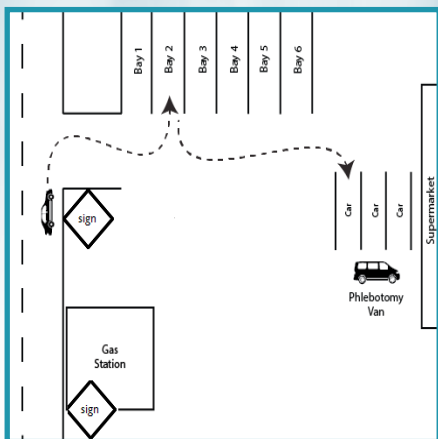


2013–2014 National Roadside Study of Alcohol and Drug Use by Drivers

ALCOHOL RESULTS



U.S. Department of Transportation
**National Highway Traffic Safety
Administration**



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16. Abstract This report describes the alcohol results from the 2013–2014 National Roadside Survey (NRS), a national field study to estimate the prevalence of alcohol-, drug-, and alcohol-plus-drug-involved driving, primarily among nighttime weekend drivers, but also daytime Friday drivers. This study involved a random sample of drivers at 300 locations across the continental United States. The sites were selected through a stratified random sampling procedure. Data was collected during one 2-hour Friday daytime session (either 9:30 to 11:30 a.m. or 1:30 to 3:30 p.m.) at 60 locations and during four 2-hour nighttime periods (10 p.m. to midnight and 1 to 3 a.m. on both Friday and Saturday nights) at 240 locations. Data included observational and biological samples. Biological samples included breath-alcohol measurements from 9,455 respondents, oral fluid samples from 7,881 respondents, and blood samples from 4,686 respondents. This report focuses on the alcohol breath-test results, presents the 2013–2014 prevalence estimates for alcohol-involved driving, and compares them with the four previous NRS studies. The data indicates a continuing trend of decreasing alcohol-involved driving on U.S. roads during weekend nights over the five NRS studies, including a large change in the percentage of drivers who were alcohol positive, from 36.1% in 1973 to 8.3% in 2013-2014, and an 80% reduction in the percentage of drivers with breath alcohol concentrations (BrACs) of .08 grams per deciliter (g/dL) and higher, from 7.5% in 1973 to 1.5% in 2013-2014.					
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Appendices

Appendix A: Weighting the Data

Appendix B: Imputing Breath Alcohol Concentration (BrAC)

List of Acronyms and Abbreviations

AC.....	alcohol concentration
AUD.....	alcohol use disorders
BAC	blood alcohol concentration
BrAC.....	breath alcohol concentration
DAST.....	Drug Abuse Screening Test
DOT	Department of Transportation
DUD.....	drug use disorders
FARS	Fatality Analysis Reporting System
g/dL.....	grams per deciliter
GES.....	General Estimates System
IIHS.....	Insurance Institute for Highway Safety
N/A.....	not applicable
NASS	National Automotive Sampling System
NHTSA	National Highway Traffic Safety Administration
NIAAA	National Institute on Alcohol Abuse and Alcoholism
NIDA	National Institute on Drug Abuse
NIH	National Institutes of Health
NIJ.....	National Institute of Justice
NRS.....	National Roadside Survey
NSDUH.....	National Survey on Drug Use and Health
PAS	passive alcohol sensor
PBT	preliminary breath tester
PIRE.....	Pacific Institute for Research and Evaluation
PSU	primary sampling unit
Ref.....	reference group
Rx.....	prescription drug
SM.....	survey manager

Executive Summary

Background

In 2013, the National Highway Traffic Safety Administration contracted with the Pacific Institute for Research and Evaluation to conduct the fifth National Roadside Survey to estimate the prevalence of alcohol and drug use by drivers¹ and to determine how this prevalence has changed over time. This report focuses on the alcohol breath-test results, presents the 2013–2014 prevalence estimates for alcohol-involved driving, and compares them with the four previous NRS studies. Details about the 2013–2014 methodology and drug results are presented in separate reports (Kelley-Baker et al., 2016; Lacey et al., in press). The survey was conducted from June 2013 to March 2014.

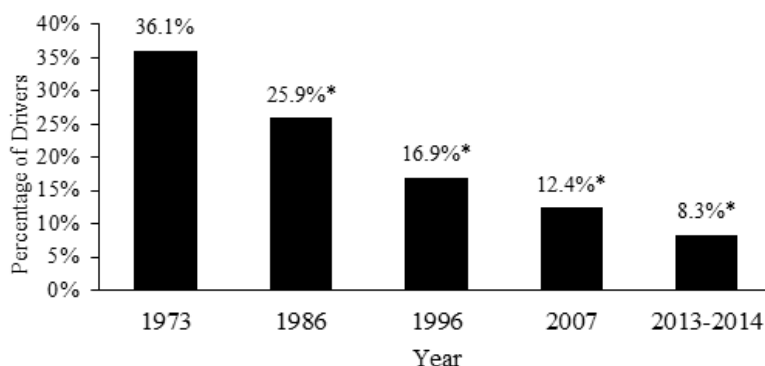
A stratified random sampling plan was developed to gather a sample representative of weekend drivers in the contiguous United States. Data was collected at five randomly selected locations in 60 sites (cities, large counties, or groups of counties) across the United States in one 2-hour Friday daytime session (either between 9:30 and 11:30 a.m. *or* between 1:30 and 3:30 p.m.) and four 2-hour nighttime sessions (both Friday and Saturday nights between 10 p.m. and midnight and between 1 and 3 a.m.). Of the 11,100 drivers eligible for participation—

- 9,455 drivers provided breath samples (2,361 daytime and 7,094 nighttime),
- 7,881 provided oral fluid samples (1,987 daytime and 5,894 nighttime), and
- 4,686 provided blood samples (1,263 daytime and 3,423 nighttime).

¹ This report uses the terms “driver” and “participant” interchangeably. The same is true of the terms “PSU” (primary sampling unit) and “site.”

Alcohol Results

The percentage of NRS weekend nighttime alcohol-positive drivers on U.S. roads continues to decline. As shown in Figure ES-1, in 1973, 36.1% of drivers had a positive breath alcohol concentration (BrAC); that is, a BrAC of .005 grams per deciliter (g/dL) and higher. The 2007 NRS Alcohol Results report indicated that there has been a steady and statistically significant



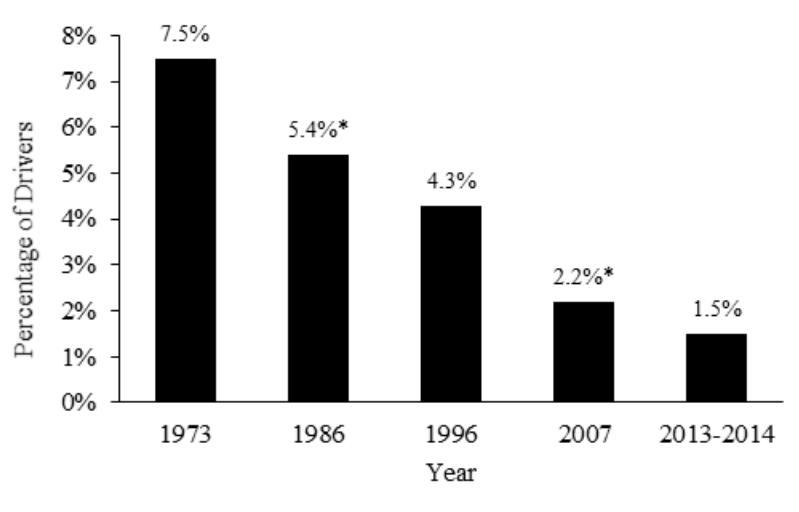
* Indicates statistically significant difference at $p < .05$.

Figure ES-1. Percentage of Weekend Nighttime Drivers Positive for Alcohol in the Five National Roadside Surveys.

decline of alcohol-positive drivers between each of the four decades, from 1973 to 2007 ($p < .05$). The 2013-2014 study determined that this trend continued. There was a statistically significant decline from 12.4% positive in 2007, to 8.3% positive in 2013–2014. There was a relative reduction of 77% from 1973 to 2013-2014.

It is illegal *per se*² for a driver to operate a motor vehicle with a blood alcohol concentration (BAC) or BrAC of .08 g/dL and higher in every State in the U.S. As shown in Figure ES-2, in 1973, 7.5% of drivers had a BrAC of .08 g/dL or higher, and the percentage of NRS weekend nighttime drivers on U.S. roads with BrAC at .08 g/dL and higher has declined continuously over time. The 2007 NRS Alcohol Results report indicated that the decline was statistically significant from 1973 to 1986 and from 1996 to 2007, but not from 1986 to 1996. As shown in Figure ES-2, there was a further decline of weekend nighttime drivers with a BrAC of .08 g/dL, from 2.2% in 2007 to 1.5% in 2013-2014, but the decline was not statistically significant ($p < .05$). The overall decline of weekend nighttime drivers with a BrAC of .08 g/dL over the four decades, from 7.5% in 1973 to 1.5% in 2013–2014, represents an 80% relative reduction since 1973 and is statistically significant ($p < .05$).

² *Per se* is a Latin phrase that means “by itself.” In other words, operating a motor vehicle while having a .08 g/dL BrAC and higher by itself means that you are guilty of driving while intoxicated without regard to any other evidence.



* Indicates statistically significant difference at $p < .05$.

Figure ES-2. Percentage of Weekend Nighttime Drivers With BrACs at .08 g/dL and Higher in the Five National Roadside Surveys.

Table ES-1 shows that, during weekday daytime hours (Friday), only 1.1% of drivers were alcohol positive, while during weekend nighttime hours (Friday and Saturday), 8.3% of drivers were alcohol positive. During weekday daytime hours, there were very few drivers with illegal BrACs (BrAC of .08 g/dL and higher), just 0.4%, while during weekend nighttime hours, 1.5% drivers had illegal BrACs. There were significantly more drivers who were alcohol positive and/or had a BrAC of .08 or greater among weekend nighttime drivers as compared to weekend daytime drivers ($p < .05$).

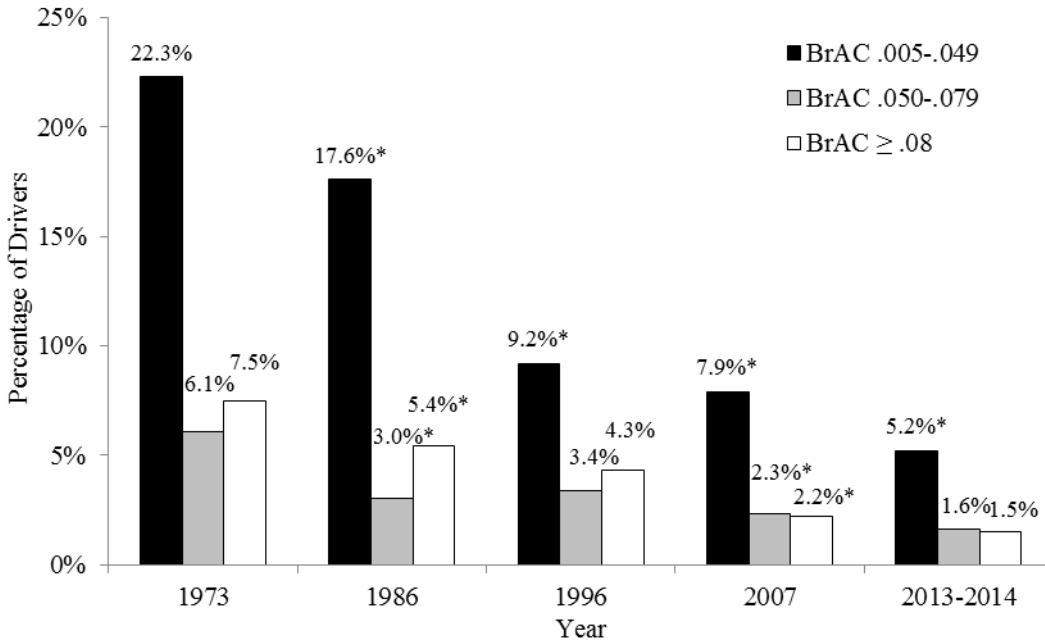
Table ES-1. Alcohol Prevalence by Data Collection Period and BrAC in the 2013-2014 NRS

Data Collection Time Period	Alcohol Prevalence	
	≥ .005 BrAC (%)	≥ .08 BrAC (%)
Weekday Daytime	1.1	0.4
Weekend Nighttime	8.3*	1.5*

* Indicates statistically significant difference at $p < .05$.

The 2007 NRS Alcohol Results report found that, in each succeeding decade, the proportion of drivers in all alcohol ranges decreased, and that the decreases were statistically significant in all alcohol ranges, with the exception of .05-.79 and .08+ from 1986 to 1996. As

shown in Figure ES-3, the 2013-2014 study determined that declines continued in all alcohol ranges from 2007 to 2013-2014, but only the declines for .005-.049 reached significance ($p < .05$).



* Indicates statistically significant difference at $p < .05$.

Total percentages in 1973 and 1986 do not equal the total presented in ES-1 due to rounding.

Figure ES-3. Percentage of Weekend Nighttime Drivers in Three BrAC Categories in the Five National Roadside Surveys

Figure ES-4 looks at drivers with alcohol concentrations at .08 g/dL and higher, by examining changes that occurred between 2007 and 2013–2014 at specific times of the day: daytime (on Friday from either 9:30 to 11 a.m. or 1:30 to 3:30 p.m.), early nighttime (Friday and Saturday nights from 10 p.m. to midnight), and late nighttime (Friday and Saturday nights from 1 to 3 a.m.). The percentage of early (10 p.m. to midnight) and late (1 to 3 a.m.) nighttime drivers with BrACs at .08 g/dL and higher decreased in 2013–2014. This reduction was not statistically significant.

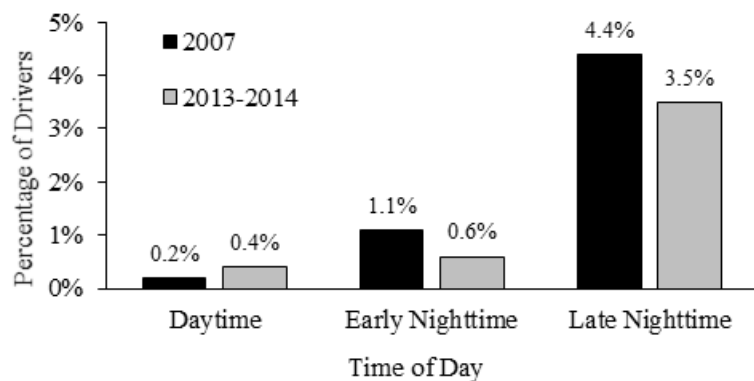


Figure ES-4. Percentage of Drivers With BrAC at .08 g/dL and Higher by Time of Day in the 2007 and 2013–2014 NRS.

Figure ES-5 shows that the percentage of female weekend nighttime drivers with a BrAC at .08 g/dL and higher remained at about the same level in the 2013–2014 NRS (1.4%), compared with the 2007 NRS (1.5%). The percentage of male drivers with a BrAC at .08 g/dL and higher decreased from 2.6% to 1.7%; however, this reduction was not statistically significant.

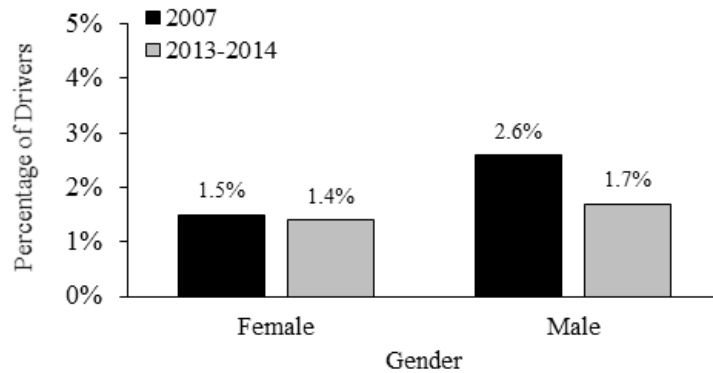
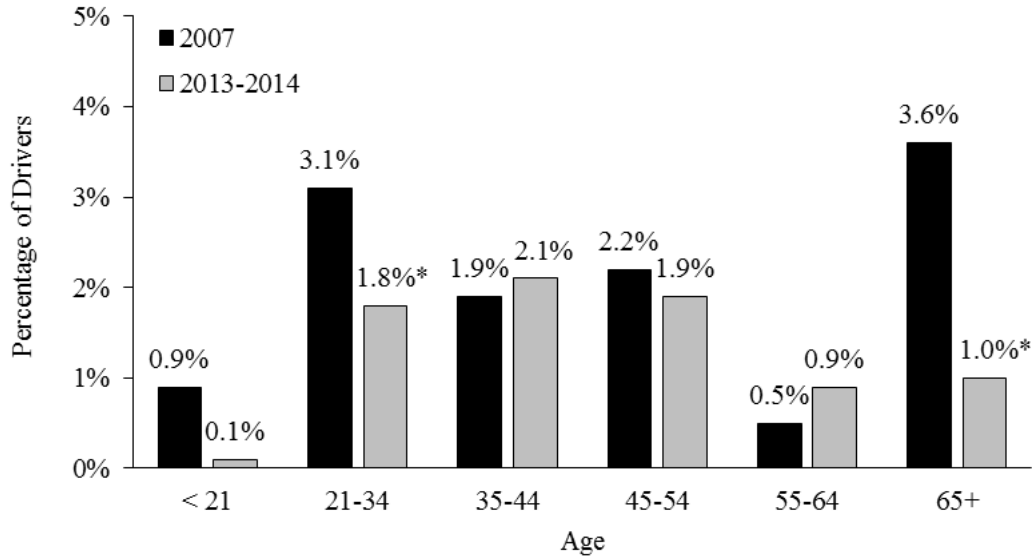


Figure ES-5. Percentage of Weekend Nighttime Drivers With BrACs at .08 g/dL and Higher by Gender in 2007 and 2013–2014 NRS.

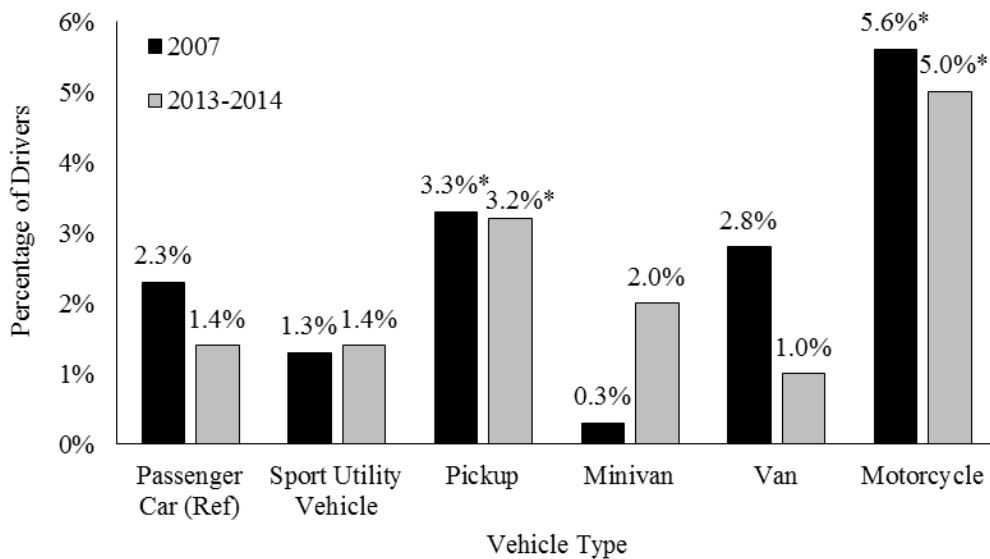
Figure ES-6 compares the 2007 and 2013–2014 proportion of weekend nighttime drivers at BrAC of .08 g/dL and higher for drivers of different age groups. For most age groups, no significant changes were detected. The percentage of drivers at BrAC of .08 g/dL and higher declined significantly ($p < .05$) between 2007 and 2013–2014 for drivers aged 21 to 34 and 65 and older. The under-21 age group had the largest relative decline, from 0.9% to 0.1%, an 88.9% relative reduction; however, the difference was not statistically significant due to the small sample size.



* Indicates the 2013–2014 vs. 2007 comparisons that are statistically significant at $p < .05$.

Figure ES-6. Percentage of Weekend Nighttime Drivers With BrACs at .08 g/dL and Higher by Age.

As was found in the 2007 NRS, the proportion of drivers at BrACs of .08 g/dL and higher in 2013–2014 was significantly higher among motorcyclists and pickup truck drivers ($p < .05$) than among those of any other vehicle type (Figure ES-7).



* Indicates statistically significant difference at $p < .05$.

Figure ES-7. Percentage of Weekend Nighttime Drivers With BrACs at .08 g/dL and Higher by Vehicle Type.

Across the five studies, reductions in the prevalence of drivers at alcohol concentrations of .08 g/dL and higher, among weekend nighttime drivers, generally paralleled reductions in the number of fatal alcohol-related crashes involving drivers with a BAC of .08 g/dL and higher. Figure ES-8 shows the percentage of NRS drivers with alcohol concentrations (AC) of .08 g/dL and higher and fatally injured drivers in FARS with ACs of .08 g/dL and higher in the years in which an NRS was conducted.³ Compared with the 2007 results, the percentage of fatally injured drivers at BAC .08 g/dL and higher in 2013–2014 remained stable, while the percentage of drivers at BrAC .08 g/dL and higher in the 2013–2014 NRS decreased from 2.2% to 1.5%. However, there were no statistically significant differences between 2007 and 2013–2014.

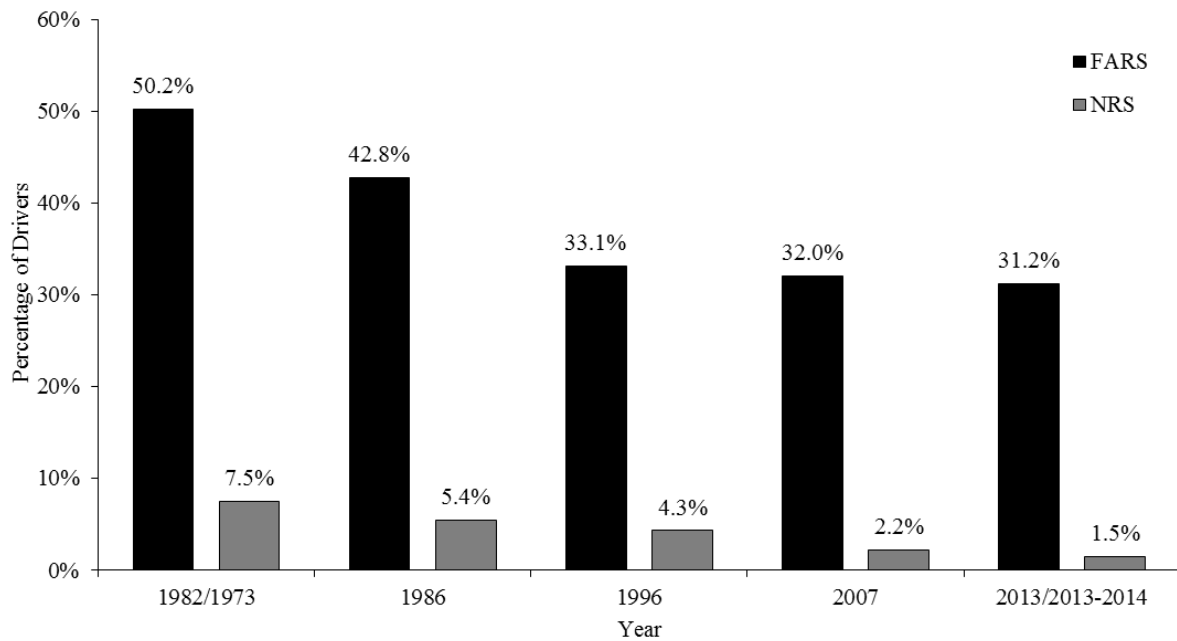


Figure ES-8. Comparison of FARS and National Roadside Survey Drivers With BAC/BrAC \geq .08 g/dL on Weekend Nighttime.

³ Data from the 2013–2014 NRS were compared with FARS data from 2013 only. FARS data for the year 2014 were not available at the time this report was completed. Because 1982 was the earliest year in which sufficient BAC data were available in the FARS, results from the 1973 the NRS were compared with the 1982 FARS.

Introduction

By the time the Department of Transportation was established in 1966, it was well understood that alcohol was an important factor in traffic crashes. In 1968, the agency that would become the National Highway Traffic Safety Administration (NHTSA) delivered a report to Congress on Alcohol and Highway Safety (U.S. Department of Transportation, 1968), pointing to the role of problem drinkers in fatal alcohol-related crashes, and highlighting a need for improved data on drinking and driving. This led to the establishment of incentives for States to conduct blood alcohol concentration (BAC) tests on fatally injured drivers, riders, and pedestrians, and eventually to the establishment in 1975 of NHTSA's Fatality Analysis Reporting System⁴ (FARS), a census of qualifying fatal crashes occurring in the United States.

The development of accurate handheld breath testers for use at the roadside in the early 1970s provided a means for evaluating the effectiveness of impaired driving laws and enforcement programs, and for tracking progress in reducing drinking and driving over time. These handheld devices made it more feasible to conduct roadside studies of a random sample of drivers.

Over the years, data on impaired driving in the United States have been gathered and assessed in several ways—an ongoing government census of fatal crashes, a number of self-report surveys, and numerous studies (Lacey, Jones, & Smith, 1999) that used handheld breath test devices that measure an individual's breath alcohol concentration (BrAC).⁵

Fatality Analysis Reporting System (FARS)

FARS is a nationwide census that has documented all qualifying traffic fatalities occurring within the 50 States, the District of Columbia, and Puerto Rico since 1975. To qualify as a FARS case, the crash must involve a motor vehicle traveling on a roadway customarily open to the public and have resulted in the death of a motorist or a non-motorist within 30 days of the crash. FARS provides NHTSA, Congress, and the American public with yearly data regarding fatal injuries suffered in motor vehicle traffic crashes. This information serves to identify highway safety problem areas, provides a basis for regulatory and consumer information initiatives, and forms the

⁴ Originally called the "Fatal Accident Reporting System."

⁵ In this report, most references to alcohol concentration, both in the text and in tables, concern breath test alcohol concentrations, which will be referred to as BrAC. A few cases, mostly tables, include both breath alcohol concentrations and blood alcohol concentrations. In those instances, we will note that we are referring to both BrAC and BAC.

basis for cost and benefit analyses of highway safety initiatives. FARS alcohol information comes primarily from blood samples obtained from deceased drivers, and blood or breath samples of non-fatally injured drivers in fatal crashes.

Self-Report Surveys

One of the largest self-report studies, the National Survey on Drug Use and Health (NSDUH) conducted by the Substance Abuse and Mental Health Services Administration, is an annual nationwide survey of approximately 70,000 randomly selected individuals age 12 and older (Substance Abuse and Mental Health Services Administration, 2015). Since 1979, the NSDUH has provided national and State-level data on the use of tobacco, alcohol, and illicit drugs (including non-medical use of prescription drugs) and on mental health in the United States. The most recent NSDUH found that in 2013, past-year rates of self-reported driving under the influence of alcohol were highest among persons 21 to 25 years, and persons aged 26 to 29 years (19.7% and 20.7%, respectively). This survey also estimated that 3.8% of 16- or 17-year-olds and 10.8% of 18- to 20-year-olds reported driving under the influence of alcohol in the past year.

However, self-report data on impaired driving have been suspected of possible bias because of recall errors and underreporting due to stigma. Recently, the public has shown increasing reluctance to participate in phone surveys (Battaglia et al., 2008; Groves et al., 2006; Maynard & Hollander, 2014), which further raises concern on the validity of using self-report data from such surveys to estimate the prevalence of drinking and driving.

Studies Using Breath Test Devices

The development of breath alcohol testing devices broke ground for researchers by enabling them to gather accurate data on impaired driving. A breath testing device invented in 1954 (Borkenstein & Smith, 1961) was used in a study in Grand Rapids in the 1960s that determined the relationship between BrAC and crash risk (Borkenstein, Crowther, Shumate, Ziel, & Zylman, 1974). However, that device was large and heavy and, therefore, impractical for roadside applications. The device was powered by a generator, necessitating the use of a motor home to house the equipment. The development of accurate mobile handheld breath testers in the early 1970s made it more feasible to conduct surveys at the side of the road and collect accurate BrACs. Portable breath testers provided a means to evaluate the effectiveness of impaired driving laws and enforcement programs in roadside surveys and track progress over time.

The Relationship Between Alcohol and Crash Risk

The Grand Rapids Study in 1964 helped establish a quantitative relationship between BrAC and crash risk (Borkenstein et al., 1974). This study provided compelling evidence that moderate BrAC levels ($\sim .04$ g/dL) were associated with increased crash risk for drivers. That risk grew exponentially at higher BrACs.

In the late 1990s, further efforts were made to update the risk estimates obtained from the Grand Rapids Study. Between 1996 and 1998, NHTSA conducted a study at two sites—Long Beach, California, and Fort Lauderdale, Florida—which examined the relative crash risk associated with elevated BrACs of drivers (see Figure 1) (Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2005). The authors found that, among fatally injured and surviving drivers in fatal crashes, the relative risk of crash involvement across every age and gender group increased following an S-shaped curve as the driver's BrAC increased.

Zador and colleagues (Zador, Krawchuk, & Voas, 2000a) also reported similar increasing S-shaped curves in a study that combined FARS crash data with exposure data from the 1996 NRS. Additionally, Voas et al. (2012) found the same S-shaped curves by combining FARS and 2007 NRS data.

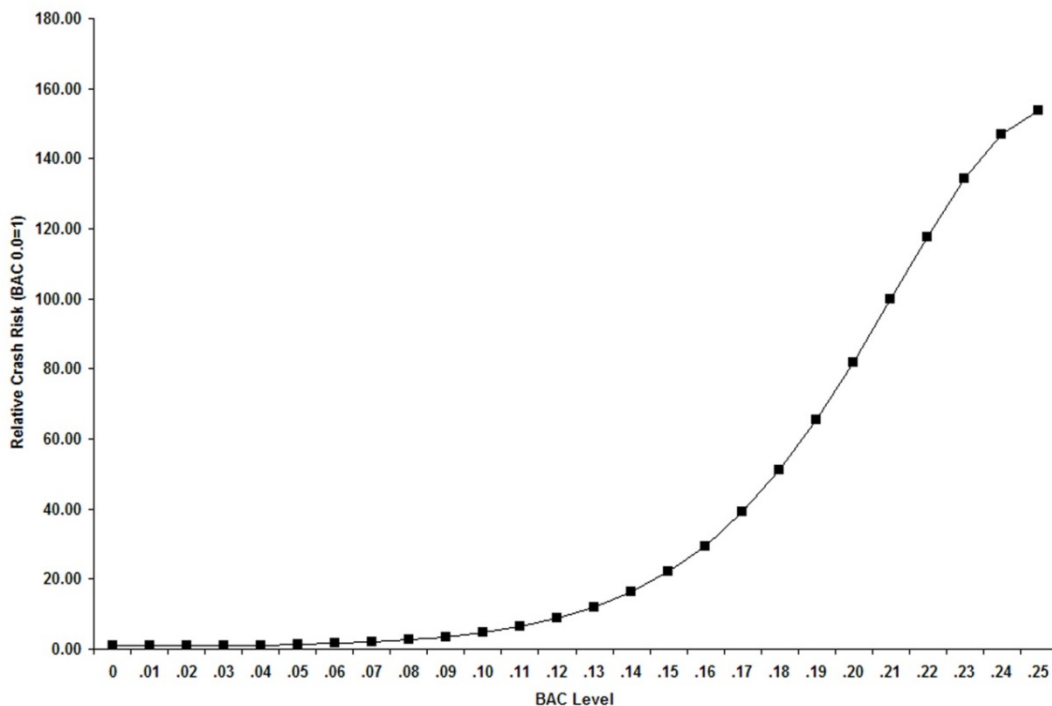


Figure 1. Adjusted Relative Risk Estimates. Source: Blomberg et al., 2005.

National Roadside Surveys

NHTSA established the NRS in 1973 to test the BrAC of random drivers on U.S. roads, which could address the limitations of self-report data. Since 1973, four additional NRS studies have been conducted to estimate the prevalence of drinking and driving and to determine how this prevalence has changed.

1973, 1986, and 1996 NRS

NHTSA sponsored the first NRS in 1973 (Wolfe, 1974), which was conducted by the University of Michigan's Highway Safety Research Institute. The Insurance Institute for Highway Safety (IIHS) sponsored the second NRS (Lund & Wolfe, 1991) in 1986, which was conducted by the University of Michigan's Transportation Research Center. In 1996, IIHS and NHTSA jointly sponsored the third NRS study (Voas et al., 1998), which was conducted by the Pacific Institute for Research and Evaluation (PIRE). These first three studies used the same basic methodology, which included collecting data on Friday and Saturday nights via a brief verbal questionnaire and a breath sample to measure alcohol concentrations.

2007 NRS

In 2007, PIRE conducted the fourth NRS, sponsored by NHTSA with additional funding from the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the National Institute on Drug Abuse (NIDA), and the National Institute of Justice (NIJ) (Lacey et al., 2009).

As in the three prior studies, the 2007 NRS included a verbal questionnaire and breath sample, but added a series of self-administered written surveys (funded by NIAAA, NIDA, and NIJ) and collected two biological samples (oral fluid and blood) to determine not only the presence of alcohol but also the presence of other drugs in the driving population. Unlike previous NRS efforts, the 2007 study began collecting data on Fridays during the daytime. The rationale for this addition was that, although drinking and driving is much more prevalent during nighttime weekends than during the daytime, it is possible that unlike alcohol, drugs may be more prevalent during the daytime (Romano & Pollini, 2013).

These additions to the protocol made the 2007 NRS more comprehensive than previous roadside studies, allowing for a broader view of alcohol and drugs in the driving population and producing the first national prevalence estimate of drug presence among drivers.

2013–2014 NRS

This fifth study was funded by NHTSA with additional funds from NIDA and IIHS - it replicated the basic methodology from the 2007 NRS, using technological advancements, incorporating lessons learned during from the 2007 study, and examining prescription drug use.⁶

⁶ NIDA funded the prescription drug survey. IIHS funded the Drug Abuse Screening Test (DAST), Drug Use Disorder (DUD), Alcohol Use Disorder (AUD), and Drug Use surveys. NHSTA provided permission to conduct these after a determination was made that doing so would not detract or impeded the NHTSA-funded activities.

Method

Sampling Design

Conducting a census of all 212 million drivers in the United States (Federal Highway Administration, 2012) would be infeasible and impossible. Therefore, a sampling system was constructed to represent drivers in the 48 contiguous States. Study locations were limited to roads where data could be collected safely but with sufficient traffic to recruit the number of participants required for valid estimates of the national prevalence of drinking drivers. This approach was also followed in the previous NRS studies.

The first three NRS studies provided information on non-commercial, four-wheel vehicle operators at randomly selected locations during weekend, nighttime periods, when drinking and driving is most prevalent. The 2007 NRS collected data on non-commercial vehicle operators during the same days and times, but added one Friday daytime period and included motorcycle operators as eligible participants. The 2013–2014 NRS followed the same sampling protocol as the 2007 NRS, sampling non-commercial vehicle drivers, including motorcycle drivers, during weekend nighttime periods and also one Friday daytime period.

The 2013–2014 NRS followed the practice of the four previous studies by using a multistage sampling system that represented the drivers most at risk for crash involvement in the 48 contiguous States for the year the roadside data were collected. In this process, the initial sample structure was taken from the National Automotive Sampling System/General Estimates System (NASS/GES) (NHTSA, 2006), which was constructed to provide a basis for making nationally representative estimates of highway crashes. A full description of the sample selection process can be found in Kelley-Baker et al. (2016). The following four steps describe the general procedures:

1. *Selecting the primary sampling units (PSUs)—cities, large counties, or groups of counties—from within four regions of the United States and three levels of population density.* These constituted the 60 research sites. The PSUs were identified by NHTSA to develop a representative sample of motor vehicle crashes in the continental United States.
2. *Randomly selecting and numbering 30 specific square-mile grid areas within each PSU.* We then recruited the cooperation of local law enforcement agencies that had jurisdiction over the selected grids, who assisted in the selection of data collection locations and also provided onsite security for staff and participants. One law enforcement agency often covered several of the selected square-mile grid areas.
3. *Identifying five appropriate locations from the 30 square-mile grid areas.* Appropriate locations were required to have a safe area large enough to accommodate the data

collection operation and had sufficient traffic flow to generate an adequate number of drivers. In some cases, more than one such location was available within a square-mile grid. In this case, the survey manager selected the optimal location for safe data collection. This step resulted in five data collection locations within each PSU.

4. *Randomly selecting drivers from traffic passing by the location.* The total number of eligible vehicles was counted to determine the proportion of the traffic passing by each location that was sampled.

Although we sampled approximately the same number of drivers at each site, the actual number of individuals driving past each sampling site was not uniform. Therefore, to make the sample of drivers at each site representative of the actual number of drivers, we applied statistical weighting.

These sampling procedures ensured that the probabilities of selecting a site, a study location within each PSU, and a driver at a location were known at each of the sample design stages. Knowing these probabilities permitted the computation of the probability that a given driver would be interviewed in the study. This was achieved by multiplying the sampling probabilities at each of the four procedure steps previously mentioned to obtain the final overall probability of being sampled. The weight given to each case in the final totals (sampling weight) was computed as the inverse of the sampling probability. This statistical procedure accounted for differences in the size of the driver population among PSUs. This ensured that the basic requirement of sampling theory—that every driver had an equal chance of being interviewed—was met by adjusting for the biases inherent in the selection of locations within the sampling frame.

An issue with this staged sampling system was obtaining support from local officials. Although most law enforcement agencies contacted to participate did so, some were unable to, either due to lack of available officers or concerns about participating in the study. When a site was unable to participate, an alternative of the same site type (city, large suburban area, etc.) was identified within the same geographic region as defined by NASS/GES that had similar characteristics.⁷ The 60 PSUs used in the 2013–2014 NRS are shown in Figure 2. Even though some states had more than one site, and some states had no sites, all 60 sites as a whole provide representation of the country.

⁷ For more information on site replacement, see Lacey, Kelley-Baker, Furr-Holden, Voas, Moore, et al., 2009, and Kelley-Baker et al., 2016. Similar site replacement strategies were followed in previous NRS studies.



Figure 2. The 2013–2014 NRS Sites.

Addition of Daytime Data Collection

Drinking and driving has consistently been found to be more prevalent at nighttime than during the daytime. Because of this pattern, initial NRS studies (from 1973 to 1996) focused exclusively on collecting information on the drinking and driving of weekend nighttime drivers. Unlike alcohol, however, some drugs (for instance, prescription drugs and some illegal drugs) have also been measured during daytime hours (Romano & Pollini, 2013). In order to capture not only nighttime drinking and driving patterns but also drug-positive patterns at different times of the day, the 2007 NRS added a Friday daytime collection to the traditional nighttime survey.

The procedures for the Friday daytime period, either from 9:30 to 11:30 a.m. *or* 1:30 to 3:30 p.m., were identical to standard Friday and Saturday nighttime data collections, with minor word changes to some questions (e.g., “today” was substituted for “tonight”).

Preparation for the 2013–2014 NRS Survey

The 2007 and 2013–2014 studies had more components than the first three NRS studies. Additionally, there were other differences between the 2007 and 2013–2014 studies. For example, the 2013–2014 study included a prescription drug survey and a Drug Abuse Screening Test

(DAST) questionnaire, used an upgraded preliminary breath tester (PBT), and used an electronic tablet rather than a personal digital assistant. Table 1 compares differences and similarities between all five National Roadside Surveys.

Table 1. Differences between the 1973, 1986, 1996, 2007, and 2013–2014 NRS Studies

	1973	1986	1996	2007	2013–2014
Number of nighttime participants	3,353	2,971	6,045	6,920	6,630
Number of daytime participants	N/A	N/A	N/A	2,174	2,174
Number of sites	24 sites	24 sites	24 sites	60 sites	60 sites
Data collection periods	Four 2-hour periods	Four 2-hour periods	Four 2-hour periods	Five 2-hour periods	Five 2-hour periods
<i>Fri. Daytime</i>	N/A	N/A	N/A	9:30 to 11:30 a.m. or 1:30 to 3:30 p.m.	9:30 to 11:30 a.m. or 1:30 to 3:30 p.m.
<i>Fri. Nighttime</i>	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.
<i>Sat. Nighttime</i>	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.	10 p.m. to 12 a.m. <u>and</u> 1 to 3 a.m.
Samples collected	<ul style="list-style-type: none"> ▪ Breath 	<ul style="list-style-type: none"> ▪ Breath 	<ul style="list-style-type: none"> ▪ Breath 	<ul style="list-style-type: none"> ▪ Breath ▪ Oral fluid ▪ Blood* 	<ul style="list-style-type: none"> ▪ Breath ▪ Oral fluid ▪ Blood
Team composition	<ul style="list-style-type: none"> ▪ 3 Teams ▪ 3 Data Collectors 	<ul style="list-style-type: none"> ▪ 3 Teams ▪ 3 Data Collectors 	<ul style="list-style-type: none"> ▪ 3 Teams ▪ 3 Data Collectors 	<ul style="list-style-type: none"> ▪ 6 Teams ▪ 1 Survey Manager ▪ 6-8 Data Collectors ▪ 1 Phlebotomist 	<ul style="list-style-type: none"> ▪ 6 Teams ▪ 1 Survey Manager ▪ 6 Data Collectors ▪ 1 to 2 Traffic Staff ▪ 1 Phlebotomist
Preliminary breath tester	<ul style="list-style-type: none"> ▪ Intoximeter Alco-sensor; Omicron Intoxilyzer; Intoximeter Field Crimper 	<ul style="list-style-type: none"> ▪ Lion Alcolmeter S-D2 	<ul style="list-style-type: none"> ▪ CMI, Inc. Intoxilyzer SD-400 	<ul style="list-style-type: none"> ▪ CMI, Inc. Intoxilyzer PA-400 	<ul style="list-style-type: none"> ▪ PAS Systems International: Mark V Alcovisor

	1973	1986	1996	2007	2013–2014
Passive alcohol sensor (PAS)	▪ N/A	▪ PAS Systems International: flashlight version PAS	▪ Public Services Technologies: PAS III	▪ PAS Systems International: PAS Vr.	▪ PAS Systems International: PAS Vr.
Number of drugs tested	▪ N/A	▪ N/A	▪ N/A	▪ 75	▪ 98
Data collection method(s)	▪ Paper/pencil	▪ Paper/pencil	▪ Paper/pencil	▪ Personal digital assistant: Tungsten E2 ▪ Paper/pencil ▪ Front seat passenger questionnaire	▪ Tablet: Apple iPad2 ▪ Paper/pencil ▪ Front seat passenger questionnaire

*Blood was only collected during nighttime sessions.

Data Collection

The basic procedure in the 2013–2014 NRS, as well as in the previous studies, was for a law enforcement officer to provide instruction to the study team on the most appropriate method to alert potential participants to the data collection location. Officers were onsite mainly for the safety of the public and the team. This protocol varied slightly by site depending on the local law enforcement agency’s level of cooperation.

The driver was guided into a research bay where a data collector approached the driver, explained the study, and asked him or her to participate. The data collector informed the prospective participant that he or she had done nothing wrong and that the study was voluntary, anonymous, confidential, and concerned traffic safety. If the individual agreed to participate, the data collector asked core questions on driving behaviors and requested a breath sample. If the driver provided a breath sample, the data collector asked the driver to provide an oral fluid sample and complete a self-administered series of questions on alcohol and drug use. As a last step, drivers were then asked to provide a sample of their blood. Drivers received monetary compensation based on their level of participation. Drivers were told they could stop participation at any time.

Overall, 8,648 nighttime drivers entered the location. Of those, 8,483 were eligible for participation, and 83.6% of the eligible drivers provided a valid breath sample. As noted in Table 2, overall, there was a slightly higher proportion of drivers who did not participate in 2013–2014 than in 2007. However, the vast majority of drivers did participate.

Table 2. Comparison of Number of Nighttime Participants by Year in the NRS

	1973	1986	1996	2007	2013–2014
Signaled to enter data collection area	Not reported	3,260	6,480	9,553	10,782
Did not enter data collection area	Not reported	217	182	1,016	2,134
Stopped and entered data collection area	3,698	3,043	6,298	8,537	8,648
Eligible for study*	Not reported	Not reported	Not reported	8,384	8,483
Entered data collection area and interviewed	3,353 (90.7%)	2,971 (97.6%)	6,045 (96.0%)	6,920 (82.5%) [†]	6,630 (78.2%) [†]
Provided breath sample	3,192 (86.3%)	2,850 (93.7%)	6,028 (95.7%)	7,159 (85.4%) [‡]	7,094 (83.6%) [‡]

Ns and percentages are unweighted.

* Commercial and emergency vehicles not eligible. Underage drivers, drivers that were too impaired to properly consent and drivers who did not speak English or Spanish were also not eligible.

[†] Because previous studies did not inform about the eligibility of the drivers, percentages for the 1973, 1986, and 1996 studies are based on drivers who stopped and entered the site. Percentages for 2007 and 2013–2014 are based on drivers who not only were stopped and entered site, but also were eligible for the study. Percentages are based on nighttime drivers.

[‡] Some drivers provided breath samples but declined to participate in the questionnaire surveys.

Survey Equipment

As technology progressed over the past 40 years, so have the instruments used to conduct the NRS. For the first three NRSs, data collectors used paper and pencil to record participant responses. In 2007, data collectors used a personal digital assistant to record responses, and participants completed the drug questionnaires using paper and pencil. For the 2013–2014 NRS, data collectors and participants recorded their responses on an Apple iPad2 tablet. Through a special application developed for the 2013–2014 NRS, the tablet provided a means of prompting the data collector through each step of the data collection process.

The technological advances in portable preliminary breath testing also improved over the course of the NRS studies. In 1973, breath testing required the use of a large generator as a power source and ultimately required staff to conduct surveys inside a motorhome. Three different types of PBT were used throughout the 1973 project, depending on the size of the PSU. Starting with the 1986 study, a handheld PBT was used. The device in the 2013–2014 study was the Mark-V Alcovisor model, manufactured by PAS Systems International.

Impaired Driver Protocol

In accordance with human subject research protocols, NHTSA could not obtain data from anyone incapable of providing informed consent. Accordingly, the team had a responsibility to identify drivers who were impaired to the extent they could not properly provide consent for participation in the study, or operate a motor vehicle safely. We used an Impaired Driving Protocol to protect these individuals by finding them alternative transportation home.

While the data collector spoke with the driver, he or she also took a passive alcohol sensor (PAS) reading.⁸ This reading, along with initial observations of the driver's behavior, provided the team with an indication of alcohol level for all drivers and helped to identify whether there was a need for intervention. Additionally, while the participant was engaged with the research team, the data collector continually assessed the driver for any signs of impairment.

If a participant appeared impaired or had a high PAS reading, the data collector signaled the survey manager who observed the driver, and if warranted, explained his or her concern to the driver and requested a second breath test, now with a preliminary breath tester that displayed the result. The survey manager explained that if the subject blew a BrAC of .05 g/dL and higher, the team would make arrangements to get the driver home safely.

The impaired driver protocol included the following options:

- having another licensed occupant of the vehicle drive (if he or she was below .05 g/dL),
- calling a friend or relative to pick up the driver,
- calling a taxi (paid by the study),
- arranging for a hotel room (paid by the study), or
- calling a tow truck (paid by the study).

When the driver had a low BrAC or was not alcohol-positive but either the data collector or survey manager noticed other signs of impairment (e.g., smelled marijuana, noticed driver couldn't focus), the survey manager would implement the impaired driver protocol, regardless of substance. In the rare instance when a driver declined all of these options, the survey manager called over an onsite police officer, who reiterated the options to the driver. No subjects were arrested as a result, either directly or indirectly, of participating in data collection.

⁸ For the first 49 sites, two PAS readings were taken – one at the beginning of the consent process, and one again during the verbal questionnaire. For the last 11 sites, the PAS was only administered during the verbal questionnaire.

Modification in the Sampling Protocol

The procedures in the 2013–2014 NRS were as similar to the previous four roadside studies as possible, but lessons learned from the earlier studies, and experience collecting data in the earliest sites in 2013 led to slight changes in the procedures. Specifically, the protocol was modified for the last 11 sites so that research team members, as opposed to law enforcement officers, directed traffic and guided potential participants into the data collection area.

The results were analyzed to determine whether the changes in protocol influenced the outcomes of the study in a significant way, in terms of participation rates and distribution of alcohol- and/or drug-positive drivers. Table 3 provides a tabulation and Figure 3 a graphic visualization of the differences between the BrAC response patterns between the first 49 PSUs and the last 11 PSUs, where the modified procedures were followed. Examining the data after the protocol modification revealed that the prevalence of alcohol-positive drivers dropped from 8.6% to 6.4%, but this was not a statistically significant change. There was a statistically significant decrease ($p < .05$) in BrAC between zero and .079 g/dL, but no other differences were statistically significant.

Table 3. Comparison of the Percentage of Nighttime Drivers in Various BrAC Categories in the First 49 Sampled PSUs and the Last 11 Sampled Sites

BrAC (g/dL)	First 49 Sites		Last 11 Sites		All Sites	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
.00	5,678	91.4	1,009	93.6	6,687	91.7
>.00	571	8.6	45	6.4	616	8.3
.005–.079	448	7.0	37	4.8*	485	6.8
≥.080	123	1.6	8	1.7	131	1.6

Ns are unweighted; percentages are weighted.

The row “> .00” represents all alcohol positives (applies to the two bottom rows).

* Indicates statistically significant difference at $p < .05$.

Rows may not add up to 100% due to rounding.

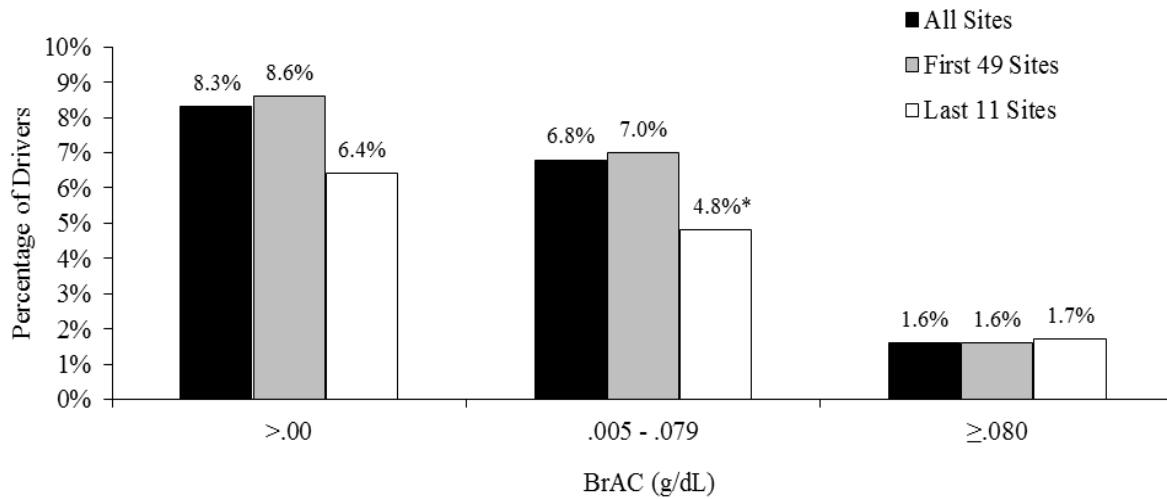


Figure 3. Comparison of the Percentage of BrAC-Positive Drivers at Various BrAC Categories in the First 49 Sampled PSUs and the Last 11 Sampled Sites.

Converted Participants

A concern for all five NRS studies was that drivers with high alcohol concentrations might be less likely to participate, resulting in an underestimation of the number of higher BrAC drivers on the road. Data from the 1996 NRS and from relative risk studies, such as that of Blomberg et al. (2005), suggested that drivers who declined the breath test were more likely to have higher BrACs than those who agreed to participate. Therefore, a non-participant conversion attempt was implemented in the first 49 sites to provide further incentive to those drivers who declined participation (Kelley-Baker et al., 2016).

Drivers who initially declined were offered an extra \$100 incentive as an inducement to participate. Of the 555 attempts, 33.3% (185) participated. As Table 4 illustrates, of the 157 nighttime drivers who then participated, 17.6% (24) were alcohol-positive – of these, 2.9% had a BrAC of .08 g/dL and higher.

Table 4. BrAC Distribution of Converted Decliners

BrAc (g/dL)	Daytime		Nighttime	
	<i>N</i>	%	<i>N</i>	%
.00	27	96.6	133	82.4
> .00	1	3.4	24	17.6
.005–.079	1	3.4	20	14.7
≥ .08	0	0.0	4	2.9
Total	28	100.0	157	100.0

*N*s are unweighted; percentages are weighted.

The row “> .00” represents all alcohol positives (applies to the two bottom rows).

Small sample size precluded meaningful statistical comparisons.

We conducted a series of independent sample comparisons to detect whether there were statistically significant differences in BrAC levels greater than .00 g/dL, between drivers classified as general participants (i.e., those who agreed to participate without conversion), and those drivers who initially declined but then did participate after the conversion offer.⁹ Table 5 compares the mean BrAC of nighttime drivers with a BrAC greater than .00 g/dL among general participants (*N* = 547) with that of the 24 converted participants. As illustrated in Table 5, the 547 general NRS participants with a BrAC greater than .00 g/dL had a mean BrAC of .054 g/dL; while the 24 converted participants had a lower mean BrAC (BrAC = .039 g/dL). The difference was not statistically significant (*p* = .107). This finding supports the view that positive BrAC levels are comparable between general participants and those who were converted, but the small sample size (and subsequent reduced statistical power), requires cautious interpretation.

Table 5. Comparison of Mean BrAC of Nighttime Drivers With a BrAC > .00 Among the General Participants and Successfully Converted Drivers

	<i>N</i>	Mean BrAC
General participants	547	.054 g/dL
Successful conversion	24	.039 g/dL

⁹ We applied a sequence of independent *t*-tests to compare the mean BrAC estimates among original NRS participants and those converted.

Data Analysis

One-way and two-way tables were built to show BrAC prevalence among drivers pertaining to different demographic groups (e.g., age, gender, race/ethnicity), in different driving situations (e.g., times of the day, vehicle type), as well as other factors (e.g., seat belt use). STATA v.11. was used to create the tables.

Weighting the Data

Information about traffic volume in the PSUs was not available for every PSU. Therefore, the previous NRS protocol was followed and the average annual frequency of drivers in fatal crashes in the PSU for the years 2009–2012 as a proxy for the relative number of driver trips in the PSU (Appendix A). Using methodology established in previous roadside studies, the case weights reflected the probability that any driver selected for participation in the study would have been randomly sampled from the total driving trips occurring at each location. Within each PSU, a randomized cluster sampling strategy was used to weight the number of driver trips.

Each of the various sampling stages (or frames) required a separate calculation of probability, which then became a component of the final probability computation, reflecting all levels or frames. The total weighted number of the sample reflects the total number of eligible drivers entering the bays, including drivers who declined, adjusted to the estimated distribution of those drivers in the 48 contiguous States, by region and by population density. Error terms for the analyses were computed by STATA (Stata Corp., 2006) to account for the sampling design.

Unless explicitly indicated, sample size (N) refers to the actual, unweighted number of respondents; percentages are weighted. To identify and present statistically significant differences in the following tables, we compared prevalence rates relative to a reference category (generally, the one with the highest frequency).

Imputing Breath Alcohol Concentration (BrAC) Values¹⁰

Previous NRS efforts have imputed BrAC values for those drivers for which that information was missing. For consistency and to facilitate comparisons with previous NRS estimates, BrAC values were imputed also in the 2013–2014 NRS. As in the 2007 NRS, missing BrAC values for drivers who did not supply breath samples were estimated based on information

¹⁰ A full description can be found in Appendix B and in the 2013-2014 NRS Methodology report (Kelley-Baker et al., 2016, under review).

collected from drivers who provided breath samples. The validity of imputation depends on the implicit assumption that no systematic differences existed between those who provided a breath sample and those who did not. We tested this assumption by comparing the BrAC of the converted participants to the BrAC of general participants (Table 5, above). The results of this examination suggest that alcohol was not a factor among converted participants. Although not conclusive (it could be argued that those drivers who accepted the additional incentive form a distinct subset of decliners), this finding supports the validity of the BrAC imputation.

It was concluded that the BrAC information provided by all participating drivers could be used to estimate the BrAC of drivers who did not participate. Unfortunately, change in sampling protocol after PSU 49 impeded the collection of data from converted non-participants, making the examination of the accuracy of the BrAC data collected after site 49 impossible. To avoid the potential confounding in estimating the BrAC of drivers who declined participation after PSU 49, only drivers who participated at the first 49 locations were used for imputation.

The following three-stage approach was used to impute the missing BrAC values:

- Used logistic regression to estimate the probability that a driver would have a BrAC greater than .00 g/dL, given explanatory variables (first PAS reading, time of day).
- Used a relative operating characteristic curve to set a suitable threshold to separate and identify alcohol-positive drivers.
- Applied a linear regression model to drivers with positive BrACs and used that model to predict positive BrACs from non-participants (Appendix B).

Table 6 shows the BrAC distribution for the 9,455 eligible drivers who provided a breath sample, and separately for the 9,712 drivers who had an actual ($N = 9,455$) or imputed ($N = 257$) BrAC.¹¹ Table 6 shows no significant difference between “Measured BrAC” and “Measured or Imputed BrAC” for any BrAC range.

¹¹ Because of missing PAS readings and changes in study protocol, imputation was possible only for 257 records with missing BrAC values (i.e., driver declined to provide a breath sample). The remainder of the cases lacked a valid BrAC measure and did not have data sufficient for imputation.

Table 6. 2013–2014 NRS Observed and Imputed BrAC Levels (Daytime and Nighttime)

BrAC (g/dL)	Measured BrAC		Measured or Imputed BrAC	
	<i>N</i>	%	<i>N</i>	%
.00	8,853	93.7	9,071	93.4
>.00	602	6.3	641	6.6
.005–.079	478	5.2	499	5.2
≥.080	124	1.2	142	1.5
Total	9,455	100.0	9,712	100.0

Both *N*s and percentages are unweighted.

The row “>.00” represents all alcohol positives (applies to the two bottom rows).

Rows may not add up to 100% due to rounding.

“Measured BrAC” indicates counts and percentages from drivers who provided a breath sample.

“Measured or Imputed BrAC” indicates counts and percentages from drivers who either provided a breath sample or have their BrAC imputed.

Results

Alcohol Results of the 2013–2014 National Roadside Survey

Table 7 shows the number of drivers who participated in the 2013–2014 NRS by daytime and nighttime data collection hours. For the 2013–2014 NRS, a total of 11,100 drivers (daytime and nighttime combined) were initially selected and determined to be eligible to participate. For the daytime data collection, 83.1% of eligible drivers entered the data collection location and answered the questions, and 90.2% of eligible drivers provided a breath sample. For the nighttime data collection, 78.2% of eligible drivers entered the location and answered the verbal questionnaire, and 83.6% of eligible drivers provided a breath sample. Overall, 85.2% (9,455) of eligible drivers provided a valid breath sample. Some eligible drivers were willing to provide a breath sample but did not answer the verbal questionnaire. Thus, a higher total number and% of drivers who provided a breath sample than drivers who answered the verbal questionnaire is known. With the inclusion of imputed BrAC, this increased the number of drivers with BrAC information to 9,712 samples (2,409 daytime and 7,303 nighttime). The subsequent tables use the measured and imputed BrAC information.

Table 7. Proportion of Eligible Drivers Entering the Survey Locations Who Answered Questions and Breath Samples in 2013–2014

	Daytime	Nighttime	Total
Entered location and eligible	2,617	8,483	11,100
Answered questions	2,174 83.1% [†]	6,630 78.2% [†]	8,804 79.3% [†]
Valid breath sample	2,361 90.2% [†]	7,094 83.6% [†]	9,455 85.2% [†]
With measured or imputed BrAC	2,409 92.1% [†]	7,303 86.1% [†]	9,712 87.5% [†]

[†] Percentage of eligible drivers.

Table 8 shows the large difference found between Friday daytime drivers and weekend (Friday and Saturday) nighttime drivers. During Friday daytime hours, 1.1% drivers were alcohol positive, while 8.3% of weekend nighttime drivers were alcohol positive. During Friday daytime hours, 0.7% of drivers had a BrAC between zero and .079 g/dL, while 6.8% of weekend nighttime drivers had a BrAC between zero and 0.79 g/dL. There were only 0.4% of Friday daytime drivers with a BrAC of .08 g/dL and higher while 1.5% of weekend nighttime drivers had BrACs of

.08 g/dL and higher. The alcohol prevalence of Friday daytime drivers compared to weekend nighttime drivers was statistically significant for all three alcohol levels ($p < .05$).

Table 8. Alcohol Prevalence by Data Collection Period and BrAC in 2013–2014 NRS

BrAC (g/dL)	<u>Daytime</u>		<u>Nighttime</u>	
	<i>N</i> = 2,409	%	<i>N</i> = 7,303	%
.00	2,384	98.9	6,687	91.7*
> .00	25	1.1	616	8.3*
.005–.079	14	0.7	485	6.8*
≥ .08	11	0.4	131	1.5*

*N*s are unweighted and percentages are weighted.

The row “> .00” represents all alcohol positives (applies to the two bottom rows).

* Indicates statistically significant difference at $p < .05$.

BrAC by Drivers’ Demographics and Time of Day

Table 9 displays BrAC levels by driver demographics and session. Drivers between the ages of 21 and 34 years are significantly less likely than drivers between 35 and 44 to be alcohol-negative ($p < .05$) for Friday late nighttime. Due to the smaller sample size, the differences for drivers with a BrAC of .08 g/dL and higher are not statistically significant. With the exception of Friday late nighttime, females show a higher prevalence of negative BrACs than males. This difference is statistically significant only among Friday daytime and Friday early nighttime drivers ($p < .05$). Small sample sizes made meaningful comparison impossible among some races and ethnicities (e.g., American Indian/Alaska Native, Native Hawaiian/other Pacific Islander, Other). Where comparisons were permitted, no significant differences by race or ethnicity were found.

Table 9.BrAC by Driver Demographics by Time of Day

	Friday												Saturday								
	Daytime				Early Nighttime				Late Nighttime				Early Nighttime				Late Nighttime				
	N	BrAC (%)			N	BrAC (%)			N	BrAC (%)			N	BrAC (%)			N	BrAC (%)			
		.00	.079	≥ .08		.00	.079	≥ .08		.00	.079	≥ .08		.00	.079	≥ .08		.00	.079	≥ .08	
All	2,409	98.9	0.7	0.4	2,094	93.9	5.4	0.7	1,528	87.9	9.6	2.5	2,212	93.9	5.6	0.5	1,469	85.8	9.5	4.6	
Age																					
16–21	110	100.0	0.0	0.0	282	98.7	1.3	0.0	168	92.4	7.6	0.0	274	98.5	1.6	0.0	190	93.0	6.6	0.4	
21–34	590	97.7	1.7	0.6	790	92.0	7.1	0.9	641	84.8*	11.9	3.3	843	93.7	6.0	0.4	629	83.9	11.0	5.1	
35–44 (Ref)	393	99.2	0.4	0.4	334	96.4	3.1	0.6	227	93.4	5.0	1.6	325	93.5	5.4	1.0	206	80.5	10.5	9.0	
45–64	762	99.2	0.5	0.3	426	94.9	4.2	0.9	284	88.1	8.9	3.0	487	95.0	4.2	0.8	243	90.1	5.9	4.0	
65+	307	99.9	0.0	0.1	74	89.7	10.3	0.0	35	96.6	1.3	2.2	77	93.6	6.4	0.0	26	90.7	1.3	7.9	
Gender																					
Male	1,231	98.1*	1.2*	0.7*	1,213	92.3*	6.8	1.0	1,009	88.0	10.2	1.9	1,277	93.5	6.0	0.5	959	84.4	10.6	5.0	
Female (Ref)	1,111	99.9	0.1	0.1	862	96.0	3.7	0.3	508	87.6	8.8	3.6	915	94.3	5.2	0.6	490	90.1	5.7	4.2	
Race/Ethnicity																					
White (Ref)	1,333	99.3	0.4	0.3	1,097	94.4	5.0	0.7	731	88.8	8.7	2.5	1,133	94.6	5.0	0.5	677	85.9	9.3	4.8	
Black or African American	371	98.0	1.4	0.6	334	94.8	5.1	0.1	292	86.8	10.2	3.1	362	94.6	4.8	0.5	265	84.2	10.4	5.5	
Hispanic	241	98.8	0.6	0.6	227	91.3	5.8	2.8	159	86.9	10.7	2.4	229	90.9	8.8	0.3	152	86.7	7.5	5.9	
Asian	62	100.0	0.0	0.0	69	94.4	5.6	0.0	56	93.6	5.8	0.7	98	99.3	0.7	0.0	53	86.9	12.0	1.2	
More than one	39	100.0	0.0	0.0	76	97.0	3.0	0.0	39	94.7	5.4	0.0	54	93.2	6.8	0.0	43	93.2	6.8	0.0	
Other	25	100.0	0.0	0.0	16	100.0	0.0	0.0	16	85.9	14.1	0.0	17	100.0	0.0	0.0	17	100.0	0.0	0.0	
Native Hawaiian or other Pacific Islander	16	100.0	0.0	0.0	9	88.7	11.4	0.0	11	100.0	0.0	0.0	21	100.0	0.0	0.0	12	100.0	0.0	0.0	
American Indian or Alaska Native	16	100.0	0.0	0.0	16	100.0	0.0	0.0	16	93.8	3.2	3.0	15	100.0	0.0	0.0	11	90.2	3.3	6.6	

Ns are unweighted; percentages are weighted.

Rows may not add up to 100% due to rounding.

* Indicates statistically significant difference at $p < .05$.

Ref: Denotes the category used for comparisons in some analyses.

Nighttime Results. This section includes combined data from both the early and late nighttime periods on both Fridays and Saturdays. As shown in Table 10, a large majority of drivers were at zero BrAC (91.7%). The prevalence of drivers with any alcohol during nighttime hours across both Friday and Saturday nights was 8.3%, with 1.5% of the drivers having BrACs of .08 g/dL and higher.

Table 10. BrAC Distributions of 2013–2014 Nighttime Drivers (Friday and Saturday Combined)

BrAC (g/dL)	<i>N</i> = 7,303	%
.00	6,687	91.7
> .00	616	8.3
.005–.079	485	6.8
≥ .08	131	1.5

*N*s are unweighted; percentages are weighted.

The row “> .00” represents all alcohol positives (applies to the two bottom rows).

Nighttime: BrAC by Drivers’ Demographics. Table 11 shows the prevalence of three BrAC levels by various demographic variables. Male drivers were significantly more likely than female drivers to be alcohol-positive ($p < .05$). For race/ethnicity,¹² Asian drivers were significantly less likely to be at BrACs of .08 g/dL and higher, than White drivers ($p < .05$). American Indian/Alaska Native drivers were significantly less likely to have BrACs between zero and .079 g/dL than White drivers ($p < .05$). Drivers 16-20 years with BrACs .08 g/dL and higher were significantly smaller than drivers age 35-44 ($p < .05$).

¹² We followed the criteria suggested by the Office of Management and Budget in 1997 (U.S. Department of Health and Human Services, 1997), which was subsequently adopted by the U.S. Census Bureau, by asking respondents to indicate first whether they regarded themselves as Hispanic and then to identify race. We then combined these two variables into a single one we called “Race/ethnicity.” As a result of that combination, Racial/Ethnic groups other than Hispanic are implicitly noted as Non-Hispanic in this report.

Table 11. 2013–2014 Nighttime: BrAC Distributions by Demographics (Gender, Race/Ethnicity, and Age Group) (Friday and Saturday Combined)

	N	BrAC (g/dL)			
		.00 (%)	Alcohol-positive		
			> .00 (%)	.005-.079 (%)	≥.08 (%)
Gender					
Male	4,458	90.6	9.4*	7.8	1.7
Female (Ref)	2,775	93.4	6.6	5.2	1.4
Race/Ethnicity					
White (Ref)	3,638	92.3	7.7	6.2	1.5
Black or African American	1,253	91.7	8.3	6.7	1.6
Hispanic	767	89.8	10.2	7.8	2.4
Asian	276	95.8	4.2	4.0	0.2*
More than one	212	95.0	5.0	5.0	0.0
Other	66	97.1	2.9	2.9	0.0
American Indian/Alaska Native	58	97.2	2.8	1.2*	1.5
Native Hawaiian/other Pacific Islander	58	98.2	1.8	1.9	0.0
Age					
16–20	914	96.6	3.4	3.3	0.1*
21–34	2,903	90.0	10.0	8.2	1.8
35–44 (Ref)	1,092	92.6	7.4	5.3	2.1
45–54	945	91.7	8.4	6.5	1.9
55–64	495	96.4	3.6	2.7	0.9
65+	212	91.8	8.2	7.2	1.0

Ns are unweighted; percentages are weighted.

The column “> .00” represents all alcohol positives (applies to the next two right-most columns).

* Indicates statistically significant difference at $p < .05$.

Rows may not add up to 100% due to rounding.

Ref: Denotes the category used for comparisons.

Table 12 shows the nighttime BrAC distribution by type of vehicle. The proportion of drivers at BrACs of .08 g/dL and higher was found to be significantly greater among motorcycle and pickup truck drivers ($p < .05$) than among drivers of any other vehicle type.

Table 12. 2013–2014 Nighttime: Vehicle Type by BrAC (Percentages Calculated by Row)
(Friday and Saturday Combined)

Vehicle Type	N	BrAC (g/dL)			
		.00 (%)	Alcohol-Positive		
			>.00 (%)	.005–.079 (%)	≥ .08 (%)
Passenger car (Ref)	4,531	92.1	7.9	6.5	1.4
SUV	1,560	91.2	8.9	7.5	1.4
Pickup	719	90.2	9.8	6.6	3.2*
Minivan	293	91.1	9.0	7.0	2.0
Motorcycle	59	86.5	13.4	8.4	5.0*
Van	57	99.0	1.0	0.0	1.0

Ns are unweighted; percentages are weighted.

The column “> .00” represents all alcohol positives (applies to the next two right-most columns).

* Indicates statistically significant difference at $p < .05$.

Rows may not add up to 100% due to rounding.

Ref: Denotes the category used for comparisons.

Nighttime: Observed Safety Behaviors. In the 2013–2014 study, seat belt use of drivers and any front seat passengers was recorded. Table 13 shows that there were no significant differences in driver BrAC and driver seat belt use and passenger seat belt use.

*Table 13. 2013–2014 Nighttime: Safety (Seat Belt Observation)
by BrAC (Percentages Calculated by Column) (Friday and Saturday Combined)*

	Driver's BrAC (g/dL)			
	.00 (%) (Ref)	Alcohol-Positive		
		> .00 (%)	.005–.079 (%)	≥ .08 (%)
Driver Seat Belt Observation				
N	6,592	605	477	128
Lap and shoulder belt	92.9	93.4	94.5	88.7
Shoulder belt only	5.5	2.4	2.5	2.2
Lap belt only	0.4	0.6	0.6	0.0
No use/no belt	1.2	3.7	2.4	9.1
Passenger Seat Belt Observation				
N	3,049	267	211	56
Lap and shoulder belt	90.9	90.4	91.9	82.2
Shoulder belt only	6.1	2.7	2.7	2.8
Lap belt only	0.9	1.4	1.7	0.0
No use/no belt	2.1	5.5	3.6	15.0

Ns are unweighted; percentages are weighted.

Columns may not add up to 100% due to rounding.

Ref: Denotes the category used for comparisons.

Table 14 summarizes helmet use among 57 nighttime motorcycle riders. The table also includes information about the subset of motorcycle riders who had passengers. About 67% of nighttime motorcycle riders were wearing a helmet. A greater percentage of motorcycle riders who were alcohol negative wore a helmet, compared with motorcycle riders who were alcohol positive. However, due to the relatively small sample size, no statistical comparisons involving helmet use by motorcycle riders were made.

Table 14. 2013–2014 Nighttime: Helmet Use of Motorcycle Riders, With and Without Passengers, by Rider BrAC (Percentages Calculated by Row) (Friday and Saturday Combined)

	N	% Motorcycle Drivers	BrAC (g/dL)			
			.00 (%)	Alcohol-Positive		
				> .00 (%)	.005 – .079 (%)	≥ .08 (%)
Motorcycle Drivers Without Passengers						
Helmet	33	64.9	92.1	7.9	2.5	5.4
No helmet use	16	35.1	88.6	11.4	11.4	0.0
Motorcycle Drivers With Passengers						
Helmet	5	79.5	59.1	40.9	21.5	19.4
No helmet use	3	20.5	30.2	69.8	43.2	26.6
All Motorcycle Drivers						
Helmet	38	67.3	88.3	11.7	4.7	7.0
No helmet use	19	32.8	82.6	17.4	15.9	1.5

Ns are unweighted; percentages are weighted.

The column “> .00” represents all alcohol positives (applies to the next two right-most columns).

Small sample size precluded meaningful statistical comparisons.

Daytime Results

This section includes data from the Friday daytime survey. Table 15 shows that 1.1% of the daytime drivers had positive BrACs. This might be expected, as Friday daytime is part of the work week, in contrast to Friday and Saturday nights when recreational driving is predominant. The Friday afternoon data collection period ended at 3:30 p.m., before the traditional “happy hour” period usually begins.

Table 15. BrAC Distributions of 2013–2014 Daytime Drivers

BrAC (g/dL)	N	%
.00	2,384	98.9
> .00	25	1.1
.005–.079	14	0.7
≥ .08	11	0.4

Ns are unweighted; percentages are weighted.

The row “> .00” represents all alcohol positives (applies to the two bottom rows).

Daytime: BrAC by Drivers’ Demographics. Table 16 includes daytime BrAC by various demographic variables. As indicated in Table 16, males were significantly more likely than females to have BrAC levels higher than zero, as well as BrAC levels between zero and

.079 g/dL, and .08 g/dL and higher ($p < .05$). No other statistically significant findings relating to gender, race/ethnicity, or age were found in the daytime sample.

Table 16. 2013–2014 Daytime: Demographics (Gender, Race/Ethnicity, and Age Group) by BrAC

	N	BrAC (g/dL)			
		.00 (%)	Alcohol-positive		
			> .00 (%)	.005-.079 (%)	≥.08 (%)
Gender					
Male	1,231	98.1*	1.9*	1.2*	0.7*
Female (Ref)	1,111	99.9	0.1	0.1	0.1
Race/Ethnicity					
White (Ref)	1,333	99.3	0.7	0.4	0.3
Black or African American	371	98.0	2.1	1.4	0.6
Hispanic	241	98.8	1.2	0.6	0.6
Asian	62	100.0	0.0	0.0	0.0
More than one	39	100.0	0.0	0.0	0.0
Other	25	100.0	0.0	0.0	0.0
American Indian/Alaska Native	16	100.0	0.0	0.0	0.0
Native Hawaiian/other Pacific Islander	16	100.0	0.0	0.0	0.0
Age					
16–20	110	100.0	0.0	0.0	0.0
21–34	590	97.7	2.3	1.7	0.6
35–44 (Ref)	393	99.2	0.8	0.4	0.4
45–54	373	99.3	0.7	0.2	0.5
55–64	389	99.1	0.9	0.8	0.1
65+	307	99.9	0.1	0.0	0.1

Ns are unweighted; percentages are weighted.

The column “> .00” represents all alcohol positives (applies to the next two right-most columns).

* Indicates statistically significant difference at $p < .05$.

Row may not add up to 100% due to rounding.

Ref: Denotes the category used for comparisons.

Because of the small sample size, comparisons involving Native Hawaiians/other Pacific Islanders or more than one racial/ethnic group were not performed.

Table 17 shows that the majority of daytime drivers were in passenger cars, followed by Sport Utility Vehicles (SUVs) and pickup trucks, which was also the case with nighttime drivers. Daytime van drivers were more likely than drivers of other vehicles to test positive for alcohol and to have a BrAC of .08 g/dL and higher (7.5%). However, due to the small sample size, the differences were not statistically significant.

Table 17. 2013–2014 Daytime: BrAC Distribution by Vehicle Type
(Percentages Calculated by Row)

Vehicle Type	N	BrAC (g/dL)			
		.00 (%)	Alcohol-Positive		
			>.00 (%)	.005–.079 (%)	≥ .08 (%)
Passenger car (Ref)	1,308	98.8	1.3	1.0	0.3
SUV	552	99.5	0.5	0.4	0.1
Pickup	274	98.8	1.2	0.5	0.7
Minivan	151	99.9	0.1	0.0	0.1
Van	34	92.5	7.5	0.0	7.5
Motorcycle	18	100.0	0.0	0.0	0.0

Ns are unweighted; percentages are weighted.

The column "> .00" represents all alcohol positives (applies to the next two right-most columns).

Rows may not add up to 100% due to rounding.

Ref denotes the level used for comparisons.

Small sample size for drivers with BrAC > .00 g/dL precluded meaningful statistical comparisons.

Daytime: Observed Safety Behaviors. Table 18 shows seat belt use of drivers and any front seat passengers. The vast majority of daytime drivers wore both lap and shoulder belts. The number of daytime drivers at positive BrACs was too small for meaningful statistical comparisons.

Table 18. 2013–2014 Daytime: Seat Belt Observation by BrAC
(Percentages Calculated by Column)

Driver/Passenger Seat Belt Observation	BrAC (g/dL)			
	.00 (%) (Ref)	Alcohol-Positive		
		> .00 (%)	.005–.079 (%)	≥ .08 (%)
Driver Seat Belt Observation	N= 2,299	N= 24	N= 14	N= 10
Lap and shoulder belt	94.7	100.0	100.0	100.0
Shoulder belt only	3.1	0.0	0.0	0.0
Lap belt only	0.6	0.0	0.0	0.0
No use/no belt	1.6	0.0	0.0	0.0
Passenger Seat Belt Observation	N=713	N= 3	N= 0	N= 3
Lap and shoulder belt	90.5	75.5	--	75.5
Shoulder belt only	6.3	0.0	--	0.0
Lap belt only	1.5	0.0	--	0.0
No use/no belt	1.8	24.5	--	24.5

Ns are unweighted; percentages are weighted.

Ref denotes the level used for comparisons.

Column may not add up to 100% due to rounding.

Small sample size for drivers with BrAC > .00 g/dL precluded meaningful statistical comparisons.

Table 19 displays helmet use among 17 daytime motorcycle riders, including information on the subset of motorcycle riders who had passengers. There were no alcohol-positive daytime motorcycle riders. Nearly 70% of all daytime motorcycle riders wore helmets. The small sample size and lack of BrAC variation precluded meaningful statistical comparisons.

Table 19. 2013–2014 Daytime: Helmet Use of Motorcycle Riders, With and Without Passengers, by Rider BrAC (Percentages Calculated by Row)

	N	% Motorcycle Riders	BrAC (g/dL)			
			.00 (%)	Alcohol-Positive		
				> .00 (%)	.005 –.079 (%)	≥ .08 (%)
Motorcycle Riders without Passengers						
Helmet	8	71.8	100.0	0.0	0.0	0.0
No helmet use	4	28.2	100.0	0.0	0.0	0.0
Motorcycle Riders with Passengers						
Helmet	3	100.0	100.0	0.0	0.0	0.0
No helmet use	0	0.0	N/A	N/A	N/A	N/A
Total Motorcycle Riders						
Helmet	11	82.5	100.00	0.0	0.0	0.0
No helmet use	4	17.5	100.00	0.0	0.0	0.0

Ns are unweighted; and percentages are weighted

The column “> .00” represents all alcohol positives (applies to the next two right-most columns).

N/A means not applicable

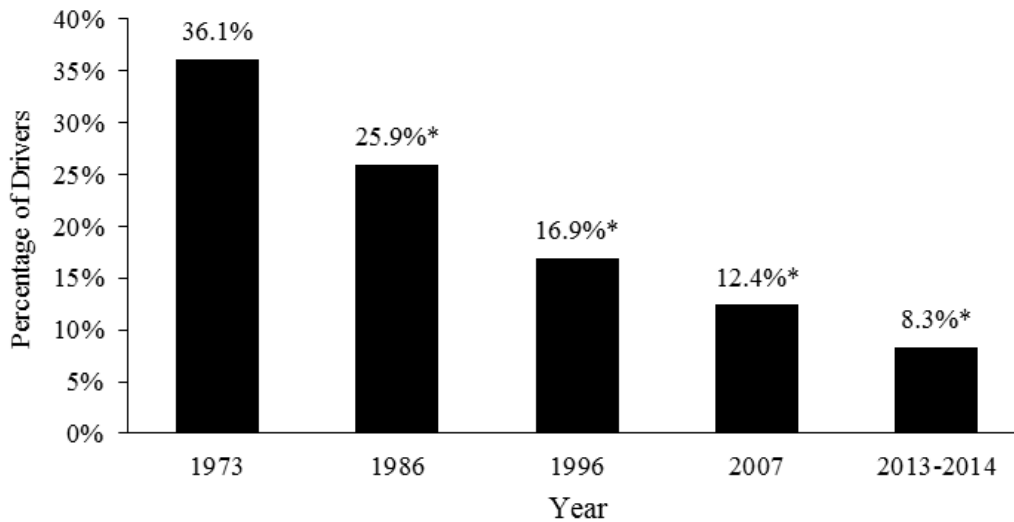
Comparing the Results of the Five National Roadside Surveys

This section of the report presents the results on the prevalence of nighttime weekend drivers at various BrACs in the 2013–2014 NRS compared with results from the previous four NRS studies. Unless noted otherwise, all percentages shown in the following sections of this report are weighted to represent the U.S. driver population, and all sample sizes (N) are unweighted to show the actual number of surveyed drivers.

At the time of the first NRS in 1973, States had various *per se* limits. Some did not have any *per se* limits established. Thus, previous study reports presented tables and figures with the value of .10 g/dL as the cut-off. To compare trends at today’s illegal *per se* level of .08 g/dL BrAC, we relied on information presented in the previous NRS studies.

Because the first three NRS studies were conducted only on nighttime weekends, comparisons for the five NRS studies are based only on nighttime weekend results. Daytime comparisons between the 2007 NRS and 2013–2014 NRS are also included.

Figures 4 and 5 summarize and compare the results of the weekend nighttime drivers from the five NRS studies. As shown in Figure 4, in 1973, 36.1% of drivers had a positive breath alcohol concentration (BrAC). The 2007 NRS Alcohol Results report indicated that there had been a steady and statistically significant decline of alcohol-positive drivers between each of the four decades, from 1973 to 2007 ($p < .05$). The 2013–2014 study determined that this trend continued in 2013–2014. There was a statistically significant decline from 12.4% positive in 2007, to 8.3% positive in 2013–2014. There was a relative reduction of 77% from 1973 to 2013–2014.



* Indicates statistically significant difference at $p < .05$

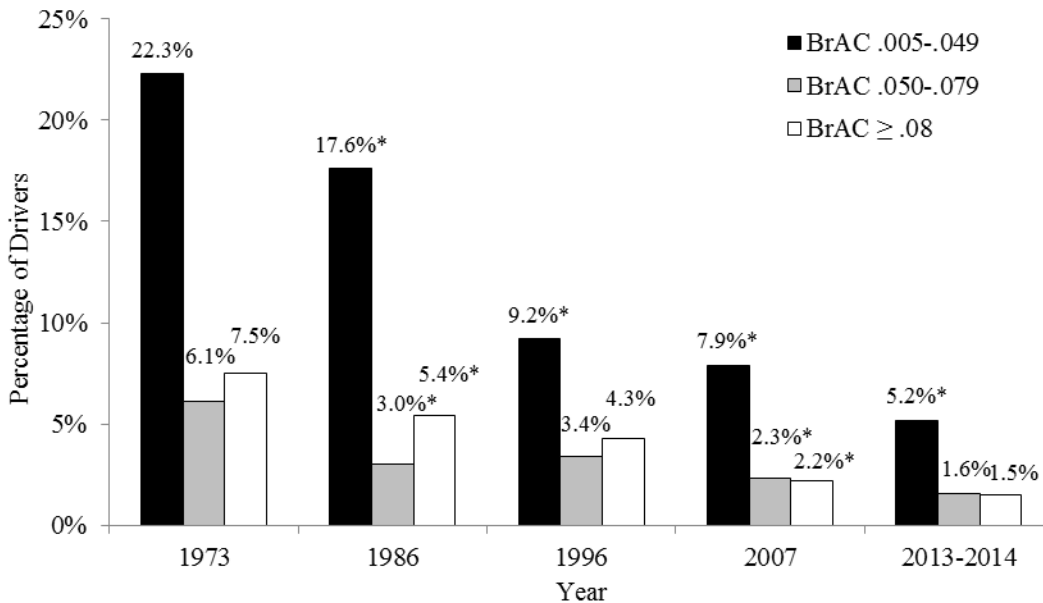
Figure 4. Percentage of Weekend Nighttime Drivers Positive for Alcohol in the Five National Roadside Surveys.

Overall, in each succeeding decade, the proportion of drivers in all alcohol ranges decreased. As previously mentioned, there were statistically significant decreases in the percentage of drivers with a BrAC of .08 g/dL and higher, from 7.5% in 1973 to 5.4% in 1986, and from 4.3% in 1996 to 2.2% in 2007. There also was a statistically significant decrease in each NRS, compared with the previous NRS during this time, in the .005–.049 g/dL BrAC category ($p < .05$) (Figure 5).

It is illegal *per se* for a driver to operate a motor vehicle with a BAC or BrAC of .08 g/dL and higher in every State in the U.S. As shown in Figure 5, in 1973, 7.5% of drivers had a BrAC of .08 g/dL or higher, and the percentage of NRS weekend nighttime drivers on U.S. roads with BrAC at .08 g/dL and higher has declined continuously over time. The 2007 NRS Alcohol Results report indicated that the decline was statistically significant from 1973 to 1986 and from 1996 to

2007, but not from 1986 to 1997. As shown in Figure 5, there was a further decline of weekend nighttime drivers with a BrAC of .08 g/dL, from 2.2% in 2007 to 1.5% in 2013-2014, but the decline was not statistically significant ($p < .05$). The overall decline of weekend nighttime drivers with a BrAC of .08 g/dL over the four decades, from 7.5% in 1973 to 1.5% in 2013–2014, represents an 80% relative reduction since 1973 and is statistically significant ($p < .05$).

The 2007 NRS Alcohol Results report found also that, in each succeeding decade, the proportion of drivers in other alcohol ranges (i.e., .005-.049 and .050-.079) decreased as well, and that the decreases were statistically significant in these alcohol ranges, with the exception of .05-.79 from 1986 to 1996. As shown in Figure 5, the 2013-2014 study determined that declines continued in all alcohol ranges from 2007 to 2013-2014, but only the declines for .005-.049 reached significance ($p < .05$).



*Indicates percentages listed are significantly different from those listed in the prior NRS (e.g., 5.2% of drivers with BrACs between .005 and .049 in 2013-2014 is significantly lower than 7.9% of drivers in that same BrAC range in 2007, 7.9% of drivers with BrACs between .005 and .049 in 2007 is significantly lower than 9.2% of drivers in that same BrAC range in 1996).

Total percentages in 1973 and 1986 do not equal the total presented in Figure 4 due to rounding.

Figure 5. Percentage of Weekend Nighttime Drivers in Three BrAC Categories in the Five National Roadside Surveys

Reductions in the prevalence of drivers at alcohol concentrations of .08 g/dL and higher among weekend nighttime drivers over the five studies generally paralleled reductions in the number of fatally injured drivers with a BAC of .08 g/dL and higher. Figure 6 shows the percentage of NRS drivers with ACs of .08 g/dL and higher, and fatally injured drivers in FARS

with ACs¹³ of .08 g/dL and higher in the years a NRS was conducted.¹⁴ Compared with 2007, the percentage of fatally injured drivers at BAC .08 g/dL and higher in 2013–2014 remained stable, while the percentage of drivers at BrAC .08 g/dL and higher in the 2013–2014 NRS decreased from 2.2% to 1.5%. There were no statistically significant differences between 2007 and 2013–2014.

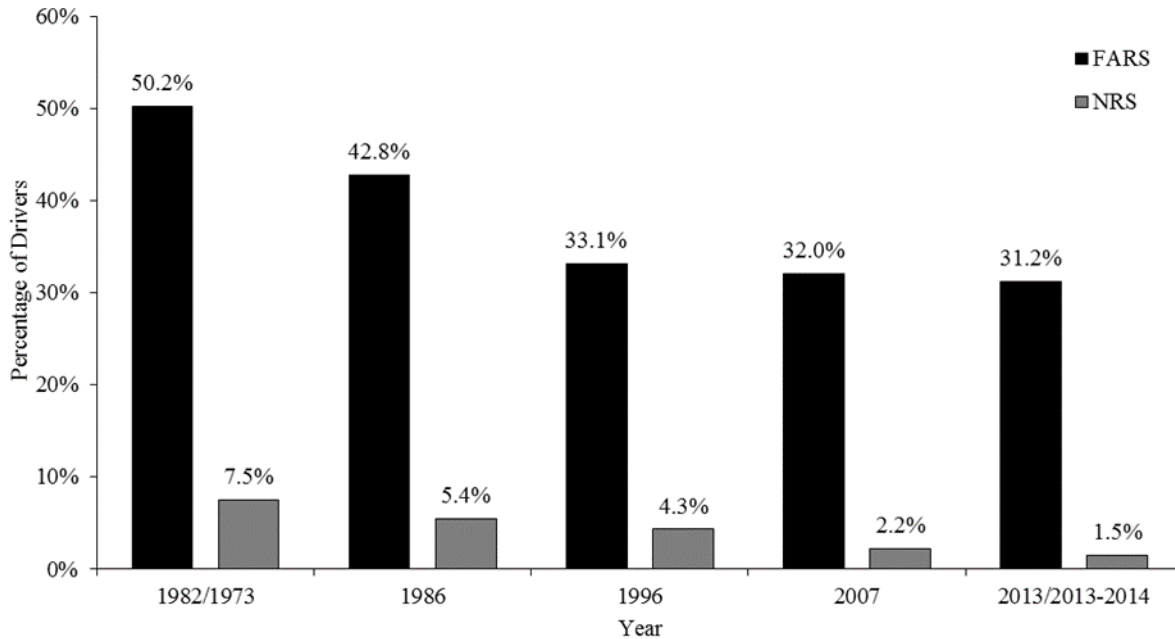


Figure 6. Comparison of FARS and National Roadside Survey Drivers With BAC/BrAC \geq .08 g/dL on Weekend Nighttime.

Younger Drivers

Of special interest are drivers age 20 and younger, a group at high risk for crash involvement when drinking (Zador, Krawchuk, & Voas, 2000b), who are subject to the National Minimum Drinking Age of 21. Figure 7 shows the percentage of underage drivers in FARS with .08 g/dL and higher BACs decreased from 1982 to 1996. From this point on, the proportion of underage drivers with BACs of .08 g/dL and higher in FARS data has remained stable. There was an overall decrease in alcohol-positive drivers. However, this decrease is not reflected in drivers

¹³ FARS data derives from blood alcohol concentrations (BAC). NRS data derives from breath alcohol concentrations (BrAC).

¹⁴ Data from the 2013–2014 NRS were compared with FARS data from 2013 only. FARS data for the year 2014 were not available at the time the analysis for this report was conducted. Because 1982 was the earliest year in which sufficient BAC data were available in the FARS, results from the 1973 the NRS were compared with the 1982 FARS.

aged 20 and younger, who have remained relatively stable over time, thus indicating that this overall reduction is attributable to drivers over the age of 20.

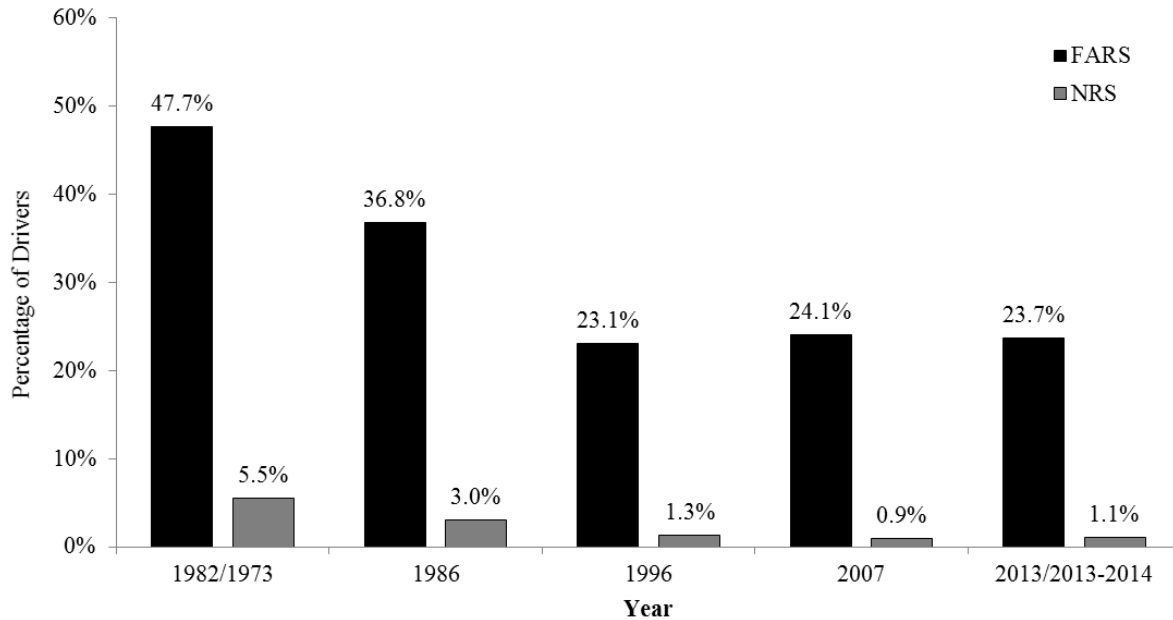


Figure 7. Comparison of FARS and NRS Drivers 20 Years and Younger with BAC/BrAC at .08 g/dL and higher on Weekend Nighttime.

Day and Time of Survey

Table 20 compares the BrACs of drivers in the five studies by time of survey (Friday daytime, Friday nighttime, Saturday nighttime). Comparisons at .05 g/dL and .10 g/dL are shown for all five studies. The proportion of drivers at .08 g/dL and higher is shown only for the 2007 and 2013–2014 surveys. Counts of drivers with BrAC at .08 g/dL and higher were not tabulated for the first three NRS studies, when the prevailing illegal *per se* limit in the United States was .10 g/dL. Because .08 g/dL has since become the illegal *per se* limit in all States, the 2007 and 2013–2014 NRS included the .08 g/dL cutoff level along with .05 g/dL and .10 g/dL.

The 2013–2014 results show that the percentage of daytime drivers at or above .05 g/dL and .08 g/dL has remained low in both 2007 and 2013–2014. Results show lower percentages of .10 g/dL and .08 g/dL BrAC drivers in 2013–2014 than in the 2007 NRS during most early and later time periods on both weekend nights. The exceptions include a slight increase between 2007 and 2013–2014 in both the .08 g/dL and .10 g/dL BrAC categories late on Saturday nights (1 to 3 a.m.) and no change in the percentages of .10 g/dL drivers for total Saturday nights. In comparing the 2007 and 2013–2014 results, there were statistically significant reductions at and above BrACs of .05 g/dL and .08 g/dL late on Friday nights (1 to 3 a.m.) and for the total Friday nights. On

Saturday nights, the differences in prevalence of the three alcohol ranges in the 2013–2014 NRS compared with that in the 2007 NRS were not statistically significant.

Table 20. Comparison of Driver BrAC (g/dL) Results in Relation to Time of Survey

	1973 BrAC			1986 BrAC			1996 BrAC			2007 BrAC				2013–2014 BrAC			
	<i>N</i>	≥ .05 (%)	≥ .10 (%)	<i>N</i>	≥ .05 (%)	≥ .10 (%)	<i>N</i>	≥ .05 (%)	≥ .10 (%)	<i>N</i>	≥ .05 (%)	≥ .08 (%)	≥ 0.10 (%)	<i>N</i>	≥ .05 (%)	≥ .08 (%)	≥ .10 (%)
Friday Daytime																	
9:30 to 11:30 a.m. <i>or</i> 1:30 to 3:30 p.m.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,482	0.2	0.2	N/A	2,617	0.5	0.4	0.3
Friday Nighttime																	
10 p.m. to midnight	845	9.5	3.0	750	4.7	1.6	1,842	4.2	1.0	2,123	2.5	1.2	1.1	2,094	2.1	0.7	0.6
1 to 3 a.m.	755	20.6	7.3	648	11.9	5.0	1,492	13.1	4.0	1,948	9.1	4.8	2.9	1,528	4.7*	2.5*	2.0
Total for Friday nighttime	1,600	14.7	5.0	1,398	8.0	3.2	3,334	8.2	2.3	4,071	4.5	2.3	2.0	3,622	2.9	1.2*	1.0
Saturday Nighttime																	
10 p.m. to midnight	841	9.5	3.4	833	6.7	2.8	1,865	5.3	2.4	2,280	2.1	1.1	0.6	2,212	1.6	0.5	0.3
1 to 3 a.m.	751	21.6	10.1	619	15.0	5.5	1,281	16.4	6.7	1,876	9.0	4.0	2.7	1,469	7.2	4.6	3.3
Total for Saturday nighttime	1,592	15.2	6.6	1,452	10.2	4.0	3,146	9.2	4.2	4,156	4.4	2.0	1.3	3,681	3.4	1.9	1.3
Total for Nighttime 10 p.m. to 3 a.m.	3,192	13.7	5.1	2,850	8.4	3.2	6,480	7.7	2.8	8,227	4.4	2.2	1.5	7,303	3.1	1.5	1.1

*N*s are unweighted; percentages are weighted.

* Indicates the 2013–2014 vs. 2007 comparisons that are statistically significant ($p < .05$).

Daytime surveys were conducted in 2007 and 2013–2014 only.

Differences between 2013–2014 and other years were not tested because confidence intervals for those earlier NRS estimates were unavailable.

Demographics

Table 21 compares driver demographic characteristics (gender, race/ethnicity, and age) across the five studies for nighttime weekend drivers at BrACs $\geq .05$ g/dL and $\geq .08$ g/dL. To capture changes in the *per se* laws, the two most recent NRS studies also reported prevalence at BrAC levels equal and higher than or equal to .08 g/dL. Because of data unavailability, statistical tests were conducted only between 2007 NRS and 2013–2014 NRS results.

Table 21. Comparison of Nighttime Drivers' BrACs (g/dL) by Demographic Characteristics

	1973 BrAC			1986 BrAC			1996 BrAC			2007 BrAC				2013–2014 BrAC			
	N	≥ .05 (%)	≥ .10 (%)	N	≥ .05 (%)	≥ .10 (%)	N	≥ .05 (%)	≥ .10 (%)	N	≥ .05 (%)	≥ .08 (%)	≥ .10 (%)	N	≥ .05 (%)	≥ .08 (%)	≥ .10 (%)
Gender																	
Male	2,648	14.7	5.5	2,114	9.9	3.9	4,229	8.7	3.5	5,147	5.3	2.6	1.8	4,458	3.5*	1.7	1.1
Female	526	8.8	3.0	728	3.9	1.3	1,984	5.8	1.5	3,042	3.0	1.5	1.0	2,775	2.6	1.4	1.2
Race/Ethnicity																	
White	2,803	13.3	5.1	2,352	7.4	2.7	4,362	7.1	2.3	4,712	4.6	2.4	1.8	3,638	2.9	1.5	1.0
Black or African American	256	16.5	6.0	328	13.5	5.9	947	9.4	3.6	1,358	3.4	2.0	1.0	1,253	2.9	1.6	1.3
Hispanic	43	22.0	3.3	124	13.0	4.4	612	14.9	7.5	1,473	5.6	2.1	1.5	767	4.5	2.4	1.9
Asian	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	302	3.8	2.5	1.9	276	0.4*	0.2*	0.2*
More than one	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	98	2.2	0.6	0.1	212	0.7	0.0	0.0
Other	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	107	2.3	0.6	0.6	66	0.0	0.0	0.0
American Indian/Alaska Native	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	103	5.1	2.1	1.4	58	2.0	1.5	1.5
Native Hawaiian/other Pacific Islander	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	34	0.0	0.0	0.0	53	0.0	0.0	0.0
Age Group																	
16–20	767	10.9	4.1	506	4.6	2.7	977	2.8	0.3	1,062	1.9	0.9	0.6	914	1.5	1.1	0.2
21–34	1,393	15.4	5.7	1,341	9.9	3.3	2,634	11.3	3.8	2,842	5.9	3.1	2.2	2,903	3.7	1.8	1.3
35–44	419	15.9	5.8	497	9.4	4.7	1,215	6.9	3.7	1,253	3.9	1.9	1.4	1,092	3.7	2.1	1.8
45–54	339	13.3	4.7	245	9.1	2.2	747	5.9	2.3	968	4.0	2.2	1.5	945	3.3	1.9	1.2
55–64	169	11.0	3.7	169	4.4	0.4	338	3.9	1.0	486	2.2	0.5	0.5	495	1.5	0.9	0.5
65+	51	8.4	2.2	75	3.9	3.9	134	4.7	0.8	186	4.5	3.6	0.0	212	3.7	1.0	1.0

Ns are unweighted; percentages are weighted.

* Denotes statistically significant ($p < .05$) when compared to the 2007 NRS. Information from earlier NRS reports was not available for additional comparisons. Because of missing records on the demographic values, totals (N) do not match those in Table 9. Also note that each BrAC column includes all positive cases in that range (e.g., $\geq .05$ g/dL also includes $\geq .08$ g/dL and $\geq .10$ g/dL cases).

Data for American Indian/Alaskan, Asian, more than one race, Native Hawaiian or other Pacific Islander, and other race not available for the 1973, 1986, or 1996 NRS.

Prior to the 2007 NRS, information on drivers' race/ethnicity was visually obtained. For the 2007 and 2013–2014 NRS, information on race/ethnicity was self-reported (for cases in which the self-reported information was missing, the data collectors' visual indications of race/ethnicity were applied).

Gender. In general, Table 21 shows an overall decline in the percentage of drivers at each of the BrAC levels under study for both male and female drivers. A few exceptions took place among female drivers, including an increase in drivers with BrACs at or above .05 g/dL and .10 g/dL from 3.9% in 1986 to 5.8% in 1996, and in drivers with BrACs at or above .10 g/dL from 1.3% in 2007 to 1.5% in 2013–2014. Only the reduction in the prevalence of drivers at BrACs at or above .05 g/dL was found to be statistically significant, with a decrease from 5.3% in 2007 to 3.5% among males in 2013–2014 ($p < .05$).

Race/Ethnicity. Unlike the first three NRS studies, which included information only on Whites, African Americans, and Hispanics,¹⁵ the 2007 and 2013–2014 NRS followed the race/ethnicity categorization from the U.S. Census Bureau, including categories for race/ethnicity covering American Indian/Alaska Native, Asian, Pacific Islander, and more than one race. Overall, the reduction in the prevalence of nighttime BrAC that was noted in previous tables took place in each of the racial/ethnic groups under study. Among the changes observed between the 2007 NRS and 2013–2014 NRS, only the reduction in the prevalence of drinking and driving among Asian drivers was statistically significant, reaching significance across all BrAC levels examined ($p < .05$).

Age. Table 21 also shows nighttime comparisons across age groups. Percentages of drivers of all age groups with BrACs of .05 g/dL and higher decreased over the five NRS studies with a few exceptions; specifically, increases from 1986 to 1996 for 21–34 and 65+ age groups. The prevalence of drivers at BrACs at and higher than .10 g/dL also decreased over time, with the exception of drivers aged 65 and older who showed an increase from 1973 to 1986; drivers 21–34, 45–54 and 55–64 who showed an increase from 1986 to 1996; drivers 16–20 who showed an increase from 1996 to 2007; drivers 35–44 and 65+ who showed an increase from 2007 to 2013–2014 and drivers 55–64 in 2007 to 2013–2014 who stayed the same. None of these changes over time were statistically significant.

¹⁵ Measures for Hispanics before the 2007 NRS should be made with extreme caution, as they were based only on observations. In the 2007 NRS a self-reported measures of the drivers' race and ethnicity was added. We followed the criteria suggested by the Office of Management and Budget in 1997, which was subsequently adopted by the U.S. Census Bureau, asking respondents to indicate first whether they regarded themselves as Hispanic and then to identify race.

Logistic Regression: The contribution of drivers' demographics and driving situational variables to BrAC at each NRS survey

We compared the five NRS studies by examining the contribution of drivers' demographics (gender, age, and race/ethnicity) and driving situational variables, including time of day (early and late night) and day of the week (Friday and Saturday) to the likelihood of finding drivers with .05 g/dL BrAC and higher BrAC. For the 2007 and 2013-2014 NRS, BrAC of .08 g/dL and higher were included as well. For the 2007 and 2013–2014 NRS studies, we conducted logistic regression analyses.¹⁶

Except for the 1986 NRS, the odds of finding a BrAC at .05 g/dL and higher or at .08 g/dL and higher did not differ by the day of the week (Friday or Saturday). The 1986 NRS reported that the odds of finding a BrAC at .05 g/dL and higher was significantly greater (by 34%) on Saturdays than on Fridays.

The time of night (early nighttime vs late nighttime) was related to the odds of finding an alcohol-positive driver in every NRS. In each NRS, late nighttime drivers were more likely than early nighttime drivers to have BrACs of .05 g/dL and higher. Late nighttime drivers were also more likely than early nighttime drivers to have BrACs of .08 g/dL and higher in both the 2007 and 2013–2014 study.

In the 1973, 1986, and 2007 NRS, male drivers were more likely than females to have BrACs of .05 g/dL. This gender difference was not detected in the 1996 or 2013–2014 NRS. In the 2007 NRS, male drivers were also more likely to be at a BrAC of .08 g/dL or higher, compared to their female counterparts. This gender difference was not detected in the 2013–2014 NRS.

In terms of race and ethnicity, Asian drivers had significantly lower rates of BrAC at or above .05 g/dL, compared to White drivers in both the 2007 and 2013–2014 studies, and rates of BrAC at or above .08 g/dL, compared to White drivers in the 2013–2014 NRS, but not in the 2007 NRS. Information about Asian drivers was collected in the 1973, 1986 or 1996 studies but because the information wasn't indicated in the demographic field as being an Asian driver we could not compare data on Asian drivers for those years. American Indians/Alaska Natives had significantly higher rates of BrAC at or above .05 g/dL, compared to White drivers in 1986, and Hispanic

¹⁶ Logistic regression analysis is a statistical technique that models the likelihood a variable of interest would take a certain value (in this case that a driver would be found at certain BrAC levels) as a function of several contributing factors (e.g., driver's gender, age, etc.). Logistic regression analyses provide estimates of the relative odds that each factor would contribute to the prediction of a specific BrAC level.

drivers had significantly higher rates of BrAC at or above .05 g/dL, compared to White drivers in 1996. Other than Asian drivers, there were no significant findings in any other racial or ethnic groups in the 2007 or 2013-2014 NRS studies.

Drivers 20 years and younger were less likely to have BrACs at or above .05 g/dL, compared to driver age 45 years and older. This trend became apparent during the 1996 study and continued through 2007 and 2013–2014. In 1996, drivers age 21-34 were more likely to have BrACs at or above .05 g/dL, compared to drivers age 45 and older. This statistically significant difference did not continue in 2007 or 2013-2014.

Table 22. Results of Logistic Regression Models Predicting the Odds of Nighttime BrAC $\geq .05$ g/dL and/or BrAC $\geq .08$ g/dL

	Odds Ratios (95% CI)						
	1973	1986	1996	2007		2013–2014	
	BrAC $\geq .05$	BrAC $\geq .05$	BrAC $\geq .05$	BrAC $\geq .05$	BrAC $\geq .08$	BrAC $\geq .05$	BrAC $\geq .08$
Day of the week							
Saturday	1.05	1.34*	1.22	0.90 (0.60–1.42)	0.77 (0.49–1.21)	1.21 (0.74–1.98)	1.50 (0.80–2.83)
Friday (Ref)							
Time of the Night							
Late at night	2.66*	2.53*	3.35*	4.48* (2.80–6.56)	4.96* (3.05–8.08)	3.74* (2.20–6.34)	7.05* (3.34–14.89)
Early (Ref)							
Gender							
Male	1.82*	2.72*	1.44	1.59* (1.04–2.14)	1.63* (1.01–2.62)	1.25 (0.78–1.99)	1.02 (0.55–1.92)
Female (Ref)							
Race/Ethnicity							
American Indian/ Alaska Native	1.24	1.81*	0.99	1.07 (0.42–2.73)	0.91 (0.18–4.54)	.66 (0.19–2.31)	0.98 (0.22–4.36)
Asian	N/A	N/A	N/A	0.50* (0.25–.99)	0.87 (0.39–1.93)	0.11* (0.04–0.35)	0.15* (0.03–0.66)
Black/ African American	N/A	N/A	N/A	0.70 (0.33–1.47)	0.80 (0.22–2.98)	0.92 (0.53–1.62)	0.91 (0.40–2.05)
Hispanic	0.95	1.65	1.67*	1.05 (0.80–1.39)	0.70 (0.28–1.76)	1.57 (0.80–3.07)	1.50 (0.68–3.30)
Other	N/A	N/A	N/A	0.45 (0.09–2.26)	0.21 (0.03–1.26)	N/A (II)	N/A (II)
More than one	N/A	N/A	N/A	0.40 (0.11–1.41)	0.21 (0.02–2.03)	0.40 (0.13–1.26)	0.40 (0.06–2.56)
White (Ref)							
Age Group[†]							
16–20	0.82	0.68	0.39*	0.41* (0.18–.94)	0.38 (0.13–1.10)	0.18* (0.06–.55)	0.05* (0.01–.34)
21–34	1.09	1.38	1.82*	1.40 (0.67–2.93)	1.32 (0.58–3.05)	1.10 (0.72–1.66)	1.05 (0.55–2.02)
35–44	1.26	1.3	1.09	0.99 (0.53–1.85)	0.89 (0.40–1.98)	1.08 (0.53–2.20)	1.21 (0.42–3.45)
45+ (Ref)							

* Odds ratios significantly different from 1 ($p < .05$).

Ref: Denotes for each variable, the group used for comparisons.

N/A: Denotes lack of information.

N/A (II): For the 2013–2014 NRS, Native Hawaiian/other Pacific Islander drivers were included as “Other.” Also for the 2013–2014 NRS, the lack of any drivers in this category who had a BrAC higher than .05 g/dL did not allow for an examination of this category (“Other”). Early Nighttime and Late Nighttime denote the following two sets of hours: from 10 p.m. to midnight (early night) and from 1 to 3 a.m. (late night).

[†] Throughout this report, analyses by age generally use driver age 35–44 as the reference group (i.e., the group to which other drivers are being compared). To be consistent with prior NRS groupings, age groups for this table followed those set in 1973. The “45+” age group was chosen as the reference group because of the interest of examining the odds for the younger drivers relative to that of the more mature ones.

Table 23 displays BrAC-positive daytime drivers for both the 2007 and 2013–2014 NRS. There was an increase in male drivers at and above .00 g/dL, .05 g/dL and .08 g/dL in the 2013–2014 study compared to the 2007 study, along with a decrease at all three levels among female drivers. There was an increase at all three levels also among drivers who are Black, Hispanic, and between the ages of 21 and 34. However, none of these changes were significantly different between the two studies.

Table 23. Comparison of Daytime Drivers' BrACs (g/dL) by Demographic Characteristics

	2007 BrAC				2013–2014 BrAC			
	<i>N</i>	> .00 (%)	≥ .05 (%)	≥ .08 (%)	<i>N</i>	> .00 (%)	≥ .05 (%)	≥ .08 (%)
Gender								
Male	1,397	1.5	0.2	0.1	1,231	1.9	0.8	0.7
Female	1,069	0.6	0.2	0.2	1,111	0.1	0.1	0.1
Race/Ethnicity								
White	1,615	1.4	0.2	0.2	1,333	0.7	0.3	0.3
Hispanic	363	0.9	0.4	0.4	241	1.2	0.6	0.6
Black or African American	350	0.7	0.1	0.0	371	2.1	0.8	0.6
Asian	59	0.0	0.0	0.0	62	0.0	0.0	0.0
Other	34	0.0	0.0	0.0	25	0.0	0.0	0.0
More than one	21	1.4	0.0	0.0	39	0.0	0.0	0.0
American Indian/Alaska Native	20	4.8	0.0	0.0	16	0.0	0.0	0.0
Native Hawaiian/other Pacific Islander	4	0.0	0.0	0.0	16	0.0	0.0	0.0
Age Group								
16–20	106	1.2	0.6	0.6	110	0.0	0.0	0.0
21–34	504	0.9	0.1	0.1	590	2.3	0.6	0.6
35–44	437	0.8	0.1	0.1	393	0.8	0.7	0.4
45–54	462	1.2	0.6	0.4	373	0.7	0.6	0.5
55–64	326	0.5	0.0	0.0	389	0.1	0.1	0.1
65+	292	0.1	0.1	0.1	307	0.1	0.1	0.1

*N*s are unweighted; percentages are weighted.

Total *N* may not match that in previous tables due to missing information.

Discussion

The alcohol results across the five roadside studies (1973, 1986, 1996, 2007, and 2013–2014) show a continual, steady, statistically significant downward trend in the proportion of drivers on roads on weekend nights who are alcohol-positive, from 36.1% in 1973, to 25.9% in 1986, 16.9% in 1996, 12.4% in 2007, and 8.3% in the 2013–2014 study (Figure 4). This decline is a positive indicator that suggests that the comprehensive efforts undertaken in the U.S. to reduce impaired driving are working.

The percentage of drivers on weekend nights who had a BrAC of .08 g/dL and higher was significantly lower in 2013–2014 (1.5%) than in 1973 (7.5%) (Figure 5). It was also lower than in 2007 (2.2%), when the fourth study was conducted, although this difference is not statistically significant.

The NRS data included demographic details about drivers, which enabled us to categorize alcohol use by driver characteristics, including gender, age, and race/ethnicity, as well as by vehicle type and day and time (Tables 9, 11, 12, 16, and 17).

Response rates achieved in 2013–2014 were slightly lower than in previous decades (Table 2), perhaps reflecting national changes in the culture and attitudes toward survey participation (e.g., concerns about the disclosure of personal information and government intrusion). However, there was still an extremely high participation rate in 2013–2014. Overall, 85.2% of drivers provided a valid breath sample in 2013–2014 (Table 7).

In 2013–2014, the NRS found that 3.5% of males on weekend nights had a BrAC of .05 g/dL and higher, which included 1.7% with a BrAC of .08 g/dL and higher, and 1.1% with a BrAC of .10 g/dL and higher (Table 21). From 2007 to 2013–2014, there was a statistically significant decrease in the percentage of males on weekend nights with BrACs of .05 g/dL and higher, from 5.3% to 3.5% (Table 21). The reduction of male drivers at .05 g/dL and higher is a 34% relative decrease between 2007 and 2013–2014. For females, there was a reduction of 14%, which was not statistically significant. While the number of females included in the 2013–2014 NRS was small (526, compared with 2648 for males), the percentage of females on weekend nights who drove with a BrAC of .08 g/dL and higher (1.4%) and with a BrAC of .10 g/dL and higher (1.2%) was very similar to those of males (Table 21). These findings may suggest that the

disparity between males and females who drive at night at these BrAC levels is diminishing and that policymakers should carefully consider how to most effectively address the problem of impaired driving for both males and females.

The first three NRS studies obtained race/ethnicity data in terms of Whites, African Americans, and Hispanics. The 2007 and 2013–2014 studies were revised to follow the U.S. Census Bureau race/ethnicity categorization and added categories for American Indians/Alaska Natives, Asians, Pacific Islanders, and “More than one” race. Results showed that there was a decline at levels of .05 g/dL and higher for each racial/ethnic group, except Hispanic drivers from 1986 to 1996 (Table 21). This decline was statistically significant only for Asian drivers (Table 21). The percentage of Asian drivers with BrACs of .05 g/dL and higher decreased significantly from 3.8% in 2007 to .4% in 2013–2014 ($p < .05$). It also declined significantly for Asian drivers with BrACs at or above .08 g/dL and .10 g/dL (Table 21). No other differences were statistically significant.

There was a decrease in the percentage of weekend nighttime drivers with BrACs of .05 g/dL and higher for all age groups from 2007 to 2013–2014, but these reductions were not statistically significant (Table 21). Of special interest were drivers 16–20 years, a group at high risk for crash involvement when drinking (Zador et al., 2000b). Among weekend nighttime drivers in 2013–2014, the prevalence of drivers 16–20 years who were at .08 g/dL and higher was significantly smaller than that of drivers aged 35 to 44 (Table 11).

From 1996 to 2013, FARS shows a slight decline in the percentage of fatally injured drivers with a BAC of .08 g/dL and higher, and the NRSs show a comparable decline in the percentage of drivers with BrACs .08 g/dL and higher (Figure 6). From 1996 to 2013, FARS shows a slight increase in the percentage of fatally injured drivers age 16–20 with a BAC of .08 g/dL and higher, while the NRSs show a slight decline in the percentage of drivers age 16–20 with BrACs .08 g/dL and higher (Figure 7). However, none of these differences were statistically significant.

The 2013–2014 NRS, like the NRS in 2007, included data collection for one Friday daytime period, either from 9:30 to 11:30 a.m. *or* from 1:30 to 3:30 p.m. There was an increase in male drivers with a BrAC at or above .00 g/dL, .05 g/dL and .08 g/dL in the 2013–2014 study (1.9%, 0.8% and 0.7%, respectively) compared to the 2007 study (1.5%, 0.2% and 0.1%,

respectively), and a decrease among female drivers (from 0.6%, 0.2% and 0.2% in 2007 to 0.1%, 0.1% and 0.1% in 2013-2014) (Table 20). There were increases in drivers at all three levels from 2007 to 2013-2014 who are Black, Hispanic, and between the ages of 21 and 34. However, none of these changes between the two studies were statistically significant (Table 20). The percentage of nighttime drivers who had BrACs above .00 g/dL (8.3%), between .005 and .079 g/dL (6.8%) and at or above .08 g/dL (1.5%) were significantly higher than those of daytime drivers at all three levels (1.1%, 0.7% and 0.4%, respectively) (Table 8).

We hope that this study provides information that is useful to policymakers as they develop and implement programs intended to reduce the toll of alcohol-impaired driving.

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Appendix A: Weighting the Data

Weighting the Data

The objective of the 2013–2014 National Roadside Survey (NRS) was to estimate the prevalence of alcohol- and drug-positive drivers on the nation’s roads during Friday days and weekend nights. Because a truly random sample—in which every driver has an equal probability of being selected—is impossible, statisticians used multi-stage system for weighting.

The weighting reflected known distributions of the overall population by geographic region and urban/rural population density and reflects the probability that any driver included in the study would have been randomly sampled from among the population of driving trips¹ during the study hours.

Primary Sampling Units

The first sampling stage selected sizeable geographical areas in the contiguous States, where study sites were randomly selected. These geographical areas called “Primary Sampling Units” (PSUs) or “sites” were single counties, clusters of contiguous and roughly homogenous counties, or large cities with metropolitan areas. Statisticians used NHTSA’s National Automotive Sampling System (NASS) to select 60 PSUs. The NASS PSU’s that constitute the General Estimates System (GES) are drawn from the population of potential PSUs which included 1,193 geographic units². PSUs were selected reflecting the likelihood that was proportional to their contribution to the overall population’s composition, or what is termed a “Probability Proportionate to Size” (PPS) scheme. If equally sized random samples are taken within each PSU and then weighted by each case within each PSU according to the PSU’s relative proportional size, the composite estimate for the entire population would approximate the distribution of

¹ Driving Trips as the Units of Population: For the 2007 and 2013–2014 studies, a sample was drawn for Friday daytime drivers between 9:30 a.m.-11:30 a.m. *or* 1:30 p.m.-3:30 p.m. The statistical population we wished to infer, that is, drivers who were actually on the road traveling during those hours, not the overall U.S. population, or geographical areas, or U.S. licensed drivers generally. Thus, if it were possible to take a completely perfect random sample, the population of observational units to be sampled—the units to be shuffled and randomly drawn from a hat—from which we could obtain a representative random sample of driving trips during those hours. These trips (and their drivers) were linked to and correlated with population generally, and “located” within geographically defined areas. To represent Friday daytime and weekend nighttime trips, the sampling frames needed to be treated as separate but parallel populations rather than more generally representative of population or of geography.

² Note: A handful of these units have been re-drawn or merged in the years since the schema was developed.

individual cases that would have been sampled under an ideal (but pragmatically impossible) simple random sample.

The 2013–2014 NRS used a set of 60 PSUs previously chosen from a sampling frame designed according to the principles for NASS’s General Estimates System (GES) project. Using the GES PSUs was appropriate for the NRS because a) there is an established history of cooperation from police jurisdictions in these sites, increasing the likelihood that permission could be obtained; b) the PSUs for the 1996 and 2007 NRS studies were from this set; and c) doing so would allow comparisons between the NRS study to national crash estimates which use the same sampling sites. NASS provided one of the best estimates of driving trips and driving exposure.

Data collection required the cooperation of officials in that site, such as police agencies and the State Highway Safety Office. Although most sites allowed data collection some declined, requiring replacement sites. It was necessary to replace 19 sites with alternates. Each replacement PSU was selected from PSU candidates that had been narrowed from the 1,193 to match the general characteristics of the PSU being replaced (i.e., by region of the country, county / or city population size, injury crash experience, and economic factors). This strategy precluded replacing a site with an inappropriate match, for example, replacing Los Angeles, California with Dubuque, Iowa. Replacement sites were had general geographic and demographic comparability to the distribution and diversity of the original GES sites. The replacement PSU was weighted in accordance with the original GES scheme for PSU weights, using the same overall PPS measure as was applied to those GES PSUs that allowed data collection. To account for the amount of variance associated with sampling stage, the study’s analyses took into account the “resampling” of replacement PSUs from the 1,193 geographic entities from which GES’s PSUs were originally drawn.

Additionally, to ensure that there were no geographic regional biases, PPS-based weighting of PSUs was performed separately by region, and then adjusted to reflect the national distribution of drivers by region. This was not necessary if cooperating PSUs were of similar relative size across regions, but because of the weighting for large mega-cities (e.g., New York City, Chicago, Los Angeles, Houston), having more such cooperating PSUs in one region (West) and fewer or none in another region could produce a sample more representative of the West than of the entire nation. While this was not an issue in 2007, it was a factor in 2013–2014.

Definition of “Size” for PSU Weighting

In consultation with the Insurance Institute for Highway Safety (IIHS) who established the 1996 NRS methods for weighting sites, we determined that the crash experience (annual frequency of drivers in injury crashes) of a particular geographic locale was a better reflection of driver trips than mere population. Not only was this likely to be a much better surrogate measure or indicator of trips than population, but it also provided a smaller error term for the sampling frame (see Lestina et al., 1999). Note that a PSU with more crash injuries is “bigger” than another county/city PSU with fewer crashes. Therefore, in a PPS sampling design, the subject cases in that “bigger” PSU needed to be weighted to reflect a higher probability of being in a crash than a “smaller” PSU. How much bigger (or smaller) must be determined via those crash injury totals.

The 1996 study (Voas et al, 1998) benefited from a national census of crash statistics that NASS had recently performed to revise the GES sampling. NASS had collected detailed injury crash tallies for the 1,195 geographical clusters that constituted the population of potential PSUs.³ The 1996 study used these recently collected crash statistics for their PSU weighting; however, because no recent census by county clusters had been performed in the decade after that, we obtained similar crash statistics from the States and counties for the most recent years available.

This updating of county and city crash statistics needed for PSU weighting was facilitated by State crash databases, some of which are then shared with NHTSA for the State Data System (SDS) program. Additionally, PIRE obtained other States’ crash data files for various other crash analysis projects. From those files, we identified the appropriate counts of drivers involved in known injury crashes (coded as K,A,B using the police crash report KABCO coding scheme used by all States, as defined by the American National Standards Institute) separately for many of the geographic unit or county clusters that defined our study PSUs. For the remaining PSUs in 2007 without access to their State crash files, we tracked down the statistics either from published annual reports, via direct query to State Departments of Transportation (DOTs) or State police officials or, occasionally, from those county or city police departments that had complete jurisdiction over the entire PSU. For the 2013-2014 NRS, however, the data gap was much larger and tracking down the missing information was more difficult. We could obtain access to fewer of

³ There were two more geographic units in the early 1990s than there are today.

these crash data in 2013–2014 than we could for the 2007 study, preventing this information from being as reliable a metric in 2013–2014 as it was in the past. We relied on much of the same injury crash data gathered for the 2007 study’s weighting, which were updated with a heavier reliance on a surrogate measure—namely, FARS crashes for the four most recent years available (2009–2012), to track population shifts that had taken place since 2007.⁴

Secondary Sampling Frames (within PSUs)

The ideal strategy would take a random sample of all driver trips occurring within the data collection time window. However, it is not possible to identify the geographic distribution of that population without knowing the area of each trip (the process of data collection would be impossible to implement). However, in a randomized cluster sampling scheme, similar in principle to the selection of PSUs throughout the country, we randomly selected four⁵ geographic locations within a PSU’s boundaries with equal probability of selection. For each PSU, we divided a map of the entire PSU into 30 square-mile grids, and then selected one daytime and four nighttime of those grids at random. A logistically appropriate roadway location was chosen in each of those five random grids by the Project Manager. This resulted in a sampling frame in which a specific roadway location had a probability of being selected equal to every other roadway location in the PSU boundaries. All the driver trips passing through the selected points were treated as cluster samples, and the relative probability of any driver (or driver trip) being sampled was calculated from traffic-flow counts at each site.

The information for random grid locations and traffic flow was incorporated into the case weights to reflect both the probability that any driver trip taking place within that cluster would be sampled into the data collection area; and the differential weights among clusters, based on the sheer volume of driver trips they contained (essentially, a nested level of PPS sampling within PSU). The result of this stage of served to reconstitute the estimated distribution of driving trips by day of week and time of night within a PSU, to reflect not only the relative driver-trip densities, but also the differential probabilities that any given driver could be sampled. (The count of drivers

⁴ We adjusted via extrapolation those crash totals we had used from 2005/2006 using the complete 1993 and 1995 data we obtained from NHTSA, plus the current years’ FARS totals and historic population changes from the U.S. Census for these counties for each year between 1990 to 2013.

⁵ Actually, there were a total of five: one daytime location and four nighttime locations. However, because the day sample and the night samples represent two different populations of interest, which will not be combined for any analysis, we treated them as though they were separate studies.

being sampled was defined as any eligible driver directed into the bays, including drivers who declined to participate, as well as those who did not complete the study but gave a single breath test only.)

Some situations required deviations from the sampling design. Not all randomly selected one-square-mile grid contained roads with sufficient traffic volume to make data collection worthwhile, and some contained no roads at all, such as lakes, mountains, or private property. A few were deemed unsafe by local police.

There was occasional replacement selection of random grid-square clusters. Some PSUs covered vast geographic areas but contained few roadways with sufficient traffic. The probability that a given geographic square, randomly sampled, might contain any single driver trip was equal for all driver trips (before the square's selection is known). The relative traffic density of all squares within a PSU was not known and not knowable (realistically). The traffic volume counts obtained at locations were the best measure of the effect of cluster at this level, and these drivers' differential probabilities of having been selected. Traffic volume was estimated at each location by a team member or officer using a hand-held counter to determine the number of passing vehicles.

Intended Data Collection Numbers: Oversampled and Undersampled Quotas

Once a PSU was weighted for PPS, it was assumed that the goal of 25 cases per location would be sampled so that the location would not be over- or under-represented due to chance fluctuations in data collection success (i.e., more experienced data collection teams, extreme weather conditions, an anomalous event in the neighborhood, or an unusual volume of traffic). This meant that data "blocks" within each sampling frame or nested level were to be comprised of an equal quota of eligible drivers. To the extent that any PSU had more or fewer eligible drivers sampled, the weights were adjusted to correct for over- or under-sampled quotas.

Case Weights

For each driver participating in the study, the case weight reflects the product of a joint set of probabilities, which reflect the probability that a particular driver—relative to all others who participated—would be selected for the study from among the pool of drivers in the contiguous United States. The case weight is actually an inverse of the probability of being selected, relative to all other cases.

Each of the various frames that were sampled, as previously described, required a separate calculation of probability, which then became a component of the final probability computation reflecting all the frames. The total weighted sample size (N) was identical to the total number of eligible drivers entering the bays, including drivers who declined to participate, but was adjusted to reflect the estimated distribution of those drivers in the 48 contiguous States. Error terms for the analyses were computed by STATA (2006) to account for the differential weights and the amount of variance attributable to the sampling frames.

Daytime Sample

Most of the procedures above applied to daytime data collection as well; however, with only one daytime location randomly selected from each PSU, descriptions accounting and adjusting for multiple sites/locations within a PSU do not apply.

Weights for daytime study cases were calculated separately from nighttime cases, as though the daytime portion were a quasi-separate study.

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*Appendix B: Imputing
Breath Alcohol Concentration (BrAC)*

Imputing Breath Alcohol Concentration (BrAC)

Data collectors obtained passive alcohol sensor (PAS 1) readings from 91.9% of drivers. When a driver’s alcohol concentration information was missing, a 3-stage statistical approach was used to impute (estimate) the BrAC based on data from drivers who provided breath samples.

First Stage

A logistic model was used to estimate the probability of $\text{BrAC} > 0.00 \text{ g/dL}$, given certain predictors. The variable BrAC was redefined as a binary variable (BrAC2), where:

$$\text{BrAC2} = 0 \text{ if } \text{BrAC} = 0$$

$$\text{BrAC2} = 1 \text{ if } \text{BrAC} > 0$$

Table 1. List of Predictors

Covariate	Levels
PAS 1 reading	0 through 8
Session	0 through 4
Level of intoxication observed by data collector	1 = No alcohol or drugs 2 = Some alcohol or drug signs 3 = Alcohol and/or drugs and intoxication
Driver’s age	1 = under 22 years 2 = 22-29 years 3 = 30-37 years 4 = 38-45 years 5 = 46-53 years 6 = 54-61 years 7 = 62 years and over
Driver’s race	1 = White/European American 2 = Black/African American 3 = Asian/Asian American 4 = Other
Driver’s sex	1 = Male 2 = Female

Session refers to the data collection session: Friday daytime (session 0), Friday 10 p.m. to 12 am (session 1), Friday 1 a.m. to 3 a.m. (session 2), Saturday 10 p.m. to 12 am (session 3), or Saturday 1 a.m. to 3 a.m. (session 4). The data collector's estimation of the driver's level of intoxication, age, race, and sex were the other explanatory variables in the model. There may have been missing values in some of these variables. Due to protocol changes during the study, BrAC imputation was only calculated from the first 49 sites.

Second Stage

From the probability of a positive BrAC: $P(\text{BrAC} > 0.00) = p$ in the first stage, there was a receiver operating characteristic (ROC¹) approach to establish $\xi^2 = .787$, a threshold value chosen for predicting BrAC = .00 g/dL. Thus, a BrAC = .00 g/dL value was assumed each time $p < \xi$, and at that point the imputation was complete. For all other cases in which $p \geq \xi$, a BrAC > .00 g/dL was assumed, the third stage of imputation was conducted.

Third Stage

This stage imputed values for those cases with missing BrAC values with $p \geq \xi$. These cases were assumed to have a positive BAC. Linear regression models were used for such imputation. The same variables entered as in the first stage were used, with the addition of the predicted probability obtained at the end of that stage. To correct for lack of a normal distribution among cases where $p \geq \xi$ and improve the model's goodness of fit, the response variable was transformed (Log_{10} transformation). The imputed BrAC was equal to $g(\text{BrAC})$ transformed back to its original scale.

¹ A ROC curve is a commonly accepted statistical tool which plots a false positive rate versus a true positive rate while the sensitivity (or threshold - ξ) is varied to accommodate a range of cut-off parameters.

² ξ (or lower case ksi) is a Greek symbol frequently used to denote a threshold such as the one we use in the ROC curve.



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