

2012 State of Colorado Pre-mobilization Seat Belt Survey

Colorado Department of
Transportation

SEAT BELT
STUDY



Colorado
State
University®

INSTITUTE OF TRANSPORTATION MANAGEMENT

EXECUTIVE SUMMARY

In May 2012, the Institute of Transportation Management of Colorado State University conducted a pre-mobilization seat belt usage assessment in the State of Colorado. The study was sponsored by the Colorado Department of Transportation, Office of Transportation Safety and involved observations at 221 sites in 29 counties across the State of Colorado. The survey was conducted from May 13 through 19, 2012, as a “pre-enforcement wave” study, and included drivers and front seat outboard passengers within cars, vans, sport utility vehicles (SUVs), light trucks, and select commercial vehicles 10,000 pounds and under.

Observational data were entered into a SAS system database for computation and review. The survey data and subsequent analyses yielded the results presented below for seat belt usage in the State of Colorado for 2012. Results for 2010 and 2011 are included for comparative purposes.

2010

Cars:	85.4%
Vans:	87.3%
SUVs:	83.0%
Trucks:	72.5%
Overall Estimated Usage Rate:	81.8%

2011

Cars:	82.9%
Vans:	90.3%
SUVs:	84.3%
Trucks:	71.7%
Overall Estimated Usage Rate:	81.6%

2012

Cars:	81.0%
Vans:	86.1%
SUVs:	84.1%
Trucks:	72.6%
Commercial:	69.3%
Overall Estimated Usage Rate:	80.3%

2012 (without inclusion of Commercial vehicles)

Cars:	81.0%
Vans:	86.1%
SUVs:	84.1%
Trucks:	72.6%
Overall Estimated Usage Rate:	80.8%

All vehicle types except for trucks had a slight drop in usage for 2012. Trucks improved from 71.7 to 72.6.

This was the first year that commercial vehicles were included in the study. All commercial vehicles with a gross weight of 10,000 pounds and under were included with the exception of delivery vans such as FedEx and UPS vehicles wherein drivers are frequently standing and seldom make use of any seat belt or safety restraining device. The usage rate for commercial vehicles of 69.3% contributes to the overall decline in the seat belt usage from 81.6 in 2011 to 80.3 in 2012.

ADMINISTRATIVE EVALUATION

Dr. G.J. Francis served as Principal Investigator, Burt Deines as Project Coordinator, and Felicia Zamora as Field Administrator for this pre-mobilization study. Observers and supervisors were trained by the ITM team in observation and recording methods in order to properly conduct the field survey and collect data. The need for consistency and accuracy in the process of data collection was emphasized in the training and pre-survey phase of the study.

Seat belt usage data were collected from 221 separate sites from May 13 through May 19, 2012. With the analyses of the data and the submission of this report, all project tasks and requirements were met within the parameters of the contract.

The majority of the observers gathering data in this study were retired Colorado State Highway Patrolmen. Because of their familiarity with interstate and state highways, local and county roads, and safety procedures, many potential location and safety problems were minimized or eliminated. The experience and expertise of the retired Highway Patrolmen strengthened the validity and the reliability of the results of the survey.

James Zumbrunnen of the Graybill Statistical Laboratory in the College of Natural Sciences at Colorado State University served as the lead statistician in the analysis of the data. Mr. Zumbrunnen and others within the Laboratory assumed major roles in the research design and methodology which gave the statistical analyses independence from the survey process.

Objectives of the Study

The primary objectives of the study were to:

- Conduct a seat belt usage survey within the State of Colorado immediately prior to the Seat Belt Usage Awareness Program (“Click It or Ticket”) and the enforcement wave.
- Design a sampling procedure to allow the optimal selection of survey sites that would be statistically representative of State usage figures while adhering to NHTSA guidelines.
- Design a methodology to minimize sampling error and variability.
- Complete the study within budget and file a final report.

SURVEY DESIGN AND METHODOLOGY

The 2012 Colorado Pre-mobilization Seat Belt Usage Survey has been designed to meet all the requirements established by the Uniform Criteria for State Observational Surveys of Seat Belt Use issued by the National Highway Traffic Safety Administration (NHTSA) Final Rule, Federal Register, Vol. 76, No. 63, April 1, 2011.

1. Samples were probability-based on population road segments within each county, and estimates were therefore representative of seat belt usage for the State's driver and outboard front seat passenger population for vehicles falling within the parameters of this study.
2. The sample data were collected through direct observation of seat belt usage at the pre-determined sites by qualified and trained observers. Observation times were assigned and rescheduled if weather interfered or other conditions existed which made observations at a particular site unsafe.
3. The population of interest was the driver and outboard front seat passenger of cars, vans, SUVs, light trucks, and select commercial vehicles 10,000 pounds and under.
4. Observations were conducted in daylight hours from May 13 through May 19, 2012 between the hours of 7:00 AM and 6:00 PM.
5. Observation start times were staggered in order to obtain a representative sample from rush hour and non-rush hour time frames.
6. Observational data were recorded on counting sheets and summarized. The data were then transcribed to create a digital record and entered onto field summary forms, which served as input into SAS programs for data reduction.

The pre-mobilization study was therefore designed as a statewide probability-based sample of road segments. In order to provide optimal comparative analyses, the study made use of sites selected from the statewide survey. Observation sites from the statewide survey were randomly selected from each county included in the study. The total number of sites (221) included in the pre-mobilization study represented approximately 30% of the total sites of the statewide study. Weights associated with the statewide samples were adjusted for the smaller sample used in the pre-mobilization study.

The research design involved a stratified systemic PPS sample of data collection sites described below:

1. Fatality Analysis Reporting System (FARS) data for the period of 2007 to 2009 were used to determine the average number of crash-related fatalities per county. It was determined that 29 counties accounted for 85% of Colorado's total crash-related fatalities. These 29 counties comprise the sample frame and were used as strata for sampling road segments. See Table in Appendix.
2. Road segments were selected systematically with probability proportional to size (PPS) from all segments in the stratified counties. The road segments were serpentine sorted by latitude and longitude within counties, which makes the sampling spatially more uniform within counties.

For the purposes of this survey, an observational site was defined as a specific road intersection or interstate ramp where observations take place. Observations were conducted at each site for 40 minutes of each hour between the hours of 7:00 a.m. and 6:00 p.m. for the week of May 13. Twenty minutes were allowed for recording data and moving to the next observation site.

The survey was designed to produce an overall state estimate of seat belt usage before the mobilization effort. Roads within the counties were grouped using the State's classification of "major" roads and "local" roads. A major road is determined by the road's length and volume of traffic. All road segments in the sample counties were identified, and a sample of these segments was selected for observation.

A total of 221 sites (road segments) on major roads and local roads was determined to be a representative sample based upon previous surveys. When possible, traffic was observed from inside the sample road segment at or near the point where the traffic was leaving the segment (for safety reasons).

Determination of Sample Size

Sample size determination was, in large measure, governed by time constraints and the precision requirement of the study (the relative error: standard error divided by the parameter estimate ≤ 0.025). A decision as to how many roadways to select and assign for observation during the observation period required a balance between issues of statistical reliability and observer productivity. Statistical theory, which considers correlations and the need for independent observation, would suggest that the number of roadway locations be as large as possible. However, there was a practical need to select an optimal number of road segments for study so that observers would not spend inordinate amounts of time traveling from site to site. With all of those issues given consideration as well as the needs of the contracting organizations, a total sample of 221 observational time periods and sites were selected.

Estimation

The basic estimate derived from this Colorado Pre-mobilization Seat Belt Usage Survey is the estimate of seat belt usage for all drivers and outboard front seat occupants of cars, vans, sport utility vehicles (SUVs), light trucks, and select commercial vehicles 10,000 pounds and under.

The seat belt usage rate of 80.3% for Colorado was determined by using a survey sampling methodology to obtain information about a large population of Colorado drivers and outboard front seat passengers by selecting and measuring a sample of that population. Fundamental to the analysis of this survey is the concept of cluster analysis, a collection of statistical methods that can be used to assign cases to groups (clusters). Group members share certain properties in common, and it is therefore assumed that the resultant classifications will provide insight into seat belt usage for the State of Colorado.

SURVEY RESULTS

The 2012 Colorado Pre-mobilization Seat Belt Usage Survey of the State of Colorado was conducted at 221 sites as a stratified random sample. The design for the survey was developed in compliance with the Uniform Criteria for State Observational Surveys of Seat Belt Use issued by the National Highway Traffic Safety Administration (NHTSA) Final Rule, Federal Register, Vol. 76, No. 63, April 1, 2011. Driver and outboard front seat passenger seat belt usage data were collected from these 221 sites in 29 counties from May 13 through May 19, 2012. This study was significantly larger than past years when there were 76 sites in nine counties.

There were 39,501 vehicle observations in this pre-mobilization study. The data were recorded, tabulated, and analyzed with assistance from the Graybill Statistical Laboratory of the College of Natural Sciences. As shown in Table 1, the point estimate of the overall seat belt usage rate for the Colorado Pre-mobilization Seat Belt Usage Survey was 80.3%. This estimate may vary due to sampling variability and a number of uncontrolled sampling errors that may have entered into the observational survey. Therefore, a 95% confidence interval constructed about the point estimated seat belt usage rate is from 78.0% to 82.6%.

Table 1: Statewide Seat Belt Usage by Vehicle Type

Vehicle Type	Usage Observed
Car	81.0%
Van	86.1%
SUV	84.1%
Truck	72.6%
Commercial	69.3%
Overall Average	80.3%

Seat belt usage is slightly different depending upon the speed of vehicles. For example, occupants of vehicles traveling between 0 and 30 miles per hour demonstrated a 75.9% seat belt usage, while occupants of vehicles traveling more than 50 miles per hour had an 84.5% seat belt usage. The estimate of seat belt usage for those traveling between 31 and 50 miles per hour was 80.2%. These estimates in seat belt usage support previous findings and the positive correlation of vehicle speed and seat belt usage. The range of vehicle speed and overall seat belt usage rates are shown in Table 2.

Table 2: Seat Belt Usage by Vehicle Speed

Vehicle Speed	Usage Observed
0-30 miles per hour	75.9%
31-50 miles per hour	80.2%
Greater than 50 miles per hour	84.5%

As shown in Table 3, the seat belt usage on local roads (78.0%) was lower than the seat belt usage on primary roads (87.3%). Even though these results are not practically different, the gap that does exist is most likely due to the average speed traveled on the two categories of roads.

There was some variability in seat belt usage across the 29 counties. This is an expected result as the differences in urban and rural counties are exacerbated by the road types and vehicle speed. Rural counties such as Alamosa, Huerfano, and Las Animas tended to have the lowest usage rates with all being under 70%. The more urban counties of Adams, Douglas, and Jefferson were all above 85% usage rates. Rural counties having rates above 85% included Grand, Mesa, Montezuma, Morgan, Summit, and Weld. Urban counties falling below 80% included Boulder, Denver, and El Paso.

Table 3 also illustrates the difference in seat belt usage among vehicle types. Van front seat occupants were highest in seat belt usage among vehicle types (86.1%) followed by SUVs (84.1%), cars (81.0%), trucks (72.6%), and commercial (69.3%). Although there has been steady improvement over the last decade, trucks continue to have the lowest seat belt usage of all vehicles in the seat belt usage surveys.

It was noted by observers that the commercial usage rate was most negatively impacted by “local” commercial vehicles. Vehicles used by landscapers, lawn service, and delivery trucks were least likely to make use of seat belts. The usage rates for drivers of vehicles associated with larger companies were much higher and more consistent across all categories of vehicles.

Table 3: Summaries of Estimates of Seat Belt Usage 2012

	# of Sites	Estimate %	Std Error	CV	Confidence Interval	
					Lower 95% Limit	Upper 95% Limit
Vehicle Overall Average	221	80.3	1.2	1.46	78.0	82.6
County						
Adams	11	85.4	3.3	3.83	79.0	91.9
Alamosa	4	64.9	6.0	9.28	53.1	76.8
Arapahoe	16	84.0	1.6	1.96	80.8	87.3
Baca	4	65.1	2.5	3.84	60.1	70.0
Boulder	11	75.0	3.3	4.38	68.5	81.5
Delta	4	79.4	2.2	2.80	75.1	83.8
Denver	11	78.0	2.8	3.59	72.5	83.5
Douglas	16	87.5	0.8	0.86	86.0	89.0
Eagle	4	84.4	4.0	4.73	76.5	92.2
El Paso	16	69.7	3.0	4.36	63.7	75.7
Fremont	4	75.5	1.8	2.42	71.9	79.1
Garfield	5	81.2	5.0	6.13	71.4	91.0
Grand	4	91.2	1.4	1.52	88.4	93.9
Huerferno	4	69.2	7.8	11.2	53.9	84.5
Jefferson	11	88.1	1.4	1.55	85.4	90.8
La Plata	4	71.1	5.7	7.96	60.0	82.3
Larimer	13	80.4	1.8	2.26	76.8	83.9
Las Animas	4	66.3	10.1	15.2	46.4	86.2
Lincoln	4	78.6	5.1	6.53	68.5	88.7
Logan	4	77.7	4.5	5.85	68.7	86.6
Mesa	10	88.2	3.2	3.64	81.9	94.5
Montezuma	4	89.9	1.6	1.75	86.8	93.0
Montrose	4	73.2	2.3	3.12	68.7	77.7
Morgan	4	86.7	3.5	4.01	79.8	93.6
Park	10	84.0	1.1	1.27	81.9	86.1
Pueblo	16	68.0	2.2	3.20	63.7	72.3
Routt	4	83.7	2.1	2.48	79.6	87.8
Summit	4	86.7	0.7	0.77	85.4	88.0
Weld	11	85.1	1.5	1.81	82.0	88.1
Vehicle Speed						
0-30 miles per hour	52	75.9	2.4	3.14	71.2	80.6
31-50 miles per hour	60	80.2	2.0	2.43	76.4	84.1
Greater than 50 miles per hour	109	84.5	1.5	1.78	81.5	87.5
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	# of Sites	Estimate %	Std Error	CV	Lower 95% Limit	Upper 95% Limit
Vehicle Type						
Car	221	81.0	1.6	2.03	77.7	84.2
Van	221	86.1	1.9	2.15	82.4	89.7
SUV	221	84.1	1.2	1.40	81.8	86.4
Truck	221	72.6	1.6	2.23	69.4	75.8
Commercial	221	69.3	2.7	3.93	64.0	74.7
Road Class						
Primary	49	87.3	0.9	1.01	85.5	89.0
Secondary	122	79.6	1.0	1.24	77.7	81.5
Local	50	78.0	1.8	2.32	74.4	81.6

Standard Error, CV and Lower and Upper Confidence Interval Limits

The columns labeled **Std Error**, **CV** and **Lower 95%** and **Upper 95% Confidence Intervals** are statistical terms defining measures of risk. The Std Error is a measure of the sampling errors that are uncontrollable in a statistical experiment. It is preferred that these sampling errors remain below .05 or 5%. The column entitled CV is the coefficient of variation. It is a dimensionless measure of variability, designed to allow comparisons of variation for samples with different sizes. The Confidence Intervals (Lower and Upper 95%) give ranges of results that are most likely to be observed in repeated trials of this statistical experiment.

Analysis

The PROC SURVEYMEANS procedure of SAS was used to perform statistical analysis of the survey data. This analytical procedure takes into account the design used to select the sample to be analyzed. The sample design was a complex design which incorporated stratification and unequal weighting. The SURVEYMEANS procedure computes ratio estimates and provides standard errors and confidence intervals for the ratios and for any specified domain analysis, such as road class.

Using this procedure, seat belt usage rates in Colorado were estimated along with a determination of the standard errors and coefficients of variation. The survey sample size was large enough to allow estimates of usage rates for various domains of vehicle, speed, and local vs. major roads. The estimates for all domains, their standard errors and coefficients of variation (CV) and intervals are shown in Table 3.

Given the differences among the seat belt usage rates for the low speed (75.9%), moderate speed (80.2%), and high speed (84.5%), it is not likely that the differences can be attributed to sampling variability. In combination with these results and similar, consistent findings in previous studies, it can be concluded that there is an increase in seat belt usage at higher speeds.

Usage rates by different types of vehicles were also analyzed (cars-81.0%, vans-86.1%, SUVs-84.1%, trucks-72.6%, commercial-69.3%). Clearly, the differences in usage rates between trucks and all other vehicle types are statistically significant. In other words, the differences in seat belt usage rates for front seat occupants among the various types of vehicles when compared to trucks are due to something other than sampling error.

CONCLUSIONS

The survey of 39,501 vehicles at 221 sites provided an adequate sample as confirmed through comparative analyses with the results of previous State of Colorado seat belt surveys and by the consistency of the results of several different and independent methods of analyses. The overall statewide seat belt usage rate in this pre-mobilization survey is estimated to be 80.3% with a lower limit of 78.0% and an upper limit of 82.6% at 95% confidence. A standard error of 1.2 was well within the NHSTA established guidelines of 2.5.

Although the pre-mobilization study has fewer sites and observations than the statewide survey, it provides some insight into the changing behaviors of Colorado drivers and their passengers. As this study is nearly a year removed from the “Click-It-or-Ticket” program and the enforcement wave, the seat belt usage rates are most likely a manifestation of internalized behaviors and are not influenced by the aforementioned programs. While the improvements over the last several years have come in small increments, the usage rates remain fairly consistent. For a secondary law state, the pre-mobilization seat belt usage rate of 80.3% represents a significant measure of success. The pre-mobilization sample and the results are representative in that both rural and urban observations are included, and the study is well removed from any external influences of special education and enforcement programs. In this regard, the results of this study reinforce the importance of continued educational efforts designed to internalize safe behaviors among drivers and passengers and to thus improve seat belt usage in the State of Colorado.

APPENDIX

Colorado Average Motor Vehicle Crash-Related Fatalities by County 2007-2009*

County	FIPS	Average Fatality Counts (2007-2009)	Fatality Percentage Within Colorado	Cumulative Fatality Percentage
WELD	123	43.7	8.2	8.2
EL PASO	041	42.7	8.0	16.2
DENVER	031	40.3	7.6	23.8
ARAPAHOE	005	36.3	6.8	30.7
JEFFERSON	059	35.3	6.6	37.3
ADAMS	001	33.3	6.3	43.6
LARIMER	069	26.0	4.9	48.5
PUEBLO	101	23.7	4.5	52.9
MESA	077	20.0	3.8	56.7
BOULDER	013	19.0	3.6	60.3
DOUGLAS	035	15.7	2.9	63.2
GARFIELD	045	14.3	2.7	65.9
LA PLATA	067	12.3	2.3	68.2
DELTA	029	8.7	1.6	69.8
EAGLE	037	8.7	1.6	71.5
MONTROSE	085	6.7	1.3	72.7
PARK	093	6.7	1.3	74.0
FREMONT	043	6.0	1.1	75.1
ROUTT	107	6.0	1.1	76.2
LAS ANIMAS	071	5.7	1.1	77.3
MONTEZUMA	083	5.3	1.0	78.3
HUERFANO	055	5.0	0.9	79.2
GRAND	049	4.7	0.9	80.1
LINCOLN	073	4.7	0.9	81.0
MORGAN	087	4.7	0.9	81.9
SUMMIT	117	4.7	0.9	82.8
BACA	009	4.0	0.8	83.5
LOGAN	075	4.0	0.8	84.3
ALAMOSA	003	3.7	0.7	85.0

*Fatality data from the Fatality Analysis Reporting System (FARS) 2007-2009