# 2009 State of Colorado Teen Seat Belt Survey

## Colorado Department of Transportation

## SEAT BELT STUDY

Colorado State University®

INSTITUTE OF TRANSPORTATION MANAGEMENT

# EXECUTIVE SUMMARY

A seat belt usage assessment of teen drivers and front seat outboard passengers of non-commercial vehicles in the State of Colorado was conducted by the Institute of Transportation Management (ITM) from April 13 through April 24, 2009. The study was sponsored by the Colorado Department of Transportation, Office of Transportation Safety, Occupant Protection Program and involved observations at 207 sites in 18 counties across the State of Colorado. Specifically, teen drivers and front seat outboard passengers were observed for seat belt usage 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 an SAS system database for computation and review. The survey data and subsequent analyses yielded the following results for seat belt usage among teen drivers and front seat outboard passengers in the State of Colorado:

| | |
|---|---|
| Cars: | 79.7% |
| Vans: | 88.7% |
| SUVs: | 83.3% |
| Trucks: | 70.2% |

**Overall Estimated Usage Rate 80.6%**

# ADMINISTRATIVE EVALUATION

Drs. G.J. Francis and Walter Hivner served as Principal Investigator and Project Statistician, respectively. Observers and supervisors were trained in how to properly conduct the field observations 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 207 separate sites on the weekdays between April 13 and April 24, 2009. Because of weather-related delays some observations were conducted during the week of April 27.

Retired Colorado State Highway Patrol Officers comprise the core of the observers who collected data. The experience and expertise of the retired Highway Patrol Officers strengthened the validity of the results of the survey. Because of their familiarity with interstate highways, state highways, local and county roads, and safety procedures, many potential location and safety problems were minimized or eliminated.

The use of the Statistical Laboratory of the College of Natural Sciences at Colorado State University was also an important factor in the success of this study. The Laboratory's statistical analyses contributed to the reliability and validity of the usage estimates and gave the analyses independence from the survey process.

With the analyses of the data and the submission of this report, all project tasks and requirements were met within the time constraints and financial parameters of the contract.

## Objectives of the Study

The primary objectives of the study were to:

- Conduct a seat belt usage survey within the State of Colorado to estimate the seat belt usage of teen drivers and outboard passengers in cars, vans, SUVs, and light trucks.
- Design a sampling procedure that would allow the optimal selection of survey sites and be statistically representative of State usage figures.
- Design a methodology that would minimize sampling error and variability.
- Complete the study within budget with a final report filed on or before July 1, 2009.

# SURVEY DESIGN

The sampling design for the study is a statewide, multistage probability-based sample of possible observation sites. The following steps were taken in drawing the sample sites where observations were to be conducted:

1. Selection of strata
2. Determination of sample clusters
3. Selection of 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. These clusters are represented by counties within the strata. Finally, the selection of high schools, community colleges, state colleges, and universities within the selected counties was made. Exact sites for observation and data collection were then determined for each school. These sites were selected as representing the highest concentration of individuals in the age group being studied and thus minimized observational error.

For the purposes of this survey, an observational site is defined as a specific road intersection or parking lot entrance/exit where observations take place. Observations were conducted at each selected site for 40 minutes once per week over the two-week time period. Thus, each site was observed twice to collect data.

The 2009 survey of teens was 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 are therefore representative of seat belt usage for the State's teen drivers and outboard front seat passenger population.

2. The sample data were collected through direct observation of seat belt usage on selected roadways and in parking lots close to high schools and colleges by qualified and trained observers. Observation times were assigned for 40 minutes of every hour scheduled.

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

4. Observations were conducted in daylight hours from April 13 through April 24, 2009. Additional observations were made during the week of April 27 due to weather-related delays.

5. Observational data were recorded on counting sheets and summarized. The data were then transcribed to create a digital record. The digital record 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 requirements of the study (the relative error: standard error divided by the parameter estimate <= 0.05). The decision as to how many sites to select and assign for observation during the observation period required finding a balance among issues of statistical reliability, observer productivity, and site feasibility.

Statistical theory, which considers correlations and the need for independent observation, would suggest that the study assign as many observation sites as possible. However, there is also a practical need to select sites for study that will not require inordinate amounts of time traveling from site to site. In addition, selected sites need to provide access to the targeted population of teen drivers. Sites near high schools, community colleges, and college and university dorms were therefore given priority.

## Estimation

The basic estimate derived from this study was the estimate of seat belt usage for teen drivers and outboard front seat passengers in 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 vehicle drivers and outboard front seat passengers by selecting and measuring a sample of that population. The fundamental basis for the analyses of the data from the survey lies in the concept of cluster analysis. Group or "cluster" members share certain properties in common, such as age, and the resultant classification should provide insight into seat belt usage among teens in the State of Colorado.

# SURVEY METHODOLOGY

The PROC SURVEYREG procedure of SAS was used to perform statistical analyses 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 were based on population and vehicle miles traveled. Next, the county clusters from each stratum were determined along with the county cluster weighting. Specific 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 2009 Colorado Teen Seat Belt Usage Survey of the State of Colorado was conducted at 207 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 207 sites from April 13, 2009 through April 24, 2009. The survey was extended into the week of April 27 because of the rain storms that forced a delay in the observations.

There were 60,452 vehicle observations in the 18 counties surveyed. The data were recorded, tabulated, and analyzed with assistance from the Statistical Laboratory of the College of Natural Sciences. As shown in Table 3, the statewide point estimate of the overall seat belt usage rate for the 2009 Colorado Teen Seat Belt Usage Survey was 80.6%. 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 ranged from 76.5% to 84.7%.

Tables 1, 2, and 3 show estimates of seat belt usage for teen drivers and outboard front seat passengers by type of vehicle (cars, vans, SUVs and trucks) for the years 2007, 2008, and 2009, respectively.

**Table 1: 2007 Statewide Seat Belt Usages by Vehicle Type**

| Vehicle Type | Usage Observed |
|---|---|
| Car | 72.0% |
| Van | 82.0% |
| SUV | 76.2% |
| Truck | 64.3% |
| Overall Average | 72.9% |

**Table 2: 2008 Statewide Seat Belt Usages by Vehicle Type**

| Vehicle Type | Usage Observed |
|---|---|
| Car | 76.7% |
| Van | 91.9% |
| SUV | 82.9% |
| Truck | 74.4% |
| Overall Average | 79.2% |

**Table 3: 2009 Statewide Seat Belt Usages by Vehicle Type**

| Vehicle Type | Usage Observed |
|---|---|
| Car | 79.7% |
| Van | 88.7% |
| SUV | 83.3% |
| Truck | 70.2% |
| Overall Average | 80.6% |

The overall average seat belt usage has increased each year from 2007 to 2009 even though cars and SUVs are the only vehicle types showing consistent improvements over the three-year period.

Tables 3a, 3b, and 3c show a summary of the estimates of seat belt usage by region, county, weather, and vehicle type for the years 2007, 2008, and 2009, respectively.

**Table 3a: 2007 Summaries of Estimates of Seat Belt Usage**

| | | | | Confidence Interval | |
|---|---|---|---|---|---|
| | **Estimate %** | **Std Error** | **CV** | **Lower 95% Limit** | **Upper 95% Limit** |
| **Vehicle Overall Usage** | 72.9 | 1.3 | 1.82 | 70.0 | 75.8 |
| | | | | | |
| **County** | | | | | |
| Adams | 64.0 | 2.1 | 3.35 | 59.6 | 68.3 |
| Arapahoe | 71.8 | 0.8 | 1.17 | 70.1 | 73.5 |
| Boulder | 79.1 | 2.0 | 2.58 | 74.9 | 83.2 |
| Denver | 79.4 | 1.4 | 1.81 | 76.5 | 82.3 |
| Douglas | 77.5 | 4.1 | 5.26 | 68.7 | 86.3 |
| El Paso | 76.9 | 1.9 | 2.46 | 73.1 | 80.7 |
| Garfield | 66.5 | * | * | * | * |
| Gunnison | 64.3 | * | * | * | * |
| Jefferson | 76.3 | 1.6 | 2.05 | 73.2 | 79.4 |
| LaPlata | 42.2 | * | * | * | * |
| Larimer | 95.2 | 0.7 | 0.72 | 93.7 | 96.7 |
| Logan | 54.6 | | | * | * |
| Mesa | 67.6 | 1.0 | 1.0 | 65.1 | 70.0 |
| Moffat | 69.4 | * | * | * | * |
| Morgan | 53.8 | * | * | * | * |
| Pueblo | 66.2 | 3.1 | 4.76 | 59.4 | 73.0 |
| Routt | 80.3 | * | * | * | * |
| Weld | 62.5 | 4.8 | 7.69 | 52.5 | 72.5 |
| **Region** | | | | | |
| Eastern | 58.1 | 3.5 | 5.97 | 43.2 | 73.0 |
| Front Range | 74.2 | 1.7 | 2.24 | 70.2 | 78.3 |
| Western | 68.5 | 1.7 | 2.49 | 63.7 | 73.2 |
| **Weather** | | | | | |
| Clear | 72.9 | 1.2 | 1.69 | 70.2 | 75.2 |
| Not Clear | 73.7 | 5.0 | 6.79 | 61.8 | 85.5 |
| **Vehicle Type** | | | | | |
| Car | 72.0 | 1.7 | 2.39 | 68.2 | 75.8 |
| Van | 82.0 | 4.4 | 5.41 | 72.3 | 91.7 |
| SUV | 76.2 | 1.4 | 1.89 | 73.1 | 79.4 |
| Truck | 64.3 | 3.9 | 6.04 | 55.8 | 72.8 |

***Note:** In these counties, there were too few observations to make an estimate of Confidence Intervals.

**Table 3b: 2008 Summaries of Estimates of Seat Belt Usage**

| | | | | Confidence Interval | |
|---|---|---|---|---|---|
| | **Estimate %** | **Std Error** | **CV** | **Lower 95% Limit** | **Upper 95% Limit** |
| **Vehicle Overall Usage** | 79.2 | 2.4 | 3.06 | 73.9 | 84.5 |
| | | | | | |
| **County** | | | | | |
| Adams | 75.1 | 1.1 | 1.5 | 72.8 | 77.4 |
| Arapahoe | 78.4 | 1.1 | 1.45 | 76.1 | 80.7 |
| Boulder | 75.4 | 2.1 | 2.78 | 71.1 | 79.7 |
| Denver | 83.1 | 1.3 | 1.62 | 80.4 | 85.8 |
| Douglas | 83.0 | 1.5 | 1.77 | 79.9 | 86.0 |
| El Paso | 81.6 | 1.4 | 1.76 | 78.7 | 84.5 |
| Garfield | 75.0 | * | * | * | * |
| Gunnison | 70.5 | * | * | * | * |
| Jefferson | 74.4 | 1.2 | 1.64 | 71.9 | 76.8 |
| LaPlata | 65.2 | * | * | * | * |
| Larimer | 95.1 | 0.5 | .57 | 93.9 | 96.2 |
| Logan | 71.3 | | | * | * |
| Mesa | 72.5 | 1.1 | 1.45 | 70.0 | 75.0 |
| Moffat | 71.5 | * | * | * | * |
| Morgan | 63.7 | * | * | * | * |
| Pueblo | 66.8 | 2.1 | 3.21 | 62.2 | 71.3 |
| Routt | 87.7 | * | * | * | * |
| Weld | 74.3 | 2.1 | 2.8 | 69.9 | 78.6 |
| **Region** | | | | | |
| Eastern | 72.6 | 2.3 | 3.17 | 62.7 | 82.5 |
| Front Range | 80.1 | 2.8 | 3.52 | 73.2 | 87.0 |
| Western | 75.5 | 3.0 | 4.02 | 65.8 | 85.1 |
| **Weather** | | | | | |
| Clear | 79.4 | 2.6 | 3.33 | 73.6 | 85.2 |
| Not Clear | 77.7 | 2.3 | 2.93 | 72.4 | 82.9 |
| **Vehicle Type** | | | | | |
| Car | 76.7 | 1.9 | 2.42 | 72.6 | 80.7 |
| Van | 91.9 | 3.6 | 3.89 | 84.0 | 99.8 |
| SUV | 82.9 | 2.3 | 2.76 | 77.9 | 87.9 |
| Truck | 74.4 | 4.7 | 6.3 | 64.1 | 84.7 |

***Note:** In these counties, there were too few observations to make an estimate of Confidence Intervals.

**Table 3c: 2009 Summaries of Estimates of Seat Belt Usage**

| | | | | Confidence Interval | |
|---|---|---|---|---|---|
| | **Estimate %** | **Std Error** | **CV** | **Lower 95% Limit** | **Upper 95% Limit** |
| **Vehicle Overall Usage** | 80.6 | 1.9 | 2.33 | 76.5 | 84.7 |
| | | | | | |
| **County** | | | | | |
| Adams | 78.6 | 1.4 | 1.73 | 75.8 | 81.3 |
| Arapahoe | 79.9 | 1.4 | 1.74 | 77.1 | 82.6 |
| Boulder | 80.2 | 1.3 | 1.68 | 77.4 | 82.9 |
| Denver | 76.3 | 1.5 | 1.96 | 73.3 | 79.3 |
| Douglas | 84.9 | 0.8 | 0.99 | 83.1 | 86.6 |
| El Paso | 87.3 | 1.3 | 1.46 | 84.8 | 89.9 |
| Garfield | 65.8 | * | * | * | * |
| Gunnison | 64.4 | * | * | * | * |
| Jefferson | 75.4 | 1.2 | 1.58 | 73.1 | 77.8 |
| LaPlata | 59.2 | * | * | * | * |
| Larimer | 92.2 | 0.9 | 0.97 | 90.4 | 94.0 |
| Logan | 76.5 | * | * | * | * |
| Mesa | 71.3 | 0.7 | 1.04 | 69.5 | 73.0 |
| Moffat | 72.7 | * | * | * | * |
| Morgan | 76.8 | * | * | * | * |
| Pueblo | 63.3 | 2.2 | 3.53 | 58.5 | 68.1 |
| Routt | 80.0 | * | * | * | * |
| Weld | 81.9 | 1.5 | 1.8 | 78.8 | 85.0 |
| **Region** | | | | | |
| Eastern | 80.7 | 1.4 | 1.70 | 74.8 | 86.7 |
| Front Range | 81.9 | 2.2 | 2.69 | 76.5 | 87.3 |
| Western | 71.0 | 2.7 | 3.79 | 63.5 | 78.4 |
| **Weather** | | | | | |
| Clear | 80.2 | 2.1 | 2.63 | 75.6 | 84.8 |
| Not Clear | 83.3 | 0.9 | 1.14 | 81.0 | 85.6 |
| **Vehicle Type** | | | | | |
| Car | 79.7 | 1.7 | 2.19 | 75.9 | 83.5 |
| Van | 88.7 | 1.5 | 1.64 | 85.5 | 91.9 |
| SUV | 83.3 | 1.8 | 2.18 | 79.4 | 87.3 |
| Truck | 70.2 | 3.7 | 5.27 | 62.1 | 78.3 |

***Note:** In these counties, there were too few observations to make an estimate of Confidence Intervals.

The columns in Tables 3a, 3b, and 3c labeled Std Error, CV, and Lower 95% and Upper 95% Confidence Intervals are statistical terms defining measures of risk. Standard Error (Std Error) is a measure of the sampling errors that are uncontrollable in a statistical experiment. It is preferred that these sampling errors are below 5.0 or 5%. Coefficient of Variation (CV) is a dimensionless measure of variability, designed to allow comparisons of variation for samples with different sizes. The CV for vehicle types is quite low and indicates a small variation within samples. The Confidence Intervals (Lower and Upper 95%) give a range of results that are most likely to be observed in repeated trials of this statistical study.

## Analysis

Using the procedures discussed above, usage rates in Colorado for teen drivers and outboard front seat passengers were estimated along with estimates of the Standard Error and Coefficient of Variation. The overall estimate of State teen seat belt usage in Colorado from this survey is 80.6%. This estimate may vary because of sampling errors, since not all areas within the State were observed and other types of survey errors may also be possible.

The survey sample size is large enough to allow estimates of usage rates for various subgroups: regions, most surveyed counties, weather, and vehicle types. Estimates based upon the speed of vehicles were not included in this study as observations were conducted close to ingress and/or egress roads for parking lots of high schools, community colleges, and college and university dorms. The Estimates, Standard Errors, Coefficient of Variation (CV), and Confidence Intervals are shown in Tables 3a, 3b, and 3c for 2007, 2008, and 2009, respectively, for information and comparison purposes. Table 4.0 illustrates the differences in estimates of the 2008 and 2009 surveys.

**Table 4.0: Differences in Estimates of the 2008 and 2009 Surveys**

| Vehicle Type | Observed Seat Belt Usage | | Standard Error | |
|---|---|---|---|---|
| | 2008 | 2009 | 2008 | 2009 |
| **Car** | 76.7% | 79.7% | 1.9 | 1.7 |
| **Van** | 91.9% | 88.7% | 3.6 | 1.5 |
| **SUV** | 82.9% | 83.3% | 2.3 | 1.8 |
| **Truck** | 74.4% | 70.2% | 4.7 | 3.7 |
| **Overall Average** | 79.2% | 80.6% | 2.4 | 1.9 |

# CONCLUSIONS

The results on a statewide basis indicate that teen drivers and their passengers had a 1.4% higher seat belt usage in 2009 (80.6%) than in 2008 (79.2%). While it is difficult to know with any certainty the cause for the improvement, it can be assumed that educational processes as well as other related factors are indeed affecting the seat belt usage among teens. Future studies will help ascertain the cause and duration of this upward movement in seat belt usage.

Weather conditions did not contribute to seat belt usage in a significant manner (clear observation days vs nonclear observation days), and as mentioned earlier in the report, estimated speed was not considered a part of the study.

In conclusion, the survey of 207 sites and 60,452 vehicles observed was an excellent sample as confirmed by the consistency of the results when compared to previous studies. The data generated by the study provide an additional baseline with which to make comparisons in the future. Patterns of seat belt usage among teens appear to be similar to the results of the more comprehensive statewide surveys.

When compared to the 2005 results, the 2009 data becomes even more impressive. The 2005 study, then known as the 16 to 20 Year Old Youth Seat Belt Survey, was the first of the statewide teen studies. As this first iteration was conducted in October, it preceded the 2009 study by only three and a half years. Within this relatively short period of time, the overall seat belt usage rate for teen drivers and passengers improved by over 10%. The improvement by vehicle types ranged from 8.6 for SUVs (74.7 to 83.3) to 13.2 for trucks (57.0 to 70.2), and vans moved from 78.2 to 88.7 for a 10.5 improvement. The human, societal, and economic impact of such gains is an undeniable benefit of the educational efforts of the teen motor vehicle safety coalitions and the initiatives presented in high schools throughout the State. Additional improvements will likely be dependent upon successfully addressing cultural and lifestyle issues through education, public announcements, and enforcement.