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DIRECT OBSERVATION OF SAFETY BELT USE IN MICHIGAN: FALL 2000

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16. Abstract

Reported here are the results of a direct observation survey of safety belt use conducted in the fall of 2000. In this study, 14,366 occupants traveling in four vehicle types (passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks) were surveyed during August 31 to September 18, 2000. Belt use was estimated for all commercial/noncommercial vehicle types combined (the statewide safety belt use rate) and separately for each vehicle type. Within and across each vehicle type, belt use by age, sex, road type, day of week, time of day, and seating position were calculated. Statewide belt use was 81.9 percent. When compared with last year's rate, this year's estimated use rate shows that safety belt use in Michigan has increased by almost 12 percentage points over the past year. Belt use was 85.0 percent for passenger cars, 83.1 percent for sport-utility vehicles, 83.2 percent for vans/minivans, and 71.2 percent for pickup trucks. For all vehicle types combined, belt use was higher for females than for males and higher for drivers than for passengers. In general, belt use was high during the morning and evening rush hours. Belt use did not vary systematically by day of week. Belt use was lowest among 16-to-29 year olds, and highest among the 4-to-15 and 60-and-older age groups. Survey results suggest that the implementation of standard enforcement safety belt use laws and the accompanying enforcement and public information efforts have been very effective in increasing safety belt use in Michigan over the past year.

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INTRODUCTION

It is well established that mandating the use of safety belts is the most effective way to increase the frequency of belt use. In addition to significantly increasing safety belt use, the introduction of mandatory use laws has been accompanied by a decrease in the number of fatalities and severe nonfatal injuries resulting from motor vehicle crashes (Rivara, Thompson, & Cummings, 1998). It has been shown that the correct use of a safety belt reduces the risk of fatal injury to front seat passenger car occupants by 45 percent, and the risk of moderate to critical injury by 50 percent (National Highway Traffic Safety Administration, NHTSA, 1999a). As a result, the overall medical costs from motor vehicle crashes decrease. It has been estimated that as much as 85 percent of these costs are absorbed by society (NHTSA, 1999a) through taxes, insurance premiums, lost wages, and lost productivity (United States General Accounting Office, GAO, 1992). These costs can increase by as much as 50 percent when the individual is not wearing a safety belt (NHTSA, 1999a). As part of a national program to reduce motor vehicle fatalities and injuries, and the resulting costs to society, numerous states began writing legislation to mandate statewide safety belt use. New York enacted the first law mandating safety belt use for motor vehicle occupants in July of 1984.

As other states began to discuss adopting safety belt use laws, citizens voiced concerns that these laws were in violation of their individual rights, and more importantly, that safety belt use laws could be used as a tool for police harassment. In an attempt to address these concerns, legislators in the state of New Jersey included a secondary enforcement provision in their safety belt use law (Moffat, 1998). This provision stated that a police officer could only issue a safety belt citation if he or she were to stop a vehicle for some other violation. Thus, if a vehicle is otherwise being operated in a legal manner, unbelted occupants in the vehicle cannot be stopped or cited for disobeying the mandatory safety belt use law. By including this provision in their law, New Jersey legislators created a distinction between secondary enforcement and standard enforcement (NHTSA, 1999a), where an officer can stop a vehicle and cite an occupant solely for failure to wear a safety belt. No other laws make this distinction. The New Jersey law set a standard of legislative compromise which was followed by many other states (Moffat, 1998); Illinois and Michigan passed similar legislation the following year (Lund, Pollner, & Williams, 1986).

In subsequent years, numerous states followed the example of New York, New Jersey, Illinois, and Michigan and began writing legislation to mandate statewide safety belt use. These laws were initially unpopular, and some were subsequently repealed by voter referendum, then later reinstated (GAO, 1992). Despite initial opposition to these laws, by the year 2000, New Hampshire was the only state without a mandatory safety belt use law for adult motor vehicle occupants (Insurance Institute for Highway Safety, IIHS, 2000). Many New Hampshire residents view a safety belt use law as an infringement on their personal freedom (Wortham, 1998). However, restraint use is not merely a question of individual rights; it has been found that unbelted drivers have less opportunity to control their vehicle in a crash (NTHSA, 1999a), thereby increasing the likelihood of injury to others. Additionally, unbelted occupants can become projectiles during a collision, causing injury and death to others.

In general, these laws have produced a dramatic increase in belt use immediately following implementation, followed by a subsequent decline in belt use that generally remains above prelaw levels, as was the case in Michigan (Eby, Molnar, & Olk, 2000). While these mandatory use laws, coupled with visible enforcement and public education, raised safety belt use dramatically, belt use in the early 1990s was still only about 60 percent nationally (NHTSA, 1997). As national safety belt use rates reached plateaus, mandatory safety belt use laws with more effective enforcement provisions were needed (Moffat, 1998).

Prior to 1993 only nine states had laws allowing standard enforcement: Connecticut, Hawaii, Iowa, Mississippi, New Mexico, New York, North Carolina, Oregon, and Texas (Motor Vehicle Manufacturers Association, 1991). Mississippi later amended their law to allow standard enforcement only for child occupants (Winnicki, 1995). Findings from numerous studies indicate that states with standard enforcement have significantly higher safety belt use rates than states with secondary enforcement (e.g., see Campbell, 1987; Campbell, Stewart, & Campbell, 1988; Rivara, Thompson, & Cummings, 1998). Safety belt use is positively correlated with level of enforcement, in states with a standard enforcement law and in states with a secondary enforcement law. However, when levels of enforcement are comparable, safety belt usage is higher in states with standard enforcement (Campbell, 1987). Additionally, states with standard enforcement report lower automobile crash fatality rates for front-seat occupants. An analysis of some of the first states to enact safety belt legislation found that secondary enforcement resulted in a reduction in fatality rates of about 7 percent, while states with standard enforcement saw a reduction of almost 10 percent (Wagenaar, Maybee, & Sullivan, 1987). Research by Evans and Graham (1991) yielded more substantial results. When fatality rates were compared among 16 states, a reduction of 7 percent was found in states with secondary enforcement, while states with standard enforcement showed a reduction in fatality rates of greater than 20 percent.

It has been demonstrated that the most significant and cost-effective way for states with secondary enforcement to increase their safety belt use rate is to upgrade their mandatory safety belt law to standard enforcement (Russell, Dreyfuss, & Cosgrove, 1999). Dramatic increases in safety belt use rates have been seen when a state changes from secondary to standard enforcement. As a result, several states began to reexamine the enforcement provision of their laws and, starting in 1993, a handful of states passed legislation to change their mandatory safety belt use law from secondary to standard enforcement. Since 1993, eight jurisdictions have both passed and enacted such legislation (IIHS, 2000). California was the first state to revise their safety belt use law. California's belt use rate rose from 70 percent to 83 percent, an increase of 13 percentage points. Louisiana was the second state to revise, in September, 1995. The safety belt use rate in Louisiana increased by 18 percentage points, from 50 percent prior to the change to 68 percent in the year following implementation. In July, 1996, Georgia became the third state to change to a standard enforcement law. Georgia saw results similar to those in California and Louisiana, with an overall increase of 15 percentage points, resulting in a safety belt use rate of 68 percent in the year following the change (NHTSA, 2000). Maryland enacted legislation to change their safety belt use law to standard enforcement in October, 1997 and saw an increase of 13 percentage points within the first year (NHTSA, 1999a). Four other jurisdictions have since both passed and enacted such legislation: Alabama, District of Columbia, Indiana, and Oklahoma. It is interesting to note that New Jersey, who started the trend to pass safety belt legislation with a secondary enforcement provision, also recently passed standard enforcement legislation (IIHS, 2000).

Michigan has also recently passed standard enforcement legislation. Michigan's original mandatory safety belt use law with secondary enforcement took effect July 1, 1985. Safety belt use increased immediately after the law was passed, then declined by a small amount before leveling off at a rate more than 20 percentage points higher than prelaw levels (Eby, Molnar, & Olk, 2000). The presence of extensive enforcement and Public Information & Education (PI&E) programs, combined with national publicity on the effectiveness of safety belts contributed to the continual increase in Michigan's safety belt use rate. The safety belt use rate eventually reached a plateau of 70 percent, at which it remained for several years (Eby, Molnar, & Olk, 2000). It has been suggested that this was the highest level of safety belt use that could be reached without the introduction of standard enforcement legislation (Worthman, 1998).

Michigan's change to standard enforcement was implemented March 10, 2000. After a multiyear struggle by state safety officials and community members, Michigan's standard enforcement law (Senate Bill 335) was signed on May 26, 1999, seven years after standard enforcement legislation was first introduced (Winnicki, 1995). The law mandates safety belt use for all front seat occupants of motor vehicles operated on streets and highways. Any person found in violation of this law is responsible for a civil infraction with no license points assessed and will receive a maximum fine of $25, in addition to court costs. All children under 4 years of age must be in a federally approved child restraint device, such as a child safety seat, and children 4 to 15 years of age must be properly restrained by a safety belt in all seating positions. In response to concerns that the change to standard enforcement would increase the potential for harassment of certain segments of the population, the law contains additional provisions to address these concerns: law enforcement agencies must investigate all reports of police harassment resulting from enforcement of the law, and an independent agency will assess the effects of the law on harassment. An additional point was included to ensure that the law achieved its intent. If after December 31, 2005, the Michigan Office of Highway Safety Planning certifies that there has been less than 80 percent compliance with the safety belt requirements during the preceding year, the law will revert back to secondary enforcement.

This final point sets an important goal for the coming years; Michigan needs to maintain a sufficient level of compliance with the safety belt use law in order to preserve standard enforcement. Besides this internally set goal for safety belt use, national goals have also been set. The President of the United States directed the Secretary of Transportation to develop a plan for increasing safety belt use, called the *Presidential Initiative for Increasing Seat Belt Use Nationwide*. One of the goals of the plan was to increase the national safety belt use rate to 85 percent by the year 2000 and 90 percent by 2005 (NHTSA, 1997). NHTSA (1999a) estimates that this increase in safety belt use by 2005 would prevent about 5,536 fatalities and 132,700 injuries, and result in economic savings of about 8.8 billion dollars annually.

In order to reach the goals of the *Presidential Initiative*, a four-point plan for increasing nationwide belt use provides a good framework for further increasing and maintaining safety belt use in Michigan. Michigan has already taken steps to implement this plan throughout the state. The first point is to build strong public/private partnerships at local, state, and national levels. Developing partnerships can provide the public with the same message from a variety of sources; it is believed that a positive attitude toward safety belt use can become a "national attitude." Such partnerships would also serve as a conduit for the distribution of Public Information and Education (PI&E) programs. The Michigan Safety Belt Coalition currently consists of 95 organizations with very diverse interests and different audiences (NHTSA, 2000). The critical element of this point is to provide the public with a simple, single message from a variety of sources and media.

The second point of the plan involves enacting standard enforcement legislation. When levels of enforcement are comparable, safety belt usage is higher in states that allow for standard enforcement of their safety belt use laws than states with only secondary enforcement (Campbell, 1987). With the help of private and public sector partners, Governor Engler, and a clear concise message, the change to standard enforcement was implemented in Michigan on March 10, 2000 (NHTSA, 2000).

The next point highlights the importance of active and visible enforcement programs. It is well known that enforcement efforts combined with publicity about those enforcement efforts lead to increased compliance with a law. Throughout Michigan, enforcement of the safety belt law has been a cooperative effort. State, local, and county law enforcement work from a joint strategic enforcement plan. To enhance public awareness of intensified enforcement, law enforcement agencies have found that special emphasis patrols and local publicity are very effective (NHTSA, 2000). Michigan has also worked hard to keep a 'human face' on 'Click It or Ticket,' the new enforcement campaign, keeping the focus on fewer deaths and serious injuries, not more tickets (NHTSA, 2000).

The last point outlined in the plan -- increasing effective public education -- has also been effective in elevating and maintaining safety belt use in Michigan. Neither enforcement without PI&E programs, nor PI&E programs without enforcement are sufficient to achieve high rates of safety belt use (Stoke & Lugt, 1991). Michigan focused on increasing the dissemination of effective educational messages to the groups that needed it most: young males, minorities, and pickup truck occupants. Michigan spent close to $125,000 on radio and television ads carefully aimed at target groups, along with advertising the message on 100 - 125 donated billboards in urban areas (NHTSA, 2000).

Although Michigan's current safety belt use rate did not meet the national goals for safety belt use set for 2000, the change to standard enforcement has already placed Michigan's safety belt use rate within reach of the national goal of 90 percent by 2005. The purpose of this study, conducted about six months after the introduction of a standard enforcement law, is to evaluate the effect of this new legislation, and continue to track the long term trends in Michigan's safety belt use. Annual surveys will continue to measure safety belt use rates to continue to determine these trends and to ensure that state and national goals are met.

METHODS

Sample Design

The sample design for the present survey was closely based upon the one used by Streff, Eby, Molnar, Joksch, and Wallace (1993). While the entire sampling procedure is presented in the previous report, it is repeated here for completeness, with the modifications noted.

The goal of this sample design was to select observation sites that accurately represent front-outboard vehicle occupants in eligible commercial and noncommercial vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) in Michigan, while following federal guidelines for safety belt survey design (NHTSA, 1992, 1998). An ideal sample minimizes total survey error while providing sites which can be surveyed efficiently and economically. To achieve this goal, the following sampling procedure was used.

To reduce the costs associated with direct observation of remote sites, NHTSA guidelines allow states to omit from their sample space the lowest population counties, provided these counties collectively account for 15 percent or less of the state's total population. Therefore, all 83 Michigan counties were rank ordered by population (U.S. Bureau of the Census, 1992) and the low population counties were eliminated from the sample space. This step reduced the sample space to 28 counties.

These 28 counties were then separated into four strata. 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 University of Michigan Transportation Research Institute (UMTRI) surveys (Wagenaar & Molnar, 1989; Wagenaar, Molnar, & Businski, 1987b, 1988). Since no historical data were 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).[1] These factors have been shown previously to correlate positively with belt use (e.g., Wagenaar, Molnar, & Businski, 1987a). Wayne County was chosen as a separate stratum because of the disproportionately high VMT for Wayne County and because we wanted to ensure that observation sites were selected within this county. Three other strata were constructed by rank ordering each county by historical belt use rates and then adjusting the stratum boundaries until the total VMT was roughly equal within each stratum. The stratum boundaries were high belt use (greater than 54.0 percent), medium belt use (45.0 percent to 53.0 percent), low belt use (44.9 percent or lower), and Wayne County (41.9 percent belt use). The historical belt use rates and VMT by county and strata are shown in Table 1.

To achieve the NHTSA required precision of less than 5 percent relative error, the minimum number of observation sites for the survey (N = 56) was determined based on within- and between-county variances from previous belt use surveys and on an estimated 50 vehicles per observation period in the current survey. This minimum number was then increased (N = 168) to get an adequate representation of belt use for each day of the week and for all daylight hours.

Because total VMT within each stratum was roughly equal, observation sites were evenly divided among the strata (42 each). In addition, since an estimated 23 percent of all traffic in Michigan occurs on limited-access roadways (Federal Highway Administration, 1982), 10 (24 percent) of the sites within each stratum were freeway exit ramps, while the remaining 32 were roadway intersections.

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

Table 1. Descriptive Characteristics of the Four Strata[2]					
Strata	County	Historical Belt Use, Percent	Belt Use Average, Percent	VMT, billions of miles	Total VMT, billions of miles
1			56.3		17.48
	Ingham	54.3		1.98	
	Kalamazoo	54.3		1.98	
	Oakland	54.5		10.66	
	Washtenaw	62.0		2.86	
2			48.8		17.42
	Allegan	***45.2***		0.86	
	Bay	53.7		1.13	
	Eaton	52.5		0.90	
	Gr. Traverse	47.2		0.63	
	Jackson	46.2		1.41	
	Kent	48.9		4.07	
	Livingston	***48.7***		1.44	
	Macomb	48.0		4.83	
	Midland	***50.7***		0.68	
	Ottawa	47.4		1.45	
3			40.9		17.15
	Berrien	41.6		1.68	
	Calhoun	***43.2***		1.40	
	Genesee	42.8		4.12	
	Lapeer	39.6		0.71	
	Lenawee	44.4		0.82	
	Marquette	39.6		0.56	
	Monroe	44.2		1.53	
	Muskegon	41.8		1.11	
	Saginaw	40.7		1.86	
	Shiawassee	***41.6***		0.64	
	St. Clair	34.1		1.38	
	St. Joseph	***41.6***		0.51	
	Van Buren	36.7		0.83	
4					
	Wayne	41.9	41.9	15.29	15.29

[2]Note: Boldface italic type indicates values estimated from multiple regression. The belt use percentages were used only for statistical purposes in this design. Caution should be taken in interpreting these values.

Within each stratum, observation sites were randomly assigned to a location using different methods for intersections and freeway exit ramps. The intersection sites were chosen using a method that ensured each intersection within a stratum an equal probability of selection. Detailed, equal-scale road maps for each county were obtained and a grid pattern was overlaid on each county map. The grid dimensions were 62 lines horizontally and 42 lines vertically. The lines of the grid were separated by 1/4 inch. With the *3/8 inch:mile* scale of the maps, this created grid squares that were .67 miles per side. (Because Marquette County is so large, it was divided into four maps and each part was treated as a separate county.) Each grid square was uniquely identified by two numbers, a horizontal (*x*) coordinate and a vertical (*y*) coordinate.

The 42 sites for each stratum were sampled sequentially. The 32 local intersection sites were chosen by first randomly selecting a grid number containing a county within a stratum.[3] This was achieved by generating a random number between 1 and the number of grids within the stratum. So, for example, since the high belt use stratum had four grid patterns overlaying four counties, a random number between 1 and 4 was generated to determine which grid would be selected. Thus, each grid had an equal probability of selection at this step. Once the grid was selected, a random *x* and a random *y* coordinate were chosen and the corresponding grid square identified. Thus, each intersection had an equal probability of selection. If a single intersection was contained within the square, that intersection was chosen as an observation site. If the square did not fall within the county, there was no intersection within the square, or there was an intersection but it was located one road link from an already selected intersection, then a new grid number and *x*, *y* coordinate were selected randomly. If more than one intersection was within the grid square, the grid square was subdivided into four equal sections and a random number between 1 and 4 was selected until one of the intersections was randomly chosen. This happened for only two of the sites.

[3] It is important to note that grids were selected during this step rather than counties. This was necessary only because it was impractical to construct a single grid that was large enough to cover all of the counties in the largest stratum when they were laid side by side.

Once a site was chosen, the following procedure was used to determine the particular street and direction of traffic flow that would be observed. For each intersection, all possible combinations of street and traffic flow were determined. From this set of observer locations, one location was randomly selected with a probability equal to 1/number of locations. For example, if the intersection, was a "+" intersection, as shown in Figure 1, then there would be four possible combinations of street and direction of traffic flow to be observed (observers watched traffic only on the side of the street on which they were standing). In Figure 1, observer location number one indicates that the observer would watch southbound traffic and stand next to Main Street. For observer location number two, the observer would watch eastbound traffic and stand next to Second Street, and so on. In this example, a random number between 1 and 4 would be selected to determine the observer location for this specific site. The probability of selecting an intersection approach is dependent on the type of intersection. Four-legged intersections like that shown in Figure 1 have four possible observer locations, while three-legged intersections like "T" and "Y" intersections have only three possible observer locations. The effect of this slight difference in probability accounts for .01 percent or less of the standard error in the belt use estimate.

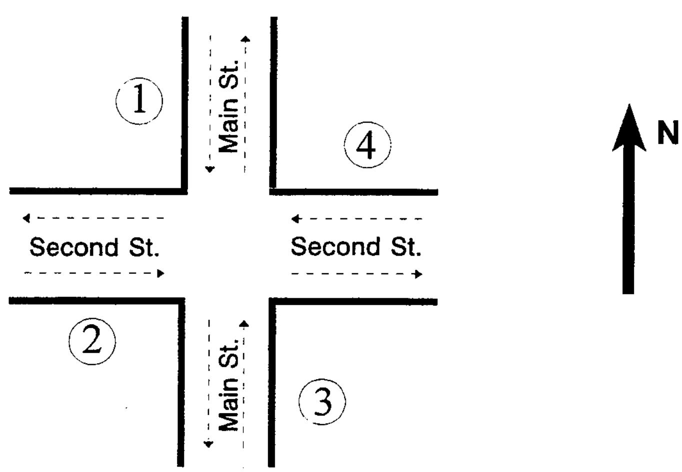

Figure 1. An Example "+" Intersection Showing 4 Possible Observer Locations.

For each chosen primary intersection site, an alternate site was also selected. The alternate sites were chosen within a 20 x 20 square unit area around the grid square containing the original intersection, corresponding to a 13.4 square mile area around the site. This was achieved by randomly picking an *x*, *y* grid coordinate within the alternate site area. Grid coordinates were selected until a grid square containing an intersection was found. No grid squares were found that contained more than one intersection. The observer location at the alternate intersection was determined in the same way as at the primary site.[4]

The 10 freeway exit ramp sites within each stratum also were selected so that each exit ramp had an equal probability of selection.[5] This was done by enumerating all of the exit ramps within a stratum and randomly selecting without replacement 10 numbers between 1 and the number of exit ramps in the stratum. For example, in the high belt use stratum there were a total of 109 exit ramps. To select an exit ramp, a random number between 1 and 109 was generated. This number corresponded to a specific exit ramp. To select the next exit ramp, another random number between 1 and 109 was selected with the restriction that no previously selected numbers could be chosen. Once the exit ramps were determined, the observer location for the actual observation was determined by enumerating all possible combinations of direction of traffic flow and side of ramp on which to stand. As in the determination of the observer locations at the roadway intersections, the possibilities were then randomly sampled with equal probability. The alternate exit ramp sites were selected by taking the first interchange encountered after randomly selecting a direction of travel along the freeway from the primary site. If this alternate site was outside of the county or if it was already selected as a primary site, then the other direction of travel along the freeway was used. If the exit ramp had no traffic control device on the selected direction of travel, then a researcher visited the site and randomly picked a travel direction and lane that had traffic control.

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[4]For those interested in designing a safety belt survey for their county or region, a guidebook and software for selecting and surveying sites for safety belt use is available (Eby, 2000) by contacting UMTRI -SBA, 2901 Baxter Rd., Ann Arbor, MI 48109-2150, or accessing http://www-personal.umich.edu/~eby/sbs.html/.

[5] An exit ramp is defined here as egress from a limited-access freeway, irrespective of the direction of travel. Thus, on a north-south freeway corridor, the north and south bound exit ramps at a particular cross street are considered a single exit ramp location.

The day of week and time of day for site observation were quasirandomly assigned to sites in such a way that all days of the week and all daylight hours (7:00 am - 7:00 pm) had essentially equal probability of selection. The sites were observed using a clustering procedure. That is, sites that were located spatially adjacent to each other were considered to be a cluster. Within each cluster, a shortest route between all of the sites was decided (essentially a loop) and each site was numbered. An observer watched traffic at all sites in the cluster during a single day. The day in which the cluster was to be observed was randomly determined. After taking into consideration the time required to finish all sites before darkness, a random starting time for the day was selected. In addition, a random number between one and the number of sites in the cluster was selected. This number determined the site within the cluster where the first observation would take place. The observer then visited sites following the loop in either a clockwise or counterclockwise direction (whichever direction left them closest to home at the end of the day). This direction was determined by the project manager prior to sending the observer into the field. Because of various scheduling limitations (e.g., observer availability, number of hours worked per week) certain days and/or times were selected that could not be observed. When this occurred, a new day and/or time was randomly selected until a usable one was found. The important issue about the randomization is that the day and time assignments to the sites were not correlated with belt use at a site. This pseudorandom method is random with respect to this issue.

The sample design was constructed so that each observation site was self-weighted by VMT within each stratum. This was accomplished by selecting sites with equal probability and by setting the observation interval to a constant duration (50 minutes) for each site.[6] Thus the number of cars observed at an observation site reflected safety belt use by VMT; that is, the higher the VMT at a site, the greater the number of vehicles that would pass during the 50-minute observation period. However, since all vehicles passing an observer could not be surveyed, a vehicle count of all eligible vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) on the traffic leg under

[6] Because of safety considerations, sites in the city of Detroit were observed for a different duration. See data collection section for more information.

observation was conducted for a set duration (5 minutes) immediately prior to and immediately following the observation period (10 minutes total).

Table 2 shows descriptive statistics for the 168 observation sites. As shown in this table, the observations were fairly well distributed over day of week and time of day. Note that an observation session was included in the time slot that represented the majority of the observation period. If the observation period was evenly distributed between two time slots, then it was included in the later time slot. This table also shows that nearly every site observed was the primary site and the majority of observations were conducted during sunny weather conditions.

Table 2. Descriptive Statistics for the 168 Observation Sites

Day of Week		Observation Period		Site Choice		Weather	
Monday	13.1%	7-9 a.m.	13.1%	Primary	98.2%	Sunny	63.1%
Tuesday	14.3%	9-11 a.m.	19.6%	Alternate	1.8%	Cloudy	35.1%
Wednesday	11.9%	11-1 p.m.	14.9%			Rain	1.8%
Thursday	17.2%	1-3 p.m.	22.6%			Snow	0.0%
Friday	14.3%	3-5 p.m.	19.1%				
Saturday	16.7%	5-7 p.m.	10.7%				
Sunday	12.5%						
TOTALS	100%		100%		100%		100%

Data Collection

Data collection for the study involved direct observation of shoulder belt use, estimated age, and sex. Trained field staff observed shoulder belt use of drivers and front-right passengers traveling in passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks during daylight hours from August 31 through September 18, 2000. Observations of safety belt use, sex, age, vehicle type, and vehicle purpose (commercial or noncommercial) were conducted when a vehicle came to a stop at a traffic light or a stop sign.

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 (freeway exit ramp or intersection), site choice (primary or alternate), observer number, date, day of week, time of day, weather, and a count of eligible vehicles traveling on the proper traffic leg. A place on the form was also furnished for observers to sketch the intersection 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 (e.g., school, shopping mall) 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, passenger information, and vehicle information (see Appendix A). Each observation form was divided into four boxes, with each box having room for the survey of a single vehicle. For each vehicle surveyed, shoulder belt use, sex, and estimated age for the driver as well as vehicle type were recorded on the upper half of the box, while the same information for the front-outboard passenger could be recorded in the lower half of the box if there was a front-outboard passenger present. Children riding in child safety seats (CSSs) were recorded but not included in any part of the analysis. Occupants observed with their shoulder belt worn under the arm or behind the back were noted but considered as belted in the analysis. Based upon NHTSA (1999b) guidelines, the observer also recorded whether the vehicle was commercial or noncommercial. A commercial vehicle is defined as a vehicle that is used for business purposes and may or may not contain company logos. This classification includes vehicles marked with commercial lettering or logos, or vehicles with ladders or other tools on them. 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

All sites in the sample were visited by one observer for a period of 1 hour, with the exception of sites in the city of Detroit. To address potential security concerns, these sites were visited by two-person teams of observers for a period of 30 minutes. Observations at other Wayne County sites scheduled to be observed on the same day as Detroit sites were also completed by two observers. Because each team member at these sites recorded data for different lanes of traffic, the total amount of data collection time was equivalent to that at single observer sites.

Upon arriving at a site, observers determined whether observations were possible at the site. If observations were not possible (e.g., due to construction), observers proceeded to the alternate site. Otherwise, observers completed the site description form and then moved to their observation position near the traffic control device.

Observers were instructed to observe only the lane immediately adjacent to the curb for safety belt use, regardless of the number of lanes present. At sites visited by two-person teams, team members observed different lanes of the same traffic leg with one observer on the curb and one observer on the median (if there was more than one traffic lane and a median). If no median was present, observers were instructed to stand on diagonally opposite corners of the intersection.

At each site, observers conducted a 5-minute count of all eligible vehicles on the designated traffic leg before beginning safety belt observations. Observations began immediately after completion of the count and continued for 50 minutes at sites with one observer and 25 minutes at sites with two observers. During the observation period, observers recorded data for as many eligible vehicles as they could observe. If traffic flow was heavy, observers were instructed to record data for the first eligible vehicle they saw and then look up and record data for the next eligible vehicle they saw, continuing this process for the remainder of the observation period. At the end of the observation period, a second 5-minute vehicle count was conducted at single-observer sites.

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 and the traffic leg to be observed (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 the practice sites were the same as sites observed during the study. Training at each practice site focused on completing the site description form, determining where to stand and which lanes to observe, conducting the vehicle count, recording safety belt use, and estimating age 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 eight times. Each observer pair practiced recording safety belt use, sex, and age until there was an interobserver reliability of at least 85 percent for all measures on drivers and front-right passengers for each pair of observers.

Each observer 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 plan travel routes to the sites. After marking the sites on their maps, the marked locations were compared to 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 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 and discussed with field staff. 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

The site description form and observation form data were entered into an electronic format. 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, the data from randomly selected sites were reviewed for accuracy by a second party and all site data were checked for inconsistent codes (e.g., the observation end time occurring before the start time). Errors were corrected after consultation with the original data forms.

For each site, computer analysis programs determined the number of observed vehicles, belted and unbelted drivers, and belted and unbelted passengers. Separate counts were made for each independent variable in the survey (i.e., site type, time of day, day of week, weather, sex, age, seating position, and vehicle type). This information was combined with the site information to create a file used for generating study results.

As mentioned earlier, our goal in this safety belt survey was to estimate belt use for the state of Michigan based on VMT. As also discussed, the self-weighting-by-VMT scheme employed is limited by the number of vehicles for which an observer can accurately record information. To correct for this limitation, the vehicle count information was used to weight the observed traffic volumes so they would more accurately reflect VMT.

This weighting was done by first adding each of the two 5-minute counts and then multiplying this number by five so that it would represent a 50-minute duration.[7] The resulting number was the estimated number of vehicles passing the site if all eligible vehicles had been included in the survey during the observation period at that site. The estimated count for each site is divided by the actual number of vehicles observed there to obtain a volume weighting factor for that site. These weights are then applied to the number of actual vehicles of each type observed at each site to yield the weighted N for the total number of drivers and passengers, and total number of belted drivers and passengers for each vehicle type. Unless otherwise indicated, all analyses reported are based upon the weighted values.

The overall estimate of belt use per VMT in Michigan was determined by first calculating the belt use rate within each stratum for observed vehicle occupants in all vehicle types using the following formula:

$$r_i = \frac{\textit{Total Number of Belted Occupants, weighted}}{\textit{Total Number of Occupants, weighted}}$$

where r_i refers to the belt use rate within any of the four strata. The totals are the sums across all 42 sites within the stratum after weighting, and occupants refers to only front-outboard occupants. The overall estimate of belt use was computed by averaging the belt use rates for each stratum. However, comparing total VMT among the strata, one finds that the Wayne County stratum is only 88 percent as large as the total VMT for the other three strata (see Table 1). In order to represent accurately safety belt use for Michigan by VMT, the Wayne County stratum was multiplied by 0.88 during the averaging to correct for its lower total VMT. The overall belt use rate was determined by the following formula:

$$r_{all} = \frac{r_1 + r_2 + r_3 + (0.88 * r_4)}{3.88}$$

[7] As mentioned previously, the Detroit sites were visited by pairs of observers for half as long. For these sites, the single 5-minute count was multiplied by five to represent the 25-minute observation period.

where r_i is the belt use rate for a certain vehicle type within each stratum and r_4 the Wayne County stratum.

The estimates of variance and the calculation of the confidence bands for the belt use estimates are complex. See Appendix C for a detailed description of the formulas and procedures. The same use rate and variance equations were utilized for the calculation of use rates for each vehicle type separately.

RESULTS

As discussed previously, the current direct observation survey of safety belt use in Michigan reports statewide use for four vehicle types combined (passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks), in addition to reporting use rates for occupants in each vehicle type separately. Following NHTSA (1999b) guidelines, this survey included commercial vehicles. In the sample, only 4.6 percent of occupants were in commercial vehicles. In order to determine if the inclusion of commercial vehicles significantly changed statewide belt use rates, the statewide rate was calculated separately both with and without commercial vehicles. Analysis showed that there was no difference between the rates. Thus, all rates shown in this report include occupants from both commercial and noncommercial vehicles.

Overall Safety Belt Use

As shown in Figure 2, 81.9 percent ± 1.4 percent of all front-outboard occupants traveling in either passenger vehicles, sport-utility vehicles, vans/minivans, or pickup trucks in Michigan during September 2000 were restrained with shoulder belts. 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 safety belt use rate falls somewhere between 80.5 percent and 83.3 percent. When compared with last year's rate of 70.1 ± 2.2 percent, this year's estimated safety belt use rate shows that safety belt use in Michigan has increased significantly over the last year.

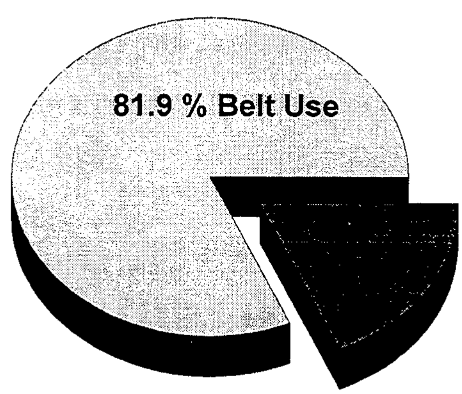

Figure 2. Front-Outboard Shoulder Belt Use in Michigan (All Vehicle Types and Commercial/Noncommercial Combined).

Estimated belt use rates and unweighted numbers of occupants (N) by strata are shown in Table 3. As is typically found in Michigan, the safety belt use rates for Strata 1 and 2 were the highest in the state, while the use rates for Stratum 3 and Stratum 4 were lower. There was no significant difference between the use rates in Stratum 3 and Stratum 4. When compared with last year's stratum belt use rates of 74.4, 71.7, 67.9, and 65.8 percent for Strata 1 through 4, respectively, we find significant increases within each stratum over the rates from last year.

Table 3. Percent Shoulder Belt Use by Stratum (All Vehicle Types)

	Percent Use	Unweighted N
Stratum 1	85.7	4,967
Stratum 2	82.7	2,177
Stratum 3	79.4	1,901
Stratum 4	79.7	5,321
STATE OF MICHIGAN	**81.9 ± 1.4 %**	14,366

Estimated belt use rates and unweighted numbers of occupants by stratum and vehicle type are shown in Table 4a to 4d. Within each vehicle type we find that belt use was highest within Strata 1 and 2, except for sport utility vehicles, where belt use was highest for Strata 1 and 4. Belt use in the other two strata tended to be similar. When compared with last year's results (Eby, Vivoda, & Fordyce, 1999), we find that shoulder belt use has increased significantly for all vehicle types, with the most notable increase, of 17.5 percentage points, for pickup truck occupants. Even with this large increase, the overall belt use rate of 71.2 ± 3.2 percent for pickup trucks was significantly lower than for any other vehicle type (Table 4d); this result was expected based upon data from previous surveys (e.g., Eby & Christoff, 1996; Eby & Hopp, 1997; Eby & Olk, 1998; Eby, Streff, & Christoff, 1995; Eby, Vivoda, & Fordyce, 1999). Thus, enforcement and PI&E programs should continue to target pickup truck occupants.

Table 4a. Percent Shoulder Belt Use by Stratum (Passenger Cars)		
	Percent Use	Unweighted N
Stratum 1	87.5	2,709
Stratum 2	85.7	1,047
Stratum 3	84.0	968
Stratum 4	82.6	3,112
STATE OF MICHIGAN	**85.0 ± 1.4 %**	7,836

Table 4b. Percent Shoulder Belt Use by Stratum (Sport-Utility Vehicles)		
	Percent Use	Unweighted N
Stratum 1	85.2	692
Stratum 2	83.4	272
Stratum 3	79.2	208
Stratum 4	84.6	635
STATE OF MICHIGAN	**83.1 ± 2.9 %**	1,807

Table 4c. Percent Shoulder Belt Use by Stratum (Vans/Minivans)		
	Percent Use	Unweighted N
Stratum 1	86.5	681
Stratum 2	84.9	414
Stratum 3	81.2	272
Stratum 4	79.8	830
STATE OF MICHIGAN	**83.2 ± 2.3 %**	2,197

Table 4d. Percent Shoulder Belt Use by Stratum (Pickup Trucks)		
	Percent Use	Unweighted N
Stratum 1	79.6	885
Stratum 2	71.8	444
Stratum 3	67.3	453
Stratum 4	65.5	744
STATE OF MICHIGAN	**71.2 ± 3.2 %**	2,526

Safety Belt Use by Subgroup

Site Type. Estimated safety belt use by type of site is presented in Table 5 as a function of vehicle type and all vehicles combined. As is typically found in safety belt use surveys in Michigan (Eby, Molnar, & Olk, 2000), use was higher for occupants in vehicles leaving limited access roadways (exit ramps) than for occupants in vehicles on surface streets. This effect was consistent across all vehicle types except for vans/minivans.

Time of Day. Estimated safety belt use by time of day, vehicle type, and all vehicles combined is shown in Table 5. Note that these data were collected only during daylight hours. For all vehicles combined, belt use was generally highest during the morning and evening rush hours. This effect was found within each vehicle type.

Day of Week. Estimated safety belt use by day of week, vehicle type, and all vehicles combined is shown in Table 5. Note that the survey was conducted over a 4-week period that included Labor Day. Belt use clearly varied from day to day, but no systematic trends were evident.

Weather. Estimated belt use by prevailing weather conditions, vehicle type, and all vehicles combined is shown in Table 5. There was essentially no difference in belt use between sunny and cloudy days. Due to the very low number of observations during rainy conditions, we cannot make a meaningful assessment of safety belt use during rainy weather.

Sex. Estimated safety belt use by occupant sex, type of vehicle, and all vehicles combined is shown in Table 5. Estimated safety belt use is higher for females than for males in all four vehicle types studied, and for all vehicle types combined. Such results have been found in every Michigan safety belt survey conducted by UMTRI (see, e.g., Eby, Molnar, & Olk, 2000).

Age. Estimated safety belt use by age, vehicle type, and all vehicles combined is shown in Table 5. As there were only thirteen 0-to-3 year olds observed in the current study, the estimated safety belt use rate for this age group is not meaningful. Excluding the 0-to-3-year-old age group, safety belt use over all vehicles combined is generally highest for the 4-to-15 and the 60-and-over age groups. Belt use for the 16-to-29-year-old age group consistently shows the lowest belt use rate, with rates for the 30-to-59-year-old age group below that of occupants older than 59 years of age. These results are similar to findings in previous UMTRI studies (Eby, Molnar, & Olk, 2000) and shows that new drivers and young drivers (16-to-29 years of age) should be one focus of safety belt use messages and programs. Comparing these results with last year's safety belt use rates by age, we find that belt use has significantly increased across all age groups. Excluding the youngest age group, the most notable increase was observed in the 16-to-29 year old age group, with an increase of 19.6 percentage points. However, the belt use rate of 77.0 for this age group was still much lower than belt use in the other age groups.

Seating Position. Estimated safety belt use by position in vehicle, vehicle type, and all vehicles combined is shown in Table 5. This table clearly shows that across all vehicle types, safety belt use for drivers is higher than use by front-outboard passengers. This trend was also seen within each vehicle type, with the exception of sport utility vehicles.

Table 5. Percent Shoulder Belt Use and Unweighted N by Vehicle Type and Subgroup

	All Vehicles		Passenger Car		Sport-Utility Vehicle		Van/Minivan		Pickup Truck	
	Percent Use	N	Percent Use	N	Percent Use	N	Percent Use	N	Percent Use	N
Site Type										
Intersection	81.3	9,969	84.8	5,331	81.0	1,266	83.5	1,536	70.2	1,836
Exit Ramp	83.6	4,397	85.6	2,505	87.3	541	82.5	661	75.4	690
Time of Day										
7 - 9 a.m.	82.6	1,865	86.5	1,023	85.4	218	84.5	306	72.6	318
9 - 11 a.m.	83.2	1,800	89.3	875	82.2	237	80.7	321	71.3	367
11 - 1 p.m.	79.3	2,323	84.1	1,306	82.0	252	76.9	349	65.1	416
1 - 3 p.m.	83.9	2,982	87.1	1,622	77.5	375	87.2	472	75.2	513
3 - 5 p.m.	80.9	3,329	82.7	1,831	79.9	437	87.0	457	70.8	604
5 - 7 p.m.	82.9	2,067	84.4	1,179	91.2	288	77.6	292	74.5	308
Day of Week										
Monday	76.0	2,417	81.3	1,574	83.1	276	77.1	308	60.2	259
Tuesday	82.3	2,405	87.4	1,266	84.3	338	80.4	352	70.2	449
Wednesday	83.6	811	87.2	448	81.6	80	86.6	117	72.2	166
Thursday	86.0	2,168	88.6	1,090	84.8	262	89.5	356	78.2	460
Friday	81.3	2,862	84.4	1,541	66.4	339	81.6	443	66.8	539
Saturday	82.7	1,931	87.4	1,026	81.3	229	86.5	295	71.6	381
Sunday	84.5	1,772	85.2	891	85.2	283	83.4	326	82.8	272
Weather										
Sunny	82.4	8,644	85.7	4,668	82.1	1,087	83.8	1,263	72.6	1,626
Cloudy	81.8	5,509	84.7	3,060	86.0	692	82.4	894	68.7	863
Rainy	73.3	213	81.8	108	77.4	28	81.8	40	46.7	37
Sex										
Male	77.1	7,601	81.8	3,668	78.1	879	77.7	1,106	68.2	1,948
Female	87.4	6,763	87.8	4,167	87.6	928	88.8	1,090	81.6	578
Age										
0 - 3	100.0	13	100.0	6	100.0	2	100.0	2	100.0	3
4 - 15	87.8	490	87.4	236	91.8	67	93.1	112	79.9	75
16 - 29	77.0	4,152	80.6	2,623	75.7	444	77.5	361	64.9	724
30 - 59	83.0	8,358	86.3	4,067	85.8	1,193	83.6	1,528	72.8	1,570
60 - Up	87.9	1,336	90.0	896	82.5	98	86.8	189	80.8	153
Position										
Driver	82.2	11,255	85.5	6,154	82.2	1,427	83.6	1,636	71.6	2,038
Passenger	80.9	3,111	83.0	1,682	85.7	380	82.1	561	69.4	488

Age and Sex. Table 6 shows estimated safety belt use rates and unweighted numbers (N) of occupants for all vehicle types combined by age and sex. The belt use rates for the two youngest age groups should be interpreted with caution because the unweighted number of occupants is quite low. For better estimates of safety belt use for these age groups in Michigan see Eby, Kostyniuk, Vivoda, & Fordyce (2000); that study was designed to specifically target these age groups. Excluding the youngest age group, belt use for females in all age groups was higher than for males. However, the absolute difference in belt use rates between sexes varied depending upon the age group. The most notable difference is found in the 16-to-29-year-old group and the 30-to-59-year-old age group, where the estimated belt use rate is 11.7 percentage points and 11.3 percentage points higher respectively, for females than for males. These results argue strongly for statewide efforts to be directed toward persuading young males, and males in general, to use their safety belts. A comparison of the current year's safety belt use rates by age and sex with last year's rates shows significant increases within each age group, particularly with males between the ages of 16 and 29.

Table 6. Percent Shoulder Belt Use and Unweighted N by Age and Sex (All Vehicle Types Combined)

Age Group	Male		Female	
	Percent Use	Unweighted N	Percent Use	Unweighted N
0 - 3	100.0	7	100.0	6
4 - 15	87.2	241	88.4	249
16 - 29	71.3	2,124	83.0	2,027
30 - 59	77.9	4,512	89.2	3,843
60 - Up	85.8	711	90.3	625

Historical Trends

The current direct observation survey is the seventh yearly survey in a row that utilizes the sampling design and procedures implemented in 1993 (Streff, Eby, Molnar, Joksch, & Wallace, 1993). As such, it is possible to investigate safety belt use trends over the last several years.

Overall Belt Use Rate. Figure 3 shows the statewide safety belt use rate for all vehicles combined over the last 7 years. The safety belt use rate has shown a consistent increase over the last 7 years. Since 1994, the safety belt use rate has increased by 19.2 percentage points, with an increase of 11.8 percentage points in the past year. This finding shows that efforts to increase safety belt use in Michigan, particularly over the last year, have been effective and should be continued.

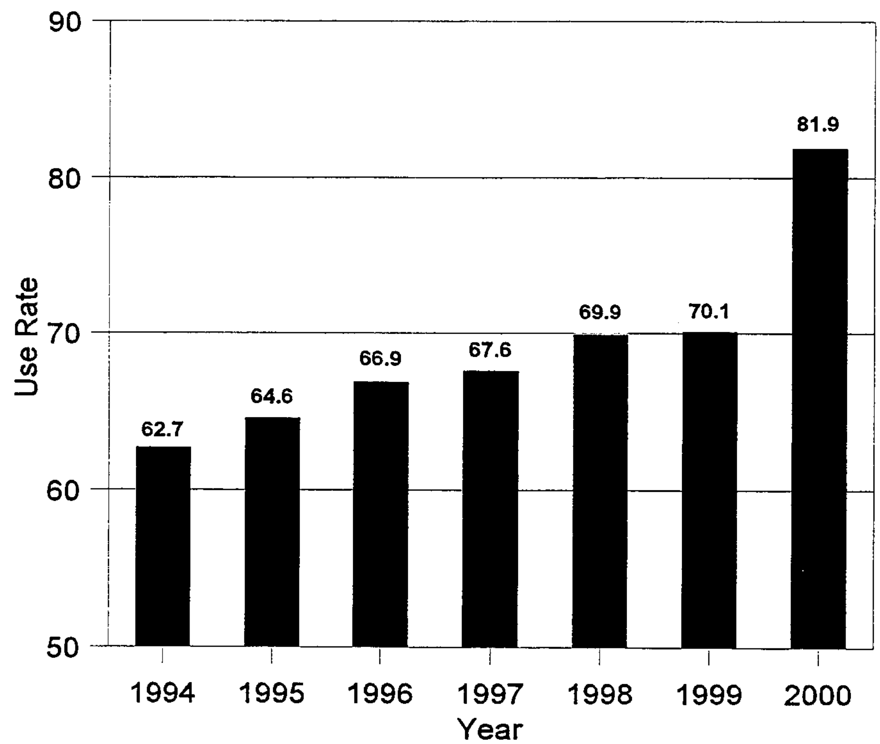

Figure 3. Front-Outboard Shoulder Belt Use by Year (All Vehicle Types Combined).

Overall Belt Use Rate by Stratum. Figure 4 shows the statewide safety belt use rate for all vehicles combined over the last 7 years by stratum. For all strata, there is a general upward trend in safety belt use from 1994 to 2000, with the greatest increase in use found in Stratum 4. Stratum 4 has seen an increase of 24.5 percentage points since 1994, with a 13.9 percentage point increase in the past year alone. Since the implementation of the standard enforcement legislation and other efforts to increase safety belt use over the last year, marked increases in the belt use rates have been observed in all strata.

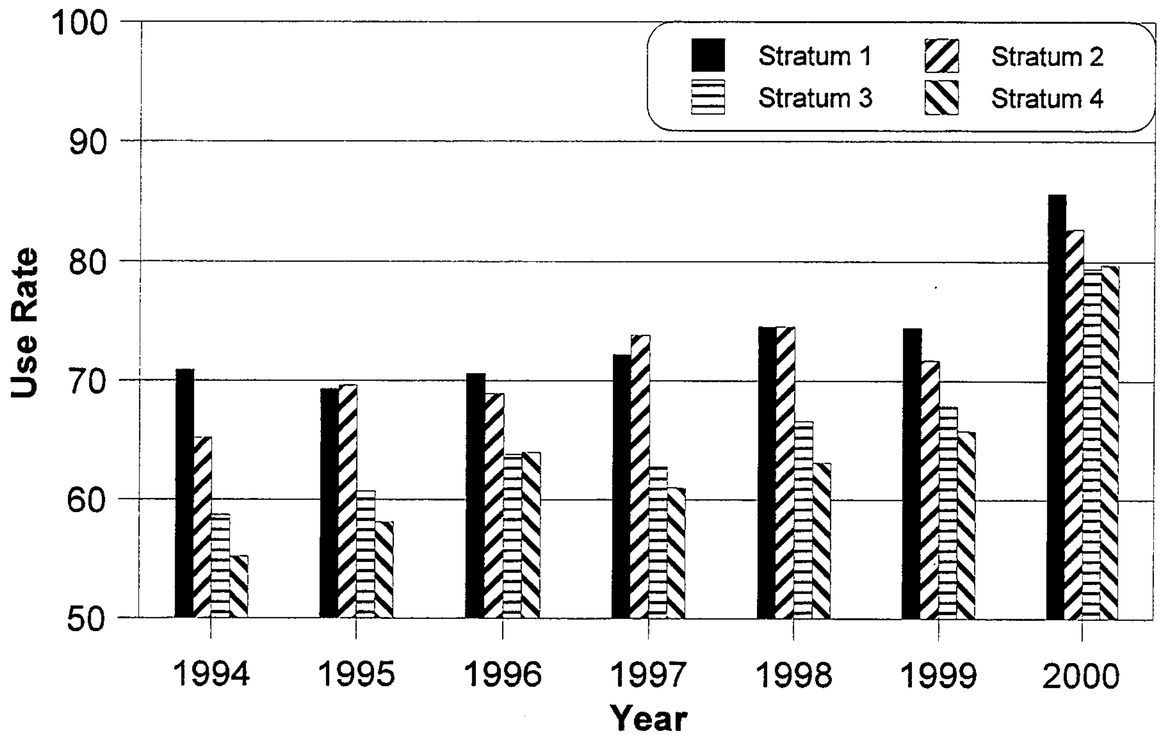

Figure 4. Front-Outboard Shoulder Belt Use by Year and Stratum (All Vehicle Types Combined).

Belt Use by Site Type. Figure 5 shows the estimated safety belt use rates for all vehicles combined as a function of whether the site was a freeway exit ramp or a local intersection. The difference in use rates has remained consistent over the last 7 years, with the use rate for freeway exit ramps consistently higher than for local intersections.

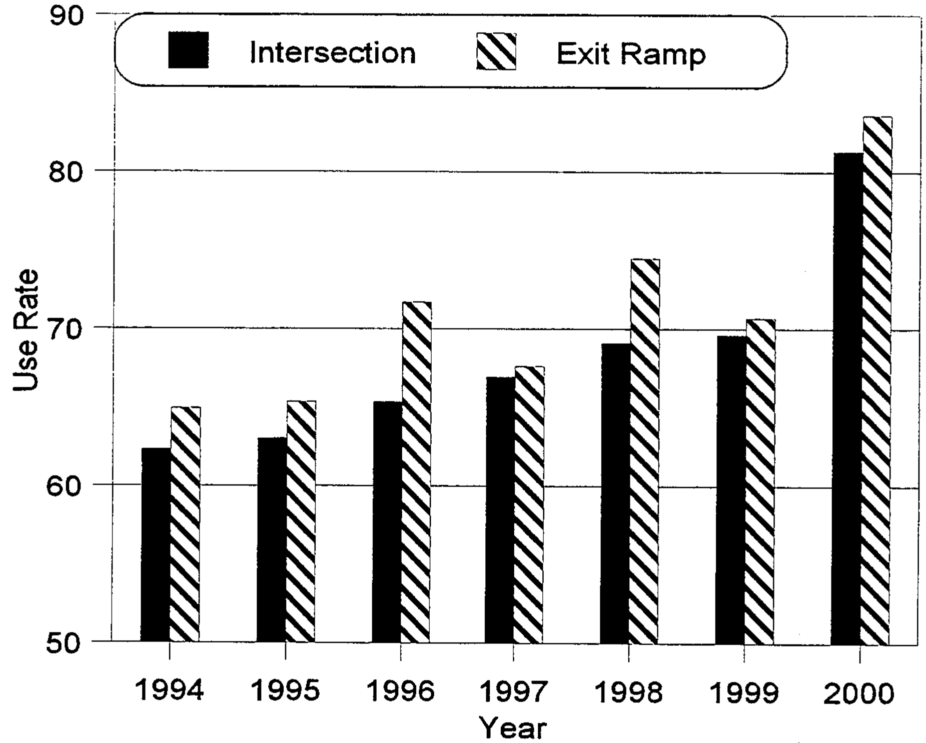

Figure 5. Front Outboard Shoulder Belt Use by Site Type and Year (All Vehicle Types).

Belt Use By Sex. Figure 6 shows front-outboard safety belt use by sex since 1994. Safety belt use by females for every survey year is significantly higher than for males. Significant increases, related to the introduction of standard enforcement legislation, were noted within each sex over the last year.

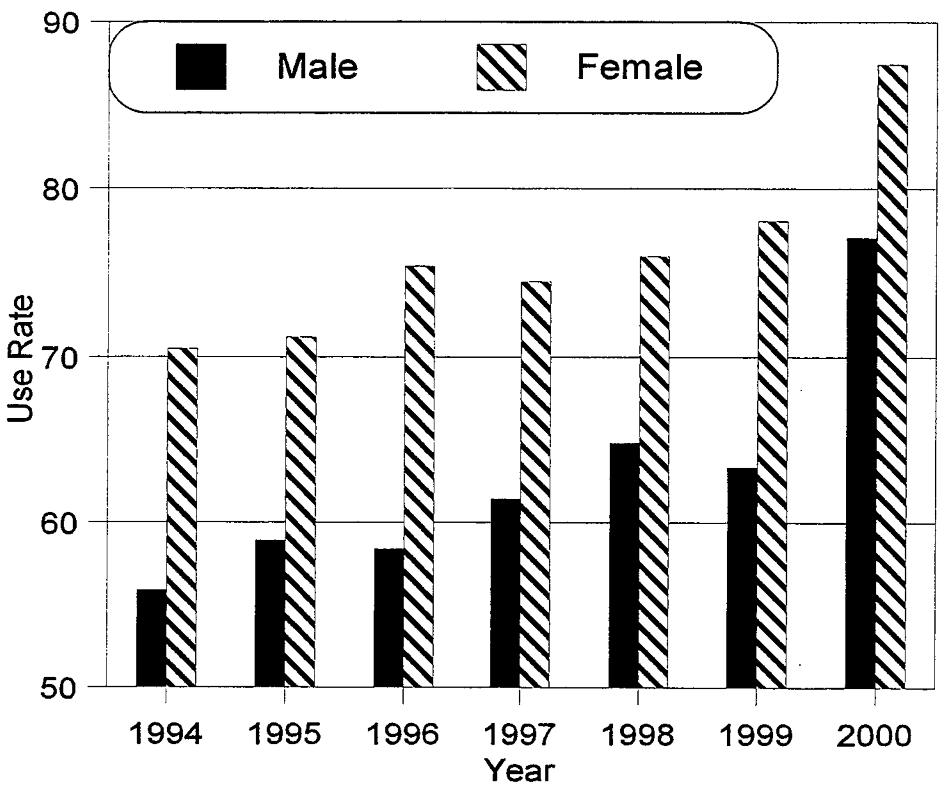

Figure 6. Front-Outboard Shoulder Belt Use by Sex and Year (All Vehicle Types Combined).

Belt Use By Seating Position. Figure 7 shows front-outboard safety belt use by seating position and year. Safety belt use by drivers has been significantly higher than for front-outboard passengers since 1994, with little change in the absolute difference between the two. These results show that efforts to increase passenger safety belt use should be strengthened.

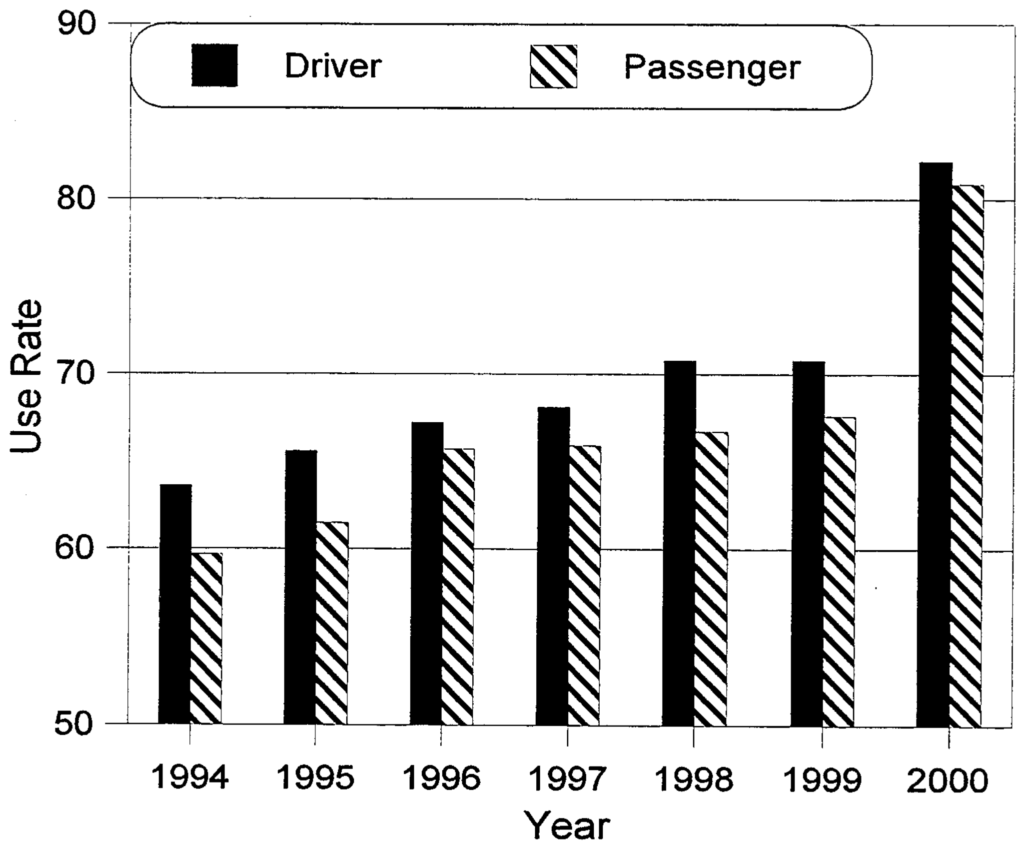

Figure 7. Front-Outboard Shoulder Belt Use by Seating Position (All Vehicle Types Combined).

Belt Use by Age. Figure 8 shows front-outboard safety belt use by age group over the last 7 years for all vehicles combined. As shown in this figure, the use rates by age have been ordered somewhat consistently each year with the 16-to-29-year-old age group having the lowest safety belt use rates. Excluding the youngest age groups, the highest belt use is typically found within the 60-up age group, followed by the 30-to-59 year olds. The two youngest age groups are typically excluded from comparisons due to the very small numbers in our sample. These trends continue to be evident in the current survey, with significant increases noted within all of the age groups.

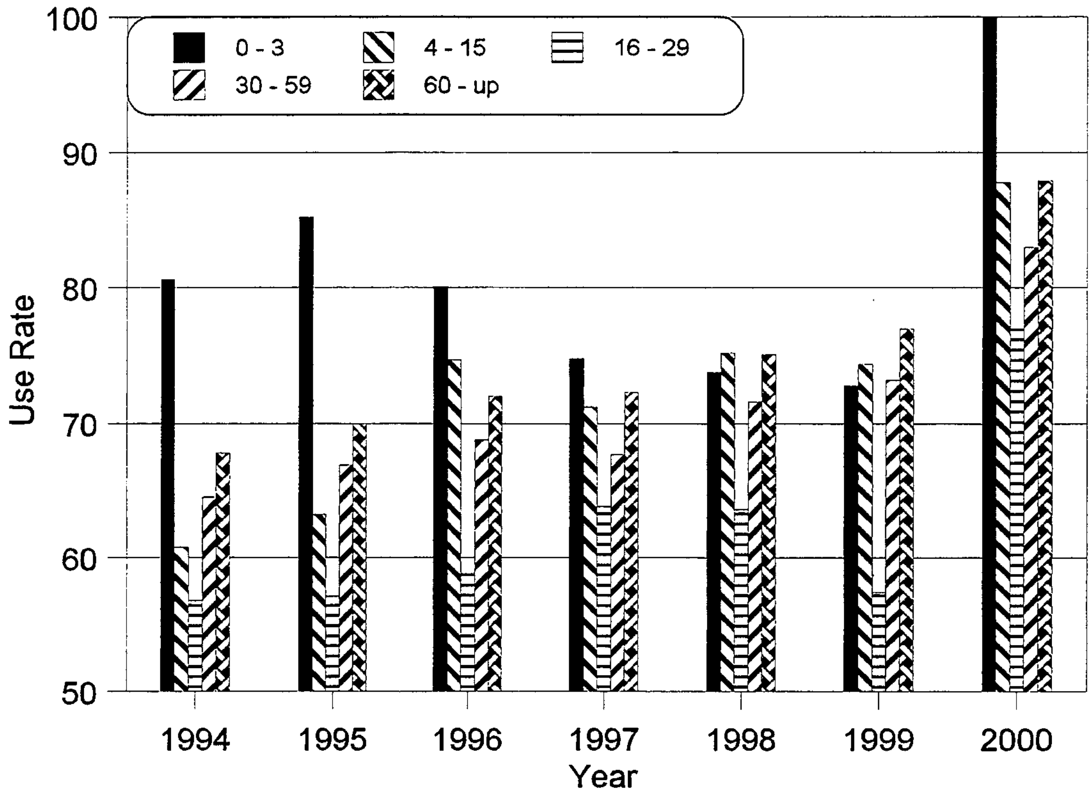

Figure 8. Front-Outboard Shoulder Belt Use by Age and Year (All Vehicle Types Combined).

Belt Use by Vehicle Type and Year. Figure 9 shows motor vehicle occupant belt use by the type of vehicle over the last 8 years. Belt use for 1993 only shows passenger vehicles because only this vehicle type was observed in that year. Significant increases have been noted in safety belt use rates for pickup truck occupants. Since 1994, there has been a gain of 26.3 percentage points. Although, as can be seen in this figure, pickup truck occupants were less likely to use a safety belt than occupants of other types of vehicles across all years studied, a trend that continues to be evident in the year 2000.

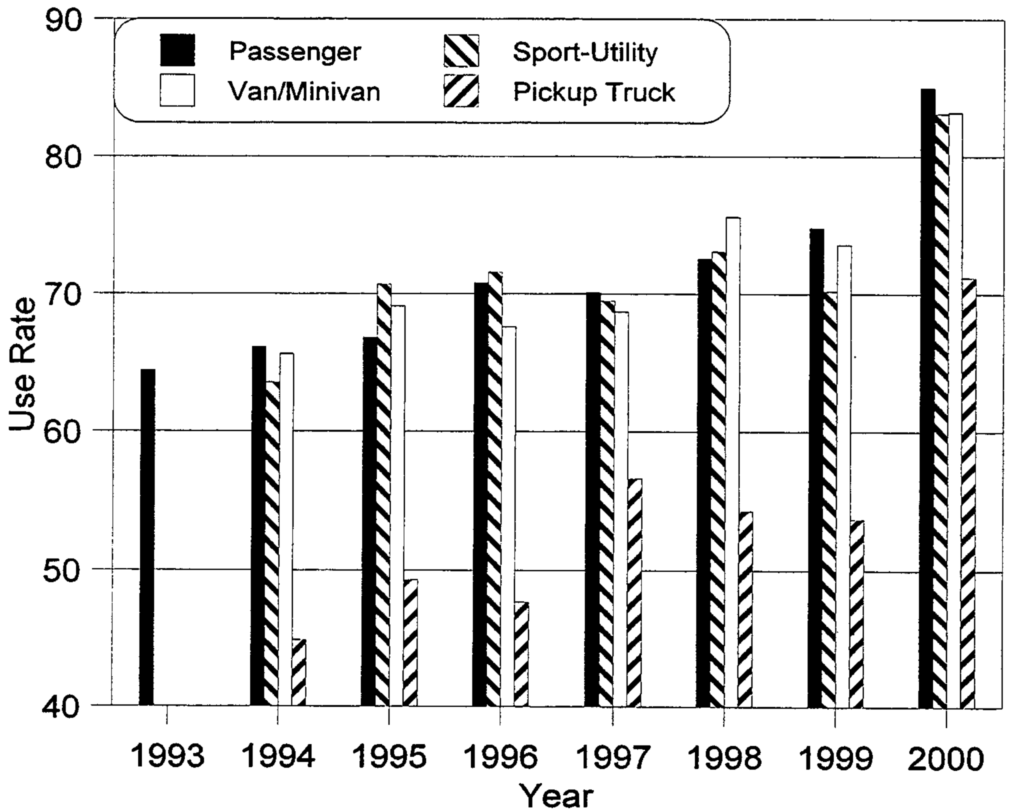

Figure 9. Front-Outboard Shoulder Belt Use by Vehicle Type and Year.

DISCUSSION

The estimated statewide belt use rate for front-outboard occupants of passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks combined was 81.9 ± 1.4 percent. When compared with last year's combined use rate of 70.1 ± 2.2 percent (Eby, Vivoda, & Fordyce, 1999), the current rate shows that front outboard shoulder belt use in Michigan has increased by almost 12 percentage points over the last 12 months. This represents the largest yearly increase in belt use that Michigan has experienced since the introduction of mandatory safety belt use laws. Furthermore, the safety belt use rate for all vehicle types combined from 1994 until now (see Figure 3), shows that safety belt use in Michigan has increased by 19.2 percentage points since 1994. This finding shows that efforts to increase safety belt use in Michigan, particularly the implementation of standard enforcement legislation within the past year, have been effective.

Comparing results over survey years indicates that progress has been made in increasing safety belt use among segments of Michigan's population least likely to use safety belts; residents of Wayne County, 16-to-29 year olds, males, and pickup truck occupants. In particular, this year's results show a large increase in Stratum 4, which includes the city of Detroit. This stratum has traditionally had the lowest belt use in the state of Michigan. The current safety belt use rate of 79.7 in Stratum 4 is 13.9 percentage points higher than last year's safety belt use rate in the stratum, and has increased a total of 24.5 percentage points over the past seven years. This finding indicates that standard enforcement legislation, enforcement efforts, and PI&E programs have been effective in increasing safety belt use among the Wayne County population. While current programs have been effective, the Wayne County residents who remain unbelted are likely to be the most difficult to reach. Therefore, current efforts must be maintained and new programs developed to further increase safety belt use among this segment of the population.

Some progress has also been made in increasing safety belt use among 16-to-29 years olds. Safety belt use rates have increased among 16-to-29 year olds by almost 20 percentage points since 1994; however, in the current study, belt use for the 16-to-29-year-old age group was the lowest of any age group, as is typically found. NHTSA has recognized that current traffic safety messages for this age group may not be cognitively appropriate and has begun an effort to better understand cognitive development and the factors which influence thinking in young drivers (see, e.g., Eby & Molnar, 1999). For instance, arguments should be presented in a positive framework. For example, it is better to say, "drive while you are alert and conscientious" than to say "do not drink and drive." Additionally, young drivers, in particular males, tend to overestimate their driving skills and underestimate the skills of others (optimism bias), and, therefore tend to perceive their crash risk as less than others; inclusion of peer-group testimonials that address this optimism bias might be effective in overcoming this incorrect reasoning. Such information may allow for the development of more appropriate traffic safety messages to continue to increase safety belt use among this age group.

From 1994 through 1999, statewide safety belt survey results show an increase of only 7.4 percentage points in the safety belt use rate for males. However, over the past year, there was an additional 13.8 percentage point increase in the safety belt use rate for males, bringing the total increase to 21.2 percentage points. This finding suggests that statewide efforts to increase belt use for males have been effective over the last 7 years and should be continued and intensified. In each survey, including the current study, the safety belt use rate is higher for females than for males. Despite the fact that female belt use is significantly higher than male belt use, females should not be ignored in PI&E efforts--their current belt use rate of 87.4 percent is still below the national goal of 90 percent by 2005.

Over the past 7 years, the safety belt use rate of pickup truck occupants has increased from 44.9 percent in 1994 to the current rate of 71.2 percent. The majority of this change has occurred over the past year. Unfortunately, the use rate for pickup truck occupants continues to be low, although the comparison across the years shows that significant strides have been made in increasing use among this population. Further analysis of safety belt use by vehicle type over the last 7 years shows that occupants of pickup trucks were less likely to use safety belts than occupants of all other vehicle types. This drastic and consistent difference suggests that occupants of pickup trucks may define a unique population in Michigan, and therefore benefit from specially designed programs.

Research has shown that the main demographic differences between the driver/owners of pickup trucks and passenger cars is that driver/owners of pickup trucks are more likely to be male, have higher household incomes, and lower educational levels (Anderson, Winn, & Agran, 1999). This information provides a starting point for the development of programs designed to influence pickup truck occupant safety belt use, as continued efforts to encourage belt use by occupants of pickup trucks are warranted.

Belt use by the various subcategories showed the usual trends that have been observed in Michigan over the past 7 years (Eby, Molnar, & Olk, 2000). Belt use was higher for exit ramps than for intersections. This difference in use rates has remained consistent over the last 7 years. As discussed by Slovic (1984; see also Eby & Molnar, 1999), this finding may show that people judge whether to use a safety belt on a trip-by-trip basis and erroneously consider travel on limited-access roadways as less safe than travel on other roadways. Such erroneous reasoning could be addressed in PI&E programs.

The study also showed that belt use for drivers has been consistently higher than for passengers over the past 7 years, although both have increased. Our analysis indicates that new efforts should be made to encourage passengers to use safety belts. Further research is essential to better understand the dynamics of passenger belt use in order to develop appropriate and effective PI&E programs.

The analysis of safety belt use by vehicle type showed that occupants in passenger cars, sport-utility vehicles, and vans/minivans used safety belts at a rate above 83 percent (see Figure 9), a significant increase over the previous years rates. A statistical analysis reveals that there is not currently a significant difference in the safety belt use rate among these vehicle types.

Collectively, these findings suggest that the change to standard enforcement and PI&E and enforcement programs by the Michigan Department of State Police, Office of Highway Safety Planning, and other local programs, have been effective in increasing belt use in Michigan over the last 7 years. However, the national goal of 90 percent belt use by 2005 (NHTSA, 1997), and Michigan's new goal of maintaining at least 80 percent compliance with the standard enforcement law suggest that these efforts must be continued. The four-point plan for increasing belt use nationwide that was outlined earlier has provided a good framework for increasing belt use in Michigan, and should continue to be applied, alongside programs aimed at increasing safety belt use among the low belt use demographic populations outlined in this paper.

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APPENDIX A

Data Collection Forms

SITE DESCRIPTION 2000

SITE # __ __ __ (1 2 3) SITE LOCATION ____

SITE TYPE	SITE CHOICE	TRAFFIC CONTROL
1☐ Intersection	1☐ Primary	1☐ Traffic Light
2☐ Freeway	2☐ Alternate	2☐ Stop sign
4	5	3☐ None
Exit No. ________		4☐ Other __________________
		6

DATE (month/day): __ __/__ __/2000 (7 8 9 10)

OBSERVER	DAY OF WEEK	WEATHER
1☐ Betty	1☐ Monday	1☐ Mostly Sunny
2☐ Steve	2☐ Tuesday	2☐ Mostly Cloudy
3☐ Jim D.	3☐ Wednesday	3☐ Rain
4☐ Jim R.	4☐ Thursday	4☐ Snow
5☐ Jonathon	5☐ Friday	13
6☐ Tiffani	6☐ Saturday	
7☐ Dave	7☐ Sunday	
11	12	

START TIME: __ __:__ __ (24 hour clock) (14 15 16 17) END TIME: __ __:__ __ (24 hour clock) (18 19 20 21)

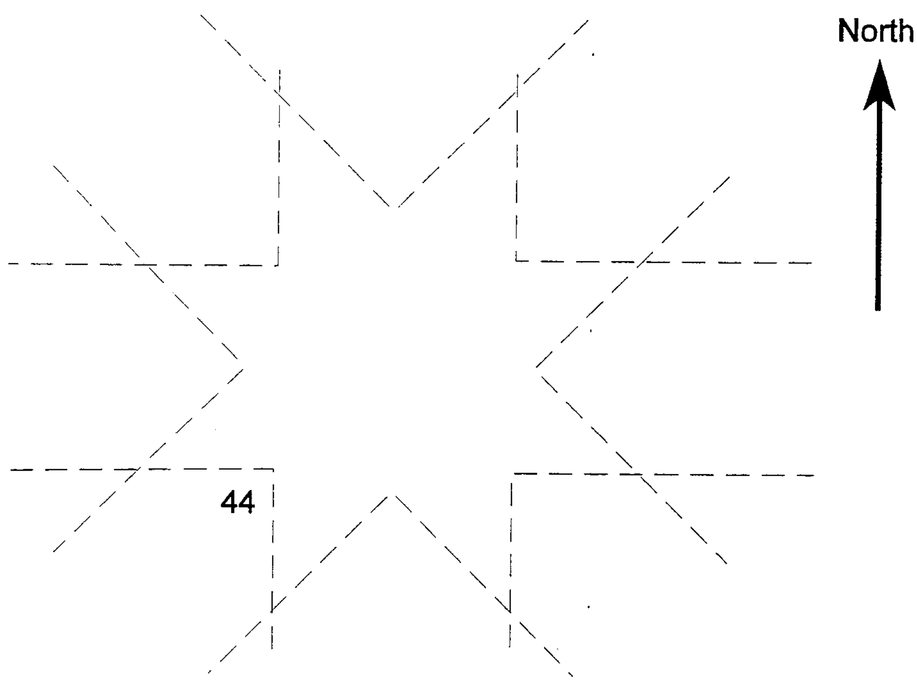
INTERRUPTION (total number of minutes during observation period): __ __ (22 23)

MEDIAN: 1☐ Yes
2☐ No
24

TRAFFIC COUNT 1: __ __ __ (25 26 27)

TRAFFIC COUNT 2: __ __ __ (28 29 30)

COMMENTS::



SITE # ___ ___ ___
1 2 3

PAGE #________

ATTENTION CODING: DUPLICATE COL 1 - 3 FOR ALL VEHICLES **2000**

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 6	VEHICLE TYPE 1☐ Passenger car 2☐ Van 3☐ Utility 4☐ Pick-up 7	
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 3 2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 10	Office Use Only: ___ ___ ___ 11 12 13	COMM. VEHICLE 1☐ No 2☐ Yes 14

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 6	VEHICLE TYPE 1☐ Passenger car 2☐ Van 3☐ Utility 4☐ Pick-up 7	
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 3 2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 10	Office Use Only: ___ ___ ___ 11 12 13	COMM. VEHICLE 1☐ No 2☐ Yes 14

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 6	VEHICLE TYPE 1☐ Passenger car 2☐ Van 3☐ Utility 4☐ Pick-up 7	
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 3 2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 10	Office Use Only: ___ ___ ___ 11 12 13	COMM. VEHICLE 1☐ No 2☐ Yes 14

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 6	VEHICLE TYPE 1☐ Passenger car 2☐ Van 3☐ Utility 4☐ Pick-up 7	
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 3 2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 10	Office Use Only: ___ ___ ___ 11 12 13	COMM. VEHICLE 1☐ No 2☐ Yes 14

APPENDIX B

Site Listing

Survey Sites By Number

No.	County	Site Location	Type	Str
001	Oakland	EB Whipple Lake Rd. & Eston Rd.	I	1
002	Kalamazoo	EB S Ave. & 29th St.	I	1
003	Oakland	SB Pontiac Trail & 10 Mile Rd.	I	1
004	Washtenaw	SB Moon Rd. & Ann Arbor-Saline Rd./Saline-Milan Rd.	I	1
005	Oakland	WB Drahner Rd. & Baldwin Rd.	I	1
006	Oakland	SB Rochester Rd. & 32 Mile Rd./Romeo Rd.	I	1
007	Oakland	SB Williams Lake Rd. & Elizabeth Lake Rd.	I	1
008	Ingham	SB Searles Rd. & Iosco Rd.	I	1
009	Kalamazoo	WB D Ave. & Riverview Dr.	I	1
010	Washtenaw	EB N. Territorial Rd. & Dexter-Pinckney Rd.	I	1
011	Washtenaw	NB Schleeweis Rd./Macomb St. & W. Main St.	I	1
012	Ingham	NB Shaftsburg Rd. & Haslett Rd.	I	1
013	Oakland	NB Middlebelt Rd. & 9 Mile Rd.	I	1
014	Washtenaw	WB Packard Rd. & Carpenter Rd.	I	1
015	Ingham	EB Haslett Rd. & Marsh Rd.	I	1
016	Washtenaw	NB Jordan Rd./Monroe St. & US-12/Michigan Ave.	I	1
017	Washtenaw	SB M-52/Main St. & Old US-12	I	1
018	Kalamazoo	SB 8th St. & Q Ave.	I	1
019	Washtenaw	NB Pontiac Trail & 7 Mile Rd.	I	1
020	Oakland	SB Lahser Rd. & 11 Mile Rd.	I	1
021	Kalamazoo	NB Ravine Rd. & D Ave.	I	1
022	Washtenaw	EB Glacier Way/Glazier Way & Huron Pkwy.	I	1
023	Washtenaw	WB Bethel Church Rd. & M-52	I	1
024	Washtenaw	SB Platt Rd. & Willis Rd.	I	1
025	Ingham	WB Fitchburg Rd. & Williamston Rd.	I	1
026	Washtenaw	EB Merritt Rd. & Stoney Creek Rd.	I	1
027	Oakland	SB Hickory Ridge Rd. & M-59/Highland Rd.	I	1
028	Kalamazoo	SB Douglas Ave. & D Ave.	I	1
029	Oakland	WB Walnut Lake Rd. & Haggerty Rd.	I	1
030	Oakland	NB Jossman Rd. & Grange Hall Rd.	I	1
031	Kalamazoo	EB H Ave. & 3rd St.	I	1
032	Kalamazoo	EB TU Ave. & 24th St./Sprinkle Rd.	I	1
033	Oakland	WBD I-96 & Milford Rd.. (Exit 155B)	ER	1
034	Washtenaw	WBP I-94 & Whittaker Rd./Huron St. (Exit 183)	ER	1
035	Kalamazoo	SBP US-131 & M-43 (Exit 38B)	ER	1
036	Washtenaw	SBD US-23 & N. Territorial Rd.	ER	1
037	Kalamazoo	EBP I-94 & Portage Rd.	ER	1
038	Oakland	EBP I-696 & Orchard Lake Rd. (Exit 5)	ER	1
039	Kalamazoo	WBP I-94 & 9th St. (Exit 72)	ER	1
040	Washtenaw	WBD I-94 & Jackson Rd.	ER	1
041	Kalamazoo	NBD US-131 & Stadium Dr./Business I-94	ER	1
042	Kalamazoo	NBP US-131 & Q Ave./Centre Ave.	ER	1

043	Livingston	SB County Farm Rd. & Coon Lake Rd.	I	2
044	Bay	WB Nebodish Rd. & Knight Rd.	I	2
045	Macomb	SB Camp Ground Rd. & 31 Mile Rd.	I	2
046	Jackson	SB Benton Rd./Moon Lake Rd. & M-50/ Brooklyn Rd.	I	2
047	Allegan	SB 6th St. & M-89	I	2
048	Kent	EB 36th St. & Snow Ave.	I	2
049	Livingston	EB Chase Lake Rd. & Fowlerville Rd.	I	2
050	Allegan	WB 144th Ave. & 2nd St.	I	2
051	Livingston	SB Cedar Lake Rd. & Coon Lake Rd.	I	2
052	Jackson	NB Mt. Hope Rd. & Waterloo-Munith Rd.	I	2
053	Kent	WB Cascade Rd. & Thornapple River Dr.	I	2
054	Allegan	NB 62nd St. & 102nd Ave.	I	2
055	Kent	SB Meddler Ave. & 18 Mile Rd.	I	2
056	Eaton	SB Houston Rd. & Kinneville Rd.	I	2
057	Macomb	SB M-19/Memphis Ridge Rd. & 32 Mile Rd./ Division Rd.	I	2
058	Allegan	NB 66th St. & 118th Ave.	I	2
059	Grn Traverse	NB Silver Lake Rd./County Rd. 633 & US-31	I	2
060	Grn Traverse	EB Riley Rd./Tenth St. & M-137	I	2
061	Bay	SB 9 Mile Rd. & Beaver Rd.	I	2
062	Kent	SB Ramsdell Dr. & M-57/14 Mile Rd.	I	2
063	Eaton	NB Ionia Rd. & M-50/Clinton Trail	I	2
064	Macomb	EB 23 Mile Rd. & Romeo Plank Rd.	I	2
065	Livingston	NB Old US-23/Whitmore Lake Rd. & Grand River Rd.	I	2
066	Jackson	SWB Horton Rd. & Badgley Rd.	I	2
067	Kent	EB Knapp St. & Honey Creek Ave.	I	2
068	Eaton	EB 5 Point Hwy. & Ionia Rd.	I	2
069	Allegan	WB 129th Ave. & 10th St.	I	2
070	Eaton	EB M-43 & M-100	I	2
071	Ottawa	WB Taylor St. & 72nd Ave.	I	2
072	Bay	EB Cass Rd. & Farley Rd.	I	2
073	Allegan	EB 126th Ave. & 66th St.	I	2
074	Bay	NB Mackinaw Rd. & Cody-Estey Rd.	I	2
075	Jackson	EBD I-94 & Elm Ave. (Exit 141)	ER	2
076	Kent	NBD US-131 & 100th St. (Exit 72)	ER	2
077	Ottawa	NBD I-196 & Byron Rd.	ER	2
078	Kent	SBP US-131 & Hall St.	ER	2
079	Macomb	SBP M-53 & 26 Mile Rd.	ER	2
080	Bay	NBD I-75 & Wilder Rd. (Exit 164)	ER	2
081	Livingston	EBD I-96 & Fowlerville Rd. (Exit 129)	ER	2
082	Macomb	EBP I-94 & 12 Mile Rd. (Exit 231)	ER	2
083	Jackson	WBD I-94 & Sargent Rd. (Exit 145)	ER	2
084	Allegan	NBP US-31/I-196 & Washington Rd./ Blue Star Hwy (Exit 47A)	ER	2
085	Genesee	SB Van Slyke Rd. & Maple Ave.	I	3
086	Monroe	WB Ida Center Rd. & Summerfield Rd.	I	3
087	Saginaw	NB Carr Rd. & Marion Rd.	I	3

088	Calhoun	NB 23 Mile Rd. & V Drive N.	I	3
089	Saginaw	WB Wadsworth Rd. & Portsmouth Rd.	I	3
090	Lenawee	WB Slee Rd. & US-223	I	3
091	Van Buren	WB 36th Ave. & M-40	I	3
092	Van Buren	EB 63rd Ave. & County Rd. 652	I	3
093	Lapeer	WB McKeen Lake Rd. & Flint River Rd.	I	3
094	St. Joseph	NB Thomas Rd. & US-12	I	3
095	Saginaw	WB Rathbun Rd. & Moorish Rd.	I	3
096	Berrien	NB Fikes Rd. & Coloma Rd.	I	3
097	Genesee	WB Hegal Rd. & M-15/State Rd.	I	3
098	Lapeer	EB M-90 & M-90/M-53	I	3
099	Saginaw	NB Thomas Rd. & Swan Creek Rd.	I	3
100	Lenawee	WB Pixley Rd. & Deer Field Rd./Beaver Rd.	I	3
101	Van Buren	NB County Rd. 665 & M-40	I	3
102	Van Buren	WB County Rd. 374 & Red Arrow Hwy./St Joseph Rd..	I	3
103	Calhoun	SEB Michigan Ave./Austin Rd. & 28 Mile Rd./N. Eaton Rd.	I	3
104	St. Clair	WB Norman Rd. & M-19/Emmett Rd.	I	3
105	Monroe	EB Oakville-Waltz Rd. & Sumpter Rd.	I	3
106	Berrien	WB Glenlord Rd. & Washington Ave.	I	3
107	Muskegon	NB Whitbeck Rd. & Fruitvale Rd.	I	3
108	Monroe	SB Petersburg Rd. & Ida West Rd./Division Rd.	I	3
109	St. Clair	WB Masters Rd. & M-19	I	3
110	St. Joseph	SB Zinmaster Rd. & M-60	I	3
111	Shiawassee	NB State Rd. & Lansing Rd.	I	3
112	Van Buren	EB Celery Center Rd. & M-51	I	3
113	Shiawassee	SB Geeck Rd. & M-21	I	3
114	Muskegon	SB Holton Duck Lake Rd. & Ryerson Rd./ Fourth St.	I	3
115	Berrien	WB Glenlord Ave. & Hollywood Rd.	I	3
116	Lenawee	SB S. Piotter Hwy & Deer Field Rd.	I	3
117	Monroe	SBP I-75 & Front St./Monroe St. (Exit 13)	ER	3
118	Lapeer	WBD I-96 & Nepessing Rd. (Exit 153)	ER	3
119	Lapeer	EBP I-69 & Lake Pleasant Rd. (Exit 163)	ER	3
120	Berrien	WBD I-94 & US-33/M-63/Niles Rd. (Exit 27)	ER	3
121	Van Buren	EBP I-94 & 64th St. (Exit 46, Hartford)	ER	3
122	Van Buren	EBD I-94 & County Rd. 652/Main St.(Exit 66)	ER	3
123	Muskegon	NBD US-31 & M-46/Apple St.	ER	3
124	Van Buren	NBP I-196 & M-140 (Exit 18)	ER	3
125	Calhoun	WBD I-94 & 26 Mile Rd.	ER	3
126	Monroe	NBP US-23 & Ida-West Rd. (Exit 13)	ER	3
127	Wayne	WB 8 Mile Rd. & Beck Rd.	I	4
128	Wayne	EB Warren Rd. & Wayne Rd.	I	4
129	Wayne	EB McNichols Rd. & Woodward Ave.	I	4
130	Wayne	NB Canton Center Rd. & Cherry Hill Rd.	I	4
131	Wayne	WB Ecorse Rd. & Pardee Rd.	I	4
132	Wayne	EB Michigan Ave. & Sheldon Rd.	I	4

133	Wayne	EB Ecorse Rd. & Middlebelt Rd.	I	4
134	Wayne	NB M-85/Fort Rd. & Emmons Rd.	I	4
135	Wayne	WB Glenwood Rd. & Wayne Rd.	I	4
136	Wayne	NB Haggerty Rd. & 7 Mile Rd.	I	4
137	Wayne	WB 6 Mile Rd. & Inkster Rd.	I	4
138	Wayne	SB Inkster Rd. & Goddard Rd.	I	4
139	Wayne	SB Merriman Rd. & Cherry Hill Rd.	I	4
140	Wayne	SEB Outer Dr. & Pelham Rd.	I	4
141	Wayne	NB Meridian Rd. & Macomb Rd.	I	4
142	Wayne	WB Ford Rd. & Venoy Rd.	I	4
143	Wayne	SWB Vernor Rd. & Gratiot Rd.	I	4
144	Wayne	WB 5 Mile Rd. & Beck Rd.	I	4
145	Wayne	EB 7 Mile Rd. & Livernois Rd.	I	4
146	Wayne	NB Gunston/Hoover Rd. & McNichols Rd.	I	4
147	Wayne	SB W. Jefferson/ Biddle Ave. & Southfield Rd.	I	4
148	Wayne	EB Goddard Rd. & Wayne Rd.	I	4
149	Wayne	WB 8 Mile Rd. & Kelly Rd.	I	4
150	Wayne	SB Merriman Rd. & US-12/Michigan Ave.	I	4
151	Wayne	SB Telegraph Rd. & Plymouth Rd.	I	4
152	Wayne	WB Sibley Rd. & Inkster Rd.	I	4
153	Wayne	NEB Mack Rd. & Moross Rd.	I	4
154	Wayne	WB Annapolis Rd. & Inkster Rd.	I	4
155	Wayne	SB Greenfield Rd. & Grand River Rd.	I	4
156	Wayne	EB Joy Rd. & Livernois Rd.	I	4
157	Wayne	SEB Conner Ave. & Gratiot Rd.	I	4
158	Wayne	NWB Grand River Rd. & Wyoming Ave.	I	4
159	Wayne	WBP I-96 & Evergreen Rd.	ER	4
160	Wayne	WBP I-94 & Haggerty Rd. (Exit 192)	ER	4
161	Wayne	NBD I-75 & Gibralter Rd. (Exit 29)	ER	4
162	Wayne	SBP I-75 & Southfield Rd.	ER	4
163	Wayne	NBD I-275 & 6 Mile Rd. (Exit 170)	ER	4
164	Wayne	NBP I-275 & M-153/Ford Rd. (Exit 25)	ER	4
165	Wayne	NBD I-275 & Eureka Rd. (Exit 15)	ER	4
166	Wayne	NBP I-75 & Springwells Ave. (Exit 45)	ER	4
167	Wayne	WBD I-94 & Pelham Rd. (Exit 204)	ER	4
168	Wayne	SBD I-75 & Sibley Rd.	ER	4

APPENDIX C

Calculation of Variances, Confidence Bands, and Relative Error

The variances for the belt use estimates were calculated using an equation derived from Cochran's (1977) equation 11.30 from section 11.8. The resulting formula was:

$$var(r) \approx \frac{n}{n-1}\sum_i \left(\frac{g_i}{\Sigma g_k}\right)^2 (r_i - r)^2 + \frac{n}{N}\sum_i \left(\frac{g_i}{\Sigma g_k}\right)^2 \frac{s_i^2}{g_i}$$

where *var(r_i)* equals the variance within a stratum and vehicle type, *n* is the number of observed intersections, g_i is the weighted number of vehicle occupants at intersection *I*, g_k is the total weighted number of occupants for a certain vehicle type at all 42 sites within the stratum, r_i is the weighted belt use rate at intersection *I*, *r* is the stratum belt use rate, *N* is the total number of intersections within a stratum, and $s_i = r_i(1-r_i)$. In the actual calculation of the stratum variances, the second term of this equation is negligible. If we conservatively estimate *N* to be 2000, the second term only adds 2.1 x 10^{-6} units to the largest variance (Stratum 4). This additional variance does not significantly add to the variance captured in the first term. Therefore, since *N* was not known exactly, the second term was dropped in the variance calculations. The overall estimated variance for each vehicle type was calculated using the formula:

$$var(r_{all}) = \frac{var(r_1) + var(r_2) + var(r_3) + 0.88^2 \times var(r_4)}{3.88^2}$$

The Wayne County stratum variance was multiplied by 0.88 to account for the similar weighting that was done to estimate overall belt use. The 95 percent confidence bands were calculated using the formula:

$$95\%\ Confidence\ Band = r_{all} \pm 1.96 \times \sqrt{Variance}$$

where *r* is the belt use of interest. This formula is used for the calculation of confidence bands for each stratum and for the overall belt use estimate.

Finally, the relative error or precision of the estimate was computed using the formula:

$$RelativeError = \frac{StandardError}{r_{all}}$$

The federal guidelines (NHTSA, 1992, 1998) stipulate that the relative error of the belt use estimate must be under 5 percent.