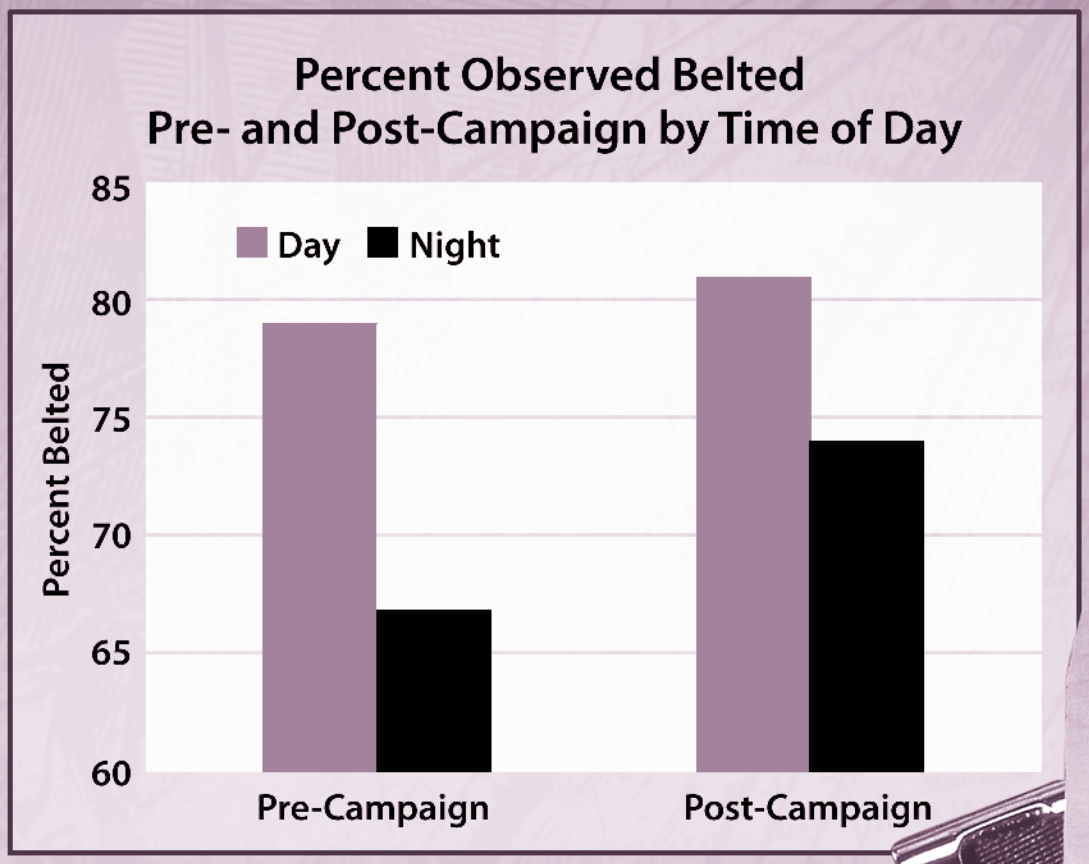
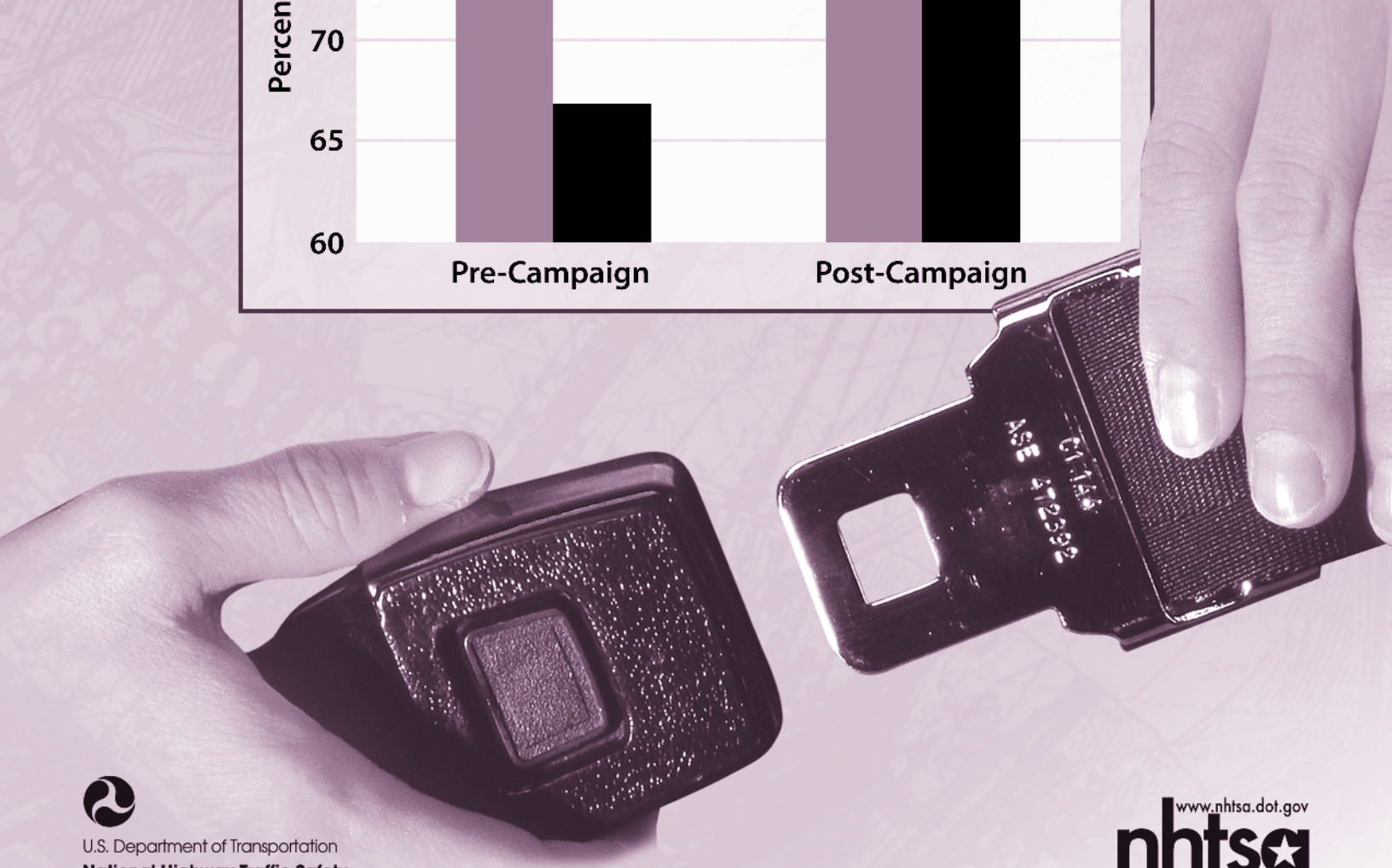
Connecticut's Day and Night Safety Belt Use

FINAL REPORT





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16. Abstract

Safety belt use in the United States has risen steadily over recent years, reaching 80 percent in 2004. Yet, using the National Highway Traffic Safety Administration's Fatality Analysis Reporting System, safety belt use among fatally injured front-seat outboard occupants of passenger vehicles was only between 42 and 46 percent for the years 1999 to 2003. One possible explanation is that safety belt use is different during different times of the day. A full statewide nighttime belt use observation survey was conducted in 2004. This survey was conducted simultaneously with Connecticut's annual full statewide daytime belt use survey. Night belt use observations of drivers and passengers are possible using newly available *near-military-grade* night vision goggles and handheld infrared spotlights. Both day and goggle-assisted night observations were conducted at 100 observation sites in Connecticut. Procedures for day and night observations were as nearly identical as possible. The night belt use rate was 6.4 percentage points lower than the day rate (83.0 versus 76.6). Consistent with belt use among Connecticut fatalities, day versus night differences were greatest in urban areas. There was evidence that day versus night differences were greater before as compared to after a May 2004 belt use enforcement program.

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Connecticut Nighttime Safety Belt Use:

Observed and FARS Analyses

Safety belt use in the United States has risen steadily over recent years (Glassbrenner, 2003). The national safety belt use rate in 2004 was 80 percent; a 5 percentage point increase over the 75 percent use rate in 2002. Yet, using the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS), safety belt use among fatally injured front-seat outboard occupants of passenger vehicles was only between 42 and 46 percent for the years 1999 to 2003.

One possible explanation for this discrepancy is that drivers most at risk of serious crashes also tend to be those who use their safety belts less often. For example, Hunter et al. (1993) showed that drivers who were unbelted had more than a third more crashes and more than two-thirds more convictions. Thus, it is likely that there is a subclass of individuals who less frequently use their belts *and* are more likely to crash.

Another possibility has to do with safety belt use during different times of the day. Reported safety belt use rates are in fact *daytime* belt use rates. Observations of belt use occur exclusively during the daylight hours and therefore exclude safety belt use rates at night. There exists the possibility that nighttime belt use is significantly lower than daytime belt use. It has been shown that there is a much higher per mile crash rate at night. Thus, if there is a lower belt use rate at night, then this lower rate would be associated with a disproportionate number of deaths and injuries. It is possible that the lives saved by safety belt use during the day are somewhat offset by lower belt use at night.

According to FARS data from NHTSA's National Center for Statistics and Analysis, nighttime occupant fatalities rose from 14,048 in 1998 to 15,657 in 2002. Daytime fatalities remained roughly constant over this time span: 15,530 in 1998 and 15,401 in 2002. While the reasons for this discrepancy are not precisely known, this unfortunate trend bears mentioning as part of the broader context of emerging efforts to increase belt use at night.

One study supports the fact that high-risk drivers fail to buckle up more at night. Noordzij et al. (1988) reported that young drivers and drinking drivers in the Netherlands were less likely to be restrained during the night. At the time of the study, young drinking drivers buckled up only 21 percent of the time.

Wells et al. (1992) conducted a study looking at the effects of a combination DUI/safety belt enforcement program on driver blood alcohol concentration and safety belt use in Binghamton, New York. Belt use was observed during the day (2 p.m. to 4 p.m.) and at night (9 p.m. to 2:30 a.m.). Safety belt use prior to enforcement during the day was 46 percent. Safety belt use at night (prior to enforcement) was 11 percentage points lower at 35 percent.

Another study also showed differential belt use by time of day. Preusser et al. (1993) conducted a study in New York where safety belt use was observed for bar patrons leaving bars at night (9 p.m. to 2 a.m.), a control group driving through intersections near the bar at night and drivers traveling through the same intersections during the day. The study demonstrated that belt use was 7 percentage points lower during the night than day. Bar patrons at night were restrained 18 percentage points less often than day drivers were. Non-bar-patron belt use steadily dropped as night approached and was lowest between 1 a.m. and 2 a.m.

The Preusser et al. study was conducted at well-lighted intersections and bar parking lots. Many highways are unlighted for many miles at a time, and rural roadways are also frequently unlit. The approach of conducting all observations in lighted areas is not only impractical (especially for nonurban areas) but could seriously bias any overall statewide results. Newly available night vision equipment, which better offsets the glare of vehicle headlights, and other special equipment may serve as a solution by allowing the observation sites to be selected regardless of the extent of overhead lighting.

Connecticut conducts a full daytime belt use survey each year in compliance with the Uniform Criteria for State Observational Surveys of Safety Belt Use conducted in connection with Section 157 of Title 23, United States Code (also known as "S. 157 compliant," or a NHTSA-approved observation plan for determining statewide belt use). In June 2004, a full statewide nighttime belt use survey using night vision equipment was conducted simultaneously to the full statewide *daytime* survey. The day-versus-night observations were nearly identical with respect to observation procedures and location. They differed primarily with respect to time of day. Additionally, analyses using FARS were conducted to explore belt use rates among the fatally injured during different times of the day.

The results of this paper begin with a discussion of night-versus-day belt use nationally, based on belt use among fatally injured occupants from FARS. There will then be a discussion regarding observed safety belt use in Connecticut. Last, there will be some analyses pertaining to Connecticut safety belt use during the day and night before and after the 2004 *Click It or Ticket* traffic enforcement program.

FARS Analyses

Method

FARS provides a comprehensive census of fatal crashes occurring in the United States. Belt use is coded for fatally injured vehicle occupants. FARS data were examined nationally for the combined years 2002 and 2003. Only passenger vehicles were included in the analyses. Analyses describing safety belt use included only drivers and passengers who were coded as being seated in the driver's seat, right-side-outboard passenger seat, or front seat "unknown." Unknown front seat was included to avoid excluding more serious crashes that may have resulted in ejections and/or severe damage to the front seat, making accurate identification of exact seat position difficult.

Daytime was defined based on the hours used in Connecticut's statewide safety belt survey. Specifically, daytime was defined as 7 a.m. until 5:59 p.m. Similarly, nighttime was defined as 9 p.m. until 3:59 a.m., as these were the hours used for the present nighttime observation survey. These hours were used for "nighttime" because 9 p.m. is generally dark for all months of the year and, given that bars in Connecticut close at 2 a.m., "nighttime" activities are generally ended after the 3 a.m. hour and "daytime" activities are about to begin at the 4 a.m. hour.

Results

FARS showed that belt use among fatally injured front-seat occupants of passenger vehicles declines steadily from its 10 a.m. daytime peak until 2 a.m., when belt use reaches 27 percent—the lowest point (see Figure 1). There is a steady increase in the percent belted up until the 10 a.m. hour, when safety belt use among the fatally injured peaks at 58 percent. There was a dip in belt use around noon.

Overall, belt use during the daytime hours was 53 percent among those who were killed. Occupants who died at night buckled up significantly less often (31 percent; $\chi^2 = 1952.35$, $p < .001$).

In 2003, according to FARS, 30 percent of fatal crashes involving passenger vehicles occurred between the hours of 9 p.m. and 3:59 a.m. Based on Hallenbeck et al. (1997), passenger vehicles traveling during nighttime hours represent only about 12 to 15 percent of the daily traffic. For Connecticut specifically, 39 percent of Connecticut's 2003 fatal crashes involving passenger vehicles occurred during these night hours. Yet, only about 10 percent of all driving in Connecticut is done during nighttime hours (data from Connecticut DOT).

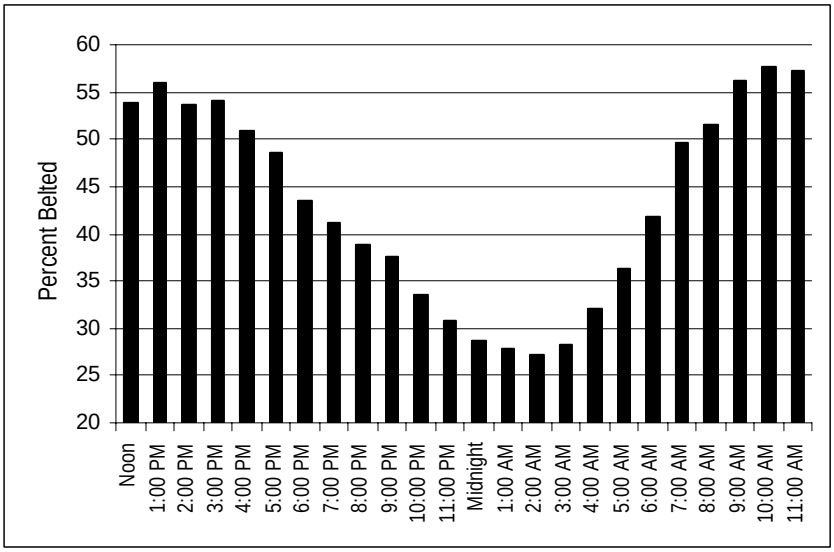

Figure 1. Percent Belted (Fatally Injured) by Hour of the Day (FARS 2002-2003)

Observed Day and Night Belt Use

Method

The sample sites used in the night (9 p.m. until 3:59 a.m.) belt observations were the same sites approved for use in Connecticut's "S. 157 compliant" full statewide belt use survey. For both day and night surveys there were 100 sites in seven of Connecticut's eight counties. These counties contain 97 percent of the State's population (See Geary and Chaudhary, 2004).

The daytime procedures followed the Uniform Criteria for State Observational Surveys of Safety Belt Use. The nighttime procedures were developed to mimic the guidelines set forth for daytime observations.

Day and night observations were conducted twice; once each pre- and post-campaign. Prior to Connecticut's May 2004 *Click It or Ticket* mobilization campaign a "mini" statewide observation of 17 sites, all of which were also part of the full statewide survey, was conducted. This mini survey was designed to give a "snapshot" of Connecticut belt use and was not intended to provide detailed analysis beyond this purpose.

Immediately following the mobilization, a second round of observations was conducted using all 100 sites included in Connecticut's statewide safety belt survey.

Relatively sophisticated night vision equipment was used for nighttime observation when roadway lighting was insufficient to make the observations. This near-military-grade equipment allows for vision in both light and dark, whereas earlier versions of night vision equipment would have been essentially blinded by the headlights of the observed vehicles. Specifically, an XR5 "Image Intensifier" tube, manufactured by Delft Electronic Products, was mounted in Unitec GS7 night vision goggles. According to the manufacturer, the XR5 tube contains an

"auto-gating" feature that results in no "blooming" and the smallest "halo" available. That is, the tube does not shut down in bright light and headlights make only a relatively small ring of light.

To supplement this equipment, handheld infrared spotlights, visible only with the use of the night-vision goggles and not to the naked human eye, further illuminated the roadway, making vehicle occupants visible for belt observations even in total darkness.

The goggle/spotlight combination requires practice to use effectively. As such, all observers for the night survey were experienced with daytime observations. Each performed night observations at several sites prior to the start of data collection.

Each observation site was observed during the day for 45 minutes. Observers coded belt use for cars, pickup trucks, sport utility vehicles, and vans for the driver and the outboard front-seat passenger (children in a front-seat child restraint are excluded from the survey). Each lane of traffic in one direction was observed for equal amounts of time. Where traffic was moving too quickly on high-volume roadways, a reference point some distance away on the road was chosen by which the next qualifying vehicle must pass before being recorded on the data sheet.

Nighttime procedures were consistent with daytime procedures, with some changes. Nighttime observations were conducted with the use of the night vision goggles and handheld infrared spotlights. Because of the equipment, observations were done by a two-person team, with one person observing traffic and the other recording the results as stated by the observer. For night observations, each lane of traffic in one direction was observed for equal amounts of time *unless* vehicles were passing at an extremely slow rate, in which case all lanes were observed simultaneously. Also, due to limitations in the equipment to observe vehicles at high speeds, observers conducted some observations on exit ramps of limited access highways as

opposed to the main travel lanes used for daytime observations. Observations were to be made on the highway itself, typically at the nearest lighted overpass or rest area, whenever possible.

Weighting

In order to render the observations at the 100 sites representative of the entire State, the data are weighted based on Average Annual Daily Traffic (AADT). This weighting results in sites that account for a higher proportion of statewide traffic holding more "weight" than those which account for less traffic. The weighting for the daytime observations are based on 24-hour traffic counts. Given that (in Connecticut, for example) about 90 percent of the travel occurs during daytime hours, this method is not problematic. Using 24-hour traffic counts to determine traffic volume for night, however, is problematic. In Connecticut, traffic patterns shift at night. Relatively more traffic at night is on interstate highways than on other types of roads.

Given this shift in traffic patterns, traffic volume for the hours 9 p.m. to 3:59 a.m. was calculated by using the traffic counts for the night hours only. Hourly counts were provided by the Connecticut DOT Bureau of Policy and Planning. Thus, unlike day observations, night observations were weighted based on the traffic counts occurring only during the times at which night observations were conducted. The weights are designed to produce an estimated belt use for the entire "night" and not for any specific hour of the night. Two sites resulted in no night observations (i.e., no vehicles passed the observers within the 45-minute observation period) and therefore did not contribute to the night belt use rate.

Results

For the full statewide (100-site) survey, for both drivers and passengers, daytime safety belt use in Connecticut produced a weighted safety belt usage rate of 83.0 percent (N = 28,269). Nighttime weighted belt use was 76.6 percent (N = 9,075). Thus, belt use was 6.4 percentage

points lower at night than during the day. Chi square analyses were run on unweighted data only as weighted data are not amenable for statistical analyses because of the transformation of the underlying N. The chi square (on the unweighted data; day: 80.6 percent; night: 73.6 percent) demonstrates a significant difference between day and night belt use ($\chi^2 = 202.06$, $p < .001$).

As described above, highway sites during the day were all measured on the highways themselves. Some of the highway sites (N = 11) during the night were observed at off ramps because poor lighting and high vehicle speeds made on-highway observations impossible. As a result, another calculation was conducted removing both day and night data from sites where relocation occurred to ensure that the difference in belt use between day and night was not due to this methodological difference. The unweighted difference between day (80.2 percent) and night (73.9 percent) belt use was 6.3 percentage points, a statistically nonsignificant difference.

Chi square analyses on vehicle type, gender, driver, and passenger belt use showed that for all categories belt use at night was significantly lower ($p < .05$) than day belt use. The greatest absolute difference in belt use by time of day was for SUV occupants, where belt use was almost 9 percentage points lower at night. According to the analyses, pickup truck occupant belt use, while lowest of the vehicle types, showed the smallest difference between day and night belt use (see Table 1).

There was an interrelationship between time of day and population density. The difference in day and night belt use was much greater on urban roadways than rural roadways. On rural roadways the difference between day (85.8 percent) and night (83.5 percent) was less than 3 percentage points ($\chi^2 = 3.04$, $p > .05$). On urban roadways the difference between day (79.6 percent) and night (72.6 percent) was 7 percentage points ($\chi^2 = 177.75$, $p < .01$). That is,

the finding that safety belt use is lower during the night than during the day is most characteristic of urban locations in Connecticut (see Figure 2).

Table 1. Percent Observed Belt Use by Time of Day (100 Post Sites in CT)

		Night	Day	Dif	χ^2 p value
Vehicle Type					
	%	74.5	82.1	7.6	<.001
car	N	6,516	17,315		
	%	56.6	62.3	5.7	<.02
pickup	N	512	2,521		
	%	76	84.8	8.8	<.001
SUV	N	1,431	5,293		
	%	72.4	79.5	7.1	<.001
van	N	615	3,133		
Gender					
	%	68.7	76	7.3	<.001
male	N	5,657	16,298		
	%	81.7	86.8	5.1	<.001
female	N	3,397	11,934		
Occupant Type					
	%	72.8	80.7	7.9	< .001
driver	N	7,002	23,500		
	%	76.4	79.9	3.5	=.001
passenger	N	2,073	4,762		

Further examination using FARS for Connecticut crashes demonstrates a similar pattern of belt use among fatally injured front seat occupants of passenger vehicles. Specifically, there was no difference ($\chi^2 = 0.00$, $p > .05$) between day and night belt use on rural roads (day: 51.7 percent; night: 51.9 percent), but there was a relatively large difference ($\chi^2 = 4.036$, $p < .05$) between belt use during the day (55.0%) and night (40.0%) on urban roads. A backward stepwise logistic regression on the observed and FARS data combined produced a significant interaction of time of day by population density ($p < .05$).

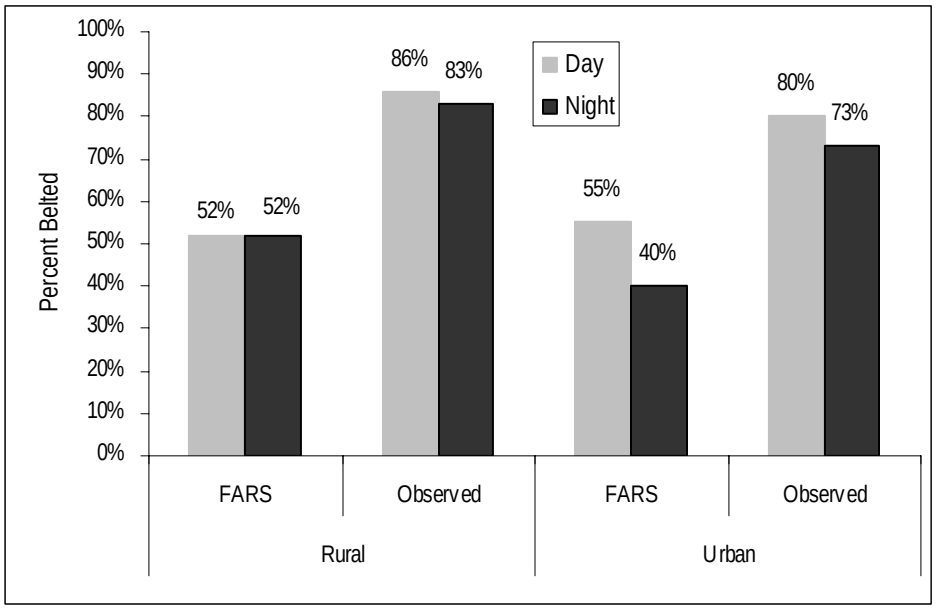

Figure 2. CT FARS (2002 – 2003) versus Observed Belt Use by Population Density (2004)

Statewide belt use observations were conducted immediately following an enforcement mobilization aimed at safety belt use. This mobilization could have had a differential affect on day versus night belt use.

A comparison of pre-campaign and post-campaign belt use was conducted. The pre-campaign data came from the 17 "mini" sites while the post-campaign data contained the full 100 sites that include the 17 mini sites. A backward binary logistic regression produced a significant ($p = .01$) interaction between times of day and pre/post campaign (see Figure 3). The difference, pre-campaign, between day (78.7 percent; N = 2,914) and night (66.5 percent; N = 872) was greater than the difference post campaign between day (80.6%) and night (73.6%). According to chi square analyses, the differences between daytime and nighttime observations were significant for both pre-campaign ($\chi^2 = 54.02$, $p < .001$) and post-campaign ($\chi^2 = 199.37$, $p < .001$). Clearly there was a smaller—yet still significant—difference between day and night

belt use following the mobilization than before. Thus, the enforcement and media campaign appeared to have an impact on nighttime safety belt use.

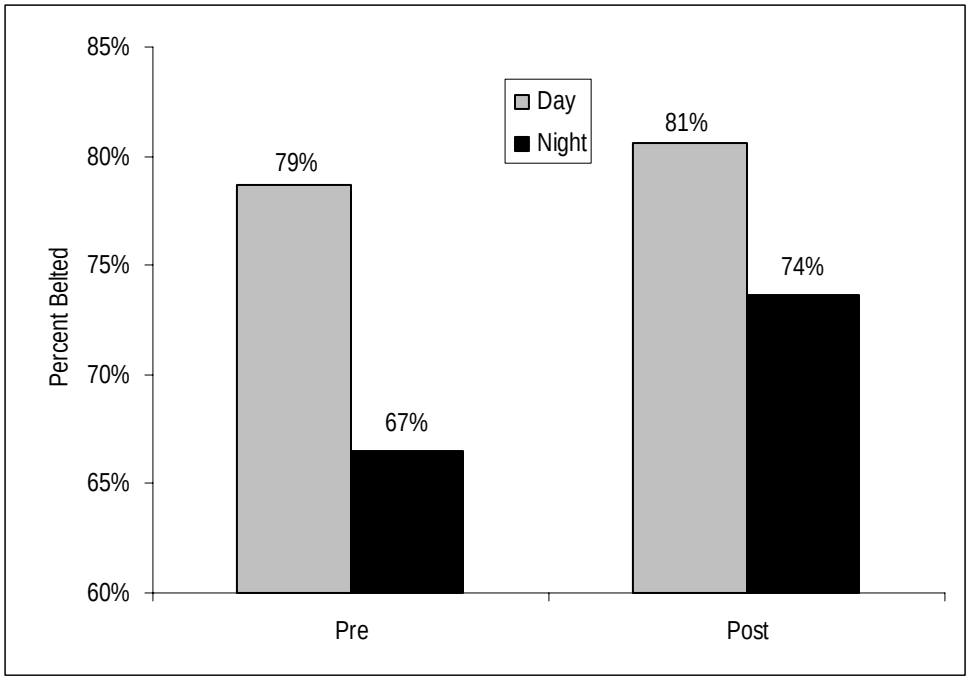

Figure 3. Percent Observed Belted Pre- and Post-Campaign by Time of Day

Discussion

There is a difference between day and night observed belt use in Connecticut. This difference is much greater in urban areas. There are likely a number of reasons why this may be the case. For instance, it is possible that the population of drivers in urban areas is different during the day versus the night. Drivers in cities during the day may live in the outlying suburbs and commute to and from the city. Connecticut suburbs are generally more affluent than Connecticut cities. By nighttime, these drivers have returned to the less urban roads. Regardless, the fact remains that belt use on Connecticut urban roadways at night is substantially lower than during the day. These observed findings are corroborated by FARS analyses.

Additionally, it appears that "daytime" enforcement of safety belt use as shown in the national *Click It or Ticket* campaign ads may have an impact on nighttime belt use. It should be noted however, that most, if not all, of the television commercials used by Connecticut depicted police officers *at night* (in an urban environment) issuing tickets for safety belt violations. It is unclear whether this advertising caused the change in belt use at night or if the daytime enforcement alone or combined with the commercials impacted nighttime belt use.

The importance of night belt use is amplified given the much higher per mile crash rate at night. It is felt that an effort to increase belt use at night, especially in urban areas, would be prudent.

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