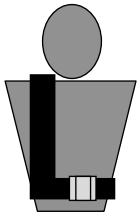
# 2011 State of Colorado Pre-mobilization Seat Belt Survey

## Colorado Department of Transportation




## STUDY

Colorado State University®

**INSTITUTE OF TRANSPORTATION MANAGEMENT**

# EXECUTIVE SUMMARY

In May 2011, the Institute of Transportation Management of Colorado State University conducted a pre-mobilization seat belt usage assessment of drivers and outboard front seat passengers of non-commercial vehicles in the State of Colorado. The study was sponsored by the Colorado Department of Transportation, Office of Transportation Safety and involved observations at 71 sites in nine counties across the State of Colorado. The survey was conducted from May 1 through May 7, 2011, as a "pre-enforcement wave" study, and included drivers and front seat outboard passengers within cars, vans, sport utility vehicles (SUVs), and light trucks normally used for personal transportation. Commercial vehicles were excluded from this survey.

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 2011. Results for 2009 and 2010 are included for comparative purposes.

**2009**

| | |
|---|---|
| Cars: | 85.7% |
| Vans: | 88.7% |
| SUVs: | 79.0% |
| Trucks: | 70.4% |
| Overall Estimated Usage Rate: 80.1% | |

**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% | |

Although cars and trucks showed a slight drop in seat belt usage from 2010 to 2011, the improvement among drivers and passengers of vans and SUVs was enough to maintain the overall seat belt usage at 81.6%. The continued strong overall seat belt usage for the last three years of 80.1, 81.8, and 81.6%, respectively, is especially significant as the pre-mobilization study occurs prior to the “Click-It-or-Ticket” program and the enforcement wave conducted in late May and is therefore not influenced by any external factors.

# ADMINISTRATIVE EVALUATION

Drs. G.J. Francis and Walter Hivner served as Principal Investigator and Project Data Analyst, respectively. Brenda Ogden was the Coordinator of data collection and Manager of payroll, and Burt Deines served as Supervisor of the observers. 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 71 separate sites from May 1 through May 7, 2011. With the analyses of the data and the submission of this report, all project tasks and requirements were met within the time and financial parameters of the contract.

Most 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.

The use of the Graybill Statistical Laboratory of the College of Natural Sciences at Colorado State University was also an important factor in the success of this study as the Laboratory's statistical analyses contributed to the reliability and validity of the usage estimates and gave the 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 and that would be statistically representative of State usage figures.
- Design a methodology to minimize sampling error and variability.
- Complete the study within budget with a final report filed on or before June 30, 2011

# SURVEY DESIGN

The sampling design for the Colorado Pre-mobilization Seat Belt Usage Survey is a statewide, multistage probability-based sample of road segments. The following steps were taken in drawing the sample sites where observations were to be conducted:

1. Select strata
2. Sample clusters
3. Select specific observation sites

For this survey, eight strata were determined; each stratum represents a unique geographic, sociological segmentation (i.e., eastern plains with a farming economy and the recreation/tourism economy of the western slope). Within each stratum, clusters, based on the identification of average vehicle miles and population, were determined and were represented by counties within the strata. Finally, major roads and local roads were selected for location of observation sites. The major and local road selection is a probability-based decision from available road segments of the design and makes use of United States Census tracts.

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 3:00 p.m. for the week of May 1. 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. Groupings of counties form the primary strata and were selected based on population contribution to the state population and vehicle miles traveled.

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.

Local roads were selected within sample tracts, and the number of tracts chosen was proportional to the population of the county. A total of 71 sites (road segments) on major roads and local roads was determined to be a representative sample. Traffic was always observed from inside the sample road segment at or near the point where the traffic was leaving the segment (for safety reasons). It has been estimated that about 30% of the State's total vehicle miles occur on local roads. However, approximately 40% of the observation time has been allocated to local roads because of a higher variability in seat belt usage on local roads compared to major roads. Statistically, it is

prudent to allocate more observation time to those areas, which have the potential for more variability, thereby minimizing sampling errors that are due to strata selection.

The 2011 Colorado Pre-mobilization Seat Belt Usage Survey has been designed to meet all the criteria set by the Uniform Criteria for State Observational Surveys of Seat Belt Use 23 CFR Part 1340, Docket No. NHTSA-98-4280. RIN 2127-AH46, Final Rule. Specifically,

1. Samples were probability-based on population and vehicle miles, and estimates were therefore representative of seat belt usage for the State's driver and outboard front seat passenger population.

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 are assigned and rescheduled if weather interferes or other conditions exist which may make observations at a particular site unsafe.

3. The population of interest was the driver and outboard front seat passenger of cars, vans, SUVs, and non-commercial light trucks.

4. Observations were conducted in daylight hours from May 1 through May 7, 2011.

5. 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 reduced data were returned to Dr. Walter Hivner for analysis and interpretation.

## 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 <= 0.05). A decision as to how many roadways to select and assign for observation during the observation period required finding 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 71 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), and light trucks.
The seat belt usage rate for Colorado for this survey was determined by using a survey sampling methodology to obtain information about a large population of Colorado adult vehicle drivers 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 METHODOLOGY

The PROC SURVEYREG 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 clustering and unequal weighting of the clusters. The survey design included eight strata, three each in the Western Slope and Front Range and two in the Eastern Plains. These strata are based on population and vehicle mile considerations. Next the county clusters from each stratum were determined along with the county cluster weighting. Observation sites within the county clusters were selected as the final step.

The SURVEYREG procedure fits linear models for survey data and computes regression coefficients and the variance-covariance matrix. The procedure also provides significance tests for the regression model effects and for any specified estimable linear functions of the model parameters.

# SURVEY RESULTS

The 2011 Colorado Pre-mobilization Seat Belt Usage Survey of the State of Colorado was conducted at 71 sites as a multistage stratified random sample. The design for the survey was developed in compliance with the National Highway Traffic Safety Administration's **Guidelines for State Observational Surveys of Safety Belt and Motorcycle Helmet Use** (Docket No. 92-12, Notice No. 02) and **Uniform Criteria for State Observational Surveys of Seat Belt Use** (23 CFR 1340; Docket NHTSA-98-4280). Driver and outboard front seat passenger seat belt usage data were collected from these 71 sites from May 1 through May 7, 2011.

There were 14,222 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 81.6%. 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 79.8% to 83.3%.

**Table 1: Statewide Seat Belt Usage by Vehicle Type**

| Vehicle Type | Usage Observed |
|---|---|
| Car | 82.9% |
| Van | 90.3% |
| SUV | 84.3% |
| Truck | 71.7% |
| Overall Average | 81.6% |

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 76.8% seat belt usage, while occupants of vehicles traveling more than 50 miles per hour had an 84.1% seat belt usage. The estimate of seat belt usage for those traveling between 31 and 50 miles per hour was 79.4%. 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 | 76.8% |
| 31-50 miles per hour | 79.4% |
| Greater than 50 miles per hour | 84.1% |

As shown in Table 3, the seat belt usage on local roads (79.8%) was lower than the seat belt usage on major roads (82.1%). Even though these results are not statistically different, the gap that does exist is most likely due to the average speed traveled on the two categories of roads.

Seat belt usage in the nine counties sampled was fairly consistent with the exception of Morgan County. Morgan County had the lowest usage rate at 74.2% and also had the greatest variation in usage. Among the remaining eight counties, El Paso was the highest with 84.9%, and Weld was the lowest at 79.2%.

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 (90.3%) followed by SUVs (84.3%), cars (82.9%), and trucks (71.7%). 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.

**Table 3: Summaries of Estimates of Seat Belt Usage 2011**

| | # of Sites | Estimate % | Std Error | CV | Confidence Interval Lower 95% Limit | Confidence Interval Upper 95% Limit |
|---|---|---|---|---|---|---|
| **Vehicle Overall Average** | 71 | 81.6 | 0.8 | 0.93 | 79.8 | 83.3 |
| **County** | | | | | | |
| Adams | 6 | 80.4 | 0.8 | 1.04 | 78.3 | 82.6 |
| Denver | 9 | 83.1 | 1.4 | 1.70 | 79.9 | 86.4 |
| Eagle | 9 | 83.0 | 1.4 | 1.70 | 79.8 | 86.3 |
| El Paso | 8 | 84.9 | 2.6 | 3.01 | 78.8 | 90.9 |
| Jefferson | 8 | 82.1 | 2.4 | 2.95 | 76.3 | 87.8 |
| Larimer | 6 | 82.9 | 1.2 | 1.43 | 79.8 | 85.9 |
| Mesa | 7 | 79.5 | 3.1 | 3.85 | 72.0 | 87.0 |
| Morgan | 8 | 74.2 | 4.6 | 6.16* | 63.4 | 85.0 |
| Weld | 10 | 79.2 | 2.0 | 2.51 | 74.7 | 83.7 |
| **Vehicle Speed** | | | | | | |
| 0-30 miles per hour | 27 | 76.8 | 1.6 | 2.03 | 73.2 | 80.5 |
| 31-50 miles per hour | 28 | 79.4 | 1.3 | 1.66 | 76.3 | 82.6 |
| Greater than 50 miles per hour | 26 | 84.1 | 0.7 | 0.80 | 82.5 | 85.7 |
| **Road Class** | | | | | | |
| Local | 38 | 79.8 | 1.2 | 1.56 | 76.9 | 82.7 |
| Major | 33 | 82.1 | 0.9 | 1.11 | 80.0 | 84.2 |
| **Vehicle Type** | | | | | | |
| Car | 71 | 82.9 | 1.1 | 1.37 | 80.3 | 85.5 |
| Van | 71 | 90.3 | 1.5 | 1.69 | 86.7 | 93.8 |
| SUV | 71 | 84.3 | 0.8 | 0.91 | 82.5 | 86.1 |
| Truck | 71 | 71.7 | 1.2 | 1.67 | 68.9 | 74.4 |

* This large CV indicates that Morgan County has more absolute variation in their seat belt usage than the other counties in this survey.

**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

Using the procedures discussed earlier in the report, seat belt usage rates in Colorado were estimated along with a determination of the standard errors and coefficients of variation. The overall estimate of seat belt usage in the State of Colorado from this survey is 81.6%. This figure may vary because of sampling errors, since not all roads in the State were observed and other types of survey errors may have occurred. Thus, a 95% confidence interval of the estimated usage rate is 79.8% to 83.3%.

The survey sample size is large enough to allow estimates of usage rates for various subgroups of vehicle, speed, and local vs. major roads. The estimates for all subgroups, 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 (76.8%), moderate speed (79.4%), and high speed (84.1%), 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. Even though speeds are generally higher on major roads versus local roads, the differences between usage rates on local (79.8%) vs. major (82.1%) are not statistically different.

Usage rates by different types of vehicles were also analyzed (cars – 82.9%, vans – 90.3%, SUVs – 84.3%, trucks – 71.7%). 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 14,222 vehicles at 71 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 81.6% with a lower limit of 79.8% and an upper limit of 83.3% at 95% confidence.

Although the pre-mobilization study has relatively fewer sites and observations than other studies in the State, it provides some insight into the changing behaviors of Colorado drivers and their passengers. As the survey 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 that are a result of something other than recent reminders of the aforementioned programs. While the improvements over the last several years have come in small increments, there is still an upward trend. For a secondary law state, a statewide seat belt usage rate of 81.6% represents a significant measure of success. The pre-mobilization sample is representative in that it includes both rural and urban observations and 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.