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An Analysis of Restraint Use by Children in Michigan

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August 1999

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16. Abstract

The objective of this study was to design and conduct an observational survey of child occupant restraint use in Michigan to provide the state with a baseline against which the effects of a special child occupant protection use program could be measured. Analysis of national personal travel data identified schools and non-school sites (fast food restaurants, skating rinks, malls, movie theaters, and recreation centers) as locations frequently visited by children 4-to-15 years of age that were also suitable for an observational study. A stratified random sampling design was developed and 132 sites (4 school and 28 nonschool in each of 4 strata) were sampled. Trained observers visited the sites, located vehicles with target age children, and recorded the occupant restraint use of the children (in all seating positions) and driver of the vehicle, along with other descriptive information. The results showed that overall child occupant restraint use in Michigan was 66 ±3.5 percent. In addition, child occupant restraint use followed closely the driver belt use, with child occupant restraint use more than 81 percent when the driver was using a safety belt. Child occupant restraint use varied by age group with children under 4 years of age more likely to be restrained than children 4-to-15 years of age. Child occupants in vans/minivans and sport utility vehicles were more likely to be restrained than those in pickup trucks and passenger cars. Restraint use varied by seating position, with older children in the front-right position more lilkely to be restrained than in other seating positions and younger children more likely to be restrained in the second row outboard seating positions than in other locations. There were no differences in restraint use by the sex of the child, the trip purpose, or by day of week.

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CONTENTS

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INTRODUCTION

Motor vehicle crashes are the leading source of injury for children under 16 years of age (Gardner, Rosenberg, & Wilson, 1996). In 1996, 11,475 children under 16 years of age were injured or killed in Michigan traffic crashes (Office of Highway Safety Planning, OHSP, 1997). Use of vehicle occupant restraints has been identified as an effective means of reducing trauma incurred by vehicle occupants involved in crashes. In order to reduce the number and rate of vehicle occupants under 16 years of age who are injured in crashes, Michigan legislation mandates that every child under 1 year of age be in a child safety seat (CSS), children between ages 1-to-3 years be in a CSS if riding in the front seat, and children 1-to-3 years of age be in a child occupant restraint device (either in a CSS or using a safety belt) when riding in the back seat (Michigan Vehicle Code 257.710d). Michigan Vehicle Code also requires children between 4 and 16 years of age to be properly secured and belted when riding in a motor vehicle (Michigan Vehicle Code 257.710e).

Michigan has received funding to undertake a special enforcement program intended to reduce child injuries caused by traffic crashes. The program will consist of high profile, zero tolerance enforcement of safety belt/child seat laws for young passengers and will also include an aggressive public information and education program for police officers, parents, and others about safety belt/child restraint use among children.

Information on the current use of occupant restraint devices by children is critical for such programs. It is needed to identify problem areas and to provide a baseline against which changes in child occupant restraint use can be measured. Based on a fairly recent survey of occupant restraint device use in Michigan of children under 4 years of age conducted by the University of Michigan Transportation Reseach Institute (UMTRI) (Eby & Kostyniuk, 1999; Eby, Kostyniuk, & Christoff, 1997), the rate of use for the youngest children is known to be about 75 percent. However, little is known about occupant restraint device use for the 4-to-15-year-old age group. The annual statewide safety belt observational study conducted by UMTRI, shows that safety belt use among 4-to-15-year-old passengers is also about 75 percent (Eby & Olk, 1998). However, because the annual

survey is designed to determine safety belt use by traffic volume, the sample does not include many occupants under 16 years of age. For example, in 1998, less than 3 percent of the sample was under 16 years of age. Further, the annual survey only considers front-outboard seating positions, so backseat occupant restraint use is unknown. Thus, a complete survey of child occupant restraint device use requires a sampling design that targets locations frequented by children in motor vehicles and a survey methodology that includes observations of children in all seating positions. The purpose of this study was to design and conduct such a survey of child occupant restraint device use in Michigan for all seating positions, to be used as a baseline to assess the effects of the state's special enforcement program.

METHODS

Sample Design

The goal of this sample design was to select observation sites that represent accurately locations visited by Michigan children 4-to-15 years of age (target age)[1]. An ideal sample minimizes total survey error while providing sites that can be surveyed efficiently and economically; in this case, sites that have a high likelihood of target age children present. To achieve this goal, the following sampling procedure was used.

Michigan consists of 83 counties, many of which are sparsely populated. To reduce the costs associated with direct observation of remote sites, the National Highway Traffic Safety Administration (NHTSA, 1992) safety belt survey guidelines allow states to omit from their sample space the lowest population counties, provided these counties account for 15 percent or less of the state's total population. These guidelines were adopted for the present survey of child occupant restraint use. Therefore, all 83 Michigan counties were rank ordered by population (U.S. Bureau of the Census, 1992) and the lowest population counties were eliminated from the sample space. This step reduced the sample space to the same 28 counties used in the most recent direct observation surveys of statewide safety belt use (see, e.g., Eby & Hopp, 1997; Eby & Olk, 1998).

Because we wanted to be able to compare child occupant restraint device use rates with statewide safety belt use and CSS use, the same statewide stratification procedure developed for the direct observation of safety belt use study and the CRD use study in Michigan (see Eby & Kostyniuk, 1999; Streff, Eby, Molnar, Joksch, & Wallace, 1993) was used in the present direct observation of statewide child occupant restraint use. The 28 counties were separated into four strata. Table 1 shows the counties contained in each stratum. The strata were constructed by obtaining historical belt use rates and vehicle miles of travel (VMT) for each county. Historical belt use rates were determined by averaging results from three previous UMTRI safety belt surveys (Wagenaar, Molnar, & Businski, 1987b 1988; Wagenaar & Molnar, 1989). Because no historical data were

[1]Children under 4 years of age were included in the survey to the extent that they appeared in vehicles at the sites optimized for observing older children.

available for six of the counties, belt use rates for these counties were estimated using multiple regression based on per capita income and education for the other 22 counties (r^2 = .56; U.S. Bureau of the Census, 1992).[2] These factors have been shown previously to correlate positively with belt use (e.g., Wagenaar, et al., 1987a). Because we wanted to ensure that observation sites were selected within Wayne County, it was made as a separate stratum. Three other strata were constructed by rank-ordering each county by historical belt use rates and then adjusting the stratum boundaries until there were roughly equal total VMT within each stratum. The stratum boundaries were high belt use, medium belt use, low belt use, and Wayne County.

Table 1. Listing of the Counties Within Each Stratum

Stratum Number	Counties
1	Ingham, Kalamazoo, Oakland, Washtenaw
2	Allegan, Bay, Eaton, Grand Traverse, Jackson, Kent, Livingston, Macomb, Midland, Ottawa
3	Berrien, Calhoun, Genesee, Lapeer, Lenawee, Marquette, Monroe, Muskegon, Saginaw, Shiawassee, St. Clair, St. Joseph, Van Buren
4	Wayne

The number of observation sites for the survey (N=128) was determined based on within- and between-county variances from previous adult belt use surveys and an estimated 20 target age children per observation period for the current survey based upon pilot testing. Adult belt use rates were used because they are likely to correlate highly with occupant restraint use by children under 16 years of age.

The types of sites to be observed were determined by examining data from the 1995 Nationwide Personal Transportation Survey (NPTS; Federal Highway Administration, 1997) for children 5-to-15 years of age from the northern Midwest region of the United States. The NPTS, conducted under sponsorship of the U.S. Department of Transportation, serves

[2] Education was defined as the proportion of population in the county over 25 years of age with a professional or graduate degree.

as the authoritative source of national data on daily personal travel of people over 5 years of age (Research Triangle Institute, 1997). Analysis of the NPTS data indicated that schools and places for recreation, eating, and shopping were the most frequent trip destinations and were easily accessed for a direct observation survey. Furthermore, for every automobile trip made to a school, there were seven trips made to nonschool locations. Therefore, schools, malls, fast food restaurants, movie theaters, skating rinks and recreational centers were selected as the sites to be observed in the study. For the purpose of sampling, malls, fast-food restaurants, movie theaters, rinks, and recreation centers were combined. The resulting sampling space consisted of two groups, the combination of sites (called nonschool) and schools.

Within each stratum, 32 observation sites were selected randomly. Of these, 28 were selected randomly without replacement from all nonschool sites likely to be visited by children under 16 years of age (malls, fast food restaurants, movie theaters, skating rinks, and recreational centers), and 4 were selected randomly without replacement from all public and private elementary, middle, and junior high schools. The random selections were made from current lists of such facilities purchased from a company that compiles lists for telemarketing and mail campaigns. In addition, alternative sites were selected for each of the 28 nonschool sites. To minimize the time required to get to an alternative site, alternative sites were selected randomly from sites within the same or adjacent zip code area. No alternative sites were selected for the school sites because observation times at schools were very restricted.

All selected observation sites were contacted to determine when the sites were open and active. Schools were contacted to determine when they were in session and start and end times of the school day. Nonschool sites were contacted to determine hours of operation and the best times to find target age children visiting the site. Once the constraints on when the site could be observed were determined, the day of week and time of day for observation were randomly assigned within the constraints. Vehicles entering nonschool sites were the ones observed. At school sites, entering vehicles were observed in the morning and departing vehicles in the afternoon to match when the children would be in the vehicle.

Table 2 shows the descriptive statistics for the 128 observation sites used in the survey. As shown in this table, the sites were fairly well distributed over the days of the week and throughout the day. The table also shows that approximately 11 percent of the sites were alternate sites and that almost 15 percent of the sites were observed in rainy weather.

Table 2. Descriptive Statistics for the 128 Observation Sites

Day of Week		Start Time		Site Choice		Weather	
Monday	11.7%	8:30-12 pm	20.3%	Primary	89.1%	Sunny	36.8%
Tuesday	15.6%	12-3 pm	30.5%	Alternate	10.9%	Cloudy	48.4%
Wednesday	12.5%	3-5 pm	28.9%			Rain	14.8%
Thursday	10.9%	5-8:30 pm	20.3%			Snow	0.0%
Friday	17.2%						
Saturday	18.0%						
Sunday	14.1%						
TOTALS	100%		100%		100%		100%

Data Collection

Data collection for the study involved direct observation of shoulder belt use and CSS use, estimated age, and sex. Trained field staff observed shoulder belt use of drivers and children under 16 years of age traveling in passenger cars, sport utility vehicles, vans, and pickup trucks during daylight hours from April 15 through April 27, 1999. Observation of safety belt use, age, and sex were conducted when a vehicle entered or exited the site.

Data Collection Forms

Two forms were used for data collection: a site description form and an observation form. The site description form (see Appendix A) provided descriptive information about the site including the site number, location, site type (school, restaurant, or entertainment/recreation), site choice (primary or alternate), observer number, date, day of week, time of day, and weather. A place on the form was also furnished for observers to sketch the site and to identify observation locations and traffic flow patterns. Finally, a comments section was available for observers to identify landmarks that might be helpful in characterizing the site and to discuss problems or issues relevant to the site or study.

The second form, the observation form, was used to record safety belt use, driver and target age passenger information, and vehicle information (see Appendix A). Each observation form was divided in half with each half having room for the survey of a single vehicle. For each vehicle surveyed, its type was recorded as well as the driver's shoulder belt use, sex, and estimated age group. For each target age passenger, restraint use, sex, age group, and seating position were recorded. Children riding in a CRD were recorded as belted even if clear misuse was observable. Occupants observed with their shoulder belt worn under the arm or behind the back were noted but considered as belted in the analysis. At each site, the observer carried several data collection forms and completed as many as were necessary during the observation period.

Procedures at Each Site

Each site in the sample was visited by a pair of observers for a period of 30 minutes. Upon arriving at a site, observers determined whether observations were possible at the site. If observations were not possible (e.g., the business was closed), observers proceeded to the alternate site. Otherwise, observers completed the site description form and then moved to their observation positions at the entrance(s) or exit(s) of the site.

During the observation period, observers recorded data for as many vehicles as they could observe. If traffic flow was heavy, observers were instructed to record data for the first vehicle they saw with target age children and then look up and record data for the next eligible vehicle they saw, continuing this process for the entire observation period.

Observer Training

Prior to data collection, field observers participated in 5 days of intensive training including both classroom review of data collection procedures and practice field observations. Each observer received a training manual containing detailed information on field procedures for observations, data collection forms, and administrative policies and procedures. Included in the manual was a listing of the sites for the study that identified the location of each site (see Appendix B for a listing of the sites), as well as a site schedule identifying the date and time each site was to be observed.

After intensive review of the manual, observers conducted practice observations at several sites chosen to represent the types of sites and situations that would actually be encountered in the field. None of these practice sites was included in the sample of sites observed during the actual study. Training at each practice site focused on completing the site description form, determining where to stand at the site, identifying vehicles with target age children, recording occupant restraint device use, and estimating age group and sex. Observers worked in teams of two, observing the same vehicles, but recording data independently on separate data collection forms. Teams were rotated throughout the training to ensure that each observer was paired with every other observer at least 8 times. Each observer pair practiced recording safety belt use, sex, and age group until there was an interobserver reliability of at least 85 percent for all measures on drivers and passengers for each pair of observers.

Each observer pair was provided with an atlas of Michigan county maps and all necessary field supplies. Observers were given time to mark their assigned sites on the appropriate maps and to plan travel routes to the sites. After marking the sites on their maps, the marked locations were compared with a master map of locations to ensure that the correct sites had been pinpointed. Field procedures were reviewed for the final time and observers were informed that unannounced site visits would be made by the field supervisor during data collection to ensure adherence to study protocols.

Observer Supervision and Monitoring

During data collection, each observer pair was spot checked in the field on at least two occasions by the field supervisor. Contact between the field supervisor and field staff was also maintained on a regular basis through staff visits to the UMTRI office to drop off completed forms and through telephone calls from staff to report progress and discuss problems encountered in the field. Field staff were instructed to call the field supervisor at home if problems arose during evening hours or on weekends.

Incoming data forms were examined by the field supervisor and problems (e.g., missing data, discrepancies between the site description form and site listing or schedule) were noted, discussed with field staff, and corrected. Attention was also given to

comments on the site description form about site-specific characteristics that might affect future surveys (e.g., traffic flow patterns, traffic control devices, site access).

Data Processing and Estimation Procedures

Information from the site and data-collection forms were manually entered into a computer data file. The accuracy of the data entry was verified in two ways. First, all data were entered twice and the data sets were compared for consistency. Second, all data were checked for inconsistent codes and out-of-range variable values. In cases of error, the original data forms were reviewed and corrections were made. Child occupant restraint use rates, variances, and confidence bands were calculated using the procedures detailed in Appendix C.

RESULTS

Description of Drivers Observed

Because the sample was designed for estimating child occupant restraint use rates, survey data are not appropriate for estimating statewide nonchild restraint use rates, such as for the driver. However, as a way of describing the drivers observed in the study, Table 3 presents several characteristics of drivers in the sample, including the percentage of safety belt use. The driver data should not be considered representative of statewide trends.

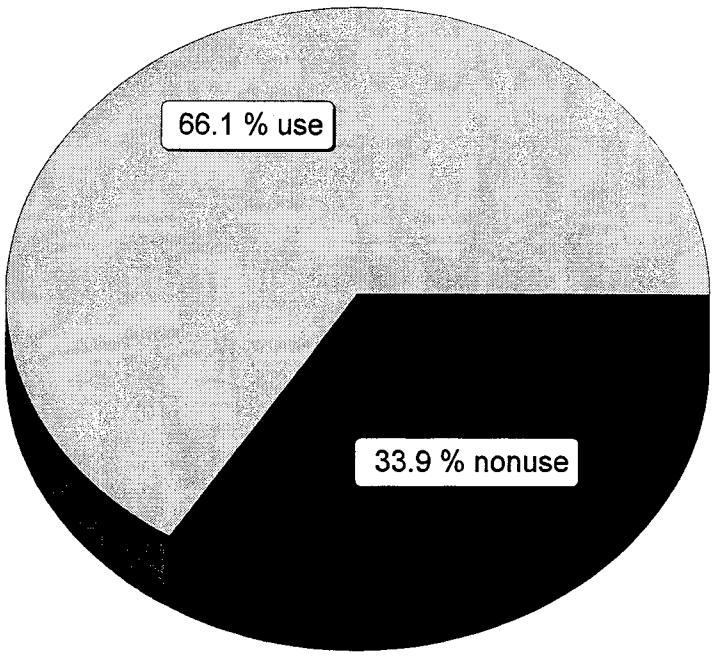
Table 3: Description of Driver Belt Use and Number Observed (N) in the Sample By Age Group and Sex.

	Male		Female		Overall	
Age	**Belted**	**Not Belted**	**Belted**	**Not Belted**	**Belted**	**Not Belted**
16-29	60.9% N=28	39.1% N=18	61.6% N=61	38.4% N=38	61.0% N=89	39.0% N=57
30-59	67.7% N=379	32.3% N=181	73.9% N=853	26.1% N=301	71.9% N=1233	28.1% N=482
60+	65.5% N=19	34.5% N=10	73.7% N=14	26.3% N=5	68.8% N=33	31.2% N=15
Overall	67.1% N=426	32.9% N=209	73.0% N=928	27.0% N=344	71.0% N=1355	29.0% N=554

Overall Child Occupant Restraint Use

As shown in Figure 1, the statewide occupant restraint use rate for passengers under 16 years of age traveling in passenger cars, sport utility vehicles, vans/minivans, and pickup trucks in Michigan during April 1999 was **66.1 ± 3.5 percent**. The "±" value following the use rate indicates a 95 percent confidence band around the percentage. This value should be interpreted to mean that we are 95 percent sure that the actual child occupant restraint use rate falls somewhere between 62.6 percent and 69.6 percent. The use rate, 95 percent confidence band, and unweighted N for all rates shown in Figures 1 -8 can be found in Appendix D.

Figure 1: Michigan Child Occupant Restraint Use Rate



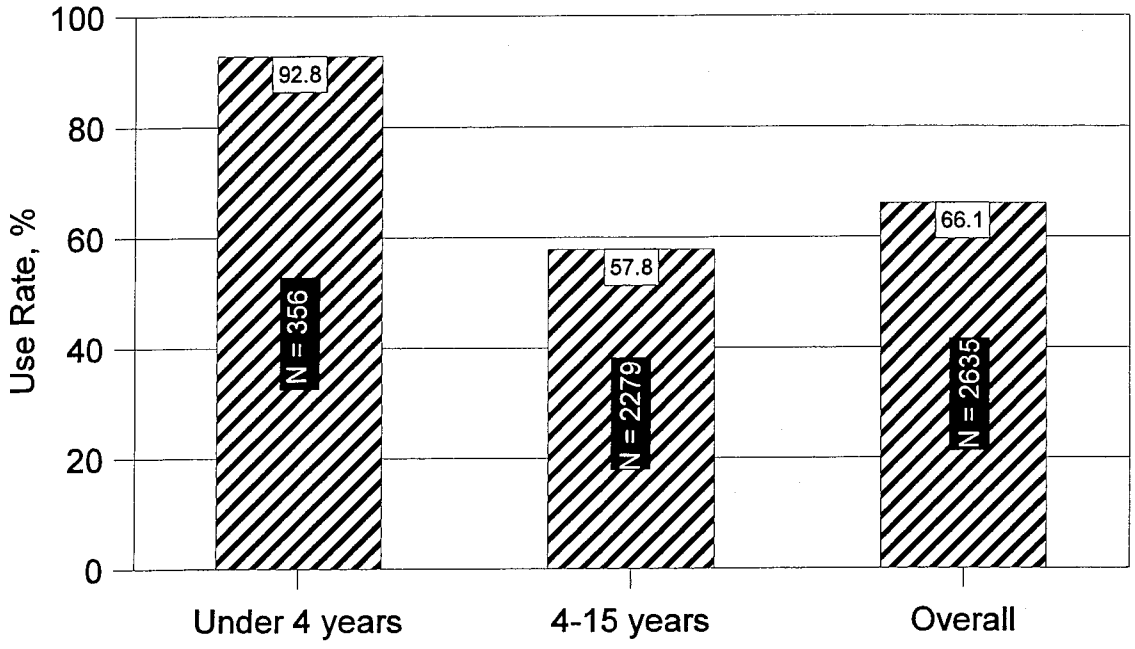
The estimated use rates and unweighted Ns for individual strata are shown in Table 4. Comparing across the strata, we find that the child occupant restraint use rates generally follow Michigan's safety belt use rates (see, e.g., Eby & Olk, 1998).

Table 4: Percent Child Occupant Restraint Use and Unweighted Number of Children Observed by Stratum and Overall.		
	Rate (%)	**Unweighted N**
Stratum 1	73.1 ± 4.9	730
Stratum 2	71.9 ± 5.5	704
Stratum 3	60.6 ± 7.7	668
Stratum 4	59.0 ± 9.0	533
STATE of MICHIGAN	**66.1 ± 3.5**	**2,635**

Child Occupant Restraint Use by Age

Figure 2 shows child occupant restraint use rates by age and the unweighted number of children observed (N). As can be clearly seen, use is significantly greater for the children under 4 years of age than for children who are older.

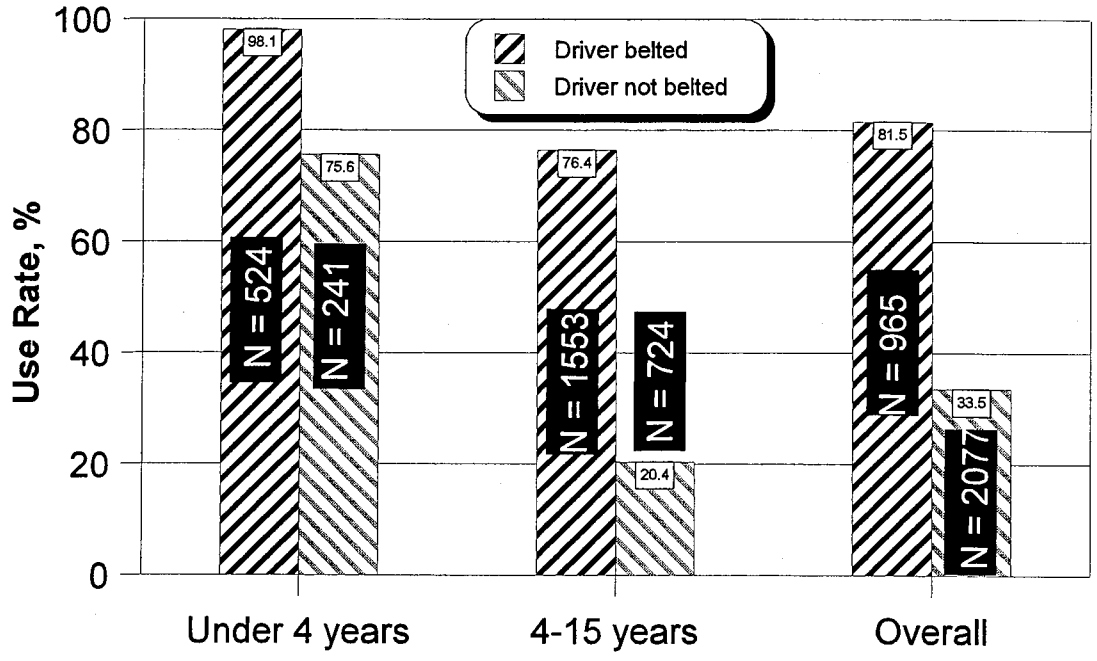
Figure 2: Child Occupant Restraint Use by Age



Child Occupant Restraint Use by Driver Belt Use

The estimated child occupant restraint use rates by driver belt use and the age of the child occupant are shown in Figure 3. As can be seen, use was generally high when the driver was belted, in agreement with the results of other studies in Michigan (see, e.g., Eby, Kostyniuk, & Christoff, 1997; Eby & Kostyniuk, 1999). Also shown is the fact that nearly all children under 4 years of age (98.1 ± 1.5 %) were restrained when the driver was restrained and use declined somewhat in the 4-to-15-year-old age group (76.4 ± 4.4 %). While not surprising, this result suggests that expanded efforts to increase safety belt use for drivers may also increase the frequency of use for children traveling in motor vehicles.

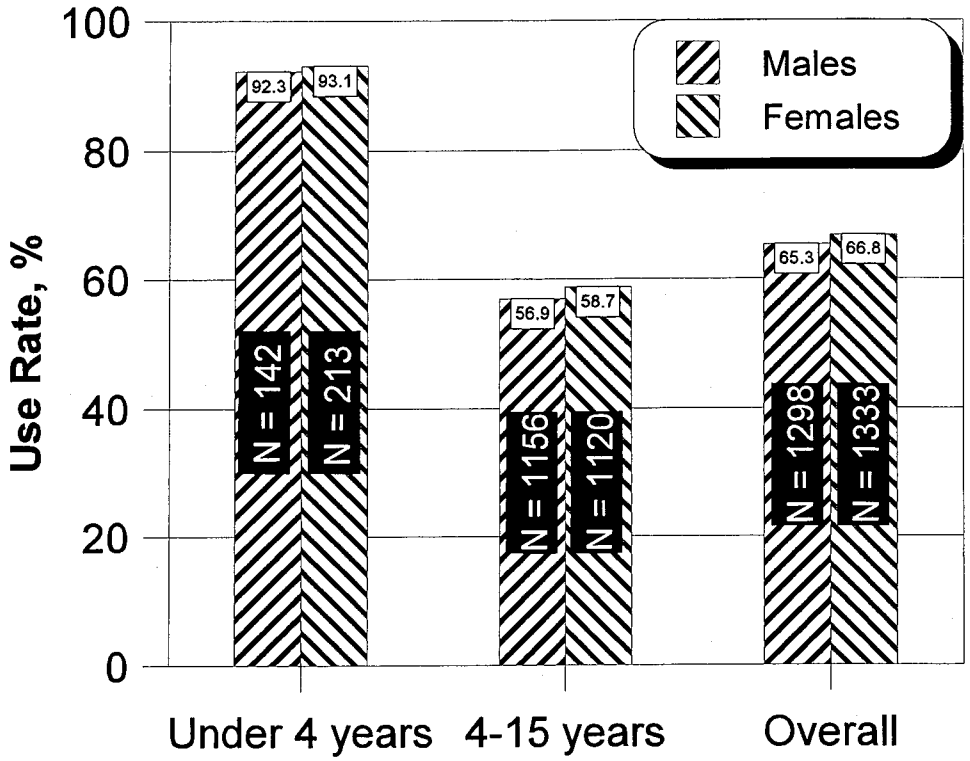
Figure 3: Child Occupant Restraint Use by Age and Driver Safety Belt Use



Child Occupant Restraint Use by Child's Sex

Statewide child occupant restraint use rates for male and female children by age group and overall are shown in Figure 4. Unlike the clear sex differences in safety belt use that have been found for adult drivers and passengers (see, e.g., Agent, 1996; Eby & Olk, 1998; Lange & Voas, 1998), there was no significant difference between male and female child occupants for either of the two age groups or with the age groups combined.

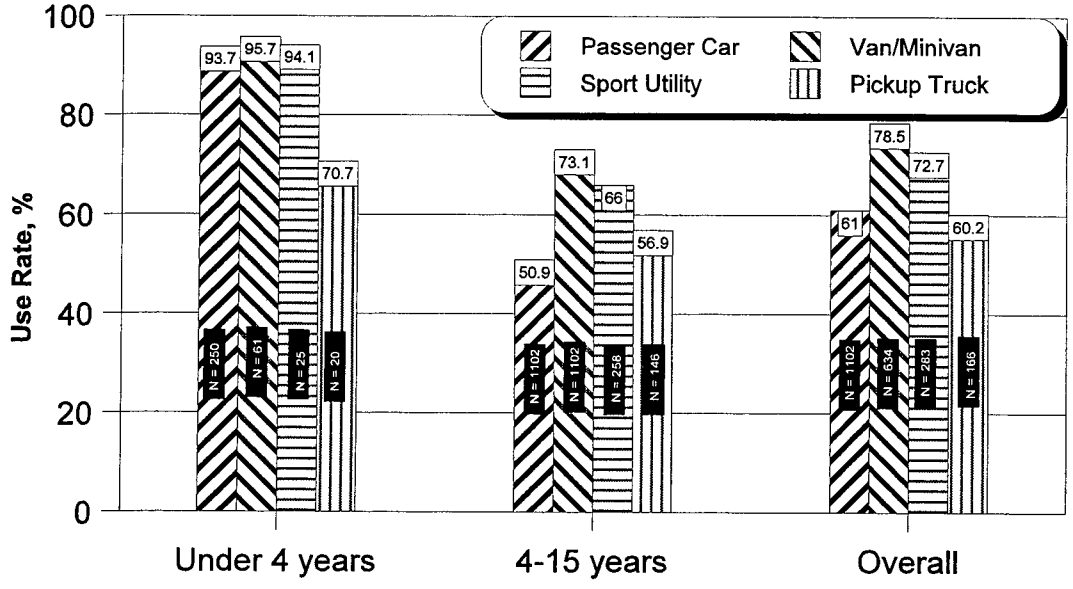
Figure 4: Child Occupant Restraint Use Rates by Child Sex and Age



Child Occupant Restraint Use by Vehicle Type

Shown in Figure 5 are the child occupant restraint use rates in Michigan by age group and overall for each of the four vehicle type observed in the study. Several interesting trends are evident. First, for all vehicle types, occupant restraint use was higher for the youngest age group than for older children. Second, within the under-4-year-old age group, restraint use (seat belt or child safety seat) did not vary as a function of whether the vehicle was a passenger car, van/minivan, or sport utility vehicle, but was considerably lower for pickup truck occupants. Third, considering only the 4-to-15-year-old age group, restraint use varied among the different vehicle types, with restraint use highest for van/minivans and sport utility vehicles, and lowest for passenger cars and pickup trucks. There was no significant difference between passenger cars and pickup trucks. This trend is similar to the current trend for safety belt use in Michigan by vehicle type, except that child restraint use in passenger cars was much lower than observed for front-seat outboard occupants in passenger cars in recent statewide surveys (see, e.g., Eby & Christoff, 1996; Eby & Hopp, 1997; Eby & Olk, 1998). Fourth, the overall child occupant restraint use rates by vehicle type followed the same trend as the rates for the older children with the highest use rate found for van/minivans and sport utility vehicles and the lowest for passenger cars and pickup trucks.

Figure 5: Child Occupant Restraint Use by Age Group and Vehicle Type



Child Occupant Restraint Use by Seating Position

Child occupant restraint use rates by seating position, age group, and overall are shown in Figures 6a-6c, with each graph showing a different row of seats in the vehicle. Examination of the front seat rates (Figure 6a) shows that occupant restraint use was low for both age groups in the center position, and very few children were found in this seating position. In the right seating position, occupant restraint device use was high for both age groups and there was no difference in use between them. The right position was also quite common for older children, with about one-half of the older children in the sample found in this position. Very few under-4-year-olds were seated in the front-right seating position. As shown in Figure 6b, the restraint use rates for the second row of seats varied greatly by age group. The youngest children, regardless of seating position, were restrained at a rate greater than 90 percent, whereas the use rates for older children were about 50 percent for the left and right position and only 26 percent for the center position. About two-thirds of the young children sampled were found in the second row of seats. Finally, very few older children were found in the third row of seats (Figure 6c), and no younger children were observed in this row. The use rates for the 4-to-15-year olds were about the same as the rates for this age group in the second row.

Figure 6a: Child Occupant Restraint Use Rates by Front Row Seating Position, Age Group, and Overall

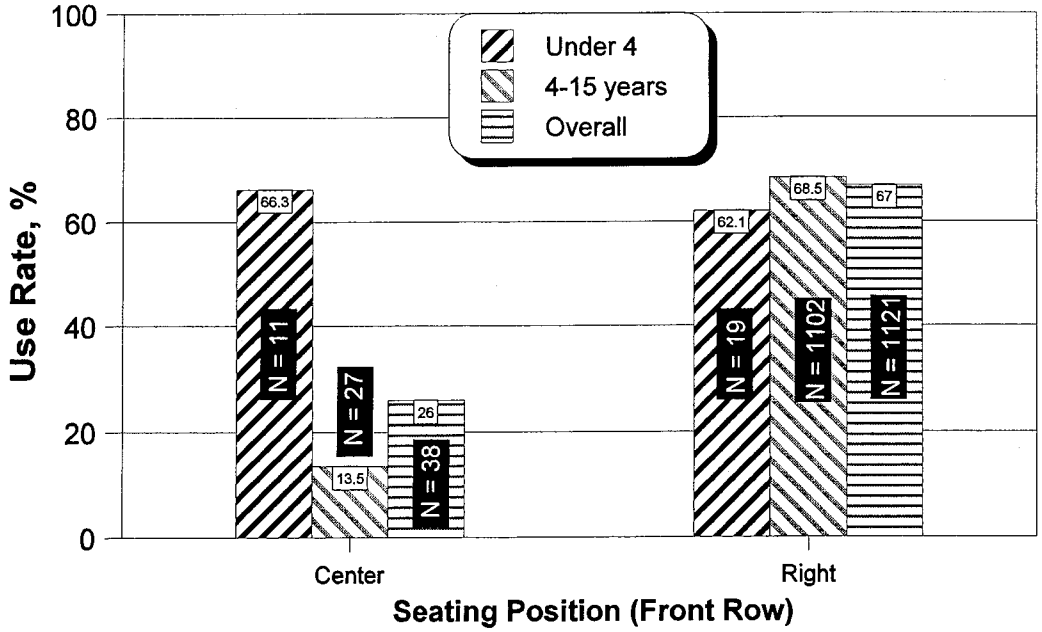


Figure 6b: Child Occupant Restraint Use Rates by 2nd Row Seating Position, Age Group, and Overall

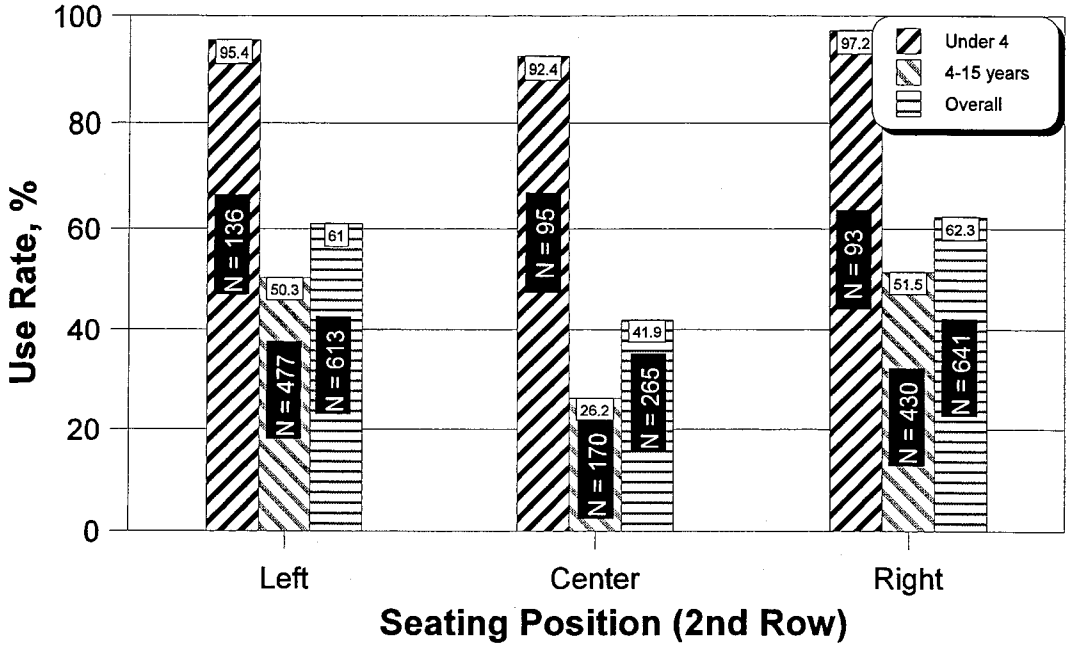
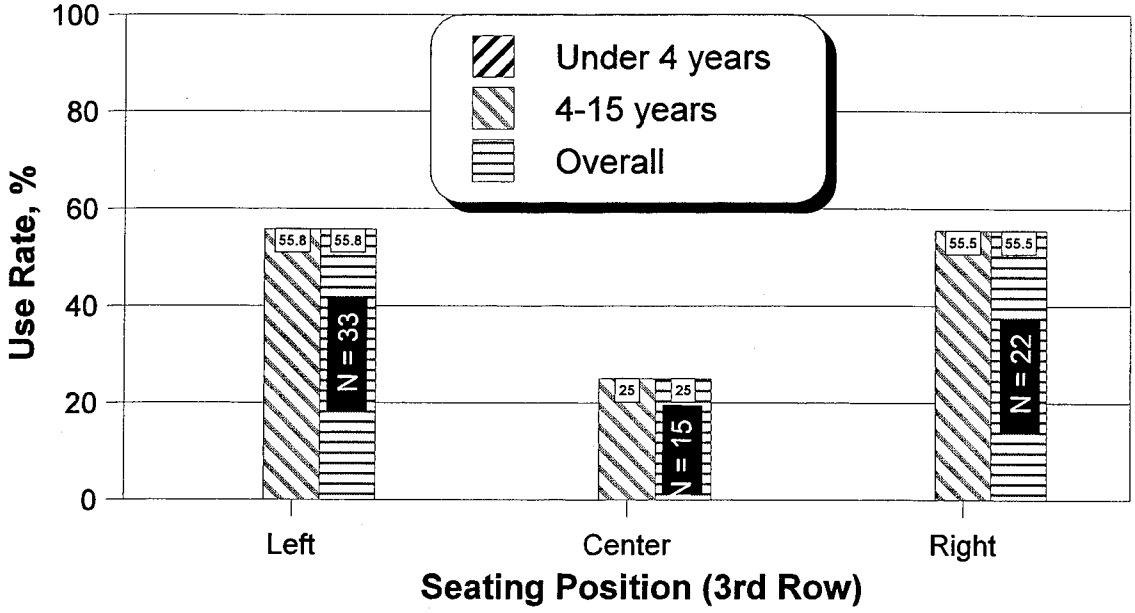


Figure 6c: Child Occupant Restraint Use Rates by 3rd Row Seating Position, Age Group, and Overall

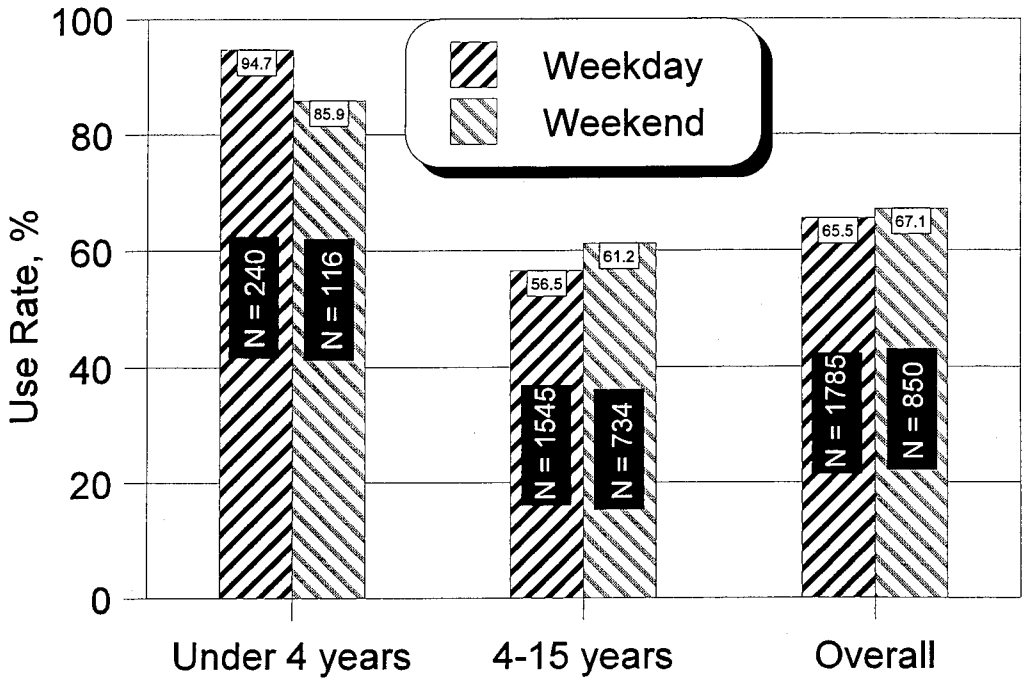


Note: There were no children under 4 years of age observed in the third row of seats.

Child Occupant Restraint Use by Weekend/Weekday

Shown in Figure 7 are the child occupant restraint use rates by weekend (Saturday and Sunday) and weekday (Monday through Friday). For the youngest age group, use was slightly higher on weekdays than weekends. For the older children and when both age groups are combined (overall), there was no significant difference between occupant restraint use on the weekend and weekdays.

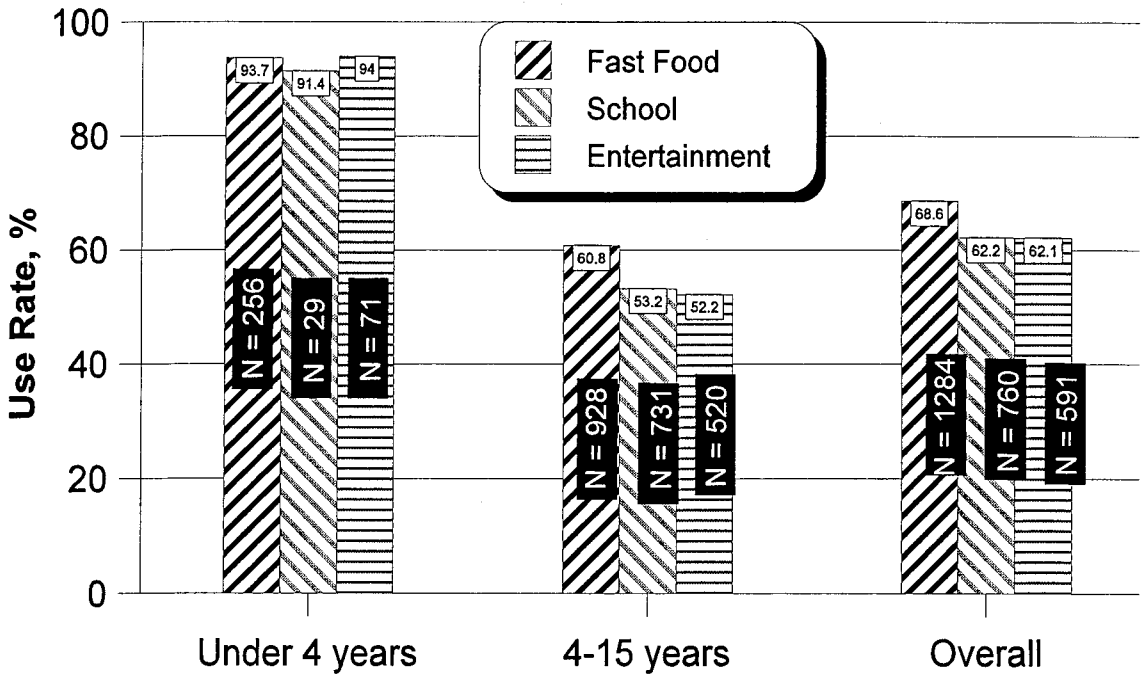
Figure 7: Child Occupant Restraint Use Rates by Age Group and Day of Week



Child Occupant Restraint Use by Type of Trip

Figure 8 shows child occupant restraint use rates by age group and the type of trip. Because of the large number of fast-food restaurants in the study, these sites were separated from other nonschool sites. Because the remaining sites were movie theaters, recreation centers, and skating rinks, these sites are referred to as entertainment sites. There was little difference in occupant restraint use by type of trip for either age group or overall. The slightly increased use seen at fast food restaurants for older children and overall is not significantly greater than rates for other types of trips.

Figure 8: Child Occupant Restraint Use Rate by Age Group and Type of Trip



DISCUSSION

The estimated, statewide child occupant restraint use rate in Michigan for children under 16 years of age was 66.1 percent. This rate shows that Michigan has a significant portion of its child population riding unrestrained in vehicles without being restrained. This rate was lower than the rate of 75.2 percent found in the annual statewide survey of safety belt use conducted by UMTRI in September 1998 for the 4-to-15 year old age group (Eby & Olk, 1998). The difference in rates most likely results from three important factors. First, the annual survey only considers front-seat outboard occupants whereas the current survey includes all seating positions. Second, the annual survey was designed to estimate belt use across the population of Michigan rather than for a specific age group, wehereas the present survey was designed specifically to estimate use rates for child occupants. Third, the estimate for safety belt use among 4-to-15-year olds from the annual survey is based upon only about 300 observations, whereas the estimate from the present survey is based upon more than 2,200 observation of children in this age group. Thus, the present survey gives a much more precise and accurate picture of child occupant restraint use in Michigan than does the annual statewide survey of safety belt use.

The study revealed that child occupant restraint use was lowest in the counties contained in strata 3 and 4: Berrien, Calhoun, Genesee, Lapeer, Lenawee, Marquette, Monroe, Muskegon, Saginaw, Shiawassee, St. Clair, St. Joseph, Van Buren, and Wayne Counties. These are the same counties that exhibit low adult belt use (see e.g., Eby & Olk, 1998) and low child safety seat use, except for Wayne County whose child safety seat use is high (Eby, Kostyniuk, & Christoff, 1997; Eby & Kostyniuk, 1999). This result suggests that public information and enforcement (PI&E) programs should be targeted to these low use areas of the state.

The study showed the child occupant restraint use varies considerably as a function of the child's age. Within all variables analyzed in the study, child occupant restraint use was greater for children under 4 years of age than for children 4-to-15 years of age, with use at nearly 93 percent for the youngest children. This rate for the under-4-year olds is greater than the 74.5 percent statewide child safety seat use rate found in 1997 (Eby,

Kostyniuk, & Christoff, 1997; Eby & Kostyniuk, 1999). Three factors account for the elevated rate for this age group in the present study. First, in the 1997 study, young children in safety belts were not considered restrained because that study's intent was to determine statewide CSS use rather than overall restraint use. The child occupant restraint use rate in the present study includes use of either a child safety seat or safety belts. Second, because of PI&E efforts in Michigan over the last year, the use rate for young children may have increased. Third, the present study sample was designed and weighted for child occupants in the older age group, whereas, the 1997 survey was designed for the under-4-year-old population in Michigan.

We also found that child occupant restraint use was closely related to driver's belt use, a trend also revealed in a recent statewide study of child safety seat use (Eby, Kostyniuk, & Christoff, 1997; Eby & Kostyniuk, 1999). When the driver was using a safety belt, child occupants in Michigan were restrained more than 80 percent of the time compared with only about 33 percent of the time when the driver was not using a safety belt. This result suggests that efforts to increase driver belt use may also have the added benefit of increasing child occupant restraint use.

The study showed that child occupant restraint use varied somewhat by the vehicle type in which the child was a passenger. For the youngest age group, use was high in all vehicle types except pickup trucks. The use rates for older children showed that use was low in both pickup trucks and in passenger cars. This finding was surprising because passenger car safety belt use in Michigan is usually about the same as use in vans/minivans and sport utility vehicles (see e.g., Eby & Christoff, 1996; Eby & Hopp, 1997; Eby & Olk, 1998). Without further research, we cannot offer a definitive explanation for the low child occupant restraint use in passenger cars relative to vans/minivans and sport utility vehicles.

As has been found in other studies in Michigan (Eby, Molnar, & Olk, 1999; Eby, Kostyniuk, & Christoff, 1997; Eby & Kostyniuk, 1999), child occupant restraint use rates varied significantly by the seating position within the vehicle. In the front seat, use was quite low in the center position. Fortunately, less than 1.5 percent of children observed in

the study were found in this position. Use rates in the front-right seating position showed that when the youngest children were seated here (only about 1 percent of the time), they were restrained much less frequently than when seated in other positions in the vehicle. On the other hand, the older children seated in the front-right position (about 50 percent of the time) were restrained more frequently here than in any other seating position. Use rates in the second row of seats showed that use was lowest for both age groups in the center position, use was quite high in all positions for the under-4-year-olds, and use was low for the older children. Examination of use rates for the third row of seats showed that no young children were placed in this row and that very few older children were seated here (less than 3 percent of the entire sample). Among those few who were found in the third row of seats, use was very low.

Finally, analysis of use rates by several other important factors showed that child occupant use did not vary by the child's sex, whether it was a weekend or weekday, or by the type of establishment where data were collected (indicative of the type of trip). The lack of a sex difference shows that parents or guardians are not discriminating by sex when they decide to restrain the child occupant. It is interesting to note that for occupants 16 years of age and older, who are more likely to be making the decision to use or not use safety belts themselves, clear sex differences in use are found, with use significantly lower for males (e.g., see Agent, 1996; Eby & Olk, 1998; Lange & Voas, 1998; Williams, Wells, & Lund, 1987).

In conclusion, the study provides a baseline for statewide assessment of child occupant restraint use programs. Several factors were identified that should prove beneficial in the design and targeting of enforcement and PI&E programs.

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Appendix A: Data Collection Forms

YOUTH SAFETY BELT STUDY SITE DESCRIPTION FORM

SITE # __ __ __ SITE LOCATION _____
1 2 3

DATE (month/day): __ __/__ __/1999
4 5 6 7 8 9 10 11

OBSERVER

1☐ John
2☐ Mary
3☐ Rolf
4☐ Steve
5☐ Graham
6☐ Shumit
7☐ Michelle
8☐ Jonathon
9☐ Dave
0☐ Lidia
12

SITE TYPE
1☐ School
2☐ Movies
3☐ Fast Food
4☐ Mall
5☐ Rec Center
6☐ Rink
7☐ Other
13

SITE CHOICE
1☐ Primary
2☐ Alternate
14

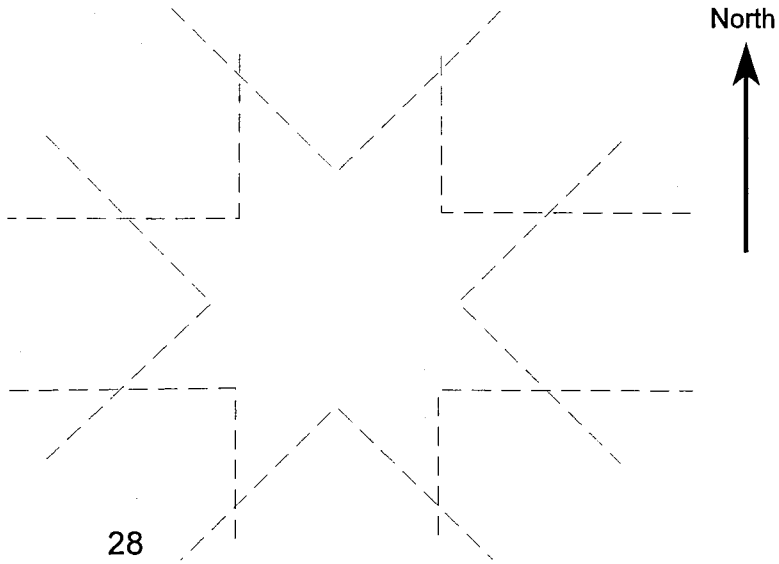
DAY OF WEEK
1☐ Monday
2☐ Tuesday
3☐ Wednesday
4☐ Thursday
5☐ Friday
6☐ Saturday
7☐ Sunday
15

WEATHER
1☐ Mostly Sunny
2☐ Mostly Cloudy
3☐ Rain
4☐ Snow
16

START TIME: __ __:__ __ (24 hour clock)
17 18 19 20

END TIME: __ __:__ __ (24 hr clock)
21 22 23 24

COMMENTS:



BSERVATION FORM
ITE # ___ ___ ___ (1 2 3) OBSERVER NO. _____ (4) Team:_____

ATTENTION CODING: DUPLICATE COL 1 - 4 FOR EACH VEHICLE
PAGE #_____

VEHICLE NO. 1

Psngr car 2☐ Van 3☐ Utility 4☐ Pick-up

DRIVER	CENTER	RIGHT
] Not belted] Belted] B Back] U Arm	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (7)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (8)
] Male] Female (9)	1☐ Male 2☐ Female (10)	1☐ Male 2☐ Female (11)
] 16 - 29] 30 - 59] 60+ (12)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (13)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (14)

~~~2ND ROW~~~

LEFT	CENTER	RIGHT
]Not belted] Belted] B Back] U Arm] CRD (5)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (16)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (17)
] Male] Female (18)	1☐ Male 2☐ Female (19)	1☐ Male 2☐ Female (20)
] 0 - 3] 4 - 9] 10-15 (21)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (22)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (23)

~~~3RD ROW~~~

LEFT	CENTER	RIGHT
] Not belted] Belted] B Back] U Arm] CRD (24)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (25)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (26)
] Male] Female (27)	1☐ Male 2☐ Female (28)	1☐ Male 2☐ Female (29)
] 0 - 3] 4 - 9] 10-15 (30)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (31)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (32)

VEHICLE NO.2

1☐ Psngr car 2☐ Van 3☐ Utility 4☐ Pick-up (5)

DRIVER	CENTER	RIGHT
1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm (6)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (7)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (8)
1☐ Male 2☐ Female (9)	1☐ Male 2☐ Female (10)	1☐ Male 2☐ Female (11)
1☐ 16 - 29 2☐ 30 - 59 3☐ 60+ (12)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (13)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (14)

~~~2ND ROW~~~

LEFT	CENTER	RIGHT
1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (15)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (16)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (17)
1☐ Male 2☐ Female (18)	1☐ Male 2☐ Female (19)	1☐ Male 2☐ Female (20)
1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (21)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (22)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (23)

~~~3RD ROW~~~

LEFT	CENTER	RIGHT
1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (24)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (25)	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD (26)
1☐ Male 2☐ Female (27)	1☐ Male 2☐ Female (28)	1☐ Male 2☐ Female (29)
1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (30)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (31)	1☐ 0 - 3 2☐ 4 - 9 3☐ 10-15 (32)

e: Form is not shown at actual size.

Appendix B: Site Listing

No	address	city	county	stratum	type
1	1630 HASLETT RD # 2	HASLETT	INGHAM	1	fast food
2	1891 CEDAR ST	HOLT	INGHAM	1	rink
3	1982 W GRAND RIVER AVE	OKEMOS	INGHAM	1	mall
4	2030 W GRAND RIVER AVE	OKEMOS	INGHAM	1	fast food
5	3477 OKEMOS RD	OKEMOS	INGHAM	1	fast food
6	2120 N LARCH ST	LANSING	INGHAM	1	fast food
7	523 S WAVERLY RD	LANSING	INGHAM	1	fast food
8	4200 STADIUM DR	KALAMAZOO	KALAMAZOO	1	fast food
9	3992 S WESTNEDGE AVE	KALAMAZOO	KALAMAZOO	1	fast food
10	24432 W 10 MILE	SOUTHFIELD	OAKLAND	1	fast food
11	2829 W 14 MILE RD	ROYAL OAK	OAKLAND	1	fast food
12	22729 PONTIAC TRL	SOUTH LYON	OAKLAND	1	fast food
13	21350 GREENFIELD RD	OAK PARK	OAKLAND	1	fast food
14	201 E AUBURN RD	ROCHESTER HILLS	OAKLAND	1	kid food
15	2801 W HAMLIN RD	ROCHESTER HILLS	OAKLAND	1	rec center
16	2140 ORCHARD LAKE RD	SYLVAN LAKE	OAKLAND	1	fast food
17	5700 DRAKE RD	WEST BLOOMFIELD	OAKLAND	1	rink
18	4820 HIGHLAND RD	WATERFORD	OAKLAND	1	fast food
19	315 N TELEGRAPH RD	WATERFORD	OAKLAND	1	mall
20	4772 DIXIE HWY	WATERFORD	OAKLAND	1	fast food
21	30170 GRAND RIVER AVE	FARMINGTON HILLS	OAKLAND	1	movie
22	2614 UNION LAKE RD	COMMERCE TWP	OAKLAND	1	fast food
23	2150 JACKSON AVE	ANN ARBOR	WASHTENAW	1	rink
24	1590 S MAIN ST	CHELSEA	WASHTENAW	1	fast food
25	1177 DEXTER ST	MILAN	WASHTENAW	1	fast food
26	3015 WASHTENAW	YPSILANTI	WASHTENAW	1	rec center
27	3825 CARPENTER RD	YPSILANTI	WASHTENAW	1	fast food
28	4100 CARPENTER RD	YPSILANTI	WASHTENAW	1	movie
29	76 S MAIN ST	PLAINWELL	ALLEGAN	2	rink
30	1218 M 89	PLAINWELL	ALLEGAN	2	fast food
31	1310 M 89	PLAINWELL	ALLEGAN	2	fast food
32	905 N EUCLID AVE	BAY CITY	BAY	2	fast food
33	6304 WEST SAGINAW RD	BAY CITY	BAY	2	fast food
34	2504 N US HIGHWAY 31 N	TRAVERSE CITY	G TRAVERSE	2	fast food
35	1313 W NORTH ST	JACKSON	JACKSON	2	rink
36	952 N WEST AVE	JACKSON	JACKSON	2	fast food
37	3306 E MICHIGAN AVE	JACKSON	JACKSON	2	fast food
38	1850 W MICHIGAN AVE	JACKSON	JACKSON	2	mall
39	1300 S WEST AVE	JACKSON	JACKSON	2	fast food
40	4341 PAGE AVE	MICHIGAN CENTER	JACKSON	2	fast food
41	13201 W MICHIGAN AVE	PARMA	JACKSON	2	fast food
42	3651 84TH ST SW	BYRON CENTER	KENT	2	rink
43	850 28TH ST SE	GRAND RAPIDS	KENT	2	fast food
44	6230 KALAMAZOO AVE SE	KENTWOOD	KENT	2	rink
45	1285 28TH ST SW	GRAND RAPIDS	KENT	2	fast food
46	3450 36TH ST SE	GRAND RAPIDS	KENT	2	rec center
47	3757 PLAINFIELD AVE NE	GRAND RAPIDS	KENT	2	fast food
48	22 44TH ST SW	GRAND RAPIDS	KENT	2	fast food
49	3639 E GRAND RIVER AVE	HOWELL	LIVINGSTON	2	fast food
50	15205 E 8 MILE RD	EASTPOINTE	MACOMB	2	fast food
51	67000 VAN DYKE	ROMEO	MACOMB	2	fast food
52	28582 DEQUINDRE RD	WARREN	MACOMB	2	fast food

53	35100 VAN DYKE AVE	STERLING HEIGHTS	MACOMB	2	movie
54	1510 S SAGINAW RD	MIDLAND	MIDLAND	2	fast food
55	4989 LAKE MICHIGAN DR	ALLENDALE	OTTAWA	2	fast food
56	219 N 7TH ST	GRAND HAVEN	OTTAWA	2	rink
57	1986 STATE ROUTE 139	BENTON HARBOR	BERRIEN	3	fast food
58	221 PAW PAW ST	COLOMA	BERRIEN	3	movie
59	929 COLUMBIA AVE W	BATTLE CREEK	CALHOUN	3	fast food
60	1260 W MICHIGAN AVE	MARSHALL	CALHOUN	3	fast food
61	1507 N EATON RD	ALBION	CALHOUN	3	fast food
62	303 S MILL ST	CLIO	GENESEE	3	fast food
63	12741 S SAGINAW ST	GRAND BLANC	GENESEE	3	mall
64	3625 S DORT HWY	FLINT	GENESEE	3	fast food
65	3215 MILLER RD	FLINT	GENESEE	3	fast food
66	5947 N LAPEER RD	NORTH BRANCH	LAPEER	3	fast food
67	3150 N ADRIAN HWY	ADRIAN	LENAWEE	3	movie
68	1357 S MAIN ST	ADRIAN	LENAWEE	3	fast food
69	503 S MERIDIAN RD	HUDSON	LENAWEE	3	fast food
70	1006 W CHICAGO BLVD	TECUMSEH	LENAWEE	3	fast food
71	US HIGHWAY 41 W	ISHPEMING	MARQUETTE	3	fast food
72	3062 US 41 west	MARQUETTE	MARQUETTE	3	fast food
73	539 TECUMSEH ST	DUNDEE	MONROE	3	fast food
74	14530 LAPLAISANCE RD	MONROE	MONROE	3	fast food
75	1455 N TELEGRAPH RD	MONROE	MONROE	3	fast food
76	2039 E APPLE AVE	MUSKEGON	MUSKEGON	3	fast food
77	3205 COLBY RD	WHITEHALL	MUSKEGON	3	fast food
78	3700 E GENESEE	SAGINAW	SAGINAW	3	fast food
79	8030 GRATIOT RD	SAGINAW	SAGINAW	3	fast food
80	7945 GRATIOT RD	SAGINAW	SAGINAW	3	fast food
81	3077 LANSING RD	PERRY	SHIAWASSEE	3	fast food
82	3100 GRATIOT BLVD	MARYSVILLE	ST CLAIR	3	fast food
83	1011 24TH ST	PORT HURON	ST CLAIR	3	fast food
84	1506 N MAIN ST	THREE RIVERS	ST JOSEPH	3	rink
85	10930 BELLEVILLE RD	BELLEVILLE	WAYNE	4	fast food
86	5714 S TELEGRAPH RD	DEARBORN HEIGHTS	WAYNE	4	fast food
87	7300 WYOMING ST	DEARBORN	WAYNE	4	fast food
88	2100 KINLOCH	DEARBORN HEIGHTS	WAYNE	4	rink
89	2205 MIDDLEBELT RD	GARDEN CITY	WAYNE	4	fast food
90	27077 S RIVER PARK DR	INKSTER	WAYNE	4	mall
91	556 SOUTHFIELD RD	LINCOLN PARK	WAYNE	4	fast food
92	2306 DIX HWY	LINCOLN PARK	WAYNE	4	fast food
93	2160 DIX HWY	LINCOLN PARK	WAYNE	4	fast food
94	39555 6 MILE RD	NORTHVILLE	WAYNE	4	fast food
95	409 N MAIN ST	PLYMOUTH	WAYNE	4	fast food
96	10500 TELEGRAPH RD	TAYLOR	WAYNE	4	fast food
97	7900 N MIDDLEBELT RD	WESTLAND	WAYNE	4	fast food
98	41465 FORD RD	CANTON	WAYNE	4	fast food
99	14791 EUREKA RD	SOUTHGATE	WAYNE	4	fast food
100	18350 HAWTHORNE ST	DETROIT	WAYNE	4	rec center
101	15170 GRATIOT AVE	DETROIT	WAYNE	4	fast food
102	420 LEIGH ST	DETROIT	WAYNE	4	rec center
103	1601 CLARK ST	DETROIT	WAYNE	4	rec center
104	6211 W WARREN AVE	DETROIT	WAYNE	4	fast food
105	9239 GRATIOT AVE	DETROIT	WAYNE	4	fast food

106	13320 E JEFFERSON AVE	DETROIT	WAYNE	4	fast food
107	16196 TELEGRAPH RD	DETROIT	WAYNE	4	fast food
108	16630 LAHSER RD	DETROIT	WAYNE	4	rec center
109	21755 W 7 MILE RD	DETROIT	WAYNE	4	rec center
110	18430 FORD RD	DETROIT	WAYNE	4	fast food
111	8000 W OUTER DR	DETROIT	WAYNE	4	fast food
112	14257 TELEGRAPH RD	REDFORD	WAYNE	4	fast food
113	3845 VANNETER RD	WILLIAMSTON	INGHAM	1	school
114	32600 FLANDERS ST	FARMINGTON	OAKLAND	1	school
115	1500 BOGIE LAKE RD	WHITE LAKE	OAKLAND	1	school
116	1655 DECKER RD	WALLED LAKE	OAKLAND	1	school
117	440 RIVER ST	ALLEGAN	ALLEGAN	2	school
118	7738 N LONG LAKE RD	TRAVERSE CITY	G TRAVERSE	2	school
119	700 ELIZABETH ST	LOWELL	KENT	2	school
120	48400 SUGARBUSH RD	NEW BALTIMORE	MACOMB	2	school
121	1716 TERRITORIAL RD	BENTON HARBOR	BERRIEN	3	school
122	701 CRAPO ST	FLINT	GENESEE	3	school
123	10109 SLEE RD	ONSTED	LENAWEE	3	school
124	4TH	HOLTON	MUSKEGON	3	school
125	24900 MEADOWS AVE	FLAT ROCK	WAYNE	4	school
126	3361 23RD ST	DETROIT	WAYNE	4	school
127	18401 W MCNICHOLS RD	DETROIT	WAYNE	4	school
128	1275 COOK RD	GROSSE POINTE	WAYNE	4	school

Appendix C: Estimation of Child Occupant Restraint Use Rates, Variances, and Confidence Bands

The statewide child occupant restraint use rate was estimated from observations at a stratified random sample of sites in Michigan known to be visited by children between the ages of 4 and 15 years, based upon results of the National Personal Transportation Survey (NPTS; Research Triangle Institute, 1997). (Children under 4 years of age were included in the sample when they appeared, but the sample was designed for older children.) The sites used in the sample were schools, restaurants (fast food), and entertainment centers (movie theaters, skating rinks, and recreation centers). Because of possible differences in the child occupant restraint use rates at schools and other sites, separate estimates were obtained for schools and nonschool sites and combined to obtain a statewide child occupant use rate.

For each stratum, there were N_s possible school sites and N_o possible other sites of which n_s school sites and n_o other sites were sampled. For school sites in stratum *i* at sample *j*, y_{sij} children were observed, of which x_{sij} were restrained. Similarly, for nonschool sites in stratum *i* at sample *j*, y_{oij} children were observed of which x_{oij} were restrained. The restraint use rate estimate for school sites in stratum *i* was calculated using Equation 1:

$$P_{si} = \frac{\sum_{j=1}^{n_{si}} x_{sij}}{\sum_{j=1}^{n_{si}} y_{sij}} \qquad (1)$$

The restraint use rate estimate for nonschool sites in stratum *i* was calculated using Equation 2:

$$P_{oi} = \frac{\sum_{j=1}^{n_{oi}} x_{oij}}{\sum_{j=1}^{n_{oi}} y_{oij}} \qquad (2)$$

The estimate of the variance for school sites in stratum *i* was calculated using Equation 3:

$$v_{si}=\frac{n_{si}}{n_{si}-1}\sum_{j=1}^{n_{si}}\left[\left(\frac{y_{sij}}{\sum_{j=1}^{n_{si}}y_{sij}}\right)^2(p_{sij}-p_{si})^2\right] \tag{3}$$

The estimate of the variance for nonschool sites in stratum *i* was calculated using Equation 4:

$$v_{oi}=\frac{n_{oi}}{n_{oi}-1}\sum_{j=1}^{n_{oi}}\left[\left(\frac{y_{oij}}{\sum_{j=1}^{n_{oi}}y_{oij}}\right)^2(p_{oij}-p_{oi})^2\right] \tag{4}$$

When combining school trips (school sites) and nonschool trips (other sites) in a stratum, school-age children were distinguished from the preschool age children because the sampling of school and nonschool sites was based on the relative frequencies of these trips by school age children and not by preschool aged children. The ratio of the number of trips to nonschool sites to the number of trips to school sites by private automobile by school aged children was defined as *t*. Because according to NPTS data, school age children make about one school trip for every seven nonschool trips in Michigan, *t* was seven for these analyses. It was assumed that *t* was constant across all strata. Combining the child occupant use rate estimates by their relative proportions yielded an overall average child occupant restraint use rate for school age children in stratum *i*. This calculation was done using Equation 5, where the prime (') indicates school age children:

$$P_i'=\frac{P_{si}'+tP_{oi}'}{1+t} \tag{5}$$

The variances for school aged children was calculated using Equation 6:

$$V_i' = \frac{V_{si}' + t^2 V_{oi}'}{(1+t)^2} \tag{6}$$

School trips by preschool children in this analysis were considered to be equivalent to nonschool (other) trips. Therefore, the population of possible sites for this age group in each stratum was $N = N_s + N_o$, and the number of sites that are sampled was $n = n_s + n_o$. At each site *j* in stratum *i*, y''_{ij} preschool children are observed and x''_{ij} of them are restrained, where the double-prime (") indicates preschool age children. The child occupant restraint use estimate for preschool age children was calculated using Equation 7:

$$P_i'' = \frac{\sum_{j=1}^{n_i} x_{ij}''}{\sum_{j=1}^{n_i} y_{ij}''} \tag{7}$$

The variance estimate for preschool age children was calculated using Equation 8:

$$V_i'' = \frac{n_i}{n_i - 1} \sum_{j=1}^{n_i} \left[\left(\frac{y_{ij}''}{\sum_{j=1}^{n_i} y_{ij}''} \right)^2 (p_{ij}'' - p_i'')^2 \right] \tag{8}$$

The child occupant restraint use rate estimate for each stratum was determined by combining the use rate estimates for both age groups and weighting the analyses by the population of children in each age group for each stratum. This calculation was done using Equation 9 where m'_i was the number of school age children in stratum *i* and m''_i was the number of preschool age children in stratum *i*:

$$P_i = \frac{m_i' P_i' + m_i'' P_i''}{m_i' + m_i''} \quad (9)$$

The variance was calculated using Equation 10:

$$V_i = \frac{(m_i')^2 V_i' + (m_i'')^2 V_i''}{(m_i' + m_i'')^2} \quad (10)$$

The overall child occupant restraint use rate, combined across the strata, was determined using Equation 11:

$$P = \frac{\sum_{i=1}^{4} m_i' P_i' + \sum_{i=1}^{4} m_i'' P_i''}{\sum_{i=1}^{4} (m_i' + m_i'')} \quad (11)$$

The variance for the overall child occupant use rate for Michigan was calculated using Equation 12:

$$P = \frac{\sum_{i=1}^{4} (m_i')^2 V_i' + \sum_{i=1}^{4} (m_i'')^2 V_i''}{\left(\sum_{i=1}^{4} (m_i' + m_i'') \right)^2} \quad (12)$$

The 95 percent confidence band for the statewide estimate were calculated with Equation 13:

$$95\,Percent\,Confidence\,Band = P \pm 1.96\sqrt{V} \tag{13}$$

Finally, the relative error or precision of the use rate estimates was computed using Equation 14:

$$Rel\,Err = \frac{\sqrt{V}}{P} \tag{14}$$

The overall statewide child occupant restraint use rate estimate for Michigan has a relative error of 2.7 percent which was well below the 5 percent relative error allowed by NHTSA (1992; 1998) for statewide surveys of safety belt use.

Appendix D: Child Occupant Restraint Use Rates, 95% Confidence Bands, and Unweighted Numbers of Observations (N)

Table 5: Child Occupant Restraint Use Rates and Unweighted Ns by Age Group		
Age	**Rate (%)**	**N**
0-3	92.8 ± 3.1	356
4-14	57.8 ± 4.5	2279
Overall	66.1 ± 3.5	2635

Table 6: Child Occupant Restraint Use Rates and Unweighted Ns by Age Group and Driver Safety Belt Use				
	Driver Belted		**Driver Not Belted**	
Age	**Rate (%)**	**N**	**Rate (%)**	**N**
0-3	98.1 ± 1.5	271	75.6 ± 11.0	85
4-15	76.4 ± 4.4	1553	20.4 ± 4.5	724
Overall	81.5 ± 3.4	1824	33.5 ± 4.3	809

Table 7: Child Occupant Restraint Use Rates and Unweighted Ns by Age Group and Sex				
	Male		**Female**	
Age	**Rate (%)**	**N**	**Rate (%)**	**N**
0-3	92.3 ± 4.6	142	93.1 ± 3.7	213
4-15	56.9 ± 5.2	1156	58.7 ± 5.7	1120
Overall	65.3 ± 4.1	1298	66.8 ± 4.4	1333

Table 8: Child Occupant Restraint Use Rates and Unweighted Ns by Age Group and Vehicle Type

	Passenger Car		Van/ Minivan		Sport Utility Vehicle		Pickup Truck	
Age	Rate (%)	N	Rate (%)	N	Rate (%)	N	Rate (%)	N
0-3	93.7 ± 3.2	250	95.7 ± 6.3	61	94.1 ± 7.6	25	70.7 ± 29.3	20
4-15	50.9 ± 4.8	1330	73.1 ± 5.6	573	66.0 ± 8.0	258	56.9 ± 11.1	146
Overall	61.0 ± 3.7	1550	78.5 ± 4.5	634	72.7 ± 6.3	283	60.2 ± 10.9	166

Table 9: Child Occupant Restraint Use Rates and Unweighted Ns in Front Row by Age Group and Seating Position

	Center		Right	
Age	Rate (%)	N	Rate (%)	N
0-3	66.3 ± 38.7	11	62.2 ± 23.7	19
4-15	13.5 ± 46.6	27	68.5 ± 4.1	1102
Overall	26.0 ± 36.7	38	67.0 ± 6.4	1121

Table 10: Child Occupant Restraint Use Rates and Unweighted Ns in Second Row by Age Group and Seating Position.

	Left		Middle		Right	
Age	Rate (%)	N	Rate (%)	N	Rate (%)	N
0-3	95.4 ± 14.0	136	92.4 ± 5.3	95	97.2 ± 3.1	93
4-15	50.3 ± 7.6	477	26.2 ± 7.7	170	51.5 ± 7.9	430
Overall	61.0 ± 6.7	613	41.9 ± 6.0	265	62.3 ± 6.1	641

Table 11: Child Occupant Restraint Use Rates and Unweighted Ns in Third Row by Age Group and Seating Position.						
	Left		Middle		Right	
Age	Rate (%)	N	Rate (%)	N	Rate (%)	N
0-3	---	0	---	0	---	0
4-15	55.8 ± 18.4	33	25.0 ± 20.4	15	55.5 ± 24.4	22
Overall	55.8 ± 18.4	33	25.0 ± 20.4	15	55.5 ± 24.4	22

Table 12: Child Occupant Restraint Use Rates and Unweighted Ns by Age Group and Day of Week				
	Weekday		Weekend	
Age	Rate (%)	N	Rate (%)	N
0-3	94.7 ± 3.0	240	85.9 ± 6.7	116
4-15	56.5 ± 5.4	1545	61.2 ± 10.5	734
Overall	65.6 ± 4.2	1785	67.1 ± 8.1	850

Table 13: Child Occupant Restraint Use Rates and Unweighted Ns by Age Group and Trip Type						
	Fast Food		School		Entertainment	
Age	Rate (%)	N	Rate (%)	N	Rate (%)	N
0-3	93.7 ± 3.0	256	91.4 ± 13.0	29	94.0 ± 5.2	71
4-15	60.8 ± 5.6	928	53.2 ± 10.3	731	52.2 ± 7.6	520
Overall	68.6 ± 4.3	1284	62.2 ± 8.5	760	62.1 ± 5.9	591