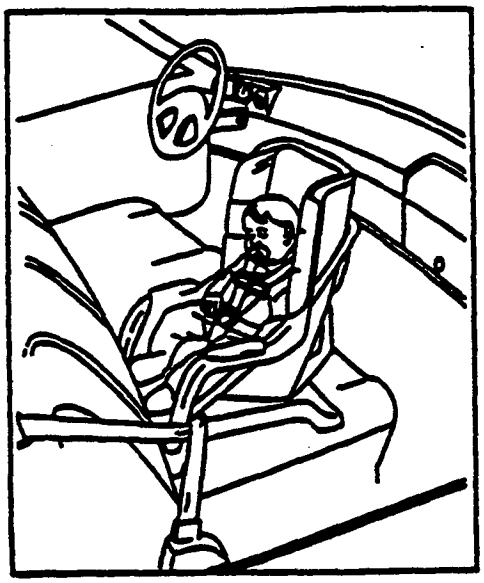


Figure 1-2. Types of Convertible Seats
(Illustrations from Canada Market Research's *Interviewer/Observer Training Manual*, 1992)

The **booster seat** can be used by children who have outgrown their convertible seats, usually beginning around 40 pounds (18 kg) up to an approximate maximum weight of 60 pounds (27 kg), depending upon the seat manufacturer's recommendations. Some have removable shields that allow use with a vehicle's three-point lap/shoulder belt combination alone. (Figure 1-3 illustrates the belt and small-shield booster seats.) There is also a creative new version of CSS which is a high-back booster (toddler/booster). It has a bucket-style, high-back contoured seat for support of the child's back and neck. It has an adjustable harness for children between 30 and 45 pounds (14 and 20 kg) and allows for use of a vehicle lap belt for children between 30 and 60 pounds (14 to 27 kg).

Belt Booster **Small-Shield Booster**

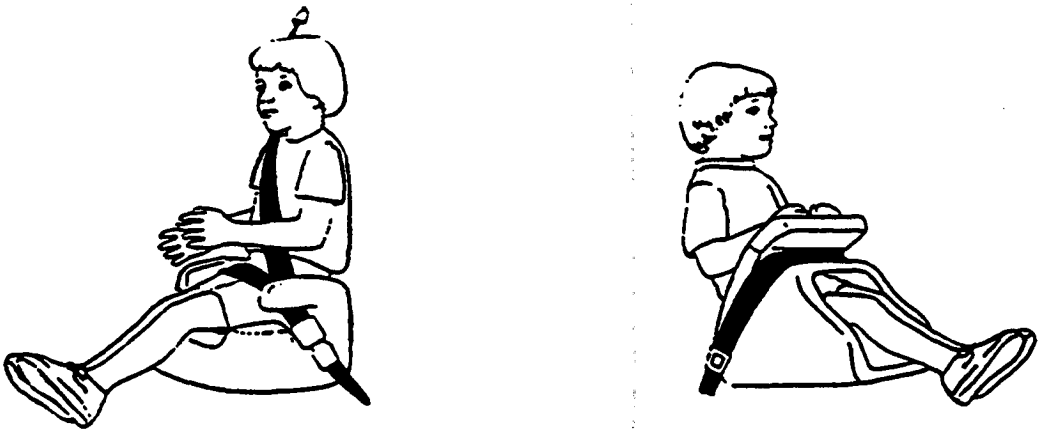


Figure 1-3. Booster Seats

(Illustrations from NHTSA's *Child Passenger Safety Resource Manual*, 1992)

Full protection for young children includes all of the following criteria for proper installation of the seat in the vehicle and proper securing of the child in the seat. These criteria include:

- seat type;
- seat direction;
- safety belt installation;
- harness restraint connections and proper placement of the retainer (chest) clip; and
- compatibility between seat and vehicle occupant protection systems.

For **seat type** and **seat direction**, young children under 20 pounds (9 kg) and under 1 year of age, should face rearward, either in an infant or convertible seat. Young children between 20 and 40 pounds (9 kg to 18 kg) and approximately between 1 and 4 years of age should be facing forward in a convertible seat. Young children between 40 and 70 pounds (18 kg to 32 kg) and approximately 4 to 10 years of age should be using a booster seat, which faces forward.

For **safety belt installation**, the vehicle's safety belt must be properly routed through the CSS and buckled. The routing method varies by CSS make and type. Belt routes for infant seats are usually across the front of the child. Convertible seats have different belt routes which depend on seat direction. Booster seats with shields can be used with lap belts. The vehicle's safety belt should be tight through the CSS, so that the seat is not loose. A locking clip should be used for continuous lap/shoulder belts with a free-sliding latch plate. In addition, the buckle and latch plate of the safety belt should be on one side of the CSS, below the frame or toward the middle of the CSS, between the sides of the frame, to allow for proper adjustment. If the buckle or latch plate lies at the point where the belt bends around the frame or through the slot of the seat, the belt will not tighten properly.

The **harness system** needs to be properly routed through the harness slots in the back of the seat; at or below shoulder level for rear-facing and at or below shoulder level for forward facing. The harness webbing must not be twisted and should be snug against the child. The crotch strap should be kept short and latched to the harness buckle. If a harness retainer (chest) clip is needed, it should be level with the child's armpits to keep the harness from slipping off the shoulders. If the seat has a shield, it should fit close to the child's body and always accompany a harness.

Concerning **CSS compatibility with vehicle occupant protection systems and seat design,** the following should be considered. If the vehicle has a front side passenger air bag, a rearward facing CSS should not be placed in the front passenger seat. In addition, CSSs should not be placed in the front seat where automatic or manual shoulder and/or lap belt combinations are attached to the vehicle door, unless a manual lap belt is installed separate from the door-mounted belt. CSSs also should not be connected with safety belts that have the latch plate in front of the bight (crease where the upper and lower cushions of the seat meet) of the seat, if this causes instability.

A more comprehensive description of the criteria for proper installation of CSSs in the vehicle and properly securing the child in the CSS is provided in NHTSA's *Child Passenger Safety Resource Manual* (1992).

Child Safety Seat Usage Rates

Early studies from the mid 1970s sponsored by the Insurance Institute for Highway Safety (IIHS), involved restraint use observations of children at amusement parks and shopping centers. From a sample of approximately 3,000 children under 4 years of age, they found only 8% restrained and only 5% in CSSs (Williams, 1976).

In the 1980s, NHTSA conducted observational studies annually in 19 cities on safety belt, CSS, and motorcycle helmet use. During the first year of observation in 1981, infant and toddler CSS use was only 40% and 19%, respectively. By the end of the decade, the infant and toddler CSS use rates had increased to 81% (NHTSA, 1991). States also conducted CSS usage observations during this time period. CSS usage rates ranged from 25% in Texas (Hatfield, et al., 1986) to 73% in Michigan (Streff and Molnar, 1990).

CSS usage data has also been collected recently. CSS use rates have been 87% (infants)/82% (toddlers) (NHTSA, 1991), 62% in Virginia (Stoke, 1992), 92.5% (infants)/85.8% (toddlers) in Ontario, Canada (Wilson, et al., 1994), and 93% (infants)/74% (toddlers) in Pennsylvania (Decina, et al., 1994). The most recent data collected for NHTSA's National Occupant Protection Use Survey (NOPUS) in late 1994 found 88% of infants (children under 1 year) in a CSS and 61% of toddlers (children ages 1 to 4) in either a CSS or safety belt (NHTSA, 1995).

Child Safety Seat Misuse Rates

The earliest CSS misuse studies date back to the late 1970s. One study by the Opinion Research Corporation found that only 45.3% of infants under 1 year old were in CSSs and only 23.2% were properly secured (76.8% misuse) (Bulger, 1983). In the early 1980s, an observational study of 600 children by Riley Hospital and the Indiana University School of Nursing found a 74% misuse rate for CSSs. Most of the misuses related to nonuse of the tether strap and harness and misrouting of the safety belt through the CSS (Bull, Stroup, and Gerhart, 1988). Another study in the same time period looked at CSS misuse at fast-food restaurants in 10 cities. The "Hardee" study, as it is commonly referred to, found 65% misuse for all types of CSSs. This study also found similar misuse characteristics: the tether strap not used; vehicle safety belts incorrectly routed; the harness and/or shield not used; and the harness and/or shield used incorrectly (Cynecki and Goryl, 1984). Another study in the same time period on a sample of over 3,400 young children, found that 81% of CSSs were either improperly anchored (either by the safety belt or tether strap connection) or not anchored at all (Shelness, 1984).

In the 1980s, NHTSA measured CSS use in conjunction with their 19 city safety belt use studies. From observing CSS use in vehicles stopped in traffic and at curbside, and from looking at seat installations in unoccupied vehicles in parking lots of shopping

centers, an estimated percentage of young children who might be properly protected was computed. For 1988, NHTSA estimated that about 56% of children in vehicles were probably properly protected from a sample of about 1,000. However, the NHTSA data had some drawbacks, which primarily related to the methodology used in computing proper CSS protection. Observations were made looking at parked vehicles with CSSs. It was assumed that drivers with properly installed CSSs were actually securing their young children in these seats correctly in the harnesses. Therefore, NHTSA's estimated fully protected rate may have been higher than the true rate.

In the 1990s, studies reported CSS proper use rates of 60.5% in Michigan on a sample of about 250 children (Streff and Molnar, 1990), 61% and 54% of infants and toddlers, respectively without a serious CSS error in a sample of about 1,500 (Wilson, et al., 1994), 68% for over 2,000 toddlers in suburban Philadelphia (Decina, et al., 1994), and 27.3% for over 13,500 young children in Texas (Womack, 1992).

CSS misuse data reported in published research literature has varied tremendously, primarily due to the CSS definition used by the researcher, and data collection and sampling methodologies. Some of this variability may be based on the researcher's definition of what constituted misuse or proper use. Some of these studies never defined proper use (Streff and Molnar, 1990; Womack, 1992). Other studies only measured gross levels of CSS misuse (e.g., seat direction, harness over child's head, vehicle belt connected through CSS) (Decina et al., 1994). A recent study by Transport Canada (Wilson et al., 1994) used five major criteria for determining CSS misuse which included safety belt connection, locking clip for certain safety belts, harness/shield attachment, harness retainer (chest) clip attachment, and tether strap. This study found a high frequency of correct use of the safety belts in about 81%, 86%, and 85% of infant, convertible, and booster seats observed, respectively; and a marginally high level of correct use of harness/shields in about 62% and 64% of infant and convertible seats observed, respectively. This study also found a low frequency of correct use for the harness retainer (chest) clip (about 39% and 27% for infant and convertible seats, respectively), tether strap (33% in convertible seats), and the locking clip when needed (10%, 20%, and 7% for infant, convertible, and booster seats, respectively). The study was based on about 1,000 seat observations. There were also differences in CSS misuse levels between shopping center and intersection site locations. Finally, a more recent study in California sampled those who attended a 2-hour class for CSS violations and found only 21% of the 5,455 CSSs brought into the class were safe to use without additional correction (e.g., harness straps needed to be put in correct slots, chest clip was needed) from instructors (Safety Belt Safe USA, 1994).

Factors Correlated With CSS Use and Misuse

A recent summary of studies comparing the relationship between CSS use and other factors shows evidence of a positive statistical correlation between increased CSS use and adult belt use, race (white), marital status (married), increased education, and increased income (Russell, Kresnow, and Brackbill, 1992). Recent direct observations of driver safety belt use and toddler restraint use in suburban Philadelphia found that for those drivers wearing shoulder belts, 73% of toddlers were in a CSS, 24% were in a safety belt, and only 3% were unrestrained. For those drivers who were not wearing shoulder belts, only 53% and 16% of toddlers were in a CSS or safety belt, respectively; 31% of the toddlers were unrestrained (Decina, et al., 1994).

The "Hardee" study examined the extent of CSS misuse and the reasons associated with types of misuse. The study found a higher prevalence of CSS misuse when the driver was not belted. Those drivers installing the seat without the aid of instruction were more likely to misuse the seat. Misuse was lower for seats purchased by the parents compared to those given as gifts. The study found misuse associated with socioeconomic level, physical characteristics of seats, education and awareness level of parents, and whether other occupants transported the children. The study found no relationship between CSS misuse and the age of the child, gender of the driver, or seat position (Cynecki and Goryl, 1984).

Summary

Past federal and state government-sponsored CSS use and misuse studies focused on obtaining samples of unsuspecting motorists and their young child passengers with as little public intrusion as possible. Data collection methods incorporated minimal interaction with drivers and "quick" observation of restraint systems and CSS misuse characteristics by looking through the windows of vehicles. For collecting general CSS use data, this method was fine. However, for collecting CSS misuse data in order to provide a better picture of how protected child passengers are in vehicles, these unobtrusive methods are inadequate. To a large extent, most of these observation techniques provide only a limited picture of CSS misuse.

1.2 PROJECT OBJECTIVES AND SCOPE OF WORK

To address the patterns of CSS misuse and the means to accurately and efficiently collect this data, the following project objectives were developed:

1. Identify CSS misuse by type of misuse characteristic (e.g., seat direction, safety belt connection, use of locking clip, harness/shield attachments, harness retainer (chest) clip use, type of seat, and CSS make and type);

2. Examine the relationship of characteristics (personal, demographic) that distinguish CSS misusers from proper users of CSS;

3. Examine the problems associated with proper installation of CSSs and current vehicle occupant protection and restraint system improvements; and

4. Identify data collection methods and techniques which are accurate and efficient for optimizing the collection of CSS misuse data. Information on the best types of sites and the methods of soliciting target vehicles, conducting interviews with drivers, and making observations of CSS use/misuse and other restraint use in vehicles is included.

To reach the objectives of this project, the following tasks were performed:

1. Development of a detailed Work Plan;

2. Establishment of a study design, which included:
   - defining the study population;
   - identifying methods for accessing study population;
   - determining the sampling plan; and
   - identifying data to collect and the data collection procedures and analysis plan;

3. Implementation of a study design, which included :
   - preparing the interview/observation forms and other data collection material;
   - obtaining Office of Management and Budget (OMB) approval;
   - selecting observation sites;
   - recruiting field site coordinators and data collectors;
   - providing training to data collectors;
   - collecting CSS misuse and other relevant data; and
   - performing descriptive analysis of data; and

4. Preparation of the final report, which included submitting an outline, a draft final report/executive summary, and the final report/executive summary.

2.0 RESEARCH METHODOLOGY AND DATA COLLECTION

This section of the report identifies the research and data collection methodology used in meeting the project objectives. A description of the data collection forms, training, sites and personnel, the interview and observation procedures, and data preparation techniques are included.

2.1 RESEARCH METHODOLOGY

The research methodology focused on using a data collection plan that would obtain accurate CSS misuse data as well as the reasons for CSS misuse. The information to be collected included driver behavior, CSS design, and vehicle occupant protection system design. The research design called for a total sample of approximately 4,000 target vehicles (drivers with young children) in four geographic regions of the country (1,000 observations each region). This project did not intend to develop or use a sampling methodology that would ensure that the data collected were statistically representative of the nation's CSS misuse. However, it was intended that the study would provide NHTSA with a benchmark of the extent of the CSS misuse problem and develop techniques necessary to collect this data efficiently and accurately.

To address the primary issue of the extent of CSS misuse and the reasons for misuse, three categories of data were collected:

1. site and driver-reported demographic characteristics;

2. observed target child and driver/other occupant restraint use and CSS misuse characteristics; and

3. driver-reported behavioral characteristics relating to CSS acquisition and installation.

This information was collected by conducting interviews with drivers with young children in the vehicle and making observations of the restraint use and CSS misuse characteristics.

Data were collected at various sites (shopping centers/malls, fast-food restaurants, daycare centers, etc.) in four different states (Pennsylvania, Missouri, Mississippi, and Washington), which represented four regions of the nation (east, midwest, south, and west). Target vehicles were selected as the first available vehicle entering the site. After completion of the interview/observation, data collectors selected the next available vehicle.

Data collection used two-person teams. One data collector interacted with the driver, obtaining permission and asking interview questions, while the other member of the

team conducted the restraint use and CSS misuse observations inside the vehicle. Data was recorded on interview and observation forms. The number of teams varied by site. In most cases it was dependent on the size of the site and number of entrances. Data collectors were hired based on their experience in conducting survey research, familiarity with child development and CSSs, physical ability to perform field work, and a proper appearance and positive attitude about the project. Teams were comprised of males and females, but never two males. Interviewers were always female. Past experience found a higher probability of a driver being receptive to participate if the interviewer (person approaching the vehicle) was a female. Data collectors wore a photo identification badge (with the name of the participating community safety group), an orange safety vest, and carried a clipboard with a "Child Safety Survey" sign on the back.

Data was checked and verified in the field by the coordinators, as well as project management staff. Inconsistencies and mistakes on recording information were resolved with data collectors and brought to the attention of all project staff. Data entry began with an initial "keying" of the data; a second person verified the accuracy of the initial entry by comparing the forms and the input data displayed on the computer monitor.

Computer programs were written to perform descriptive analysis and cross-tabulations of the data, to summarize findings of CSS use and misuse rates, and to identify possible relationships among CSS misuse, driver behavior/demographics, and vehicle occupant protection systems.

To address the secondary issue of finding effective techniques to collect CSS misuse data, field coordinators and field site supervisors made observations, talked with data collectors, and recorded problems and identified effective data collection procedures for each type of site. Coordinators also noted the most productive methods for: obtaining permission to conduct CSS use/misuse observations at sites; recruiting data collectors; and training data collectors in the classroom and in the field.

2.2 DATA COLLECTION

The content of the data collection forms, training of field coordinators and data collectors, site selection and recruitment of field staff, procedures for data collection, and verification of recorded data are documented in this section.

Data Collection Forms

Interview and observation forms were developed with the intent of providing an efficient tool to collect the appropriate data in an accurate and timely manner. Data collection forms used in similar CSS use/misuse studies (e.g., Decina et al., 1994; Canada Market Research Ltd., 1992) provided a basis for the development of these forms.

The interview form consisted of 25 response boxes for recording:

- data collector identification;
- date and time information;
- site identification;
- driver demographic and traveling behavior;
- occupant restraint use and seating position;
- vehicle characteristics; and
- CSS acquisition and installation information.

The form was set up to record most of the interview responses by circling the appropriate data categories. Also, each interview form had a unique identification number. The form was 8½ by 14 inches (21.5 by 38 cm) and forms from each state were printed on a different color paper. A copy of the interview form is provided in Appendix A.

The observation form consisted of two sets of seven observation boxes for recording:

- (box 1) target child restraint use, seating position, and age/weight of each child;
- (box 2) type of vehicle restraint system, other vehicle seating characteristics, and position of safety belt latch plate;
- (box 3) infant seat correct/incorrect use elements and CSS make and type information;
- (box 4) convertible seat correct/incorrect use elements and CSS make and type information;
- (box 5) preschooler, booster seat correct/incorrect use elements and CSS make and type information;
- (box 6) lap belt use correct/incorrect use elements; and
- (box 7) shoulder belt correct/incorrect use elements.

Vehicle type and license plate number information were also provided in the bottom of the form. The form was set up to record information by circling the appropriate data categories. Also, each observation form had a unique identification number that corresponded with the interview form. Additional observation forms were used in cases where target vehicles had more than two target children. The observation form was the same size and color as the interview form and a copy is provided in Appendix B.

Training

Prior to the training of data collectors, a 3-day "train-the-trainer" workshop was held for the field site coordinators during the first week of August 1994 at a subcontractor's (Calspan) headquarters in Buffalo, New York. This site was selected because of the subcontractor's knowledge and experience in CSS compliance testing for crash dynamics and their in-house inventory of a large selection of CSSs. The workshop was attended by the contractor team, NHTSA contracting technical officer, field site coordinators from the four states, two national CSS experts and a member of NHTSA's "Blue Ribbon Panel," and the principal investigator of a recently completed Canadian CSS misuse study.

A workshop training manual was developed and disseminated at the workshop. The manual was developed from excerpts of past training manuals (Decina, et al., 1994; Canada Market Research Ltd., 1992), American Academy of Pediatrics material, NHTSA's *Child Passenger Safety Resource Manual* (1992), and discussions with the state coordinators and other child safety seat experts. The training manual was revised based on feedback from the workshop participants and the revised manual was used at each state's training sessions.

On Day One, the following workshop events took place: (1) an introductory session that explained the purpose and background of the study and workshop; (2) a CSS crash test demonstration using an accelerator sled; (3) a presentation of child development issues; and (4) a presentation and discussion of the appropriate CSS misuse data to collect for the study. (See Figure 2-1.)

CSS misuse characteristics and the criteria for misuse were identified during the first phase of training by the project team and CSS experts that attended the workshop. The SAE Children's Restraint Systems Task Force also reviewed the misuse criteria. It is important to note that the selection of misuse criteria was not weighted by criticality of the misuse characteristic in terms of severity of possible injuries associated with that misuse type, but based on the key misuse characteristics that are commonly reported and that can be identified through the observation methods used for the study.

Day Two events included: (1) a presentation of actual CSS misuse case studies; (2) a presentation and discussion of what should be included on the data-collection forms; (3) a discussion of the most appropriate techniques and procedures to use for

The following CSS proper use characteristics were defined for use in data collection and analysis:

- **Seat* direction.** Proper use was defined as children under 20 pounds (9 kilograms) facing rearward and children 20 pounds and over (9 kilograms and over) facing forward.** In addition, infant seats cannot be placed in the front passenger seat of vehicles with a passenger-side airbag.

- **Vehicle safety belt use.** Proper use was defined as the vehicle safety belt correctly routed through the CSS and attached to vehicle safety belt's latchplate and belt not severely twisted (not more than one twist). The vehicle safety belt needed to be fairly tight, with no visible slack, so that the CSS is not loose.*** In addition, a CSS placed in a seat with a forward-anchored belt, not at the bight (crease where the upper and lower cushions of the vehicle seat meet) was considered a misuse.

- **Locking clip use.** A locking clip must be properly used (within 6 inches or 15 cm from latchplate) on all vehicle safety belts that have a sliding latchplate.++

- **Harness+ connection.** Proper use was defined as the harness buckle buckled to the crotchplate.

- **Harness strap+ use.** Proper use includes using the harness strap with no misrouting (e.g., under child's arm), straps in the correct seat slots behind the child's shoulders, and straps not severely loose or twisted.

- **Harness retainer (chest) clip+ use.** Proper use was defined as use of a chest clip on the harness straps with the proper attachment (if needed by the CSS make) and chest clip properly positioned (at the armpit level of the child).+++

* CSS recalls were not checked in this study.

** Age categories (e.g., children under one year of age should be facing rearward) were not used in measures for determining CSS misuse.

*** Data collectors were not allowed to remove children from CSSs to determine various degrees of CSS looseness.

\+ Defective/broken CSS elements were included under each specific misuse characteristics.

++ Newer vehicle restraint systems with an "engaged" adjustable locking shoulder belt were also checked. (This replaces need for locking clip.) Distinctions with heavy-duty locking clip were made during field observations.

+++CSS manufacturers and model types were checked to confirm the necessity of the chest clip.

Figure 2-1. Child Safety Seat Misuse Definitions for Study

data collection; (4) a hands-on demonstration of CSSs; and (5) practice data collection at the workshop facility. On the last day, pilot testing of the data-collection procedures was conducted at a shopping center. Data collection was conducted for approximately 25 target vehicles. The day concluded with a discussion of what was learned during the data collection and revisions were made to the data-collection procedures, forms, and training manual.

Training for data collectors was held in each state by the field coordinators who attended the "train-the-trainer" workshop. The field coordinators were supplied with training manuals, a large selection of CSSs which represented each type of seat, and practice data-collection forms. The field coordinators were responsible for finding a facility to train the crew and a location to conduct practice and live data collection.

The training manual used for classroom instruction included the following:

- a directory of appropriate contacts for the project, project background, and project objectives;
- the training schedule, child development issues, and seat types;
- age and weight issues;
- CSS use and misuse characteristics;
- CSS manufacturer and make and type lists; and
- data collection procedures and observation and interview forms.

Classroom instruction highlighted the content of the training manual and provided extensive demonstration of CSS use and misuse with a variety of seats. Demonstrations were provided of the variety of safety belt systems, including use and misuse with CSSs. Comprehensive training on data-collection procedures, and use of the interview and observation forms was provided. Instruction also included personal appearance and expected professional behavior for interacting with the public. Field crew were instructed on the logistic issues of the daily routines, performing daily clerical chores, maintaining adequate supplies, and recording daily summary information.

Classroom instruction lasted 3 days, with the last day including practice data collection in the facility's parking lot. Two more days of practice data collection, interspersed with actual data collection, rounded out the first week of training. The second week was a full week of actual data collection under close supervision of the field coordinators, with further instruction provided as needed. Figure 2-2 illustrates training activities at one of the training sites.

Figure 2-2. Training Activities at the Missouri Training Site

Sites and Personnel

Sites and field personnel were selected by the state field coordinators. Site selection was based on several criteria identified at the "train-the-trainer" workshop and discussions with NHTSA. Suggestions on recruiting of appropriate field personnel were given to the state field coordinators, based on past field study experience.

Site Selection/Characteristics

Sites were selected based on the following criteria: a large volume of the target group visiting the site; a limited number of entrances to facilitate recruiting target vehicles; adequate visibility and space for safely conducting the interviews and observations; and permission from the proprietor or shopping center manager to conduct data collection. Sites were also selected in suburban areas. Each state field coordinator was asked to find a variety of sites to use for the study. They could include: community shopping centers; malls; amusement parks or zoos; playgrounds or parks; fast-food restaurants; hospitals or pediatric centers; daycare centers or schools;

and any other type of site, which met the site selection criteria. Figure 2-3 illustrates the field site locations.

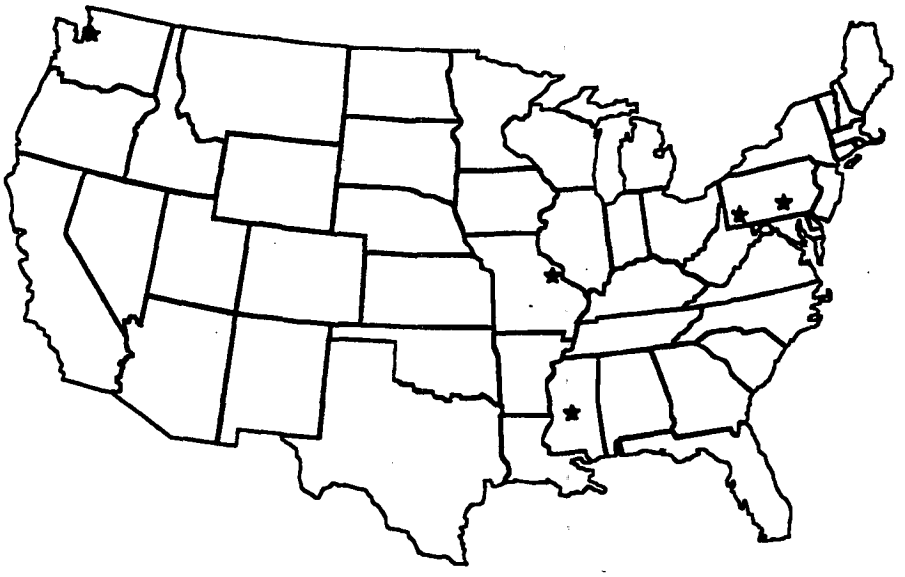


Figure 2-3. Field Site Locations

In Mississippi, eight sites were used for the study. These sites were located in Clinton and Jackson in Hinds County and Ridgeland in Madison County, which are located in the south-central part of the state. (See Appendix C, Table C-1.) A selection of socio-economic characteristics for the two counties and three municipalities where the sites were located is identified in Appendix C, Table C-2.

In Missouri, three sites were used for the study. All of the sites were located in St. Peters City in Saint Charles County, which is in central eastern Missouri, just west of St. Louis (western side of the Mississippi River). (See Appendix C, Table C-3.) A selection of socio-economic characteristics for St. Charles County, St. Peters City, and the area immediately surrounding the three sites is identified in Appendix C, Table C-4.

In Pennsylvania, 13 sites were used in the study. Two-thirds of the data were collected in central Pennsylvania. These sites were located in Lemoyne, Camp Hill, Lisburn, and Boiling Springs in Cumberland County (western side of the Susquehanna River) and Harrisburg in Dauphin County (eastern side of the Susquehanna River). The remaining data were collected in southwestern Pennsylvania. All of these sites were located in Washington County, which is southwest of Pittsburgh. (See Appendix C, Table C-5.) A selection of socio-economic characteristics of the counties and municipalities where the Pennsylvania data were collected is identified in Appendix C, Table C-6.

In Washington, 10 sites were used for the study. The sites were located in Seattle, Kirkland, Tukwila, Federal Way, Bellevue, and Factoria--all of which are in the

greater Seattle area in King County, which is in the northwestern part of the state. (See Appendix C, Table C-7.) A selection of the socio-economic characteristics of King County and the municipalities where the sites were located is identified in Appendix C, Table C-8.

All four states participating in the study have similar child restraint and safety belt laws. Three of the four states require children up to 4 years of age to be in a CSS. Washington requires children up to 3 years of age to be in a CSS. All four states require young children over 4 years of age (over 3 years of age in Washington) to be in safety belts. However, only Washington requires safety belt use in the back seats, as well as the front seats. Table 2-1 identifies the child restraint and safety belt laws of the four states.

Table 2-1. Occupant Restraint Laws of Project States (IIHS, 1995)

Child Restraint Laws

State	Who Is Responsible	Covers Children Up to What Age?	May Substitute Adult Safety Belt?	Max. Fine 1st Offense
Mississippi	driver	4 yrs.	no	$25
Missouri	driver	4 yrs.	all children in rear seat	$25
Pennsylvania	driver	4 yrs.	no	$25
Washington	driver	10 yrs.	3-10 yrs.	$47

Safety Belt Use Laws

State	Type of Enforcement	Driver Responsibility for Others By Age and Seating Position	Max. Fine 1st Offense
Mississippi	secondary	all ages*	$25
Missouri	secondary	4-16 yrs. in front seat	$10
Pennsylvania	secondary	4-18 yrs. in front seat	$10
Washington	secondary	15 yrs. & younger in all seats	$47

* Kay Brodbeck (Mississippi Safety Services), personal communication, December 9, 1995.

State Field Coordinators and Data Collectors

State field coordinators were recruited early in the study. Upon identification of the four states in which data would be collected, letters were sent to community and highway safety groups requesting cooperation in assisting with state coordination of the data collection effort. Telephone interviews were then conducted with candidate groups. The selected groups and coordinators were:

- Mississippi Safety Services (Jackson, Mississippi), Cynthia Huff and Kay Brodbeck;

- Safety Council of Greater St. Louis (Missouri), Jerald Miller;

- Juli McGreevy (Pennsylvania consultant), assisted by the Pennsylvania Traffic Injury Prevention Project (Bryn Mawr and Pittsburgh, Pennsylvania), Kathy Strotmeyer and Lorrie Walker; Washington County, Pennsylvania Regional Comprehensive Highway Safety Program, Terri Anthony; and South Central Pennsylvania Highway Safety Program, Sherry Miller and Linda Doty; and
- Washington Safety Restraint Coalition (Seattle, Washington), Kathryn Kruger.

Recruiting data collectors was the responsibility of the coordinators. As needed, they placed ads in local papers, highway safety bulletins, and college newspapers. Candidates were interviewed by telephone and in person. They were briefed on what was expected from them during the 2-month data-collection period. Candidates were selected based on past experience in survey administration and child development fields, availability of time, and personal conduct and appearance during the interview. Each state coordinator recruited 16 to 20 individuals for data collection.

Interview/Observation Procedures

Data was collected in teams of two, an interviewer and an observer. The interviewer's responsibilities included: identifying the candidate target vehicle entering the site; stopping the driver and asking for permission to a conduct a child safety survey; directing the driver to pull the vehicle to a designated safety zone; introducing the observer; informing the driver of what to expect during the "safety check" (such as stating that the observer will be entering the vehicle to check child restraints); and conducting the interview with driver. The observer's responsibilities included performing the observational tasks necessary to record restraint and CSS use and misuse elements.

The following procedures were used to collect CSS use and misuse data in the field:

1. Select a target vehicle entering the site and approach the driver;

2. Identify oneself and partner, briefly explain the purpose, and request permission to conduct interview and observations;

3. Upon positive response from driver, direct the driver to the designated safety zone;

4. Interviewer asks interview form questions in the order specified during training; observer enters vehicle and conducts observations of occupant restraint use and target children restraint/CSS use and misuse;

5. Upon completion of survey, thank the driver;

6. Interviewer and observer review collected data and verify what was recorded; and

7. Team moves back into position to wait for next candidate target vehicle.

Each site had a field supervisor responsible for overseeing the field operation whose duties included: collecting data; observing techniques used by data collectors; supplying coding forms; collecting the data; assisting with time sheets and work scheduling; tallying daily and weekly summaries of data; and communicating with field coordinators. Field supervisors were at the sites daily. Following the two weeks of training, state coordinators conducted weekly visits to the sites.

Data were sent to the contractor on a weekly basis. The data were checked for consistency, missing data, incorrect coding patterns, and other miscellaneous items. Upon completion of the review, data were sent to data-entry staff, who were trained on what to expect in terms of recorded data. They were also briefed on CSS use and misuse elements. Each data collection form was entered once and then verified by another data-entry staff member. Thus each form was double-checked for accuracy.

3.0 RESULTS AND ANALYSIS

This chapter presents: sample size characteristics; driver behavior issues; driver/other occupant restraint use; and child restraint use/misuse observations and correlation with driver variables.

3.1 SAMPLE SIZE CHARACTERISTICS

A total of 4,019 vehicles (drivers), 5,869 target children under the weight of 60 pounds (27 kg), and 2,223 other vehicle occupants were involved in the study. Table 3-1 identifies this sample size by the four states in the study.

Table 3-1. Study Sample Size

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
Number Vehicles/ Drivers	580	1,012	1,207	1,220	4,019
Number Target Children Under 60 Pounds (27 kg)	758	1,534	1,846	1,731	5,869
Number Other Vehicle Occupants	560	460	553	650	2,223
Total Participants	1,898	3,006	3,606	3,601	12,111

It should be noted that all the remaining tables in this report exclude those observations with unknown or missing data, so the total vehicle/target child counts may differ for each table from the totals presented above.

Driver

The drivers were mostly under age 40 (82%), female (77%), the parent of the target child (87%), and usually the mother (68%). Only 3% of the drivers were a friend or other non-relative. As shown in Table 3-2, this pattern is similar across all four states.

Table 3-2. Driver Characteristics - Sample Size and (Percent of Total)

	STATE				
	Mississippi	Missouri	Pennsylvania	Washington	Total
Driver Gender					
Male	198 (34.5%)	140 (13.9%)	284 (23.6%)	299 (24.6%)	921 (23.0%)
Female	376 (65.5%)	869 (86.1%)	918 (76.4%)	917 (75.4%)	3,080 (77.0%)
TOTAL	**574 (100%)**	**1,009 (100%)**	**1,202 (100%)**	**1,216 (100%)**	**4,001 (100%)**
Driver Age					
<30 Years Old	220 (38.3%)	239 (24.3%)	299 (25.1%)	308 (25.5%)	1,066 (26.9%)
30-39	255 (44.3%)	603 (61.3%)	636 (53.5%)	676 (55.9%)	2,170 (54.8%)
40-49	68 (11.8%)	100 (10.2%)	161 (13.5%)	164 (13.6%)	493 (12.5%)
50+ Years Old	32 (5.6%)	42 (4.3%)	93 (7.8%)	61 (5.0%)	228 (5.8%)
TOTAL	**575 (100%)**	**984 (100%)**	**1,189 (100%)**	**1,209 (100%)**	**3,957 (100%)**
Driver Relationship to Child					
Mother	302 (52.8%)	798 (79.6%)	760 (64.0%)	817 (68.0%)	2,677 (67.5%)
Father	165 (28.8%)	124 (12.4%)	236 (19.9%)	264 (22.0%)	789 (19.9%)
Grandmother	28 (4.9%)	46 (4.6%)	86 (7.2%)	55 (4.6%)	215 (5.4%)
Grandfather	12 (2.1%)	10 (1.0%)	28 (2.4%)	13 (1.1%)	63 (1.6%)
Friend	15 (2.6%)	1 (0.1%)	25 (2.1%)	21 (1.7%)	62 (1.6%)
Relative	42 (7.3%)	16 (1.6%)	27 (2.3%)	17 (1.4%)	102 (2.6%)
Other	8 (1.4%)	7 (0.7%)	26 (2.2%)	14 (1.2%)	55 (1.4%)
TOTAL	**572 (100%)**	**1,002 (100%)**	**1,188 (100%)**	**1,201 (100%)**	**3,963 (100%)**

Target Children

The study results are presented for the following three groups of target children:

Target Group	Description
Infant -	children under 20 pounds (under 9 kg)
Toddler -	children 20 to 40 pounds (9 to 18 kg)
Pre-schooler -	children 40 to 60 pounds (18 to 27 kg)

Children over 60 pounds were grouped with other occupants for reporting purposes.

The total number of target children (by weight) included: 559 from birth to 20 pounds (up to 9 kg), 3,419 from 20 to 40 pounds (9 to 18 kg), and 1,871 from 40 to 60 pounds (18 to 27 kg). Over 95% of the drivers gave the interviewers the estimate of the target children's weight. Data collectors estimated the child's weight for the remaining observations. Target children fell into the following age ranges: infant (birth to 1 year) (12.0%); toddler (1 to 4 years) (53.4%); and pre-schooler (over 4 years) (34.6%). Table 3-3 presents this weight and age information for each state.

Table 3-3. Target Children Characteristics - Sample Size and (Percent of Total) (up to 60 pounds or 27 kg)

	STATE				
	Mississippi	Missouri	Pennsylvania	Washington	Total
Target Child Weight					
Under 20 lbs (9 kg)	52 (6.9%)	137 (8.9%)	169 (9.2%)	201 (11.7%)	559 (9.6%)
20 to 40 lbs (9 to 18 kg)	430 (56.9%)	913 (59.6%)	1,045 (56.9%)	1,031 (59.8%)	3,419 (58.5%)
40 to 60 lbs (18 to 27 kg)	274 (36.2%)	483 (31.5%)	622 (33.9%)	492 (28.5%)	1,871 (32.0%)
TOTAL	**756 (100%)**	**1,533 (100%)**	**1,836 (100%)**	**1,724 (100%)**	**5,849 (100%)**
Target Child Age					
Under 1 year old	69 (9.1%)	182 (11.9%)	200 (10.8%)	253 (14.6%)	704 (12.0%)
1 to 4 years old	437 (57.7%)	792 (51.7%)	975 (52.9%)	929 (53.7%)	3,133 (53.4%)
Over 4 years old	252 (33.2%)	559 (36.5%)	669 (36.3%)	547 (31.6%)	2,027 (34.6%)
TOTAL	**758 (100%)**	**1,533 (100%)**	**1,844 (100%)**	**1,729 (100%)**	**5,864 (100%)**

The four seating positions most frequently observed for target children were as follows: front seat-passenger side (28.5%); middle seat-passenger side (24.1%);

middle seat-driver side (21.7%); and middle seat-middle position (18.6%). Table 3-4 identifies the seating positions of the target children by state.

Table 3-4. Seat Position of Target Children - Sample Size and (Percent of Total) (up to 60 lbs or 27 kg)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
Front					
Middle	54 (7.2%)	30 (2.0%)	22 (1.2%)	25 (1.4%)	131 (2.2%)
Passenger side	255 (33.8%)	424 (27.7%)	476 (25.9%)	508 (29.4%)	1,663 (28.5%)
Middle					
Driver side	127 (16.8%)	333 (21.8%)	425 (23.1%)	384 (22.3%)	1,269 (21.7%)
Middle	157 (20.8%)	292 (19.1%)	330 (18.0%)	307 (17.8%)	1,086 (18.6%)
Passenger side	141 (18.7%)	360 (23.5%)	461 (25.1%)	446 (25.9%)	1,408 (24.1%)
Back*					
Driver side	6 (0.8%)	28 (1.8%)	30 (1.6%)	21 (1.2%)	85 (1.5%)
Middle	2 (0.3%)	20 (1.3%)	34 (1.9%)	17 (1.0%)	73 (1.2%)
Passenger side	5 (0.7%)	42 (2.7%)	53 (2.9%)	16 (0.9%)	116 (2.0%)
Cargo	5 (0.7%)	--	6 (0.3%)	1 (0.1%)	12 (0.2%)
Total	**752 (100%)**	**1,529 (100%)**	**1,837 (100%)**	**1,725 (100%)**	**5,843 (100%)**

* Back is defined as the third row of seats in mini-vans, station wagons, and other vehicles with this seating arrangement.

Residence

Most of the drivers were within a 15-mile (24-kilometer) distance (92.5%) and 30-minute ride (95.8%) from their last stop. This indicates that most of the target population used in the study were local residents. Table 3-5 provides information on residence characteristics for state of residence and travel distance and time from last stop to observation/interview site. Figure 3-1 illustrates the residence of the drivers. (In the figure, the dots represent zip code residence of drivers interviewed.)

Table 3-5. Driver Residence Characteristics - Sample Size and (Percent of Total)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
In-State/Out-of-State Vehicle					
In-State	523 (90.2%)	975 (96.3%)	1,180 (97.8%)	1,182 (96.9%)	3,860 (96.0%)
Out-of-State	57 (9.8%)	37 (3.7%)	27 (2.2%)	38 (3.1%)	159 (4.0%)
TOTAL	**580 (100%)**	**1,012 (100%)**	**1,207 (100%)**	**1,220 (100%)**	**4,019 (100%)**
Distance Since Last Stop (Miles)					
< 1 mile (1.6 km)	75 (13.2%)	372 (37.4%)	153 (13.0%)	292 (24.1%)	892 (22.6%)
1-5 miles (1.6-8 km)	212 (37.4%)	353 (35.5%)	592 (50.3%)	480 (39.6%)	1,637 (41.4%)
5-15 miles (8-24 km)	200 (35.3%)	189 (19.0%)	378 (32.1%)	361 (29.8%)	1,128 (28.5%)
>15 miles (24 km)	80 (14.1%)	81 (8.1%)	55 (4.7%)	80 (6.6%)	296 (7.5%)
TOTAL	**567 (100%)**	**995 (100%)**	**1,178 (100%)**	**1,213 (100%)**	**3,953 (100%)**
Time Since Last Stop (Minutes)					
<10 minutes	352 (62.5%)	729 (73.9%)	726 (61.7%)	771 (63.9%)	2,578 (65.5%)
10-30 minutes	161 (28.6%)	207 (21.0%)	426 (36.2%)	396 (32.8%)	1,190 (30.2%)
30-60 minutes	30 (5.3%)	44 (4.5%)	23 (2.0%)	36 (3.0%)	133 (3.4%)
>60 minutes	20 (3.6%)	7 (0.7%)	2 (0.2%)	4 (0.3%)	33 (0.8%)
TOTAL	**563 (100%)**	**987 (100%)**	**1,177 (100%)**	**1,207 (100%)**	**3,934 (100%)**

Vehicle Characteristics

The vehicle driven by the study participants was primarily a sedan/coupe (53.2%) or passenger/mini-van (21.0%) as shown in Table 3-6. In addition, 35.4% of the vehicles had driver-side airbags, 13.5% of the vehicles had passenger-side airbags, and 1.0% of the vehicles had built-in child safety seats. Table 3-7 contains information on the occupant protection systems by state.

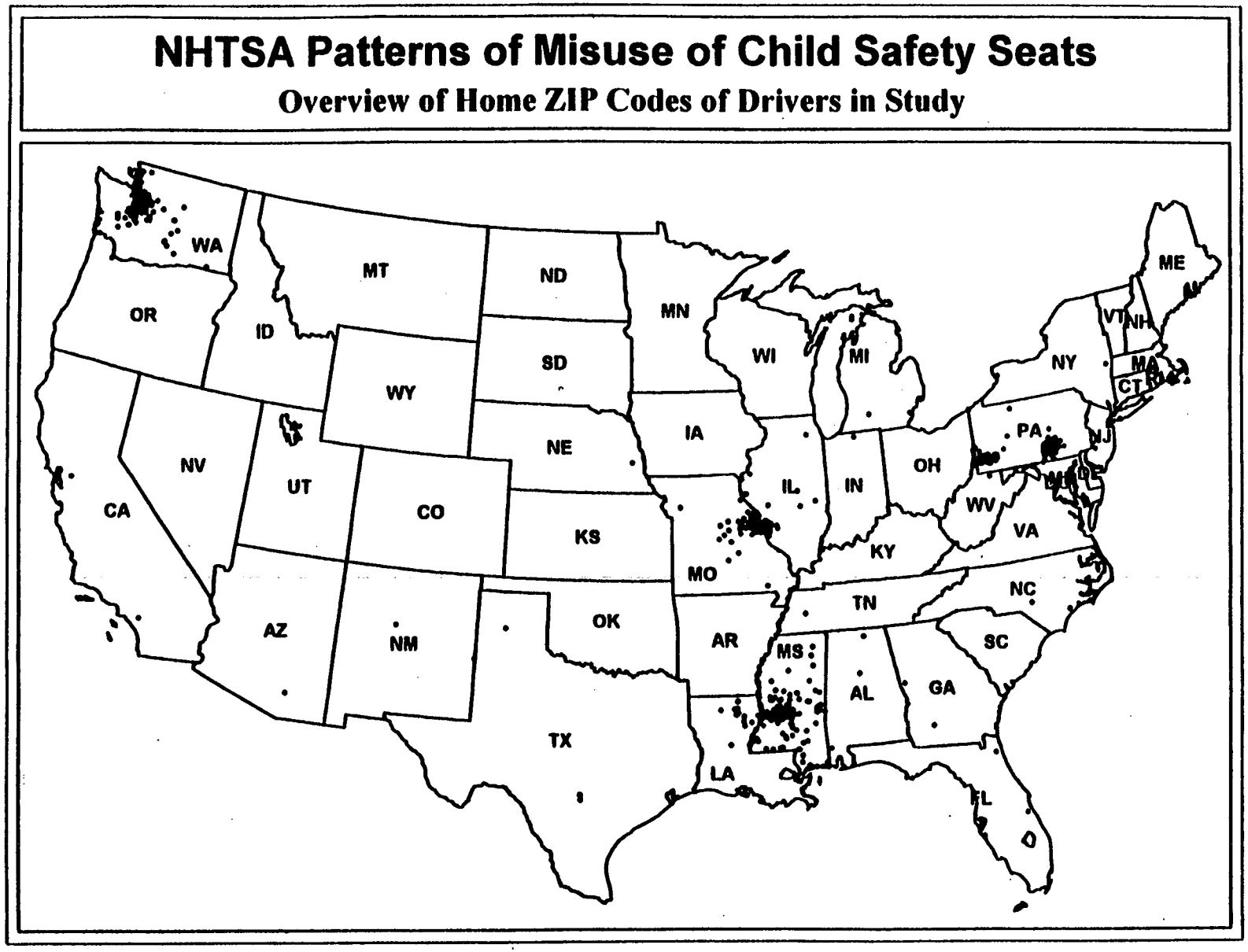


Figure 3-1. Overview of Home ZIP Codes of Drivers in Study

Table 3-6. Vehicle Characteristics - Sample Size and (Percent of Total)

	STATE				Total
	Mississippi	Missouri	Pennsylvania	Washington	
Vehicle Type					
Sedan/Coupe	385 (70.6%)	502 (50.6%)	625 (53.0%)	561 (47.5%)	2,073 (53.2%)
Hatchback	14 (2.6%)	19 (1.9%)	68 (5.8%)	45 (3.8%)	146 (3.7%)
Station Wagon	11 (2.0%)	56 (5.6%)	96 (8.1%)	130 (11.0%)	293 (7.5%)
Sports Vehicle	10 (1.8%)	22 (2.2%)	32 (2.7%)	8 (0.7%)	72 (1.8%)
Passenger/Mini-Van	49 (9.0%)	283 (28.5%)	248 (21.0%)	239 (20.2%)	819 (21.0%)
Jeep/4x4/Utility Vehicle	25 (4.6%)	70 (7.0%)	69 (5.8%)	151 (12.8%)	315 (8.1%)
Pick-up Truck	51 (9.4%)	41 (4.1%)	42 (3.6%)	45 (3.8%)	179 (4.6%)
Other	--	--	--	3 (0.3%)	3 (0.1%)
TOTAL	**545 (100%)**	**993 (100%)**	**1,180 (100%)**	**1,182 (100%)**	**3,900 (100%)**

Table 3-7. Vehicle Occupant Protection Systems - Sample Size and (Percent of Total)

	STATE				Total
	Mississippi	Missouri	Pennsylvania	Washington	
With Air Bag					
Driver	187 (32.2%)	399 (39.4%)	455 (37.7%)	383 (31.4%)	1,424 (35.4%)
Passenger	81 (14.0%)	137 (13.5%)	197 (16.3%)	129 (10.6%)	544 (13.5%)
No Air Bag System	393 (67.8%)	613 (60.6%)	752 (62.3%)	837 (68.6%)	2,595 (64.6%)
Built-in CSS	5 (0.9%)	11 (1.1%)	20 (1.7%)	4 (0.3%)	40 (1.0%)
TOTAL	**580 (100%)**	**1,012 (100%)**	**1,207 (100%)**	**1,220 (100%)**	**4,019 (100%)**

3.2 DRIVER BEHAVIOR ISSUES

How Often Vehicle is Regularly Driven

The majority of drivers (90.8%) reported that the vehicle they were driving is the one they regularly drive. Table 3-8 presents this data by state.

Table 3-8. Regular Use of Vehicle Observed - Sample Size and (Percent of Total)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
Regular vehicle driven	511 (88.6%)	921 (91.5%)	1,098 (92.3%)	1,087 (89.7%)	3,617 (90.8%)
Not regular vehicle driven	66 (11.4%)	86 (8.5%)	91 (7.7%)	125 (10.3%)	368 (9.2%)
TOTAL	**577 (100%)**	**1,007 (100%)**	**1,189 (100%)**	**1,212 (100%)**	**3,985 (100%)**

Child Safety Seat Removal From Vehicle

It was reported by about 60% of the drivers of vehicles with CSSs installed that they infrequently or never remove the CSS from the vehicle. About 23% of the drivers said that they frequently remove the CSS. Table 3-9 identifies the data by state.

Table 3-9. Frequency of Child Safety Seat Removal From Vehicle - Sample Size and (Percent of Total)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
Frequently	51 (29.0%)	135 (20.6%)	183 (23.5%)	187 (22.6%)	556 (22.8%)
Sometimes	32 (18.2%)	90 (13.7%)	171 (21.9%)	141 (17.0%)	434 (17.8%)
Infrequently	39 (22.2%)	170 (26.0%)	239 (30.6%)	283 (34.1%)	731 (30.0%)
Never	54 (30.7%)	260 (39.7%)	187 (24.0%)	218 (26.3%)	719 (29.5%)
TOTAL	**176 (100%)**	**655 (100%)**	**780 (100%)**	**829 (100%)**	**2,440 (100%)**

Child Safety Seat Acquisition, Installation, and Child Placement

The majority of drivers (84.3%) stated that they acquired new CSSs either by purchase or gift. Table 3-10 shows the results by state for those vehicles with CSSs.

Table 3-10. Acquisition of Child Safety Seats - Sample Size and (Percent of Total)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
Purchased New	140 (72.9%)	552 (70.9%)	600 (64.9%)	737 (73.4%)	2.029 (70.0%)
Purchased Used	11 (5.7%)	37 (4.7%)	112 (12.1%)	64 (6.4%)	224 (7.7%)
Gift/New	23 (12.0%)	136 (17.5%)	140 (15.1%)	116 (11.6%)	415 (14.3%)
Loaner Program	3 (1.6%)	4 (0.5%)	2 (0.2%)	6 (0.6%)	15 (0.5%)
Other	15 (7.8%)	50 (6.4%)	71 (7.7%)	81 (8.1%)	217 (7.5%)
TOTAL	**192 (100%)**	**779 (100%)**	**925 (100%)**	**1,004 (100%)**	**2,900 (100%)**

The majority of drivers (93.9%) reported that they (77.4%) or a spouse (16.5%) installed the CSS in the vehicle driven that day to the site. In addition, the majority of drivers (84.7%) reported that they put the child in the CSS that day. However, 15.3% of the drivers reported that someone else (such as a spouse or relative) placed the child in the CSS of the vehicle. Table 3-11 reports this information by state for those vehicles with CSSs.

Table 3-11. Installation of Child Safety Seat/Placement of Child in Child Safety Seat - Sample Size and (Percent of Total)

	STATE				Total
	Mississippi	Missouri	Pennsylvania	Washington	
Who Installed the CSS?					
Self	145 (74.7%)	649 (84.2%)	632 (68.3%)	818 (80.9%)	2,224 (77.4%)
Spouse	30 (15.5%)	95 (12.3%)	197 (21.3%)	156 (15.4%)	478 (16.5%)
Relative	3 (1.5%)	10 (1.3%)	48 (5.2%)	12 (1.2%)	73 (2.5%)
Friend	1 (0.5%)	1 (0.1%)	12 (1.3%)	7 (0.7%)	21 (0.7%)
Other	15 (7.7%)	16 (2 .1%)	36 (3.9%)	18 (1.8%)	85 (2.9%)
TOTAL	**194 (100%)**	**771 (100%)**	**925 (100%)**	**1,011 (100%)**	**2,901 (100%)**
Who Put the Child in CSS?					
Self	140 (73.3%)	693 (91.4%)	751 (81.5%)	847 (84.7%)	2,431 (84.7%)
Spouse	25 (13.1%)	22 (2.9%)	72 (7.8%)	75 (7.5%)	194 (6.8%)
Relative	7 (3.7%)	20 (2.6%)	46 (5.0%)	22 (2.2%)	95 (3.3%)
Friend	2 (1.0%)	2 (0.3%)	19 (2.1%)	9 (0.9%)	32 (1.1%)
Other	17 (8.9%)	21 (2.8%)	34 (3.7%)	47 (4.7%)	119 (4.1%)
TOTAL	**191 (100%)**	**758 (100%)**	**922 (100%)**	**1,000 (100%)**	**2,871 (100%)**

Knowledge of Child Safety Seat Installation and Child Placement

The drivers of vehicles with children in CSSs were also asked how they learned to install the CSS in the vehicle and how they learned to put the child in the CSS. About 71% of the drivers reported that they learned how to install the CSS in the vehicle by reading the instructions in/on the box or on the actual CSS. About 17% of the drivers reported that they learned on their own. Very few drivers (0.7%) said they read the vehicle owner's manual.

In addition, only 54.3% of the drivers reported that they learned how to put the child in the CSS by reading the instructions in/on the box or on the side of the CSS. A surprising 33.1% of the drivers reported that they learned how to put the child in the

seat on their own without using instructions. Table 3-12 presents the above knowledge results by state for those vehicles with CSSs.

Table 3-12. Knowledge of Installation of Child Safety Seat/ Placement of Child(ren) in Child Safety Seat - Sample Size and (Percent of Total)

	STATE				Total
	Mississippi	Missouri	Pennsylvania	Washington	
How Learned to Install CSS					
Read instructions in/on box	104 (56.5%)	427 (58.9%)	427 (55.8%)	553 (58.8%)	1,511 (57.8%)
Read instructions on side of CSS	5 (2.7%)	88 (12.1%)	105 (13.7%)	153 (16.3%)	351 (13.4%)
Someone demonstrated CSS installation	11 (6.0%)	51 (7.0%)	79 (10.3%)	58 (6.2%)	199 (7.6%)
Learned on own	52 (28.3%)	127 (17.5%)	134 (17.5%)	134 (14.2%)	447 (17.1%)
Vehicle owner's manual	1 (0.5%)	4 (0.6%)	3 (0.4%)	11 (1.2%)	19 (0.7%)
Other	11 (6.0%)	28 (3.9%)	17 (2.2%)	32 (3.4%)	88 (3.4%)
TOTAL	**184 (100%)**	**725 (100%)**	**765 (100%)**	**941 (100%)**	**2,615 (100%)**
How Learned to Put Child(ren) in CSS					
Read instructions in/on box	76 (40.2%)	388 (52.8%)	343 (40.1%)	442 (47.9%)	1,249 (46.2%)
Read instructions on side of CSS	1 (0.5%)	36 (4.9%)	105 (12.3%)	76 (8.2%)	218 (8.1%)
Someone demonstrated CSS installation	13 (6.9%)	53 (7.2%)	118 (13.8%)	74 (8.0%)	258 (9.5%)
Learned on own	89 (47.1)	235 (32.0%)	267 (31.2%)	303 (32.8%)	894 (33.1%)
Vehicle owner's manual	1 (0.5%)	3 (0.4%)	7 (0.8%)	4 (0.4%)	15 (0.6%)
Other	9 (4.8%)	20 (2.7%)	16 (1.9%)	24 (2.6%)	69 (2.6%)
TOTAL	**189 (100%)**	**735 (100%)**	**856 (100%)**	**923 (100%)**	**2,703 (100%)**

3.3 DRIVER/OTHER OCCUPANT RESTRAINT USE

Overall driver safety belt use was 81.6%. Excluding Mississippi drivers, who showed much lower usage, safety belt use for the combined three states of Missouri, Pennsylvania, and Washington was 86.4%. For non-target group occupants (other

than the driver), the overall safety belt use was 69.7%. Excluding the Mississippi sample, the same group's safety belt use was 80.2%. (Safety belt laws in all four states are very similar and all involve secondary enforcement.) In addition, there was little variability (less than 10% from the state average) among safety belt use across the larger sample size sites in all states except Mississippi, where the sites differed by less than 15% from the state average.

Overall restraint use by target children under 60 pounds (27 kg) in all four states combined was as follows:

- 50.6% in a CSS (infant seat, convertible seat, or booster seat);
- 36.6% in a safety belt; and
- 12.8% not restrained.

Excluding the Mississippi sample, the restraint use by target children in the other three states was: 54.0% in a CSS; 38.3% in a safety belt; and 7.7% not restrained. Table 3-13 identifies the restraint use by the three groups (driver, target children, and all other occupants) by state.

Table 3-13. Driver, Occupant, and Target Child Restraint Use - Sample Size and (Percent of Total)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
Driver Restraint Use					
No	267 (46.3%)	161 (17.0%)	224 (18.8%)	67 (5.6%)	719 (18.4%)
Yes	310 (53.7%)	788 (83.0%)	965 (81.2%)	1,123 (94.4%)	3,186 (81.6%)
TOTAL	**577 (100%)**	**949 (100%)**	**1,189 (100%)**	**1,190 (100%)**	**3,905 (100%)**
Other Occupant Restraint Use					
No	272 (61.1%)	77 (22.4%)	114 (27.1%)	66 (12.3%)	529 (30.3%)
Yes	173 (38.9%)	267 (77.6%)	306 (72.9%)	471 (87.7%)	1,217 (69.7%)
TOTAL	**445 (100%)**	**344 (100%)**	**420 (100%)**	**537 (100%)**	**1,746 (100%)**
Target Child Restraint Use					
Restrained in CSS	204 (26.9%)	789 (51.4%)	946 (51.3%)	1,026 (59.3%)	2,965 (50.6%)
Restrained in Safety Belt*	193 (25.5%)	642 (41.9%)	711 (38.6%)	602 (34.8%)	2,148 (36.6%)
Not Restrained	361 (47.6%)	103 (6.7%)	186 (10.1%)	102 (5.9%)	752 (12.8%)
TOTAL	**758 (100%)**	**1,534 (100%)**	**1,843 (100%)**	**1,730 (100%)**	**5,865 (100%)**

* Note, safety belts are not providing the most optimum protection for these children.

For the 2,965 target children who were secured in a CSS, over 61% were observed in convertible seats. The remainder were approximately evenly split between infant seats (17.3%) and booster seats (21.3%). Infant seat use was slightly higher in Pennsylvania (21.8%); booster seat use was highest in Missouri (28.1%). Table 3-14 presents the distribution of CSS use by state among the three types of CSSs.

Table 3-14. Child Safety Seat Use - Sample Size and (Percent of Total)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
Child Safety Seat Type					
Infant Seat	31 (15.2%)	107 (13.6%)	206 (21.8%)	170 (16.5%)	514 (17.3%)
Convertible Seat	132 (64.7%)	460 (58.3%)	582 (61.5%)	645 (62.9%)	1,819 (61.4%)
Booster Seat	41 (20.1%)	222 (28.1%)	158 (16.7%)	211 (20.6%)	632 (21.3%)
TOTAL	**204 (100%)**	**789 (100%)**	**946 (100%)**	**1,026 (100%)**	**2,965 (100%)**

Figure 3-2 presents a graphical representation of the distribution of restraint use for all target children:

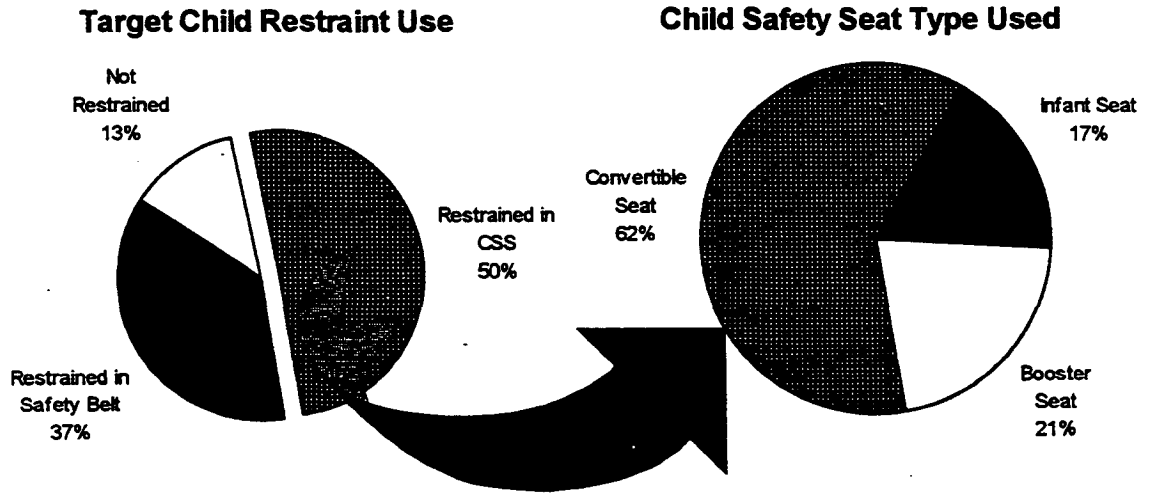


Figure 3-2. Distribution of Restraint Use for All Target Children

3.4 CHILD RESTRAINT USE AND MISUSE OBSERVATIONS

This section provides the results of the observations of restraint use and restraint misuse for target children.

Restraint Use by Weight and Age

Overall restraint use by target children varies by weight and age category as follows:

	Restrained in CSS	*Restrained in Safety Belt**	*Not Restrained*	*Total*
Target Child Weight Category				
Under 20 pounds (9 kg)	*96.6%*	*0.5%*	*2.9%*	*100%*
20-40 pounds (9-18 kg)	*67.5%*	*21.4%*	*11.1%*	*100%*
40-60 pounds (18-27 kg)	*6.1%*	*75.3%*	*18.6%*	*100%*
Target Child Age Category				
Under 1 year old	*96.4%*	*0.3%*	*3.3%*	*100%*
1-4 years old	*68.8%*	*19.3%*	*11.8%*	*100%*
Over 4 years old (but under 60 pounds or 27 kg)	*6.2%*	*76.1%*	*17.7%*	*100%*

* Note, safety belts are not providing the most optimum protection for these children.

For all target children under 40 pounds (18 kg), 71.6% were restrained in a CSS, 18.5% were restrained in a safety belt, and 9.9% were not restrained.

In the recent NOPUS survey, NHTSA (1995) reported 88% use of CSSs for children under 1 year of age and 61% use of CSSs for children under 5 years of age.

The percent of target children restrained in a CSS decreases as weight and age increase; conversely, the percent of target children secured in a safety belt increases as weight and age increase. The percent of target children who are not restrained also increases as age and weight increase.

The CSS use rates were slightly higher for Washington than for Missouri and Pennsylvania, despite the fact that their law only covers children up to the age of 3. The other states cover children up to 4 years of age. Other than this age difference, all four states have very similar CSS laws. Despite the similarity in laws, Mississippi restraint use for target children was much lower than the other three states. The percentage of Mississippi target children who were not restrained is very high (47.6%) compared to the other three states, whose average was only 7.5%. Table 3-15 presents the restraint use by state and total by weight category.

Figure 3-3 displays the variation in restraint use by weight category (aggregated over all four states).

In addition, there was little variability (less than 10% from the average) among CSS use across the large sample size sites in all states except Mississippi, where the sites differed by less than 15% from the state average.

Table 3-15. Child Restraint Use by Weight - Sample Size and (Percent of Total)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
Under 20 pounds (9 kg)					
Restrained in CSS	38 (73.1%)	137 (100%)	166 (98.2%)	199 (99.0%)	540 (96.6%)
Restrained in Safety Belt*	1 (1.9%)	--	1 (0.6%)	1 (0.5%)	3 (0.5%)
Not Restrained	13 (25.0%)	--	2 (1.2%)	1 (0.5%)	16 (2.9%)
TOTAL	**52 (100%)**	**137 (100%)**	**169 (100%)**	**201 (100%)**	**559 (100%)**
20-40 pounds (9-18 kg)					
Restrained in CSS	156 (36.3%)	632 (69.2%)	744 (71.4%)	773 (75.0%)	2,305 (67.5%)
Restrained in Safety Belt*	75 (17.4%)	235 (25.7%)	217 (20.8%)	204 (19.8%)	731 (21.4%)
Not Restrained	199 (46.3%)	46 (5.0%)	81 (7.8%)	54 (5.2%)	380 (11.1%)
TOTAL	**430 (100%)**	**913 (100%)**	**1,042 (100%)**	**1,031 (100%)**	**3,416 (100%)**
40-60 pounds (18-27 kg)					
Restrained in CSS	10 (3.6%)	19 (3.9%)	34 (5.5%)	51 (10.4%)	114 (6.1%)
Restrained in Safety Belt*	116 (42.3%)	407 (84.3%)	491 (78.9%)	395 (80.4%)	1,409 (75.3%)
Not Restrained	148 (54.0%)	57 (11.8%)	97 (15.6%)	45 (9.2%)	347 (18.6%)
TOTAL	**274 (100%)**	**483 (100%)**	**622 (100%)**	**491 (100%)**	**1,870 (100%)**

* Note, safety belts are not providing the most optimum protection for these children.

Table 3-16 presents the restraint use by state and total by age category for target children under 60 pounds (27 kg).

Figure 3-3. Variation in Restraint Use by Weight Category

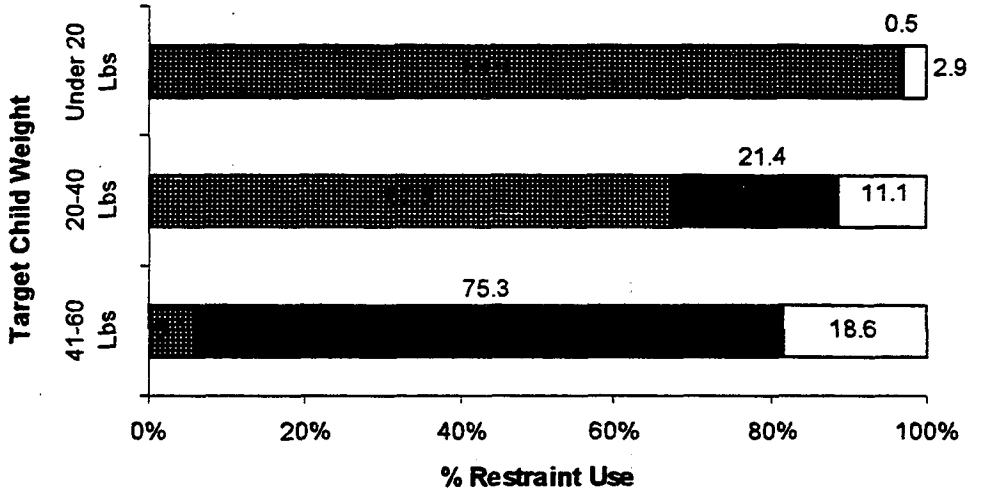


Table 3-16. Child Restraint Use by Age* - Sample Size and (Percent of Total)

	STATE				
	Mississippi	Missouri	Pennsylvania	Washington	Total
Up to 1 Year Old					
Restrained in CSS	49 (71.0%)	182 (100%)	198 (99.0%)	250 (98.8%)	679 (96.4%)
Restrained in Safety Belt**	1 (1.5%)	--	1 (0.5%)	--	2 (0.3%)
Not Restrained	19 (27.5%)	--	1 (0.5%)	3 (1.2%)	23 (3.3%)
TOTAL	**69 (100%)**	**182 (100%)**	**200 (100%)**	**253 (100%)**	**704 (100%)**
1-4 Years Old					
Restrained in CSS	150 (34.3%)	584 (73.7%)	708 (72.8%)	713 (76.7%)	2,155 (68.8%)
Restrained in Safety Belt**	77 (17.6%)	170 (21.5%)	186 (19.1%)	172 (18.5%)	605 (19.3%)
Not Restrained	210 (48.1%)	38 (4.8%)	79 (8.1%)	44 (4.7%)	371 (11.8%)
TOTAL	**437 (100%)**	**792 (100%)**	**973 (100%)**	**929 (100%)**	**3,131 (100%)**
Over 4 Years Old					
Restrained in CSS	5 (2.0%)	22 (3.9%)	38 (5.7%)	61 (11.1%)	126 (6.2%)
Restrained in Safety Belt**	115 (45.6%)	472 (84.4%)	524 (78.4%)	430 (78.8%)	1,541 (76.1%)
Not Restrained	132 (52.4%)	65 (11.6%)	106 (15.9%)	55 (10.0%)	358 (17.7%)
TOTAL	**252 (100%)**	**559 (100%)**	**668 (100%)**	**546 (100%)**	**2,055 (100%)**

* For target children also under 60 pounds (27 kg).

** Note, safety belts are not providing the most optimum protection for these children.

Child Safety Seat Misuse Characteristics

CSS misuse was defined as improper use of one or more of the most important CSS elements as identified at the workshop by a team of CSS experts and reviewed by NHTSA and the Society of Automotive Engineer's Children's Restraint Task Force. (Definitions were identified in Figure 2-1.)

For target children in CSSs (which includes infant seats, convertible seats, and booster seats), the overall percentage of proper CSS use based on the study's definition was 20.5%. The overall percentage of CSS misuse, based on observations of one or more misuses of the elements identified, was 79.5%.

Observed misuse rates (for all types of CSSs aggregated over all four states) for the CSS elements as defined above were as follows:

CSS Element	*Misuse Rate*
Seat direction	*9.6%*
Vehicle safety belt use	*16.9%*
Locking clip use	*72.0%*
Harness connection (buckle use)	*3.3%*
Harness strap use	*45.8%*
Harness retainer (chest) clip use	*58.8%*
One or more CSS element	*79.5%*

Table 3-17 presents the correct and incorrect (misuse) rates by CSS element, state, and total, accumulated for all CSS observations.

Table 3-17. Correct/Incorrect Use by Child Safety Seat Element for All Child Safety Seat Observations (Infant, Convertible, and Booster) - Sample Size and (Percent of Total)

	STATE				
	Mississippi	**Missouri**	**Pennsylvania**	**Washington**	**Total**
All Child Safety Seats: Seat Direction					
Correct	130 (87.8%)	490 (92.3%)	670 (87.6%)	686 (92.3%)	1,976 (90.4%)
Incorrect	18 (12.2%)	41 (7.7%)	95 (12.4%)	57 (7.7%)	211 (9.6%)
TOTAL	**148 (100%)**	**531 (100%)**	**765 (100%)**	**743 (100%)**	**2,187 (100%)**
All Child Safety Seats: Vehicle Safety Belt Use					
Correct	153 (78.9%)	663 (86.1%)	739 (81.2%)	838 (83.5%)	2,393 (83.1%)
Incorrect	41 (21.1%)	107 (13.9%)	171 (18.8%)	166 (16.5%)	485 (16.9%)
TOTAL	**194 (100%)**	**770 (100%)**	**910 (100%)**	**1,004 (100%)**	**2,878 (100%)**

Table 3-17. Correct/Incorrect Use by Child Safety Seat Element for All Child Safety Seat Observations (Infant, Convertible, and Booster) - Sample Size and (Percent of Total) (Continued)

	STATE				
	Mississippi	Missouri	Pennsylvania	Washington	Total
All Child Safety Seats: Locking Clip Use					
Correct	9 (34.6%)	89 (36.5%)	77 (18.1%)	141 (32.6%)	316 (28.0%)
Incorrect	17 (65.4%)	155 (63.5%)	348 (81.9%)	292 (67.4%)	812 (72.0%)
TOTAL	**26 (100%)**	**244 (100%)**	**425 (100%)**	**433 (100%)**	**1,128 (100%)**
All Child Safety Seats: Harness Connection (Buckle Use)					
Correct	148 (93.7%)	553 (99.1%)	729 (93.8%)	783 (98.5%)	2,213 (96.7%)
Incorrect	10 (6.3%)	5 (0.9%)	48 (6.2%)	12 (1.5%)	75 (3.3%)
TOTAL	**158 (100%)**	**558 (100%)**	**777 (100%)**	**795 (100%)**	**2,288 (100%)**
All Child Safety Seats: Harness Strap Use					
Correct	94 (59.9%)	350 (62.4%)	432 (55.1%)	374 (46.6%)	1,250 (54.2%)
Incorrect	63 (40.1%)	211 (37.6%)	352 (44.9%)	429 (53.4%)	1,055 (45.8%)
TOTAL	**157 (100%)**	**561 (100%)**	**784 (100%)**	**803 (100%)**	**2,305 (100%)**
All Child Safety Seats: Harness Retainer (Chest) Clip Use					
Correct	44 (46.8%)	190 (39.3%)	262 (44.7%)	227 (38.5%)	723 (41.2%)
Incorrect	50 (53.2%)	294 (60.7%)	324 (55.3%)	362 (61.5%)	1,030 (58.8%)
TOTAL	**94 (100%)**	**484 (100%)**	**586 (100%)**	**589 (100%)**	**1,753 (100%)**
All Child Safety Seats: Fully Protected (All Child Safety Seat Elements Correct)					
Correct	37 (27.2%)	148 (22.3%)	157 (18.0%)	182 (20.5%)	524 (20.5%)
Incorrect	99 (72.8%)	517 (77.7%)	717 (82.0%)	705 (79.5%)	2,038 (79.5%)
TOTAL	**136 (100%)**	**665 (100%)**	**874 (100%)**	**887 (100%)**	**2,562 (100%)**

Observed overall misuse rates for infant CSSs (summed over all four states) for the infant CSS elements defined above were as follows:

Infant Child Safety Seat Element	*Misuse Rate*
Seat direction	*24.1%*
Vehicle safety belt use	*19.7%*
Locking clip use	*72.4%*
Harness connection (buckle use)	*5.4%*
Harness strap use	*51.8%*
Harness retainer (chest) clip use	*48.9%*

With the exception of difficulty using locking clips (which is related more to knowing the type of vehicle safety belt system than the type of CSS), the majority of infant seat misuse was the result of improper use of the harness strap and harness retainer (chest) clip. Table 3-18 presents the infant CSS data by misuse element, state, and total for the infant CSS observations.

Observed overall misuse rates for convertible CSSs (summed over all four states) for the convertible CSS elements defined above were as follows:

Convertible Child Safety Seat Element	*Misuse Rate*
Seat direction	*5.4%*
Vehicle safety belt use	*17.8%*
Locking clip use	*73.0%*
Harness connection (buckle use)	*2.7%*
Harness strap use	*44.1%*
Harness retainer (chest) clip use	*62.2%*

Again, with the exception of not using a locking clip, the majority of the misuse difficulty centered on the harness retainer (chest) clip and the harness straps. Table 3-19 presents the convertible CSS data by misuse element, state, and total for the convertible CSS observations.

Observed overall misuse rates for booster CSSs (summed over all four states) for the booster CSS elements were as follows:

Booster Child Safety Seat Element	*Misuse Rate*
Vehicle lap belt use	*11.7%*
Locking clip use	*67.6%*
Shield use	*3.6%*
Vehicle shoulder belt use	*40.2%*

With exception of the lack of locking clip use, improper use of the vehicle shoulder belt was the major problem encountered with booster seats. Table 3-20 presents the booster CSS data by misuse element, state, and total for the booster CSS observations.

Table 3-18. Correct/Incorrect Use by Infant Child Safety Seat Element - Sample Size and (Percent of Total)

	STATE				
	Mississippi	Missouri	Pennsylvania	Washington	Total
Infant Seats: Seat Direction					
Correct	22 (73.3%)	91 (86.7%)	130 (64.4%)	132 (84.1%)	375 (75.9%)
Incorrect	8 (26.7%)	14 (13.3%)	72 (35.6%)	25 (15.9%)	119 (24.1%)
TOTAL	**30 (100%)**	**105 (100%)**	**202 (100%)**	**157 (100%)**	**494 (100%)**
Infant Seats: Vehicle Safety Belt Use					
Correct	23 (74.2%)	81 (75.7%)	176 (86.3%)	128 (77.1%)	408 (80.3%)
Incorrect	8 (25.8%)	26 (24.3%)	28 (13 .7%)	38 (22.9%)	100 (19.7%)
TOTAL	**31 (100%)**	**107 (100%)**	**204 (100%)**	**166 (100%)**	**508 (100%)**
Infant Seats: Locking Clip Use					
Correct	1 (20.0%)	12 (32.4%)	30 (24.6%)	29 (29.9%)	72 (27.6%)
Incorrect	4 (80.0%)	25 (67.6%)	92 (75.4%)	68 (70.1%)	189 (72.4%)
TOTAL	**5 (100%)**	**37 (100%)**	**122 (100%)**	**97 (100%)**	**261 (100%)**
Infant Seats: Harness Connection (Buckle Use)					
Correct	28 (93.3%)	105 (98.1%)	183 (91.0%)	160 (97.0%)	476 (94.6%)
Incorrect	2 (6.7%)	2 (1.9%)	18 (9.0%)	5 (3.0%)	27 (5.4%)
TOTAL	**30 (100%)**	**107 (100%)**	**201 (100%)**	**165 (100%)**	**503 (100%)**
Infant Seats: Harness Strap Use					
Correct	13 (44.8%)	67 (62.6%)	100 (48.8%)	65 (38.9%)	245 (48.2%)
Incorrect	16 (55.2%)	40 (37.4%)	105 (51.2%)	102 (61.1%)	263 (51.8%)
TOTAL	**29 (100%)**	**107 (100%)**	**205 (100%)**	**167 (100%)**	**508 (100%)**
Infant Seats: Harness Retainer (Chest) Clip Use					
Correct	11 (47.8%)	53 (53.0%)	101 (55.5%)	66 (44.9%)	231 (51.1%)
Incorrect	12 (52.2%)	47 (47.0%)	81 (44.5%)	81 (55.1%)	221 (48.9%)
TOTAL	**23 (100%)**	**100 (100%)**	**182 (100%)**	**147 (100%)**	**452 (100%)**

Table 3-19. Correct/Incorrect Use by Convertible Child Safety Seat Element - Sample Size and (Percent of Total)

	STATE				Total
	Mississippi	Missouri	Pennsylvania	Washington	
Convertible Seats: Seat Direction					
Correct	108 (91.5%)	399 (93.7%)	540 (95.9%)	554 (94.5%)	1,601 (94.6%)
Incorrect	10 (8.5%)	27 (6.3%)	23 (4.1%)	32 (5.5%)	92 (5.4%)
TOTAL	**118 (100%)**	**426 (100%)**	**563 (100%)**	**586 (100%)**	**1,693 (100%)**
Convertible Seats: Vehicle Safety Belt Use					
Correct	95 (76.0%)	386 (86.5%)	438 (79.2%)	531 (83.0%)	1,450 (82.2%)
Incorrect	30 (24.0%)	60 (13.5%)	115 (20.8%)	109 (17.0%)	314 (17.8%)
TOTAL	**125 (100%)**	**446 (100%)**	**553 (100%)**	**640 (100%)**	**1,764 (100%)**
Convertible Seats: Locking Clip Use					
Correct	6 (42.9%)	43 (31.9%)	45 (18.0%)	89 (31.8%)	183 (27.0%)
Incorrect	8 (57.1%)	92 (68.1%)	205 (82.0%)	191 (68.2%)	496 (73.0%)
TOTAL	**14 (100%)**	**135 (100%)**	**250 (100%)**	**280 (100%)**	**679 (100%)**
Convertible Seats: Harness Connection (Buckle Use)					
Correct	120 (93.8%)	448 (99.3%)	546 (94.8%)	623 (98.9%)	1,737 (97.3%)
Incorrect	8 (6.3%)	3 (0.7%)	30 (5.2%)	7 (1.1%)	48 (2.7%)
TOTAL	**128 (100%)**	**451 (100%)**	**576 (100%)**	**630 (100%)**	**1,785 (100%)**
Convertible Seats: Harness Strap Use					
Correct	81 (63.3%)	283 (62.3%)	332 (57.3%)	309 (48.6%)	1,005 (55.9%)
Incorrect	47 (36.7%)	171 (37.7%)	247 (42.7%)	327 (51.4%)	792 (44.1%)
TOTAL	**128 (100%)**	**454 (100%)**	**579 (100%)**	**636 (100%)**	**1,797 (100%)**
Convertible Seats: Harness Retainer (Chest) Clip Use					
Correct	33 (46.5%)	137 (35.7%)	161 (39.9%)	161 (36.4%)	492 (37.8%)
Incorrect	38 (53.5%)	247 (64.3%)	243 (60.1%)	281 (63.6%)	809 (62.2%)
TOTAL	**71 (100%)**	**384 (100%)**	**404 (100%)**	**442 (100%)**	**1,301 (100%)**

Table 3-20. Correct/Incorrect Use by Booster Child Safety Seat Element - Sample Size and (Percent of Total)

	STATE				
	Mississippi	Missouri	Pennsylvania	Washington	Total
Booster Seats with Shield: Vehicle Safety Belt Use					
Correct	31 (91.2%)	175 (90.2%)	106 (79.7%)	133 (90.5%)	445 (87.6%)
Incorrect	3 (8.8%)	19 (9.8%)	27 (20.3%)	14 (9.5%)	63 (12.4%)
TOTAL	**34 (100%)**	**194 (100%)**	**133 (100%)**	**147 (100%)**	**508 (100%)**
Booster Seats with Shield: Locking Clip Use					
Correct	2 (28.6%)	34 (47.2%)	2 (3.8%)	23 (41.1%)	61 (32.4%)
Incorrect	5 (71.4%)	38 (52.8%)	51 (96.2%)	33 (58.9%)	127 (67.6%)
TOTAL	**7 (100%)**	**72 (100%)**	**53 (100%)**	**56 (100%)**	**188 (100%)**
Booster Seats with Shield: Shield Use					
Correct	28 (93.3%)	190 (99.0%)	128 (95.5%)	132 (94.3%)	478 (96.4%)
Incorrect	2 (6.7%)	2 (1.0%)	6 (4.5%)	8 (5.7%)	18 (3.6%)
TOTAL	**30 (100%)**	**192 (100%)**	**134 (100%)**	**140 (100%)**	**496 (100%)**
Booster Seats without Shield: Vehicle Lap Belt Use					
Correct	4 (10.0%)	21 (91.3%)	19 (95.5%)	46 (90.2%)	90 (91.8%)
Incorrect	0 (0%)	2 (8.7%)	1 (5.0%)	5 (9.8%)	8 (8.2%)
TOTAL	**5 (100%)**	**23 (100%)**	**20 (100%)**	**51 (100%)**	**98 (100%)**
Booster Seats without Shield: Vehicle Shoulder Belt Use					
Correct	3 (50.0%)	14 (63.6%)	12 (70.6%)	29 (55.8%)	58 (59.8%)
Incorrect	3 (50.0%)	8 (36.4%)	5 (29.4%)	23 (44.2%)	39 (40.2%)
TOTAL	**6 (100%)**	**22 (100%)**	**17 (100%)**	**52 (100%)**	**97 (100%)**

Table 3-21 presents the specific incorrect uses for each misuse element by type of CSS (infant, convertible, or booster), totaled over all CSS observations in all four states.

Table 3-21. Child Safety Seat Correct/Incorrect Use by Misuse Element

	Infant Seats		Convertible Seats		Booster Seats		Totals	
Seat Direction	n	%	n	%	n	%	n	%
Correct	375	75.9%	1,601	94.6%	--		1,976	90.4%
Incorrect	119	24.1%	92	5.4%	--		211	9.6%
Total	494	100%	1,693	100%	--		2,187	100%
Safety Belt Use:								
Correct	408	80.3%	1,450	82.2%	535	88.3%	2,393	83.1%
Unbuckled/ Disconnected	10	2.0%	33	1.9%	12	2.0%		
Misrouted	17	3.3%	42	2.4%	6	1.0%		
Improper Use/Fit	73	14.4%	239	13.5%	53	8.7%	485	16.9%
Total	508	100%	1,764	100%	606	100%	2,878	100%
Locking Clip Use:*								
Correct	72	27.6%	183	27.0%	61	32.4%	316	28.0%
Not Used	164	62.8%	439	64.6%	108	57.5%		
Improper Use/Fit	25	9.6%	57	8.4%	19	10.1%	812	72.0%
Total	261	100%	679	100%	188	100%	1,128	100%
Harness Connection (Buckle Use):								
Correct	476	94.6%	1,737	97.3%	--		2,213	96.7%
Unbuckled/ Disconnected	27	5.4%	48	2.7%	--		75	3.3%
Total	503	100%	1,785	100%	--		2,288	100%
Harness Strap Use:								
Correct	245	48.2%	1,005	55.9%	--		1,250	54.2%
Misrouted	68	13.5%	72	4.0%	--			
Not Used	19	3.7%	52	2.9%	--			
Improper Use/Fit	176	34.6%	668	37.2%	--		1,055	45.8%
Total	508	100%	1,797	100%	--		2,305	100%
Harness Retainer (Chest) Clip Use:*								
Correct	231	51.1%	492	37.8%	--		723	41.2%
Not Used	69	15.3%	287	22.1%	--			
Improper Use/Fit	152	33.6%	522	40.1%	--		1,030	58.8%
Total	452	100%	1,301	100%	--		1,753	100%

* Cases where the locking clip or harness retainer (chest) clip were not required have not been included in the correct/incorrect use statistics. The total cases where the locking clip was not required were: 221 for infant seats, 1,040 for convertible seats, and 299 for booster seats. The total cases where the harness retainer (chest) clip was not required were: 48 for infant seats and 454 for convertible seats.

Figure 3-4 illustrates the specific correct use/misuse types for each misuse element by type of CSS.

Figure 3-4. Correct/Incorrect Use by Misuse Element

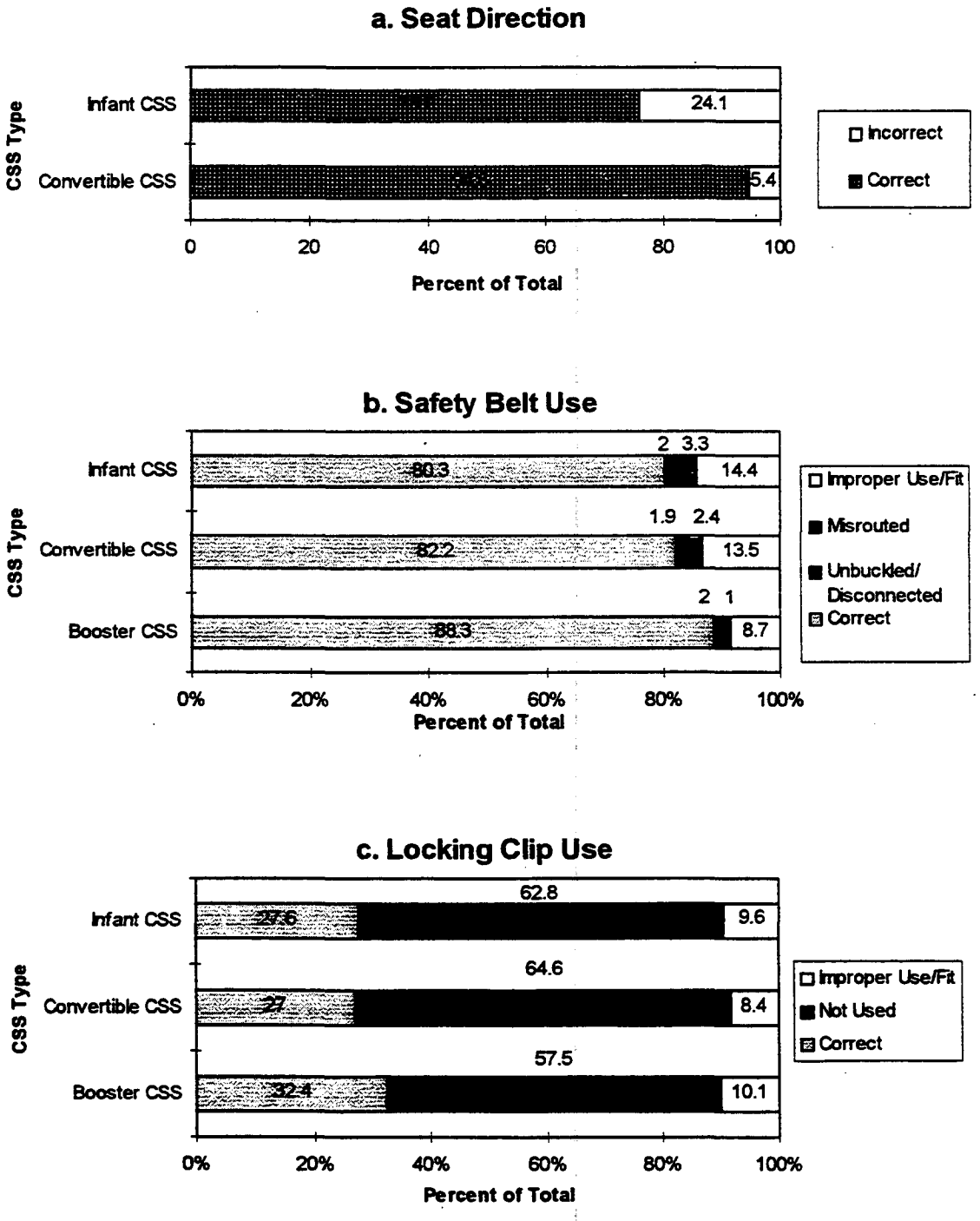
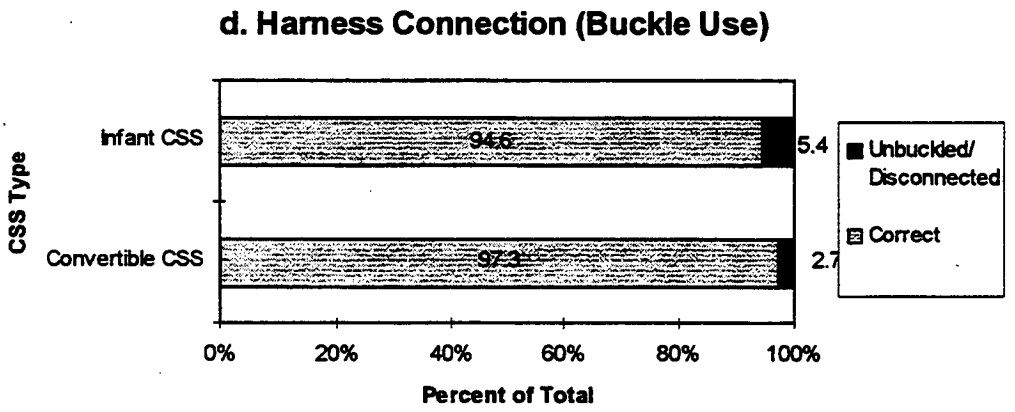
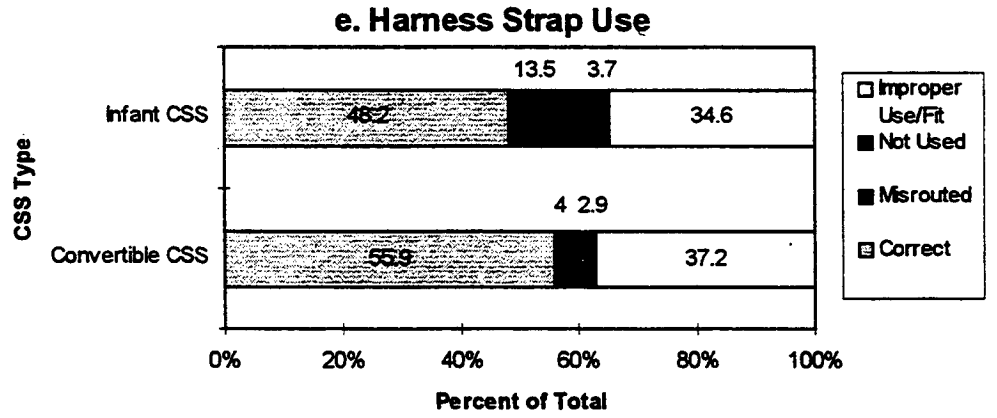
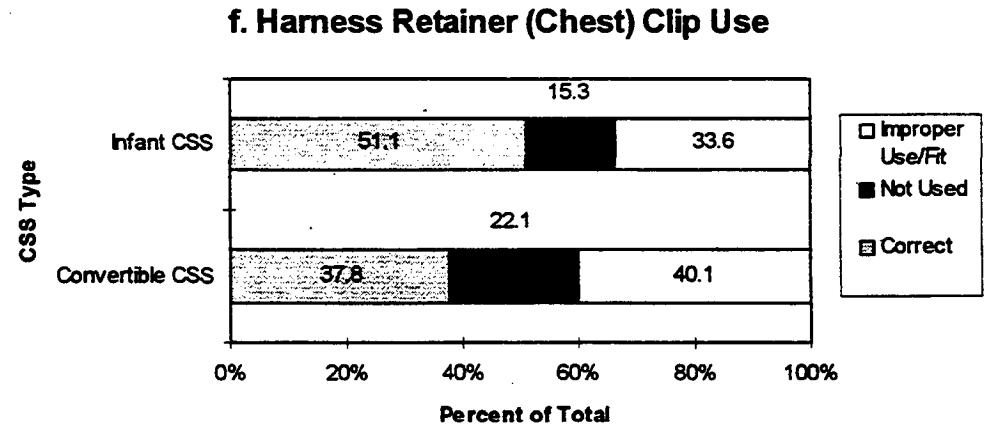


Figure 3-4. Correct/Incorrect Use by Misuse Element (Continued)







The most frequent combinations of misuse elements involved harness straps, harness retainer (chest) clips, and locking clips when more than one CSS misuse element was identified in the analysis. For infant and convertible seat observations involving 2 misuse elements, the most prevalent misuse combination was misuse/no use of the harness straps and harness retainer (chest) clips (35.5% infant and 51.9% convertible). No other combination of 2 misuse elements was found in more than 15% (infant seat) or 12% (convertible seat) of the total sample used in either analysis.

For infant and convertible seat observations involving 3 misuse elements, the most frequent combination was misuse/no use of the harness straps, harness retainer (chest) clips, and locking clips (32.7% infant and 46% convertible). No other combination of 3 misuse elements was found in more than 15% (infant seat) or 9% (convertible seat) of the total sample used in either analysis. The analysis revealed over 150 observations of combinations of 4 or more misuse elements.

Child Safety Seat Misuse by Vehicle Restraint Type/Latchplate Position/Non-Standard Vehicle Seat Type

Data were collected on the relationship between CSS misuse and the following three attributes: (1) the type of vehicle safety belt system (e.g., lap/shoulder belts on the door, lap/shoulder belts 3-point, automatic lap/shoulder belts, automatic shoulder belt with manual lap belt, and lap belt 2-point); (2) safety belt latchplate position (e.g., at bight and away from bight); and (3) non-standard vehicle seat types (e.g., deeply contoured, very slanted, center curved, pull-down jump seat, narrow rear seat, and built-in CSS). This information is presented in Table 3-22.

There was slightly higher correct use with 2-point lap belts than with 3-point lap/shoulder belts. Only about 6% of CSS installations were affected by the bight position. Built-in CSSs did result in higher CSS proper use than average. Drivers were able to deal with center-curved seats somewhat better in terms of correct CSS use, as compared to other special seat conditions (i.e., deeply contoured, very slanted, and narrow rear seat).

Safety Belt Misuse

Many target children were observed in a safety belt, which is not providing the most optimum protection. It is widely recommended by the American Academy of Pediatrics (AAP) that children between 40 and 60 pounds (18 and 27 kg) be transported in booster seats. However, many states allow children above 3 and 4 years of age, who are in this weight category, to be secured with safety belts. Thus, the state laws are not adequately covering those children between 40 and 60 pounds or (18 to 27 kg) who are over 3 and 4 years of age. Data collectors reported safety belt use of all target children as well as the misuse characteristics. For lap belts, misuse was defined as the lap belt being either across the abdomen, too loose, or severely twisted (more than one twist). For shoulder belts, misuse was defined as the shoulder

belt being either too high, too loose, under the arm, behind the back, or severely twisted (more than one twist). One or more misuses for either type of safety belt was considered safety belt misuse. Table 3-23 tabulates this overall safety belt use/misuse information by state and total.

Table 3-22. Child Safety Seat Misuse by Vehicle Safety Belt Type, Safety Belt Latchplate Position, and Non-Standard Vehicle Seat Type - Sample Size and (Percent of Total)

	Correct Use	Incorrect Use (Misuse)	Total
Vehicle Safety Belt Type Where Child Restrained			
L/S Belts (To Door)	4 (14.3%)	24 (85.7%)	28 (100%)
L/S Belts (3-point)	212 (16.2%)	1,093 (83.8%)	1,305 (100%)
Auto with L/S Belts	10 (20.4%)	39 (79.6%)	49 (100%)
Auto with Safety belts	4 (14.3%)	24 (85.7%)	28 (100%)
Lap Belt (2-point)	257 (25.2%)	761 (74.8%)	1,018 (100%)
TOTAL	**487 (20.1%)**	**1,941 (79.9%)**	**2,428 (100%)**
Safety Belt Latchplate Position			
At Bight	489 (21.3%)	1,804 (78.7%)	2,293 (100%)
Away from Bight	–	107 (100%)	107 (100%)
TOTAL	**489 (20.4%)**	**1,911 (79.6%)**	**2,400 (100%)**
Non-Standard Vehicle Seat Type			
Deeply Contoured Seats	13 (22.4%)	45 (77.6%)	58 (100%)
Very Slanted Seats	28 (24.1%)	88 (75.9%)	116 (100%)
Center Curved	13 (34.2%)	25 (65.8%)	38 (100%)
Pull-down Jump Seat	–	2 (100%)	2 (100%)
Narrow Rear Seat	1 (11.1%)	8 (88.9%)	9 (100%)
Built-in CSS*	23 (56.1%)	18 (43.9%)	41 (100%)
TOTAL	**78 (29.5%)**	**186 (70.5%)**	**264 (100%)**

* Misuses for built-in seats were related to improper harness strap and retainer clip connections around the child

Table 3-23. Child Safety Belt Misuse - Sample Size and (Percent of Total)

	STATE				Total
	Mississippi	Missouri	Pennsylvania	Washington	
Safety Belt Use*					
Correct Use	43 (22.8%)	145 (22.9%)	275 (39.9%)	209 (37.1%)	672 (32.4%)
Incorrect Use (Misuse)	146 (77.2%)	489 (77.1%)	414 (60.1%)	355 (62.9%)	1,404 (67.6%)
TOTAL	**189 (100%)**	**634 (100%)**	**689 (100%)**	**564 (100%)**	**2,076 (100%)**

* Note, safety belts are not providing the most optimum protection for these children.

The highest safety belt misuse was a result of the lap belt being incorrectly positioned across the child's abdomen and the lap belt fitting too loose. Almost half of the shoulder belt misuse involved the child not using the vehicle's shoulder belt (when a shoulder belt was available). Most other shoulder belt misuse was due to the shoulder belt being positioned too high on the child.

3.5 RESTRAINT USE/CHILD SAFETY SEAT MISUSE RELATIONSHIPS

This section presents results for all target children on the relationship between restraint use (CSS, safety belt, and none), CSS use/misuse, and the following characteristics: age and weight of target child; driver restraint use; driver demographics; vehicle type, license plate type, and occupant protection system; seating position of child; number of occupants and target children; and distance and time since last stop.

For those target children secured in a CSS, the relationship between CSS use/misuse and the following attributes are then presented: regular vehicle use; CSS acquisition and installation; knowledge of CSS installation and placement of child in CSS; and frequency of CSS removal from vehicle. All of the following tables are summed over all four states.

In the tables that follow, the CSS use column is further subdivided into correct CSS use and incorrect CSS use (misuse) for those observations with complete use/misuse data. The difference between the sum of the CSS use and CSS misuse columns and the total CSS column are those CSS observations with incomplete CSS use data (approximately 14% of CSS observations).

It is important to note that Tables 3-24 to 3-36 will not always show the same grand total of CSS misuse and correct use frequencies, since there was missing data from a small portion of the observation/interview forms on many of the variables being compared against CSS misuse.

Restraint Use/Child Safety Seat Misuse By Child Weight

As previously described, three target child weight categories were defined for this study:

- infant (under 20 pounds or 9 kg);
- toddler (20 to 40 pounds or 9 to 18 kg); and
- pre-schooler (40 to 60 pounds or 18 to 27 kg).

There was a strong relationship between target child weight category and CSS use. As expected, the infant weight group had the highest CSS use (96.6%), followed by the toddler weight group (67.5%). The pre-schooler weight group showed an

extremely low CSS use rate (6.1%). The number of children who were not restrained in the toddler and pre-schooler group were very similar (11.1% and 18.6%, respectively). The results showed a remarkable high level of CSS use for infants (96.6%), but at the toddler and pre-schooler weight groups, CSS use dropped off dramatically (67.5% and 6.1%, respectively). These results were very similar to previous NHTSA (Decina et al., 1994) and Canadian (Canada Market Research Ltd., 1994) studies.

When CSSs were used, misuse was similar in the infant and toddler weight groups (79.4% and 81.1%, respectively). CSS misuse was much lower in the pre-schooler weight group (50.0%). The level of CSS misuse observed in the study is extremely high, especially for the younger target weight groups. These findings are somewhat similar to what child passenger safety advocacy groups have recently been stating (Kedjidjian, 1995).

Table 3-24 presents restraint use/misuse by target child weight and age category.

Table 3-24. Restraint Use and Child Safety Seat Misuse by Target Child Weight/Age Category - Sample Size and (Percent of Total)

	Restraint Use			Child Safety Seat Use**	
	Restrained in Child Safety Seat	Restrained in Safety Belt*	Not Restrained	Correct	Incorrect (Misuse)+
Target Child Weight Category					
Under 20 Pounds	540 (96.6%)	3 (0.5%)	16 (2.9%)	94 (20.6%)	362 (79.4%)
20-40 Pounds	2,305 (67.5%)	731 (21.4%)	380 (11.1%)	379 (18.9%)	1,625 (81.1%)
40-60 Pounds	114 (6.1%)	1,409 (75.3%)	347 (18.6%)	51 (50.0%)	51 (50.0%)
TOTAL	**2,959 (50.6%)**	**2,143 (36.7%)**	**743 (12.7%)**	**524 (20.5%)**	**2,038 (79.5%)**
Target Child Age Category					
Birth to 1 Year Old	679 (96.4%)	2 (0.3%)	23 (3.3%)	119 (20.3%)	467 (79.7%)
1 to 4 Years Old	2,155 (68.8%)	605 (19.3%)	371 (11.8%)	373 (20.0%)	1,494 (80.0%)
Over 4 Years Old (But Less Than 60 Pounds)	126 (6.2%)	1,541 (76.1%)	358 (17.7%)	32 (29.4%)	77 (70.6%)
TOTAL	**2,960 (50.5%)**	**2,148 (36.7%)**	**752 (12.8%)**	**524 (20.5%)**	**2,038 (79.5%)**

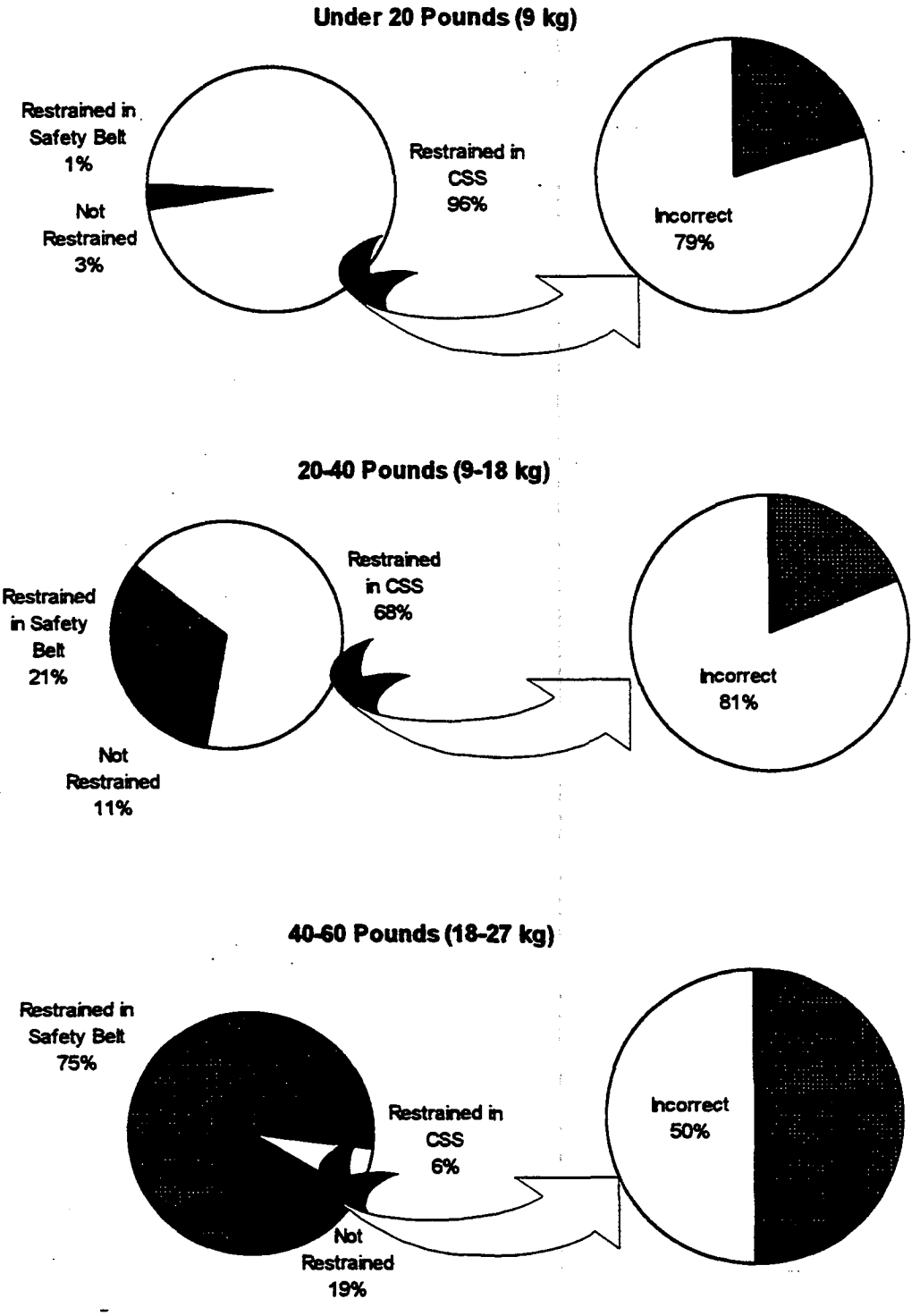
* Note, safety belts are not providing the most optimum protection for these children.

** "Child Safety Seat Use" data are a subset of "Restrained In Child Safety Seat" data.

\+ Can include one or more misuse characteristics for each target child (up to 60 pounds) in a child safety seat.

Figure 3-5 shows the distribution of child restraint use and CSS use/misuse for the three weight categories.

Figure 3-5. Restraint Use and Child Safety Seat Misuse by Weight Category



Restraint Use/Child Safety Seat Misuse by Driver Safety Belt Use

The results showed that there was a relationship between driver safety belt use and target children restraint use and CSS misuse. When drivers were observed belted, only 5.4% of the target children were not restrained; when drivers were unbelted, 47.3% were not restrained. For those drivers wearing safety belts, the target child restraint type was somewhat equally divided between safety belts and CSSs. These results are very similar to previous NHTSA findings (Decina et al., 1994). In addition, when drivers were belted, there was slightly less CSS misuse. Table 3-25 presents the relationship between driver safety belt use and target children restraint use and CSS misuse.

Table 3-25. Restraint Use and Child Safety Seat Misuse by Driver Restraint Use - Sample Size and (Percent of Total)

	Restraint Use			Child Safety Seat Use**	
	Restrained in Child Safety Seat	Restrained in Safety Belt*	Not Restrained	Correct	Incorrect (Misuse)+
Driver Restraint Use					
No	325 (31.6%)	217 (21.1%)	487 (47.3%)	33 (12.0%)	242 (88.0%)
Yes	2,548 (54.7%)	1,863 (40.0%)	250 (5.4%)	472 (21.3%)	1,746 (78.7%)
TOTAL	**2,873 (50.5%)**	**2,080 (36.6%)**	**737 (13.0%)**	**505 (20.3%)**	**1,988 (79.7%)**

* Note, safety belts are not providing the most optimum protection for these children.
** "Child Safety Seat Use" data are a subset of "Restrained In Child Safety Seat" data.
\+ Can include one or more misuse characteristics for each target child (up to 60 pounds) in a child safety seat.

Restraint Use/Child Safety Seat Misuse by Driver Age, Gender, and Relationship to Child

Results showed no particular relationship between driver age or gender and the frequency of child restraint use or CSS misuse. For drivers under 30 years of age, there were more target children who were restrained in CSSs than in safety belts. However, these younger drivers are more likely to have target children in the infant group (than in the toddler group) and infants are more likely to be restrained in CSSs. When the driver was the parent or grandparent, restraint use for the target child(ren) was very similar. However, if the driver was a friend or other relative, there was a higher percentage of target children who were not restrained. Table 3-26 presents these results.

Table 3-26. Restraint Use and Child Safety Seat Misuse by Driver Age, Gender, and Relationship to Child - Sample Size and (Percent of Total)

	Restraint Use			Child Safety Seat Use**	
	Restrained in Child Safety Seat	Restrained in Safety Belt*	Not Restrained	Correct	Incorrect (Misuse)+
Driver Age					
<30 Years Old	891 (59.9%)	339 (22.8%)	258 (17.3%)	144 (19.3%)	603 (80.7%)
30-39	1,668 (50.0%)	1,327 (39.8%)	340 (10.2%)	303 (20.7%)	1,158 (79.3%)
40-49	264 (39.6%)	305 (45.7%)	98 (14.7%)	57 (24.6%)	175 (75.4%)
50+ Years Old	105 (36.0%)	148 (50.7%)	39 (13.4%	14 (14.7%)	81 (85.3%)
TOTAL	**2,928 (50.6%)**	**2,119 (36.6%)**	**735 (12.7%)**	**518 (20.4%)**	**2,017 (79.6%)**
Driver Gender					
Male	625 (50.4%)	400 (32.3%)	214 (17.3%)	114 (21.6%)	414 (78.4%)
Female	2,334 (50.7%)	1,735 (37.7%)	531 (11.5%)	410 (20.2%)	1,618 (79.8%)
TOTAL	**2,959 (50.7%)**	**2,135 (36.6%)**	**745 (12.8%)**	**524 (20.5%)**	**2,032 (79.5%)**
Driver Relationship to Child(ren)					
Mother	2,120 (52.3%)	1,492 (36.8%)	439 (10.8%)	374 (20.4%)	1,460 (79.6%)
Father	566 (52.5%)	344 (31.9%)	169 (15.7%)	109 (22.7%)	371 (77.3%)
Grandmother	107 (37.5%)	138 (48.4%)	40 (14.0%)	16 (16.0%)	84 (84.0%)
Grandfather	30 (43.5%)	31 (44.9%)	8 (11.6%)	3 (12.0%)	22 (88.0%)
Friend	32 (43.2%)	22 (29.7%)	20 (27.0%)	3 (10.3%)	26 (89.7%)
Relative	39 (31.0%)	49 (38.9%)	38 (30.2%)	6 (20.0%)	24 (80.0%)
Other	45 (47.9%)	36 (38.3%)	13 (13.8%)	9 (23.1%)	30 (76.9%)
TOTAL	**2,939 (50.9%)**	**2,112 (36.6%)**	**727 (12.6%)**	**520 (20.5%)**	**2,017 (79.5%)**

* Note, safety belts are not providing the most optimum protection for these children.

** "Child Safety Seat Use" data are a subset of "Restrained In Child Safety Seat" data.

\+ Can include one or more misuse characteristics for each target child (up to 60 pounds) in a child safety seat.

Restraint Use/Child Safety Seat Misuse by Vehicle Type and Occupant Protection System

Results showed no specific relationships between vehicle type and target children restraint use or CSS misuse. Results showed that when the vehicle had a driver-side and/or passenger-side airbag, it was less likely that the child was not restrained. Table 3-27 presents this data.

Table 3-27. Restraint Use and Child Safety Seat Misuse by Vehicle Type and Occupant Protection System - Sample Size and (Percent of Total)

	Restraint Use			Child Safety Seat Use**	
	Restrained in Child Safety Seat	Restrained in Safety Belt*	Not Restrained	Correct	Incorrect (Misuse)+
Vehicle Type					
Sedan/Coupe	1,478 (52.0%)	939 (33.0%)	425 (15.0%)	249 (19.3%)	1,038 (80.7%)
Hatchback	102 (53.7%)	58 (30.5%)	30 (15.8%)	14 (15.9%)	74 (84.1%)
Station Wagon	239 (50.2%)	194 (40.8%)	43 (9.0%)	37 (17.9%)	170 (82.1%)
Sports Vehicle	45 (51.1%)	29 (33.0%)	14 (15.9%)	5 (13.5%)	32 (86.5%)
Passenger/Mini-Van	667 (46.9%)	643 (45.2%)	112 (7.9%)	134 (23.1%)	446 (76.9%)
Jeep/4x4/Utility Vehicle	269 (61.1%)	140 (31.8%)	31 (7.0%)	55 (23.6%)	178 (76.4%)
Pick-up Truck	79 (35.7%)	79 (35.7%)	63 (28.5%)	16 (25.0%)	48 (75.0%)
Other	2 (28.6%)	2 (28.6%)	3 (42.9%)	--	2 (100%)
TOTAL	**2,881 (50.7%)**	**2,084 (36.7%)**	**721 (12.7%)**	**510 (20.4%)**	**1,988 (79.6%)**
Does Vehicle Have Any Air Bag Protection?					
Yes	1,089 (54.1%)	759 (37.7%)	165 (8.2%)	183 (19.7%)	746 (80.3%)
No	1,779 (48.5%)	1,343 (36.6%)	545 (14.9%)	318 (20.4%)	1,238 (79.6%)
TOTAL	**2,868 (50.5%)**	**2,102 (37.0%)**	**710 (12.5%)**	**501 (20.2%)**	**1,984 (79.8%)**

* Note, safety belts are not providing the most optimum protection for these children.

** "Child Safety Seat Use" data are a subset of "Restrained In Child Safety Seat" data.

\+ Can include one or more misuse characteristics for each target child (up to 60 pounds) in a child safety seat.

Table 3-27. Restraint Use and Child Safety Seat Misuse by Vehicle Type, and Occupant Protection System - Sample Size and (Percent of Total) (Continued)

	Restraint Use			Child Safety Seat Use**	
	Restrained in Child Safety Seat	Restrained in Safety Belt*	Not Restrained	Correct	Incorrect (Misuse)+
Does Vehicle Have Driver-Side Air Bags?					
Yes	1,143 (54.7%)	775 (37.1%)	171 (8.2%)	197 (20.2%)	778 (79.8%)
No	1,788 (48.4%)	1,350 (36.5%)	559 (15.1%)	321 (20.6%)	1,241 (79.4%)
TOTAL	**2,931 (50.7%)**	**2,125 (36.7%)**	**730 (12.6%)**	**518 (20.4%)**	**2,019 (79.6%)**
Does Vehicle Have Passenger-Side Air Bags?					
Yes	417 (53.9%)	287 (37.1%)	70 (9.0%)	79 (22.2%)	277 (77.8%)
No	2,453 (49.9%)	1,815 (37.0%)	643 (13.1%)	422 (19.8%)	1,708 (80.2%)
TOTAL	**2,870 (50.5%)**	**2,102 (37.0%)**	**713 (12.5%)**	**501 (20.2%)**	**1,985 (79.8%)**

* Note, safety belts are not providing the most optimum protection for these children.
** "Child Safety Seat Use" data are a subset of "Restrained In Child Safety Seat" data.
\+ Can include one or more misuse characteristics for each target child (up to 60 pounds) in a child safety seat.

Restraint Use/Child Safety Seat Misuse by Target Child Seating Position

Results showed a higher percentage of unrestrained target children in the front middle and third level of seats (in mini-vans) than any other seating position. The middle-middle seat had the highest percentage of CSS use and proper CSS use than any other seating position for the vehicles without a third row of seats. Table 3-28 presents this data.

Table 3-28. Restraint Use and Child Safety Seat Misuse by Seating Position of Target Child - Sample Size and (Percent of Total)

	Restraint Use			Child Safety Seat Use**	
	Restrained in Child Safety Seat	Restrained in Safety Belt*	Not Restrained	Correct	Incorrect (Misuse)+
Position of Child in Vehicle					
Middle Front	25 (19.1%)	55 (42.0%)	51 (38.9%)	2 (10.5%)	17 (89.5%)
Passenger Front	630 (37.9%)	817 (49.2%)	215 (12.9%)	93 (17.1%)	451 (82.9%)
Driver Middle	651 (51.4%)	479 (37.8%)	136 (10.7%)	106 (18.9%)	455 81.1%)
Middle Middle	713 (65.7%)	213 (19.6%)	160 (14.7%)	171 (27.5%)	450 (72.5%)
Passenger Middle	864 (61.4%)	415 (29.5%)	129 (9.2%)	137 (18.3%)	613 (81.7%)
Driver Back++	30 (35.3%)	42 (49.4%)	13 (15.3%)	2 (8.3%)	22 (91.7%)
Middle Back++	16 (21.9%)	44 (60.3%)	13 (17.8%)	5 (33.3%)	10 (66.7%)
Passenger Back++	29 (25.0%)	71 (61.2%)	16 (13.8%)	6 (24.0%)	19 (76.0%)
Cargo	1 (8.3%)	2 (16.7%)	9 (75.0%)	1 (100%)	--
TOTAL	**2,959 (50.7%)**	**2,138 (36.6%)**	**742 (12.7%)**	**523 (20.4%)**	**2,037 (79.6%)**

* Note, safety belts are not providing the most optimum protection for these children.
** "Child Safety Seat Use" data are a subset of "Restrained In Child Safety Seat" data.
\+ Can include one or more misuse characteristics for each target child (up to 60 pounds) in a child safety seat.
++ Back is defined as the third row of seats in mini-vans, station wagons, and other vehicles with this seating arrangement.

Restraint Use/Child Safety Seat Misuse by Number of Vehicle Occupants and Number of Target Children

As the number of total occupants in the vehicle increased, the percent of unrestrained target children increased and the percent restrained in a CSS decreased. The same relationships held true as the number of target children in the vehicle increased. However, CSS misuse rates showed little variation over the range of total occupants and total target children. Table 3-29 presents this data.

Table 3-29. Restraint Use and Child Safety Seat Misuse by Total Number of Occupants and Total Number of Target Children - Sample Size and (Percent of Total)

	Restraint Use			Child Safety Seat Use**	
	Restrained in Child Safety Seat	Restrained in Safety Belt*	Not Restrained	Correct	Incorrect (Misuse)+
Total Number of Occupants (Driver, Target Children, and Other Occupants)					
2	935 (65.9%)	376 (26.5%)	107 (7.5%)	160 (19.5%)	662 (80.5%)
3	1,141 (51.3%)	820 (36.9%)	264 (11.9%)	221 (22.2%)	773 (77.8%)
4	604 (45.1%)	552 (41.3%)	182 (13.6%)	101 (20.0%)	404 (80.0%)
5-6	268 (32.6%)	376 (45.7%)	178 (21.7%)	39 (17.1%)	188 (82.9%)
7+	17 (27.4%)	24 (38.7%)	21 (33.9%)	3 (21.4%)	11 (78.6%)
TOTAL	**2,965 (50.6%)**	**2,148 (36.6%)**	**752 (12.8%)**	**524 (20.5%)**	**2,038 (79.5%)**
Total Target Child(ren) Under 60 Pounds (27 kg)					
1	1,379 (60.5%)	639 (28.1%)	260 (11.4%)	248 (20.6%)	957 (79.4%)
2	1,194 (48.1%)	975 (39.3%)	313 (12.6%)	210 (20.4%)	819 (79.6%)
3	299 (37.0%)	400 (49.4%)	110 (13.6%)	49 (19.8%)	198 (80.2%)
4	93 (31.4%)	134 (45.3%)	69 (23.3%)	17 (21.0%)	64 (79.0%)
TOTAL	**2,965 (50.6%)**	**2,148 (36.6%)**	**752 (12.8%)**	**524 (20.5%)**	**2,038 (79.5%)**

* Note, safety belts are not providing the most optimum protection for these children.
** "Child Safety Seat Use" data are a subset of "Restrained In Child Safety Seat" data.
\+ Can include one or more misuse characteristics for each target child (up to 60 pounds) in a child safety seat.

Restraint Use/Child Safety Seat Misuse by Distance and Time from Last Stop

Results showed little variation among distance and time since last stop for restraint use and CSS misuse for target children. Table 3-30 presents these restraint use and CSS misuse rates by distance from last stop and time since last stop.

Table 3-30. Restraint Use and Child Safety Seat Misuse by Distance and Time from Last Stop - Sample Size and (Percent of Total)

	Restraint Use			Child Safety Seat Use**	
	Restrained in Child Safety Seat	Restrained in Safety Belt*	Not Restrained	Correct	Incorrect (Misuse)+
Distance From Last Stop (Miles)					
<1 Mile (1.6 km)	615 (48.8%)	494 (39.2%)	151 (12.0%)	102 (19.4%)	425 (80.6%)
1-5 Miles (1.6-8 km)	1,217 (51.4%)	859 (36.3%)	292 (12.3%)	214 (20.0%)	854 (80.0%)
5-15 Miles (8-24 km)	867 (51.1%)	615 (36.3%)	214 (12.6%)	165 (22.1%)	581 (77.9%)
>15 Miles (24 km)	242 (54.6%)	144 (32.5%)	57 (12.9%)	36 (18.1%)	163 (81.9%)
TOTAL	**2,941 (51.0%)**	**2,112 (36.6%)**	**714 (12.4%)**	**517 (20.4%)**	**2,023 (79.6%)**
Time Since Last Stop (Minutes)					
<10 Minutes	1,855 (50.2%)	1,355 (36.7%)	487 (13.2%)	320 (19.9%)	1,291 (80.1%)
10-30 Minutes	951 (52.6%)	668 (36.9%)	190 (10.5%)	178 (21.7%)	644 (78.3%)
30-60 Minutes	98 (51.0%)	65 (33.9%)	29 (15.1%)	12 (14.8%)	69 (85.2%)
>60 Minutes	24 (49.0%)	14 (28.6%)	11 (22.4%)	4 (21.1%)	15 (78.9%)
TOTAL	**2,928 (50.9%)**	**2,102 (36.6%)**	**717 (12.5%)**	**514 (20.3%)**	**2,019 (79.7%)**

* Note, safety belts are not providing the most optimum protection for these children.
** "Child Safety Seat Use" data are a subset of "Restrained In Child Safety Seat" data.
\+ Can include one or more misuse characteristics for each target child (up to 60 pounds) in a child safety seat.

Child Safety Seat Misuse by How Often Vehicle is Regularly Used

There was very little difference in CSS misuse based on whether or not the vehicle was the one regularly driven. In fact there was less CSS misuse when the vehicle was not the one regularly driven. Table 3-31 presents this data.

Table 3-31. Child Safety Seat Misuse by How Often Vehicle is Regularly Used - Sample Size and (Percent of Total)

	Child Safety Seat Use		
	Correct	*Incorrect (Misuse)*	*Total*
Is This the Vehicle You Regularly Drive?			
Yes	465 (19.9%)	1,873 (80.1%)	2,338 (100%)
No	55 (25.7%)	159 (74.3%)	214 (100%)
TOTAL	**520 (20.4%)**	**2,032 (79.6%)**	**2,552 (100%)**

Child Safety Seat Misuse by Seat Acquisition

There was also very little difference in CSS misuse as a function of how the CSS was obtained. If the seat was purchased new or was a new gift, there was slightly less CSS misuse. Table 3-32 presents the results of these findings.

Table 3-32. Child Safety Seat Misuse by Seat Acquisition - Sample Size and (Percent of Total)

	Child Safety Seat Use		
	Correct	*Incorrect (Misuse)*	*Total*
How Was CSS Obtained?			
Purchased New	337 (19.3%)	1,409 (80.7%)	1,746 (100%)
Purchased Used	39 (18.9%)	167 (81.1%)	206 (100%)
Gift/New	84 (23.3%)	276 (76.7%)	360 (100%)
Loaner Program	1 (8.3%)	11 (91.7%)	12 (100%)
Other	51 (27.0%)	138 (73.0%)	189 (100%)
TOTAL	**512 (20.4%)**	**2,001 (79.6%)**	**2,513 (100%)**

Child Safety Seat Misuse by Installation and Placement of Child in Seat

There was only slightly higher proper CSS use when the person who installed the CSS in the vehicle was the driver, who was a parent or a relative. Also, the CSS

proper use ratios were slightly higher when the driver was a parent or relative, who put the child in the CSS. Table 3-33 presents this data.

Table 3-33. Child Safety Seat Misuse by Installation of Seat in Vehicle and Placement of Child in Seat - Sample Size and (Percent of Total)

	Child Safety Seat Use		
	Correct	*Incorrect (Misuse)*	*Total*
Who Installed CSS?			
Self	383 (19.6%)	1,567 (80.4%)	1,950 (100%)
Spouse	80 (19.7%)	326 (80.3%)	406 (100%)
Relative	11 (16.4%)	56 (83.6%)	67 (100%)
Friend	2 (10.0%)	18 (90.0%)	20 (100%)
Other*	29 (41.4%)	41 (58.6%)	70 (100%)
TOTAL	**505 (20.1%)**	**2,008 (79.9%)**	**2,513 (100%)**
Who Put Child in CSS?			
Self	428 (20.3%)	1,685 (79.7%)	2,113 (100%)
Spouse	37 (22.0%)	131 (78.0%)	168 (100%)
Relative	16 (19.0%)	68 (81.0%)	84 (100%)
Friend	3 (9.7%)	28 (90.3%)	31 (100%)
Other	23 (23.2%)	76 (76.8%)	99 (100%)
TOTAL	**507 (20.3%)**	**1,988 (79.7%)**	**2,495 (100%)**

* Category includes 43 built-in CSSs of vehicles with automobile factory-installed CSSs; 53% of these CSSs were correctly used.

Child Safety Seat Misuse by Knowledge of Installation and Placement of Child

There was very little difference in CSS misuse rates as a function of either the method used to learn how to install the CSS in the vehicle or the method used to learn how to place the child in the CSS. When drivers learned on their own how to install the CSS or how to place the child in the CSS, the CSS correct use was slightly lower. When drivers read the instructions in the box or on the side of the box for how to

secure the child in the CSS, CSS correct use was slightly lower. Table 3-34 presents this information.

Table 3-34. Child Safety Seat Misuse by Knowledge of Installation and Placement of Child in Seat - Sample Size and (Percent of Total)

	Child Safety Seat Use		
	Correct	***Incorrect (Misuse)***	***Total***
How Learned to Install CSS?			
Read Instructions in/on Box	337 (21.0%)	1,267 (79.0%)	1,604 (100%)
Read Instructions on Side of CSS	77 (20.6%)	297 (79.4%)	374 (100%)
Someone Demonstrated CSS Installation	40 (18.2%)	180 (81.8%)	220 (100%)
Learned on Own	76 (17.7%)	354 (82.3%)	430 (100%)
Vehicle Owner's Manual	3 (21.4%)	11 (78.6%)	14 (100%)
Other	24 (27.9%)	62 (72.1%)	86 (100%)
TOTAL	**557 (20.4%)**	**2,171 (79.6%)**	**2,728 (100%)**
How Learned to Put Child(ren) in CSS?			
Read Instructions in/on Box	274 (20.6%)	1,055 (79.4%)	1,329 (100%)
Read Instructions on Side of CSS	37 (15.4%)	203 (84.6%)	240 (100%)
Someone Demonstrated How to Secure Child	59 (22.0%)	209 (78.0%)	268 (100%)
Learned on Own	173 (18.9%)	743 (81.1%)	916 (100%)
Vehicle Owner's Manual	5 (29.4%)	12 (70.6%)	17 (100%)
Other	20 (27.8%)	52 (72.2%)	72 (100%)
TOTAL	**568 (20.0%)**	**2,274 (80.0%)**	**2,842 (100%)**

Child Safety Seat Misuse by How Often Seat is Removed from Vehicle

There was no significant difference in CSS misuse rates based on how often the CSS is removed from the vehicle. When the CSS was frequently removed, correct use was slightly lower than when the CSS was only occasionally removed. Table 3-35 presents this information.

Table 3-35. Child Safety Seat Misuse by Seat Removal From Vehicle - Sample Size and (Percent of Total)

	Child Safety Seat Use		
	Correct	***Incorrect (Misuse)***	***Total***
How Often Are CSS(s) Removed From Vehicle?			
Frequently	102 (17.3%)	486 (82.7%)	588 (100%)
Sometimes	91 (20.3%)	357 (79.7%)	448 (100%)
Infrequently	163 (21.0%)	615 (79.0%)	778 (100%)
Never	155 (22.1%)	546 (77.9%)	701 (100%)
TOTAL	**511 (20.3%)**	**2,004 (79.7%)**	**2,515 (100%)**

Child Safety Seat Misuse by Most Common Child Safety Seats Observed

The data collectors were able to identify the CSS manufacturer in 96% of the CSSs observed. However, they were only able to identify the CSS manufacturer and type of seat in approximately 50% of the CSSs observed. The 20 most commonly observed CSSs identified during data collection (5 infant, 10 convertible, and 5 booster) were tabulated in terms of CSS misuse. The small sample size of even the most commonly observed CSSs limits interpreting these findings. (However, it was noted that the Fisher-Price with T-shield convertible seat had the most correct use observations. State coordinator Kathryn Kruger[1] noted that this CSS has an automatic harness retractor mechanism system. Thus, when the crotchplate is buckled, the harness strap automatically adjusts to fit the child. This feature reduces the probability of improper harness fit.) Table 3-36 presents these results.

[1] Personal communication, December 8, 1995.

Table 3-36. Child Safety Seat Misuse by Manufacturer and Model - Sample Size and (Percent of Total)

	Child Safety Seat Use		
	Correct	***Incorrect (Misuse)***	***Total***
Infant Seats			
Evenflo Joy Ride	11 (17.2%)	53 (82.8%)	64 (100%)
Century 590 Series	12 (19.4%)	50 (80.6%)	62 (100%)
Century 565 Series	10 (38.5%)	16 (61.5%)	26 (100%)
Kolcraft Rock 'N Ride	2 (11.8%)	15 (88.2%)	17 (100%)
Cosco TL-C	2 (13.3%)	13 (86.7%)	15 (100%)
ALL INFANT SEAT MODELS	**65 (20.9%)**	**246 (79.1%)**	**311 (100%)**
Convertible Seats			
Fisher-Price with T-Shield	124 (49.2%)	128 (50.8%)	252 (100%)
Century 2000 STE	26 (23.4%)	85 (76.5%)	111 (100%)
Century 3000 STE	13 (15.1%)	73 (84.9%)	86 (100%)
Evenflo Ultara I	15 (22.4%)	52 (77.6%)	67 (100%)
Gerry Guard with Securelock	11 (19.3%)	46 (80.7%)	57 (100%)
Century 5000 STE	10 (23.3%)	33 (76.7%)	43 (100%)
Century 1000 STE	5 (12.2%)	36 (87.8%)	41 (100%)
Evenflo Champion	7 (17.5%)	33 (82.5%)	40 (100%)
All Built-in Seats	22 (59.5%)	15 (40.5%)*	37 (100%)
Evenflo One-Step	4 (19.0%)	17 (81.0%)	21 (100%)
ALL CONVERTIBLE SEAT MODELS	**315 (27.3%)**	**839 (72.7%)**	**1,154 (100%)**
Booster Seats			
Gerry Double Guard	5 (4.8%)	99 (95.2%)	104 (100%)
Cosco Explorer	6 (7.2%)	77 (92.8%)	83 (100%)
Century Commander	1 (5.9%)	16 (94.1%)	17 (100%)
Century Breverra	3 (21.4%)	11 (78.6%)	14 (100%)
Fisher-Price T-Shield	--	12 (100%)	12 (100%)
ALL BOOSTER SEAT MODELS	**27 (8.3%)**	**300 (91.7%)**	**327 (100%)**

* Misuses for built-in seats were related to improper harness strap and retainer clip connections around the child.

4.0 SUMMARY AND RECOMMENDATIONS

This chapter presents the summary of findings from the data analysis and state coordinator reports on field operations (i.e., training, site selection and cooperation, data-collection techniques, and other issues) relating to efficient methods to observe and collect CSS misuse data. Recommendations are included that address data-collection techniques, solutions for increasing correct use of CSSs from an engineering and education standpoint, and future research needed to reduce CSS misuse.

4.1 SUMMARY

Based on observations of about 5,900 children of CSS weight (under 60 pounds or 27 kg) in four states spanning the country, overall restraint use was 87.2%; overall CSS and safety belt use was 50.6% and 36.6% respectively, and no restraint use was 12.8%. The level of CSS use for infants (under 20 pounds or 9 kg/approximately birth to 1 year of age) was 96.6%; and for toddlers (20 to 40 pounds or 9 to 18 kg/approximately 1 to 4 years of age) was 67.5%. This data is typical of what has been reported over the last several years. However, the findings did show a major problem with CSS use for booster seat-weight children (40 to 60 pounds or 18 to 27 kg). Less than 10% of these children were in CSSs. In addition, the study revealed that when CSSs were used, misuse (based on a selection of critical misuse criteria) was very high (80%). Because of the extensive training involved and the fact that data collectors were allowed to enter vehicles to check both the children in CSSs and seat installation, the reported CSS misuse data are estimated to be reasonably accurate. The large sample of target children observed provides a good indication of CSS misuse in these four states.

Findings suggest that child weight, family relationship (e.g., parent, grandmother, grandfather, etc.), driver restraint use, and passive occupant protection systems were related to CSS use and misuse. Other findings suggest that there was slightly more CSS misuse when the seat was frequently taken out of the vehicle or the driver learned on his/her own either how to install the CSS in the vehicle or how to place the child in the CSS. However, other factors, such as driver gender and age, driver travel distance and time, driver familiarity with vehicle, number of vehicle occupants, CSS acquisition patterns, and target child seat position showed little, if any, relationship with CSS use or misuse.

The study finds that many young children who are placed in CSSs could be at risk of not attaining the full benefits of the CSS because the CSS is not being used properly, not installed according to manufacturer's recommendations, or that the child is being moved to safety belts too soon. Child restraints, as currently used, are very effective in reducing injuries and fatalities, but are more effective when used properly. The study found a high percentage of CSS misuse among target weight children, but

did not identify the impact of the type of misuse in terms of the injury potential to this target group when used properly.

In addition, it is important to note that the study is not nationally representative and that any conclusions drawn from it should be viewed with the limitations of the sample in mind.

Field Operations

The data-collection effort went very smoothly and was very successful in producing accurate CSS misuse data in a reasonably efficient amount of time. This can be attributed to many factors, including experienced state coordinators and field supervisors, selecting appropriate and cooperative sites, hiring dedicated and dependable field staff, conducting extensive training for state coordinators and field staff, having comprehensive training manuals and supporting materials, adequate training facilities, use of CSS demonstration makes and types, and using efficient and accurate data-collection techniques.

The state coordinators provided input concerning their experience in site selection, obtaining site permission, staff recruiting, training, and data collection. Their experiences and suggestions on effective techniques for collecting CSS misuse data are summarized below.

Site Selection

The most productive locations were shopping centers with family stores (e.g., grocery, children's toy and clothing, and discount department stores, such as Walmart, Kmart, etc.), child recreation centers and parks, and other locations with a high volume of family traffic. In addition, the most productive and safest data-collection sites had few entrances and long funneled entrance lanes. This gave field crew plenty of time to spot potential target vehicles in advance, casually approach the drivers, safely stop target vehicles, briefly explain the purpose of the survey, and direct the driver to a designated parking area to conduct the survey. Being able to slow down the vehicle was also important. This could be done much easier at the longer entrance lane sites. One state had great success at the local zoo, because there was only one entrance, target vehicles were easily approachable, and field staff were able to quickly direct target drivers to designated survey areas. It became evident to the coordinators during the field work that the larger sites were not necessarily the best. These sites typically had too many entrances and parking lane channels. This created some logistic difficulty in spotting target vehicles and finding the right parking lane channel on which to safely approach and stop target vehicles.

Some pilot CSS survey work in amusement parks demonstrated potential difficulty collecting accurate CSS misuse data. Coordinators from two of the states encountered families who were in too much of a hurry to enter the park. Children were unbuckling themselves from the safety belt and CSS and parents were often not willing to spend time with the survey crew. It was felt that these sites did not provide the best opportunity to collect accurate CSS data. In addition, it is important to note that most amusement parks only had summer hours and only limited weekend hours in the spring and fall. Data collection was also difficult at daycare centers. Parents were in a hurry to drop off their children and get to work, which resulted in a high refusal rate.

Site Permission

One of the most challenging tasks of the project was obtaining permission from managers or proprietors of the sites to allow data collection at their location. Several potential sites were not used in the study because permission was not granted by the proprietors. Reasons for not granting permission included the issue of liability and disruption of business by potentially creating a nuisance for store patrons. Some shopping center managers reported a strict policy of not allowing survey work of any kind at their location. Fortunately, because the state coordinators had extensive experience promoting highway safety programs in these communities and either knew the site managers or proprietors or had contacts who knew them, it was less difficult to obtain permission at some of the more familiar sites. The best approach involved including the local police department to help with the request. For the most part, these local police were well known in the community, and usually their presence attached a sense of importance to the data-collection effort. Site permission was granted for every site where local police made the request.

It was impossible to obtain permission from the large amusement/theme park sites (e.g., Wild Waves Water Park in Washington, Great Adventure-Six Flags in Missouri, and Hershey Park and Dutch Wonderland in Pennsylvania). Public relations officials were very concerned about liability and public safety issues. It was also difficult to find the right contact in the organization and to obtain a timely response from that official.

Recruiting Field Staff

Data collectors were recruited through ads in local and college newspapers and regional highway safety bulletins. Associations of retired police officers were also contacted. Candidates were interviewed by telephone and in person. Personal conduct and appearance, availability of time, survey experience, and background in the subject were criteria used in selecting staff. The background of the field staff included marketing survey workers, homemakers, part-time daycare providers, college students, retired police officers, school teachers and other professionals, and

community safety program staff. The best data collectors exhibited eagerness, motivation, and a cheerful personality. Based on earlier experience, it was suggested to the state coordinators that the interviewer (the person who makes the initial contact with the driver) should be female, since it may be less intimidating to most of the drivers who were primarily female. However, in one of the states it was found that male interviewers had equal success in gaining permission to conduct the survey. Three of the states also had great success using college students. Many of the students were highly motivated and eager to perform well. They quickly mastered the data-collection procedures and became proficient in observing and noting misuse characteristics of CSSs. Compensation for the field staff was at the discretion of the state coordinator. Data collectors were paid in the range of $6.50/hour to $8.00/hour. Field site supervisors were paid in the range of $7.50/hour to $12.00/hour.

Training

Training was conducted in two phases. The first phase was a "train-the-trainer" workshop for the state coordinators. The second phase involved training of the field staff by the state coordinators.

The "train-the-trainer" workshop taught the state coordinators what was expected of them when conducting data collection in their region. The workshop covered the following: the project's objectives; an opportunity to interact with leading CSS experts in the country; a discussion of what would be the most practical CSS misuse measures that could be quickly and accurately observed and recorded in the field; how to identify sites and recruit staff; what was involved in training; and how to supervise and conduct data collection. The 3-day event provided enough time to present technical material and data-collection techniques, demonstrate a large variety of CSSs, and conduct practice and "live" data-collection activities at a local shopping center. The experience at the workshop enabled the state coordinators to return to their region and plan and conduct their data-collection activities with minimal guidance from project staff. However, these coordinators were experienced in CSS issues and highway safety programs. State coordinators with only minimal experience in this field might need more than 3 workshop days, especially if their knowledge of CSS types and makes are inadequate.

The regional training sessions involved 3 days of classroom instruction, followed by 2 days of practice data collection and a full week of "live" data collection under close supervision of the state coordinators. In addition to basic instruction on child development and CSS and vehicle restraint issues, the classroom session included exercises on the correct methods of installing seats in vehicles and placing toy infants and toddlers in CSSs. Each region was provided with training manuals, videos, supplemental material (NHTSA's *Child Passenger Safety Resource Manual*), and numerous CSS demonstration make and types. These CSSs proved to be extremely beneficial in giving field staff a first-hand look at how to identify potential misuses with

actual CSSs. Variety in the training lessons was important. Short segments of interspersed lectures, hands-on CSS demonstrations, discussions, and video enhanced the learning experience of the data collectors. All of the state coordinators felt that the 3 days of classroom instruction were adequate, followed by a week of close supervision at the field sites. The need to closely monitor the first few of weeks of data collection was also felt to be very important, especially when identifying data recording issues, such as patterns of missing data or coding errors. Random supervision throughout the data collection period was also suggested.

Data Collection

Data-collection procedures were described earlier in this report. Based on the experience during field work, the following data-collection techniques are considered safe and effective in obtaining observations in a reasonable amount of time with a high level of accuracy .

The most effective technique to get drivers to participate involved setting up a survey station near the end of a long entrance lane that led to a parking lot. The interviewer would safely slow down potential target vehicles, and quickly, but courteously ask the driver to participate. If a positive response was obtained, and in most cases it was, the driver was directed to the designated parking area. This area was probably perceived as being very official since it was marked off with orange traffic cones and signs ("Child Safety Survey"). Sites with only a few entrances were also desirable since it was more difficult for drivers to avoid interacting with the interviewer by changing to another entrance. Entrance lanes where vehicles were moving slowly were also better, since it was easier and safer to intercept these vehicles. It was also important for the interviewer to have a safe area to solicit cooperation for the survey. Since target vehicles were slowing down, it was important that the vehicles behind them be able to maneuver around the stopped vehicle.

It was also important that the data collectors present themselves in a professional manner and look "official." They wore orange reflective vests with a photo identification badge.

Two person teams can quickly and effectively collect CSS misuse data. One person (interviewer) was responsible for interacting with the driver, conducting introductions, explaining the purpose of the survey, asking the driver if there was an interest in watching the other data collector perform the restraint observations, and completing the interview questions. Energetic, highly personable people were placed in this role. The other person (observer) was responsible for the observation tasks, which included entering the vehicle, inspecting the restraint systems, and looking for the CSS misuse criteria. The observer performed these tasks quickly, professionally, and did not touch the children or other occupants. Observers were attentive to detail and had a good working knowledge of CSS misuse characteristics. Teams were able

to complete interviews/observations in about 5 minutes. The best data-collection configuration was to place teams at all the entrance locations at a site.

The number of interviews/observations conducted per hour or per day depended on many variables. Each site varied by the level of family traffic volume and the hours of operation. During the week, the best times for data collection were from when the site (e.g., shopping center) opened to about 3 p.m. On weekends, data could be collected all day, coinciding with store hours. Recreational parks, swimming pools, and other "activity" places were very good sites to collect CSS misuse data in the summer months when school was not in session. Shopping-center sites were good throughout the spring and summer and would probably be good throughout the year, excluding periods of inclement weather. By evaluating the time sheets and quantity of data collected, it was found that the average team could complete two to three CSS misuse interviews/observations in an hour given a steady stream of family traffic volume at the site. However, rates fluctuated dramatically across sites, time of the day, and days of the week. State coordinators placed teams at sites at various times of the day and days of the week, depending on estimated family traffic volumes at these sites. State coordinators investigated these sites in advance and conducted family traffic counts to determine the optimum times for data collection.

In the beginning phase of the project, there were discussions about not collecting data during periods of harsh weather, such as the winter months. However, it was also found that during the summer in periods of very hot weather target vehicle traffic dropped off dramatically at several of the sites. In addition, it was noted that target vehicle traffic dropped off during rainy weather. It was decided not to collect data in the rain, due to issues of safety (reduced visibility), logistics (wet and damaged forms), and public sensitivity (drivers would be quite annoyed if asked to open windows and doors in the rain).

4.2 RECOMMENDATIONS

The recommendations center on two topic areas: (1) CSS misuse data-collection techniques; and (2) CSS programs, countermeasures, and future research necessary to improve CSS use and proper use.

For CSS misuse data-collection techniques, the following recommendations are provided:

- Surveys should incorporate local support to assist in site selection, field staff recruiting, and training. Local support should have expertise in conducting community highway safety programs, have experience with CSS and other occupant protection issues, and be willing to attend "train-the-trainer" workshops.

- Sites should be locations that offer a high volume of family traffic, with limited number of entrance lanes (preferably funneled to a single lane) to increase visibility for staff and provide ample time to safely intercept target vehicles. Sites should have areas to accommodate designated parking areas to conduct the surveys. Sites must also have cooperative site managers or proprietors.

- Data collection should use several teams per site in each region to provide an adequate representation of the CSS use/misuse in the area. Teams should consist of two people. One person should be designated as the spotter and contact person with the target driver, providing introductions and explaining the purpose of survey, requesting permission, and asking the survey questions. The other team member should concentrate on the CSS use and misuse observations. This team approach is the best way to conduct quick, accurate data recording and reduce inconvenience to the public. Well-trained teams are able to complete a survey in less than 5 minutes.

- Data collectors must be highly motivated, personable people, who can conduct themselves in a professional manner. It is desirable that data collectors have some knowledge of survey research and CSS use and misuse issues; however, this is not necessary. A comprehensive training program can provide the knowledge and skills needed for reliable data collection.

- At a minimum, training should include 3 days of classroom instruction and a week of practice and actual data collection under close supervision. The training should be supplemented by a training manual, and other resource material (e.g., NHTSA's *Child Passenger Safety Resource Manual* and manufacturers' instructions for child safety seats). Training should include videos on CSS misuse (e.g., NHTSA's *Automobiles and Child Restraints: At Times an Uneasy Union*), CSS demonstration makes and types that cover the full range of CSS types and harness arrangements, and safety belt configurations and vehicle seat demonstration equipment.

- The training manual should incorporate the following topics: child development issues; types and components of CSSs; types of safety belts and their configurations; guide for correct CSS use; guide for common and less common CSS misuse characteristics; safety belt misuse characteristics; description of most common CSSs; and a guide for data collection. The data-collection procedures should include the following: protocol for interviews and observations; data-collection methodology; interview and observation form instructions and a copy of the forms; vehicle and safety belt type information; case studies and completed observations; a checklist of duties for interviewer and observer; site descriptions; a checklist of daily

activities; a copy of daily and weekly reporting forms; and illustrations of common infant, convertible, and booster seats.

- Data-collection forms should be one-sided. Forms should be set up to accommodate simple coding (e.g., circling responses, putting check marks in boxes, etc.) in the field.

For CSS programs and future research necessary to improve CSS use and proper use, the following recommendations are provided:

- Conduct research to quantify the impact of CSS misuse on children involved in motor vehicle crashes. There needs to be a better understanding of how different types of misuse affect the level of protection in different CSS types. Quantitative values need to be assigned to these misuses with regard to potential injury. Potential procedures might include the use of sled testing or other simulation technology.

- There is still a need to increase CSS use and proper use. Research needs to focus on identifying countermeasures that can dramatically improve the CSS use among toddlers, especially booster-weight children, and dramatically improve the proper use rates among all CSS-weight children. Research is needed to determine what will have the most impact on people properly transporting children.

- Research should focus on the implications of promoting stronger CSS laws, which specify a higher weight or age category, to determine if this encourages people to keep their young children in CSSs longer. Most CSS laws do not include children over 4 years of age who should be in booster seats. In addition, public information and education programs should continue to reinforce the importance of keeping toddlers (20 to 40 pounds or 9 to 18 kg) and pre-school children (40 to 60 pounds or 18 to 27 kg) in CSSs.

- CSS instruction and vehicle owner manuals should provide easy to understand instructions on the proper installation of CSSs in vehicles and the proper way to secure children in CSSs. In addition, programs should include public information messages on the importance of reading CSS instruction booklets and vehicle owner manuals. Clearer language about CSS and vehicle restraint system compatibility should be used in vehicle and CSS owner manuals. In addition, CSS promotional material should include: identification of common CSS misuses (e.g., harness straps, harness retainer [chest] clip, and locking clip); other CSS incompatibility issues with vehicle occupant protection systems (e.g., passenger-side air bags and automatic shoulder belts on the door); vehicle seat design (e.g., seats with humps, deeply contoured, benches, and seats with no headrests); and vehicle safety belt system problems (e.g., CSS compatibility with forward-anchored belts).

- It is important that future programs and data-collection projects include the use of local government and business. It was found that these community members were often quite willing to assist in promoting child passenger safety programs. It was found that the local police were also very willing to help the local coordinators with training facilities and obtaining permission to collect data at the sites. It is also important that police continue to be encouraged to enforce occupant restraint laws, including violations of gross measures of CSS misuse, and adult safety belt laws, since it was shown that there is greater CSS use when the driver is wearing a safety belt. Previous studies (NHTSA, 1990; Decina et al., 1994) have reported that public information and enforcement campaigns increase CSS use and proper use. In addition, healthcare, community safety groups, and the child care community should continue to provide comprehensive information on proper CSS use and vehicle seat design and restraint compatibility issues.

- National CSS misuse data should be collected periodically. It is recommended that biennial surveys be conducted using sites that offer statistical representation of the nation. Identifying trends will provide NHTSA with feedback on the effectiveness of national, state, and local child passenger safety programs and what CSS misuse issues should be incorporated into future programs.

- Research is needed to better understand why some states have much lower occupant restraint use rates than other states.

Other considerations need to be given to CSS and vehicle restraint system design issues that arise from CSS misuses. Vehicle manufacturers should also work more closely with CSS manufacturers to make CSSs more compatible with vehicle seats and occupant protection devices.

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APPENDIX A

DATA-COLLECTION INTERVIEW FORM

Interviewer _____ CSS Observer _____ Date ___/___/____ Time ___:___ AM PM

Site: PA1 PA2 PA3 MO1 MO2 MO3 WA1 WA2 WA3 MS1 MS2 MS3

1. Driver Gender [1] Male [2] Female

2. Driver Relationship to Child(ren) [1] Mother [2] Father [3] Grandma [4] Grandpa [5] Friend [6] Relative [7] Other_____

3a. Child Number, Child Age *(months (e.g., 11m) or years after 2 (e.g., 2y))*, Weight *(estimate)*, and Restraint Type *(C-CSS, S-Safety Belt, N-None, O-Other).*
Did driver/other occupant give weight? [Yes] [No]

#	Age	Wt	RT	#	Age	Wt	RT	#	Age	Wt	RT
( )X	___	___	___	( )X	___	___	___	( )X	___	___	___
( )X	___	___	___	( )X	___	___	___	( )X	___	___	___
D	___	___		( )X	___	___	___	( )X	___	___	___

For the driver and other occupants over 8 years of age and over 70 pounds, record restraint use (Y or N) and restraint misuse (M if misuse observed).

3b. Number of total occupants in vehicle _____

4. Is this the vehicle you regularly drive? [1] Yes [2] No

5. Does vehicle have air bag(s)? Driver side [1] Yes [2] No [3] Unknown
Passenger side [1] Yes [2] No [3] Unknown

[IF THERE ARE NO CSSs IN VEHICLE, SKIP TO QUESTION NO. 12]

---

6. How often is/are CSSs removed from this vehicle?

[1] Frequently [2] Sometimes [3] Infrequently [4] Never

7. How was CSS obtained (use same Child # as identified in Question 3a)?

(____) Child # [1] Pur/New [2] Pur/Usd [3] Gift/New [4] Loan Pgm [5] Other _____
(____) Child # [1] Pur/New [2] Pur/Usd [3] Gift/New [4] Loan Pgm [5] Other _____
(____) Child # [1] Pur/New [2] Pur/Usd [3] Gift/New [4] Loan Pgm [5] Other _____
(____) Child # [1] Pur/New [2] Pur/Usd [3] Gift/New [4] Loan Pgm [5] Other _____

8. Who <u>installed</u> the CSS(s) in this vehicle (enter in same Child # order as Question 7)?

(____) Child # [1] Self [2] Spouse [3] Relative [4] Friend [5] Other _____
(____) Child # [1] Self [2] Spouse [3] Relative [4] Friend [5] Other _____
(____) Child # [1] Self [2] Spouse [3] Relative [4] Friend [5] Other _____
(____) Child # [1] Self [2] Spouse [3] Relative [4] Friend [5] Other _____

Form Number _____ _____ _____ _____

9. If driver or passenger, how did you learn how to install the CSSs in the vehicle? *(Circle all that apply.)*

[1] Read instructions that came in the box
[2] Read instructions on side of CSS
[3] Someone demonstrated CSS installation
[4] Learned on my own
[5] Vehicle owner's manual
[6] Other _____

10. Who put the child in the CSS(s) in this vehicle today (enter in same Child # order as Q7)?

(___) Child # [1] Self [2] Spouse [3] Relative [4] Friend [5] Other _____
(___) Child # [1] Self [2] Spouse [3] Relative [4] Friend [5] Other _____
(___) Child # [1] Self [2] Spouse [3] Relative [4] Friend [5] Other _____
(___) Child # [1] Self [2] Spouse [3] Relative [4] Friend [5] Other _____

11. If driver or passenger, how did you learn to put the child(ren) in the CSS device(s)? *(Circle all that apply.)*

[1] Read instructions that came in the box
[2] Read instructions on side of CSS
[3] Someone demonstrated how to secure child-
[4] Learned on my own
[5] Vehicle owner's manual
[6] Other _____

---

12. Driver Age [1] < 30 [2] 30-39 [3] 40-49 [4] 50 +

13. Distance from Last Stop: _____ Miles

14. Time since Last Stop: _____ Minutes

15. Residence Zipcode _____ _____ _____ _____ _____

16. Vehicle License Number _____ _____ _____ _____ _____ _____ _____

17. Vehicle License State _____ _____ (2-letter state code)

18. Vehicle License Type: Regular _____ Personal _____ Special _____ (e.g., Environmental)

19. *If Survey/Observation was not Completed, Check Here* _____

Reason:

20. Comments (use back of form if more space required):

APPENDIX B

DATA-COLLECTION OBSERVATION FORM

Form Number _____ _____ _____ _____ CSS Observer _____ **OBSERVAT**

START WITH YOUNGEST CHILD

CHILD 1

Age _____ yrs _____ months

Weight _____ lbs

Restrained 1 Unrestrained 2

Position X X X
X X X C
D X X

L/S blts (to door)	1	Deeply cntrd	1
L/S blts (3 pt.)	2	Very slanted	2
Auto w/ L/S blts	3	Ctr curved	3
Auto w/ S blts	4	Pull down jmp	4
Lap blt (2 pt)	5	Narrow rear st	5
Unknown	6	Built-in CSS	6

At bight 1
Away fm bight 2

INFANT SEAT

Rear Facing Yes 1 No 2

	Seat Belt	Lockng Clip	Buckle	Harnss Straps	Chest Clip
Correct	1	1	1	1	1
Unbuckled/ disconnectd	2	-	2	-	-
Misrouted	3	-	-	3	-
Not used	-	4	-	4	4
Improper use/fit	5	5	-	5	5
Not needed	-	8	-	-	8
Unknown	9	9	9	9	9

Manuf	Century	1	Kolcraft	6
	Cosco	2	Renolux/FBS	7
	Evenflo	3	Safeline	8
	Fishr-Prce	4	Strolee	9
	Gerry	5	Other _____	10

CSS Model

CONVERTIBLE SEAT

Forward Facing 1

	St Belt	Lckng Clip
Correct	1	1
Unbuckled/ disconnctd	2	-
Misrouted	3	-
Not used	-	4
Improper use/fit	5	5
Not needed	8	8
Unknown	9	9

Manuf	Century	1
	Cosco	2
	Evenflo	3
	Fishr-Prce	4
	Gerry	5

CSS Model

NEXT YOUNGEST CHILD

CHILD 2

Age _____ yrs _____ months

Weight _____ lbs

Restrained 1 Unrestrained 2

Position X X X
X X X C
D X X

L/S blts (to door)	1	Deeply cntrd	1
L/S blts (3 pt.)	2	Very slanted	2
Auto w/ L/S blts	3	Ctr curved	3
Auto w/ S blts	4	Pull down jmp	4
Lap blt (2 pt)	5	Narrow rear st	5
Unknown	6	Built-in CSS	6

At bight 1
Away fm bight 2

INFANT SEAT

Rear Facing Yes 1 No 2

	Seat Belt	Lockng Clip	Buckle	Harnss Straps	Chest Clip
Correct	1	1	1	1	1
Unbuckled/ disconnectd	2	-	2	-	-
Misrouted	3	-	-	3	-
Not used	-	4	-	4	4
Improper use/fit	5	5	-	5	5
Not needed	-	8	-	-	8
Unknown	9	9	9	9	9

Manuf	Century	1	Kolcraft	6
	Cosco	2	Renolux/FBS	7
	Evenflo	3	Safeline	8
	Fishr-Prce	4	Strolee	9
	Gerry	5	Other _____	10

CSS Model

CONVERTIBLE SEAT

Forward Facing 1

	St Belt	Lckng Clip
Correct	1	1
Unbuckled/ disconnctd	2	-
Misrouted	3	-
Not used	-	4
Improper use/fit	5	5
Not needed	8	8
Unknown	9	9

Manuf	Century	1
	Cosco	2
	Evenflo	3
	Fishr-Prce	4
	Gerry	5

CSS Model

Vehicle Information: Vehicle Type Sedan/Coupe 1 Station Wagon 3 Passenger/Mini-van 5 Pick-up
Hatchback 2 Sports 4 Jeep/4x4/Utility Vehicle 6 Other _

License Number _____ _____ _____ _____ _____ _____ _____ State of Registration _____ _____

Rear Facing 2

Buckle	Harness Straps	Chest Clip
1	1	1
2	-	-
-	3	-
-	4	4
-	5	5
-	-	8
9	9	9

Kolcraft 6
Renolux/FBS 7
Safeline 8
Strolee 9
Other _____ 10

BOOSTER Shield Type 1 Non-Shield Type 2

	Lp Blt	Locking Clip	Shld	Lap Belt	Shldr Belt
Correct	1	1	1	1	Ovr shldr 1
Unbuckled/ disconnectd	2	-	2	2	Too high 2
Misrouted	3	-	-	3	Under arm 3
Not used	-	4	4	-	Behind back 4
Improper use/fit	5	5	-	5	Behind vehicle seat 5
Not needed	-	8	8	8	Not used 8
Unknown	9	9	9	9	Unknown 9
					None 10

Manuf: Century 1, Cosco 2, Evenflo 3, Fishr-Prce 4, Gerry 5

Kolcraft 6
Renolux/FBS 7
Safeline 8
Strolee 9
Other _____ 10

CSS Model

SEAT BELT

Lap Belt	across hips	1
	across abdmen	2
Fit:	too loose	3
	twisted	4
	other incorrct	5
	not used	6
Shldr Belt	over shoulder	1
	too high	2
Fit:	too loose	3
	under arm	4
	behind back	5
	twisted	6
	none	9

Rear Facing 2

Buckle	Harness Straps	Chest Clip
1	1	1
2	-	-
-	3	-
-	4	4
-	5	5
-	-	8
9	9	9

Kolcraft 6
Renolux/FBS 7
Safeline 8
Strolee 9
Other _____ 10

BOOSTER Shield Type 1 Non-Shield Type 2

	Lp Blt	Locking Clip	Shld	Lap Belt	Shldr Belt
Correct	1	1	1	1	Ovr shldr 1
Unbuckled/ disconnectd	2	-	2	2	Too high 2
Misrouted	3	-	-	3	Under arm 3
Not used	-	4	4	-	Behind back 4
Improper use/fit	5	5	-	5	Behind vehicle seat 5
Not needed	-	8	8	8	Not used 8
Unknown	9	9	9	9	Unknown 9
					None 10

Manuf: Century 1, Cosco 2, Evenflo 3, Fishr-Prce 4, Gerry 5

Kolcraft 6
Renolux/FBS 7
Safeline 8
Strolee 9
Other _____ 10

CSS Model

SEAT BELT

Lap Belt	across hips	1
	across abdmen	2
Fit:	too loose	3
	twisted	4
	other incorrct	5
	not used	6
Shldr Belt	over shoulder	1
	too high	2
Fit:	too loose	3
	under arm	4
	behind back	5
	twisted	6
	none	9

Truck 7
_____ 8

Other Observations (Circle Child # 1 2 3 4)

NEXT YOUNGEST CHILD
CHILD 3

Age _____ yrs _____ months

Weight _____ lbs

Restrained 1 Unrestrained 2

Position X X X
X X X C
D X X

L/S blts (to door)	1	Deeply cntrd	1
L/S blts (3 pt.)	2	Very slanted	2
Auto w/ L/S blts	3	Ctr curved	3
Auto w/ S blts	4	Pull down jmp	4
Lap blt (2 pt)	5	Narrow rear st	5
Unknown	6	Built-in CSS	6

At bight 1
Away fm bight 2

INFANT SEAT
Rear Facing Yes 1 No 2

	Seat Belt	Lockng Clip	Buckle	Harnss Straps	Chest Clip
Correct	1	1	1	1	1
Unbuckled/ disconnectd	2	-	2	-	-
Misrouted	3	-	-	3	-
Not used	-	4	-	4	4
Improper use/fit	5	5	-	5	5
Not needed	-	8	-	-	8
Unknown	9	9	9	9	9

Manuf	Century	1	Kolcraft	6
	Cosco	2	Renolux/FBS	7
	Evenflo	3	Safeline	8
	Fishr-Prce	4	Strolee	9
	Gerry	5	Other _____	10

CSS Model

CONVERTIBLE SEAT
Forward Facing 1

	St Belt	Lckng Clip
Correct	1	1
Unbuckled/ disconnctd	2	-
Misrouted	3	-
Not used	-	4
Improper use/fit	5	5
Not needed	8	8
Unknown	9	9

Manuf	Century	1
	Cosco	2
	Evenflo	3
	Fishr-Prce	4
	Gerry	5

CSS Model

NEXT YOUNGEST CHILD
CHILD 4

Age _____ yrs _____ months

Weight _____ lbs

Restrained 1 Unrestrained 2

Position X X X
X X X C
D X X

L/S blts (to door)	1	Deeply cntrd	1
L/S blts (3 pt.)	2	Very slanted	2
Auto w/ L/S blts	3	Ctr curved	3
Auto w/ S blts	4	Pull down jmp	4
Lap blt (2 pt)	5	Narrow rear st	5
Unknown	6	Built-in CSS	6

At bight 1
Away fm bight 2

INFANT SEAT
Rear Facing Yes 1 No 2

	Seat Belt	Lockng Clip	Buckle	Harnss Straps	Chest Clip
Correct	1	1	1	1	1
Unbuckled/ disconnectd	2	-	2	-	-
Misrouted	3	-	-	3	-
Not used	-	4	-	4	4
Improper use/fit	5	5	-	5	5
Not needed	-	8	-	-	8
Unknown	9	9	9	9	9

Manuf	Century	1	Kolcraft	6
	Cosco	2	Renolux/FBS	7
	Evenflo	3	Safeline	8
	Fishr-Prce	4	Strolee	9
	Gerry	5	Other _____	10

CSS Model

CONVERTIBLE SEAT
Forward Facing 1

	St Belt	Lckng Clip
Correct	1	1
Unbuckled/ disconnctd	2	-
Misrouted	3	-
Not used	-	4
Improper use/fit	5	5
Not needed	8	8
Unknown	9	9

Manuf	Century	1
	Cosco	2
	Evenflo	3
	Fishr-Prce	4
	Gerry	5

CSS Model

Rear Facing 2

Buckle	Harnss Straps	Chest Clip
1	1	1
2	-	-
-	3	-
-	4	4
-	5	5
-	-	8
9	9	9

Kolcraft 6
Renolux/FBS 7
Safeline 8
Strolee 9
Other _____ 10

BOOSTER

Shield Type 1

	Lp Blt	Locking Clip	Shld
Correct	1	1	1
Unbuckled/ disconnectd	2	-	2
Misrouted	3	-	-
Not used	-	4	4
Improper use/fit	5	5	-
Not needed	-	8	8
Unknown	9	9	9

Manuf
Century 1
Cosco 2
Evenflo 3
Fishr-Price 4
Gerry 5

CSS Model

Non-Shield Type 2

Lap Belt	Shldr Belt	
1	Ovr shldr	1
2	Too high	2
3	Under arm	3
-	Behind back	4
5	Behind vehicle seat	5
8	Not used	8
9	Unknown	9
	None	10

Kolcraft 6
Renolux/FBS 7
Safeline 8
Strolee 9
Other _____ 10

SEAT BELT

Lap	across hips	1
Belt	across abdmen	2
Fit:	too loose	3
	twisted	4
	other incorrct	5
	not used	6
Shldr	over shoulder	1
Belt	too high	2
Fit:	too loose	3
	under arm	4
	behind back	5
	twisted	6
	none	9

Rear Facing 2

Buckle	Harnss Straps	Chest Clip
1	1	1
2	-	-
-	3	-
-	4	4
-	5	5
-	-	8
9	9	9

Kolcraft 6
Renolux/FBS 7
Safeline 8
Strolee 9
Other _____ 10

BOOSTER

Shield Type 1

	Lp Blt	Locking Clip	Shld
Correct	1	1	1
Unbuckled/ disconnectd	2	-	2
Misrouted	3	-	-
Not used	-	4	4
Improper use/fit	5	5	-
Not needed	-	8	8
Unknown	9	9	9

Manuf
Century 1
Cosco 2
Evenflo 3
Fishr-Price 4
Gerry 5

CSS Model

Non-Shield Type 2

Lap Belt	Shldr Belt	
1	Ovr shldr	1
2	Too high	2
3	Under arm	3
-	Behind back	4
5	Behind vehicle seat	5
8	Not used	8
9	Unknown	9
	None	10

Kolcraft 6
Renolux/FBS 7
Safeline 8
Strolee 9
Other _____ 10

SEAT BELT

Lap	across hips	1
Belt	across abdmen	2
Fit:	too loose	3
	twisted	4
	other incorrct	5
	not used	6
Shldr	over shoulder	1
Belt	too high	2
Fit:	too loose	3
	under arm	4
	behind back	5
	twisted	6
	none	9

APPENDIX C

STATE SITES AND SOCIO-ECONOMIC CHARACTERISTICS

Table C-1. Mississippi Sites

SITE ID	NAME	LOCATION	COUNTY	TYPE OF SITE
MS1*	Wal-Mart	Clinton, MS	Hinds	Discount & Community Shopping Center
MS2	Ton O Fun	Ridgeland, MS	Madison	Children's Entertainment
MS3*	K Mart	Jackson, MS	Hinds	Discount & Community Shopping Center
MS4	Toys R Us	Jackson, MS	Hinds	Toy Store
MS5*	Wal-Mart	Jackson, MS	Hinds	Discount & Community Shopping Center
MS6	Boys Baseball Association	Grove Park Fields, Jackson, MS	Hinds	Baseball Fields
MS7	Wal-Mart	Ridgeland, MS	Madison	Discount & Community Shopping Center
MS26*	Jackson Zoological Park	Jackson, MS	Hinds	Zoo

* These sites accounted for 92 percent of the vehicle observations.

Table C-2. Mississippi Socio-Economic Characteristics[1]

Location	Population	Race (% White)	Age (% 0-4)	Household Size	Household Median Income	Unemployment
Hinds County	254,606	48.4%	7.7%	2.7	$24,676	7.9%
Madison County	58,211	51.2%	8.8%	2.74	$25,887	7.1%
Clinton, MS	21,847	81.3%	6.8%	2.1	$33,787	3.4%
Jackson, MS	196,637	43.7%	7.8%	2.64	$27,410	8.8%
Ridgeland, MS	11,714	86.6%	7.6%	1.3	$31,938	3.2%

[1] Source: US Department of Commerce, Economics & Statistics Administration, Bureau of the Census, *County & City Data Book, 1994*, Washington, DC, August 1994.

Table C-3. Missouri Sites

SITE ID	NAME	LOCATION	COUNTY	TYPE OF SITE
MO1*	Mid Rivers Mall	St. Peters, MO	St. Charles	Shopping Center
MO2*	Toys R US/ Kids R Us	St. Peters, MO	St. Charles	Small Strip Mall
MO3	Bogey Hills	St. Peters, MO	St. Charles	Grocery Superstore

* *These two sites accounted for 99 percent of the vehicle observations.*

Table C-4. Missouri Socio-Economic Characteristics[2]

Location	Population	Race (% White)	Age (% 0-4)	Household Size	Household Median Income	Unemployment
St. Charles County	226,215	96.6%	8.9%	2.83	$40,307	3.8%
St. Peters, MO	49,932	88.4%	10.5%	3.00	$45,298	3.4%
Mid-Rivers Mall and Highway 94 7-mile radius	140,547	96.7%	9.5%	2.91	$43,915	3.4%

[2] Sources: Urban Information Center for the City of St. Peters, 1990 and US Department of Commerce, Economics & Statistics Administration, Bureau of the Census, *County & City Data Book, 1994*, Washington, DC, August 1994.

Table C-5. Pennsylvania Sites

SITE ID	NAME	LOCATION	COUNTY	TYPE OF SITE
PA01	Grandma's Attic	Camp Hill, PA	Cumberland	Store
PA02	Hoover's Plaza	Lemoyne, PA	Cumberland	Community Shopping Center
PA03*	East Shore Library	Harrisburg, PA	Dauphin	Community Library
PA04	BJ's Wholesale Club	Camp Hill, PA	Cumberland	Store
PA05	Darowish & Associates	Harrisburg, PA	Dauphin	Pediatrician's Office
PA06	Camp Hill Shopping Mall	Camp Hill, PA	Cumberland	Mall
PA07	Christian Publications Bookstore	Camp Hill, PA	Cumberland	Store
PA08*	Lower Allen Township Park	Lisburn, PA	Cumberland	Community Park
PA09	Camp UMC Preschool/ Childcare Center	Camp Hill, PA	Cumberland	Daycare Center
PA10	Boiling Springs Pool	Boiling Springs, PA	Cumberland	Community Pool
WC1*	Washington Mall #1	Washington, PA	Washington	Mall
WC3*	McDonalds	Charleroi, PA	Washington	Fast Food Restaurant
WC4*	McDonalds	Monongahela, PA	Washington	Fast Food Restaurant

* These five sites accounted for 83 percent of the vehicle observations.

Table C-6. Pennsylvania Socio-Economic Characteristics[3]

Location	Population	Race (% White)	Age (% 0-4)	Household Size	Household Median Income	Unemployment
Cumberland County	201,108	94.0%	5.9%	2.51	$34,493	2.9%
Dauphin County	242,025	80.9%	7.0%	2.45	$30,985	4.6%
Washington County	206,054	95.5%	5.8%	2.54	$25,469	7.6%
Camp Hill, PA	7,831	--	--	--	$35,433	--
Lemoyne, PA	3,959	--	--	--	$27,865	--
Harrisburg, PA	53,430	41.7%	8.8%	2.39	$20,329	10.4%
Washington, PA	15,864	--	--	--	$16,365	--
Charleroi, PA	5,014	--	--	--	$15,789	--
Monongahela, PA	4,928	--	--	--	$18,849	--

[3] Source: US Department of Commerce, Economics & Statistics Administration, Bureau of the Census, *County & City Data Book, 1994*, Washington, DC, August 1994.

Table C-7. Washington Sites

SITE ID	NAME	LOCATION	COUNTY	TYPE OF SITE
WA1*	Price Costco	Kirkland, WA	King	Membership Warehouse
WA2	Target	Tukwila, WA	King	Discount Retailer
WA3*	Toys R Us	Tukwila, WA	King	Volume Toy Store
WA4	Heaven Sent	Federal Way, WA	King	Children's Consignment Store
WA5	Kym's Kiddie Corner	Seattle, WA	King	Children's Entertainment
WA6*	Crossroads	Bellevue, WA	King	Shopping Mall
WA7*	Factoria	Factoria, WA	King	Shopping Mall
WA8	Heaven Sent	Seattle, WA	King	Children's Consignment Store
WA9	King County Aquatic Center	Federal Way, WA	King	Swimming Pool
WA10	Southcenter	Tukwila, WA	King	Shopping Mall

* These four sites accounted for 87 percent of the vehicle observations.

Table C-8. Washington Socio-Economic Characteristics[4]

Location	Population	Race (% White)	Age (% 0-4)	Household Size	Household Median Income	Unemployment
King County	1,557,537	82.0%	7.0%	2.4	$36,179	4.1%
Seattle, WA	519,598	74.8%	5.7%	2.09	$29,353	5.1%
Bellevue, WA	85,627	87.8%	5.9%	2.41	$43,800	3.8%
Kirkland, WA	40,758	91.2%	6.6%	2.28	$38,437	--
Federal Way, WA	67,554	--	--	--	$38,311	--
Tukwila, WA	11,874	--	--	--	$30,141	--

[4] Source: US Department of Commerce, Economics & Statistics Administration, Bureau of the Census, *County & City Data Book. 1994*, Washington, DC, August 1994.