PB2002-102279

FARS
Fatality Analysis Reporting System

NMFS
National Mortality Followback Study

Determination of Characteristics of Fatally Injured Drivers

NSDDAB
The National Survey of Drinking and Driving Attitudes and Behavior

NRS
National Roadside Survey

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

Johns Hopkins School of Public Health

NHTSA
People Saving People
www.nhtsa.dot.gov

REPRODUCED BY: NTIS
U.S. Department of Commerce
National Technical Information Service
Springfield, Virginia 22161

1. Report No. DOT HS 809 380	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Determination of Characteristics of Fatally Injured Drivers		5. Report Date 6. Performing Organization Code n/a
7. Author(s) Susan P. Baker, M.P.H. and Li-Hui Chen, Ph.D.		8. Performing Organization Report No n/a
9. Performing Organization Name and Address Johns Hopkins School of Public Health Center for Injury Research and Policy 614 N. Broadway, Baltimore MD 21205		10. Work Unit No. 11. Contract or Grant No. DTNH22-97-H-05278
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration 400 7th St., SW, Washington DC 20590		13. Type of Report and Period Covered NHTSA Final Technical Report 14. Sponsoring Agency Code

15. Supplementary Notes
Paul J. Tremont, Ph.D., is the Contracting Officer's Technical Representative (COTR) for this project

16. Abstract

Objective: To identify driver characteristics that can be used to predict driver risk of fatal crashes.

Methods: The study had three components: (1) Comparisons were made among drivers who were killed in single-vehicle crashes or were at fault or not at fault in multi-vehicle crashes using 1,115 drivers in the 1993 National Mortality Followback Survey linked with drivers in FARS ("NMFS-FARS" cases). (2) NMFS-FARS drivers killed on Friday/Saturday nights from 10 PM to 3 AM were compared with drivers in the 1996 National Roadside Survey. (3) NMFS-FARS drivers were compared with telephone respondents to the 1993 National Survey of Drinking and Driving Attitudes and Behavior.

Results: Controlling for other risk factors: (1) The risk of being killed in a single-vehicle crash is about three times as great for drivers who either drink and drive at least weekly or typically drink 5 or more drinks per occasion, and 4 times as great for those who used illicit drugs. (2) Based on comparisons with roadside surveys from 10 PM to 3 AM on Friday and Saturday nights, drivers with BACs of 0.10% or higher are 64 times (CI=33.6-122.8) as likely as drivers with BACs of 0 to 0.04% to be in a crash in which they are killed; drivers who do not use lap or shoulder belts are about 13 times as likely to be in a fatal crash as drivers who wear both lap and shoulder belts. (3) Based on the telephone survey: the likelihood of becoming a fatally injured driver is about 3 times as great for people who drink and drive at least weekly or have 5+ drinks per occasion; among drivers ages 30-64, the likelihood of driver fatality is 4.5 times as great for those with a CAGE score of 2 or higher (indicative of alcohol dependence) compared with those with a CAGE less than 2. Alcohol-related risk factors were more important than demographic factors in predicting driver involvement in fatal crashes.

Conclusions: When other factors are controlled for, alcohol and seat belt use are the strongest predictors of drivers' risk of involvement in crashes in which they are killed.

17. Key Words: risk factors, drivers, fatal crash, drinking behavior, alcohol, seat belt, NMFS, FARS, NRS, NSDDAB	18. Distribution Statement		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. Pages	22. Price

TABLE OF CONTENTS

EXECUTIVE SUMMARY V

I. INTRODUCTION 1

II. BACKGROUND 2

A. OVERVIEW OF RISK FACTORS 2
B. DEMOGRAPHIC RISK FACTORS 3
1. Age 3
2. Gender 3
3. Race/ethnicity 4
C. BEHAVIOR AND ENVIRONMENTAL FACTORS 4
1. Use of alcohol 4
2. Seatbelt use 5
3. Nighttime 5

III. METHODS 5

A. DATA SOURCES 5
1. National Mortality Followback Survey (NMFS) 5
2. Fatality Analysis Reporting System (FARS) 5
3. NMFS-FARS matched file (NMFS-FARS) 6
4. National Roadside Survey of 1996 (NRS) 6
5. National Survey of Drinking and Driving Attitudes and Behavior of 1993 (NSDDAB) 6
B. STUDY DESIGN 6
1. NMFS-FARS Single-vehicle drivers and multi-vehicle and at-fault vs. not-at-fault drivers 6
2. NMFS-FARS vs. NRS Fatally injured vs. roadside survey drivers 6
3. NMFS-FARS vs. NSDDAB Fatally injured vs. telephone survey drivers 6
C. ANALYTICAL METHODS 7
1. Cross tabulations 7
2. Logistic regression 7
3. Variable definitions 7

IV. RESULTS 8

A. NMFS-FARS *SINGLE-VEHICLE DRIVERS AND MULTI-VEHICLE AND AT-FAULT VS. NOT-AT-FAULT DRIVERS* 8
1. Cross tabulation results 8
2. Logistic regression results 11
B. NMFS-FARS VS. NRS *FATALLY INJURED VS. ROADSIDE SURVEY DRIVERS* 13
1. Cross tabulation results 13
2. Logistic regression results 15
C. NMFS-FARS VS. NSDDAB *FATALLY INJURED VS. TELEPHONE SURVEY DRIVERS* 16
1. Cross tabulation results 16
2. Logistic regression results 18

V. SUMMARY AND DISCUSSION 20

VI. CONCLUSIONS 24

VII. REFERENCES 25

APPENDIX A. DRIVER-LEVEL FACTORS 28

APPENDIX B. TABLES 29

LIST OF TABLES

TABLE 1. EXAMPLES OF FACTORS IN MOTOR VEHICLE-RELATED INJURIES 3

TABLE 2. LOGISTIC REGRESSION MODEL: FATALLY INJURED VS. NOT-AT-FAULT DRIVERS ... 12

TABLE 3. LOGISTIC REGRESSION MODEL: FATALLY INJURED DRIVERS VS. ROADSIDE SURVEY 15

TABLE 4. LOGISTIC REGRESSION MODEL: FATALLY INJURED DRIVERS VS. NSDDAB TELEPHONE SURVEY 19

TABLE 5. MAJOR DETERMINANTS OF DRIVER FATALITIES RANKED BY ODDS RATIOS 23

APPENDIX B, TABLE 1. FATALLY INJURED SINGLE-VEHICLE AND AT-FAULT VS. NOT-AT-FAULT DRIVERS 29

APPENDIX B, TABLE 2. NATIONAL ROADSIDE SURVEY VS. FATALLY INJURED DRIVERS, 10 PM-3 AM FRIDAY AND SATURDAY NIGHTS 33

APPENDIX B, TABLE 3. FATALLY INJURED DRIVERS VS. NSDDAB TELEPHONE SURVEY 35

LIST OF FIGURES

FIGURE 1. USUAL QUANTITY OF ALCOHOL CONSUMED BY FATALLY INJURED DRIVERS BY TYPE OF CRASH 9

FIGURE 2. PERCENT OF DRIVERS WHO WERE EVER PROBLEM DRINKERS BY TYPE OF CRASH 9

FIGURE 3. PERCENT OF DRIVERS WITH PROBLEM DRIVING BEHAVIORS BY TYPE OF CRASH 10

FIGURE 4. PERCENT OF DRIVERS WHO USED ILLICIT DRUGS IN LAST YEAR OF LIFE BY TYPE OF CRASH 11

FIGURE 5. PERCENT OF DRIVERS IN EACH RACIAL GROUP, FATALLY INJURED VS. ROADSIDE SURVEY DRIVERS, FRIDAY AND SATURDAY NIGHTS 13

FIGURE 6. PERCENT OF DRIVERS WITH EACH BLOOD ALCOHOL CONCENTRATION, FATALLY INJURED VS. ROADSIDE SURVEY DRIVERS, FRIDAY AND SATURDAY NIGHTS 14

FIGURE 7. PERCENT OF DRIVERS USING SEAT BELTS, FATALLY INJURED VS. ROADSIDE SURVEY DRIVERS, FRIDAY AND SATURDAY NIGHTS 14

FIGURE 8. PERCENT OF DRIVERS IN EACH MILEAGE GROUP, FATALLY INJURED VS. TELEPHONE SURVEY DRIVERS, AGE 16-29 17

FIGURE 9. PERECENT OF DRIVERS IN EACH RACIAL GROUP, FATALLY INJURED VS. TELEPHONE SURVEY DRIVERS, AGE 30-64 17

FIGURE 10. PERECENT OF DRIVERS IN EACH CAGE SCORE GROUP, FATALLY INJURED VS. TELEPHONE SURVEY DRIVERS, AGE 30-64 18

FIGURE 11. ODDS OF BEING A FATALLY INJURED OR AT-FAULT DRIVER IN RELATION TO BAC 21

PROTECTED UNDER INTERNATIONAL COPYRIGHT
ALL RIGHTS RESERVED
NATIONAL TECHNICAL INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE

Reproduced from
best available copy.

EXECUTIVE SUMMARY

BACKGROUND Motor vehicle-related injury has long been recognized as a major health problem, and the important contribution of alcohol to deaths and injuries in motor vehicle crashes is well known. However, analyses that link the circumstances of fatal crashes with information on the background and previous behavior of the drivers in those crashes are not available. Moreover, analyses have been lacking that, by controlling for demographic factors and drinking practices, make it possible to isolate and quantify the effect of each specific factor. This report fills some of these gaps using analyses of national-level data.

Despite extensive prior research based on the Fatality Analysis Reporting System (FARS), there has been little use of the wealth of information available in the National Mortality Followback Survey, the National Roadside Survey, and the National Survey of Drinking and Driving Attitudes and Behavior. To help remedy this deficit, the National Highway Traffic Safety Administration (NHTSA) provided the investigators with a linked database in which background ("followback") information from next-of-kin of drivers killed in crashes was combined with information on the same drivers and crashes, available FARS. The availability of data from all of these sources provided an opportunity to perform three sets of analyses in relation to FARS data.

OBJECTIVE The objective of this research was to shed light on the characteristics of drivers involved in fatal crashes and to identify driver characteristics that can help to predict the risk of involvement in fatal crashes.

METHOD The three basic analyses that comprise the study are as follows:

A. Information from next-of-kin on 1,115 drivers in the 1993 National Mortality Followback Survey (NMFS), who had been linked with drivers in FARS ("NMFS-FARS cases"), was analyzed: 1) to compare the characteristics of drivers killed in single-vehicle crashes with not-at-fault drivers killed in multi-vehicle crashes, in order to identify and quantify risk factors for being killed in single-vehicle crashes, and 2) to compare at-fault with not-at-fault drivers killed in multi-vehicle crashes, in order to identify and quantify risk factors for being at fault. (Note: Drivers killed through no fault of their own are generally considered to be representative of drivers who were on the road at corresponding times and places.)

B. Information provided by 5,894 drivers in the 1996 National Roadside Survey (NRS), who had been stopped at roadside check points between 10 PM and 3 AM on Friday and Saturday nights, was compared with information on 83 drivers in the linked NMFS-FARS file who were killed during the same hours. Because the NRS drivers were considered to be representative of non-crash drivers, these analyses identified and quantified risk factors for involvement in fatal crashes when driving on Friday and Saturday nights.

C. Data on 962 drivers ages 16-64 in the linked NMFS-FARS file were analyzed in relation to comparable data for 3,370 drivers interviewed by telephone in the 1993 National Survey of Drinking and Driving Attitudes and Behavior (NSDDAB), to further identify and quantify risk factors for involvement in fatal crashes. Drivers were divided into two groups, ages16-29 and 30-64.

MAJOR FINDINGS

A. Analyses limited to fatally injured drivers in the NMFS-FARS data base showed that when all factors are controlled for, the risk of being killed in a single-vehicle crash (compared with being killed in a multi-vehicle crash in which one is not at fault) is:

-

- almost 3 times as great for drivers who drink and drive weekly, compared with those who do not drink and drive,
- 3 times as great for drivers who usually have five or more drinks per occasion, compared with those who do not drink,
- 4 times as great for those who used illicit drugs compared with those who did not, and
- more than twice as great for drivers who had a history of problem driving, compared with those drivers who did not.

B. Comparisons with roadside survey data revealed that on Friday and Saturday nights, the likelihood of becoming a fatally injured driver is:

- 64 times as high if a driver has a BAC of 0.10% or higher, compared with drivers with BACs of zero to 0.04%,
- 13 times as high if a driver uses neither lap nor shoulder belts, compared with drivers who use both,
- 5 times as high for whites as for blacks,
- Almost 5 times as high for drivers with less than a high school education, compared with those with more than a high school education, and
- Almost 5 times as high for drivers living in the South or West, compared with drivers living in the Northeast.

C. Comparisons with responses to the telephone survey indicate that drivers ages 30-64 are 4.5 times as likely to be fatally injured if they are alcohol dependent. For the average driver age 16-64, the likelihood of becoming a fatally injured driver is:

- More than three times as great if they have five or more drinks per occasion at least weekly, compared with those who do so less than once a week,
- About three times as great for those who drink and drive at least once a week, compared with those who do so less than once a week,
- Twice as great for males as for females,
- Twice as great for Hispanics as for non-Hispanic whites, and
- Twice as great for those who lack education beyond high school compared with those having more than a high school education.

Results of the three components of this research consistently indicate that the primary predictor of drivers' involvement in crashes in which they are killed is alcohol, reflected in either BAC at death or a history of alcohol consumption and drinking practices. This is true even after adjusting for demographic and other important factors in the logistic regression analyses. Histories of

alcohol consumption, alcohol dependence, and drinking and driving practices were not determined for roadside survey respondents and therefore their relative importance could not be measured for that component of the study.

CONCLUSIONS A driver's drinking practices are highly predictive of involvement in a fatal crash. Major risk factors are having a BAC of 0.10% or higher, drinking and driving at least once a week, usually drinking 5 or more drinks per occasion, and being alcohol dependent. Any one of these factors increases a driver's risk of a fatal crash three-fold or more, and on Friday and Saturday nights having a BAC of 0.10% or higher may increase the risk more than 60-fold. The strength of these findings underscores the need to intensify efforts to identify and influence drivers whose drinking practices place themselves and others at substantial risk of death or serious injury.

The demographic characteristics most predictive of a driver's being killed in a crash are male gender, Hispanic ethnicity, residing in the South or West, and having only a high school education or less. Targeting these groups with a variety of injury prevention strategies, including any proven behavioral-change interventions related to drinking habits, is indicated.

On Friday and Saturday nights, an unrestrained driver has a 13-fold risk of being killed in a crash compared with drivers restrained with lap and shoulder belts. This finding, if adequately publicized, has the potential to increase seat belt use among high-risk people. Greater enforcement of seat belt use laws can also be expected to reduce deaths.

I. INTRODUCTION

Motor vehicle-related injury has long been recognized as a major public health problem. Crashes of motor vehicles are the leading cause of death in the United States for people ages 1-34, among whom more than one-fifth (23%) of deaths from all causes are caused by motor vehicle crashes (CDC 2001). According to the U.S. Department of Transportation, the total societal costs of crashes exceeded $150 billion in 1994 (NHTSA 1999). Although the death rates are slowly decreasing each year, there is still a huge burden on society: 41,611 people died in motor vehicle crashes in 1999.

To date, however, comprehensive analyses of data that link the circumstances of fatal crashes with detailed information on the background and previous behavior of the drivers in those crashes have been lacking. Moreover, analyses have been lacking that, by controlling for demographic factors and drinking practices, make it possible to isolate and quantify the effect of each specific factor. This report fills some of those gaps using analyses of national-level data.

Despite extensive prior research based on the Fatality Analysis Reporting System, little use has been made of the wealth of information available in three other data bases: the National Mortality Followback Survey, the National Roadside Survey, and the National Survey of Drinking and Driving Attitudes and Behavior. To help remedy this deficit, the National Highway Traffic Safety Administration (NHTSA) provided the investigators with a linked database in which background ("followback") information from next-of-kin of drivers killed in crashes was combined with information on the same drivers and crashes, available from the Fatality Analysis Reporting System (FARS). The availability of data from all of these NHTSA sources provided an opportunity to perform three sets of analyses in relation to FARS data.

The National Mortality Followback Survey (NMFS) provides historical data on the deceased drivers obtained from next-of-kin. The 1996 National Roadside Survey (NRS) contains responses of drivers stopped at checkpoints from 10 PM to 3 AM on Friday and Saturday nights. The 1993 National Survey of Drinking and Driving Attitudes and Behavior (NSDDAB) contains telephone responses from people who said they were or had been drivers. These data bases are described in the Methods section. The three components of the study are as follows:

1. Information on 1,115 drivers in the 1993 National Mortality Followback Survey, who had been successfully linked with drivers in FARS (NMFS-FARS cases), was analyzed to compare the characteristics of drivers killed in single-vehicle crashes with not-at-fault drivers killed in multi-vehicle crashes, and also to compare at-fault and not-at-fault drivers killed in multi-vehicle crashes. The assumption is that not-at-fault drivers are representative of drivers on the road at the times and places of fatal crashes.

2. Data on the NMFS-FARS drivers were analyzed in relation to comparable information provided by drivers who had been stopped at roadside check points, to identify risk factors for

involvement in fatal crashes. Roadside survey drivers were assumed to be representative of drivers on the road from 10 PM to 3 AM on Friday and Saturday nights, the times when the NRS survey was conducted. This portion of the research included all NMFS-FARS drivers who were killed during those same periods.

3. Data on the NMFS-FARS drivers were analyzed in relation to comparable data from the 1993 National Survey of Drinking and Driving Attitudes and Behavior (NSDDAB), a telephone survey. Drinking and driving behavioral data available from both sources made it possible to determine predictors of fatal crash involvement. Telephone survey drivers were considered to be representative of U.S. drivers. The objective was to shed light on the characteristics of drivers involved in fatal crashes and to identify driver characteristics that can help to predict the risk of drivers being involved in fatal crashes. In each component of the study, we addressed the following questions:

> What groups of drivers are at high risk (based on drivers' prior behavior and gender, race, education level, and annual miles driven) for being at fault in multi-vehicle crashes or being involved in single-vehicle crashes in which they died?
>
> What groups of drivers are at high risk of being killed in crashes, based on drinking behavior, including binge drinking (5 or more drinks on one occasion), problem drinking, drinking and driving (measured by questionnaire or Blood Alcohol Concentration), and seat belt use (measured by questionnaire or observation)?
>
> Will the relationships found above exist after controlling for drivers' gender, race, education level, and annual miles driven?

II. BACKGROUND

A. Overview of risk factors

The study examined driver characteristics (risk factors) that place them at special risk of becoming a fatally injured driver, either by increasing the likelihood that they will be in a crash or by increasing the likelihood that they will die if they are in a crash. About 30 possible contributing factors (independent or predictor variables) were examined to identify the most important factors.

The Haddon matrix (Table 1) is a model commonly used to analyze possible risk factors for injuries. It divides risk factors into three phases: "pre-crash" (contributing to the likelihood that a crash will occur), "crash" (influencing the likelihood of injury when a crash occurs), or "post-crash" (influencing the likelihood of survival after a person incurs an injury) (Haddon 1968). Since the main purpose of this study is to identify characteristics of fatally injured drivers that can be used to make predictions about who is likely to be involved in a fatal crash, human factors will be the focus of the study and emphasis will be on the precrash phase. Seat belt use, a crash phase human factor, is also analyzed. The postcrash phase is not relevant to this study.

TABLE 1. EXAMPLES OF FACTORS IN MOTOR VEHICLE-RELATED INJURIES

Phase	Human	Vehicle	Environment	
			Physical	Cultural & Social
Pre-crash	Age Gender Race/Ethnicity Education Experience Alcohol use Carrying passengers Speeding Other risk-taking behaviors Amount of travel	Brakes, tires Center of gravity Jackknife tendency Ease of control Load weight Speed capability Older cars	Nighttime Weather Visibility of hazards Road curvature and gradient Surface coefficient of friction Divided highways, one-way streets Intersections, access control Signing	Laws related to alcohol use Curfew laws Speed limits Licensing laws Law enforcement Cultural influences Economic factors
Crash	Seat belt use Choice of speed	Speed at impact Vehicle size Air bags Ejection factors Rollover tendency Older cars	Recovery area Characteristics of fixed objects Median barriers Road embankment	Speed limits Laws related to safety belt use Law enforcement
Post-crash	Age Pre-existing conditions	Fuel system integrity	Emergency communication and transport system Distance to and quality of medical services Rehabilitation programs	Support for trauma care systems Training of EMS Personnel

Source: Based on Haddon (1968) and in part on Baker (1992).

B. Demographic risk factors

Three major demographic risk factors, age, gender, and race, are discussed in this section.

1. Age

Motor vehicle death rates vary greatly by age, with the highest peak in population-based death rates during the late teenage years and early twenties. After that, death rates decline, then increase again after about age 65 (Baker et al., 1992). Similar patterns are found for mileage-based rates; teenagers have the highest rates of fatal motor vehicle crashes per million miles, followed by drivers 75 years and older (Li et al., 1998). Death rates per 10,000 licensed drivers rise sharply at age 70 and older (IIHS, 2000).

2. Gender

Males have a higher risk than females for involvement in fatal crashes, whether based on population, licensed drivers or mileage driven (Li et al., 1995, 1998; Williams, 1985a; Williams, 1995a; Laberge-Nadeau et al., 1992; Shope et al., 1996). The ratio of male to female death rates is 2.8 to 1 for all ages combined and almost 4 to 1 for ages 20-29 (Baker et al., 1992). Males are also more likely to have been responsible for crashes that are fatal (Williams and Karpf, 1984). The differences between males and females in fatal crashes reflect differences in both exposure (miles driven) and crash severity. The higher exposure-based fatal crash rates for males appear to reflect the fact that crashes of male drivers are more severe and therefore more likely to be

fatal than crashes of female drivers (Li et al., 1998).

3. Race/ethnicity

Death rates from motor vehicle crashes also vary markedly by race. Native Americans have the highest death rates from all types of motor vehicle crashes combined, 42 per 100,000 population. This compares with rates of 20 for whites, 17 for blacks, and 11 for Asians (Baker et al., 1992). Lower rates of seat belt and child restraint use among Hispanic children and teenagers than among non-Hispanic whites have been reported (Matteucci et al., 1995; Niemcryk et al., 1997; USDHHS, 1994). Low rates of restraint use have also been reported for black children and teenagers (Baker et al., 1998), and for fatally injured black drivers but not Hispanics (Braver, 2001). Racial differences in death rates might also be influenced by alcohol use. The 1996 National Roadside Breath Alcohol Survey found that 7.5% of Hispanic drivers, 3.6% of black drivers, and 2.3% of white drivers had high blood alcohol concentrations (Voas et al., 1998). (When comparisons in this report include Hispanics, 'white' includes only non-Hispanic whites and 'black' includes only non-Hispanic blacks.)

Differences in educational level appear to explain much of the racial difference in occupant death rates (Braver, 2001).

C. Behavior and environmental factors

Three major behavioral and environmental risk factors, use of alcohol, seatbelt use, and nighttime, are discussed in this section.

1. Use of alcohol

As with the above demographic factors, alcohol use is a pre-crash human factor that can determine the likelihood of a crash. Use of alcohol is a very important risk factor for motor vehicle crashes. In 1993, 31%, 59%, and 55% of drivers ages 16-19, 20-24, and 25-49, respectively, who were involved in fatal crashes had a blood alcohol concentration (BAC) higher than 0.01% (Williams, 1995). Other variables interact with alcohol to affect crash risks. One review found that in fatal crashes, male drivers in the 21-34 year age group and drivers of the white race are more likely to be alcohol-impaired than other drivers (Jones and Lacey, 1998). Increasingly, females are involved in alcohol crashes at rates closer to male rates.

There is a clear relationship between BACs and motor vehicle-related injuries: alcohol impairs driving skills even at very low BACs; the impairment effect increases rapidly with higher BACs. One report (Moskowitz and Fiorentino 2000) reviewed 112 articles of various domains, including cognitive tasks, divided attention, visual functions, etc., and concluded that drivers can be expected to experience impairment in some driving-related skills at or before reaching a BAC of 0.08%; specific performance skills are differentially affected by alcohol. Some skills are significantly impaired by BACs of 0.01%, while others do not show impairment until BACs of 0.06%. A recent study found that for every 0.02% increase in BAC, the relative risk for motor vehicle driver fatality was estimated to increase by more than 2.0 for males ages 16-20, and more than 1.6 for male drivers ages 21 or older and female drivers (Zador et al., 1999).

While the relationship between drinking behavior and motor vehicle-related *nonfatal* injuries is less-studied, some studies suggest a relationship. One cohort study based on U.S. Army data found that heavy drinking almost doubled the risk of motor vehicle-related hospitalization (Bell et. al. 2000). A case-control study found that prior arrests for drunk driving were associated with

an increased risk of dying in an alcohol-related crash (Brewer et al., 1994). Holubowycz and McLean (1994) found that as the BAC of injured male drivers increased, there was a significant increase in quantity and frequency of drinking, and in driving after drinking.

2. Seatbelt use

Seat belt use is a crash phase human factor. When a crash occurs, the risk of death is reduced by about 42 percent when both lap and shoulder belts are worn correctly (Viano, 1995). However, a recent survey of Americans indicated that only 67% reported always using seat belts, the lowest rate in the four countries surveyed (Australia, Canada, England, and United States) (IIHS, 1999).

There is a relationship between the two variables, seat belt use and intoxication. Drinking drivers are less likely to wear seat belts than the general population. One study that collected data on nighttime drivers in Minnesota found that for male drivers with BACs less than 0.10%, the odds ratio for seat belt use was 2.6, meaning they were 2.6 times as likely to be wearing a seat belt as those with BACs of 0.10% or higher (Foss et al., 1994). However, the authors found no association between seatbelt use and alcohol among female drivers.

3. Nighttime

Nighttime driving (a pre-crash environmental factor) is associated with greater risk than daytime driving in all age groups and especially for teenage males. The nighttime fatal crash involvement rate for males ages 16-19 is more than four times the daytime fatal involvement rates for males 16-19, and almost three times the nighttime rate for all ages combined. The rate difference between nighttime and daytime driving is less for female teenage drivers. Injury crash involvement rates follow the same pattern as fatal crash involvement rates, but the difference between nighttime and daytime is much smaller for nonfatal injury (Massie et al., 1995).

III. METHODS

A. Data sources

Data for this study were from four federal sources: the 1993 National Mortality Followback Survey (NMFS), the 1993 Fatality Analysis Reporting System (FARS), the 1996 National Roadside Survey (NRS), and the 1993 National Survey of Drinking and Driving Attitudes and Behavior (NSDDAB).

1. National Mortality Followback Survey (NMFS)

A total of 22,957 death certificates representing 2,215,000 adults ages 15 or older who died in 1993 in the United States, excluding South Dakota, were included in the 1993 NMFS, based on a stratified random sampling strategy. Information on decedents was obtained by mailed questionnaire, telephone, or personal interview from the informants named on the death certificates; the overall response rate was 83%. Data on use of alcohol, motor vehicle and driving behavior, problem behaviors, and demographic characteristics of the decedents were obtained from NMFS.

2. Fatality Analysis Reporting System (FARS)

FARS collects data on all fatal traffic crashes within the United States that involve a motor vehicle traveling on a public road and result in a death within 30 days of the crash. Data on blood alcohol concentration (BAC), previous history of driving under the influence, time of crash and type of vehicle were obtained from FARS.

3. NMFS-FARS matched file (NMFS-FARS)
A linked file with 1,456 matched de-identified cases from NMFS and FARS was provided by NHTSA. Of the 1,456 cases, 335 were not coded as drivers in FARS and were excluded from analysis; most of the excluded cases were pedestrians (it is possible that some of the 335 were drivers who were struck when they were outside their vehicles and therefore were coded as pedestrians by police). The remaining 1,121 drivers were analyzed in the study. The matched drivers have been compared to all drivers in FARS and found to be representative. (Baker, 1999).

4. National Roadside Survey of 1996 (NRS)
Conducted in the 48 contiguous states, the 1996 NRS collected data between 10 PM and 3 AM on Friday and Saturday nights. Drivers were selected for interviews and breath tests using a geographically stratified multi-stage cluster sample. Data on BAC, seat belt use, number of passengers, type of vehicle, and demographic characteristics of surveyed drivers were obtained from NRS.

5. National Survey of Drinking and Driving Attitudes and Behavior of 1993 (NSDDAB)
Using a multi-stage sampling design, the 1993 NSDDAB (NHTSA 1994) collected data on people ages 16 or older living in non-institutionalized dwellings with working telephones in the U.S. One eligible respondent was interviewed by telephone for each sampled household. Data on drinking and driving behaviors, seatbelt use, driving exposure and demographic and socio-economic variables were obtained from this source.

B. Study design

1. NMFS-FARS Single-vehicle drivers and multi-vehicle and at-fault vs. not-at-fault drivers
The fatally injured drivers from NMFS-FARS were divided into three responsibility groups: drivers in single-vehicle crashes, drivers who were at fault in multi-vehicle crashes, and drivers not at fault in multi-vehicle crashes. "At fault" was defined as having one or more driver-level factors assigned by the police, based on codes 20-59 in FARS (see Appendix A). Drivers who were involved in single-vehicle crashes or at fault in multi-vehicle crashes were compared with drivers not-at-fault. Demographic variables, drinking practices, driving behaviors, problem behaviors, and cognitive functioning in the decedent's last year of life were analyzed for each of the 3 responsibility groups.

2. NMFS-FARS vs. NRS Fatally injured vs. roadside survey drivers
The fatally injured drivers from NMFS-FARS were compared with roadside survey drivers from NRS for variables common to both databases. The analyses were limited to drivers killed between 10 PM-3 AM on Friday and Saturday nights, when the survey was administered. The variables analyzed included demographic variables (such as age, gender, race/ethnicity, educational level, geographic region), blood alcohol (BAC) on police report (NMFS-FARS drivers) or at the time of interview (NRS drivers), seat belt use, number of passengers, type of vehicle, and trip destination.

3. NMFS-FARS vs. NSDDAB Fatally injured vs. telephone survey drivers
The fatally injured drivers from NMFS-FARS were compared with respondents surveyed in the 1993 NSDDAB who reported that they had ever driven. Variables common to both databases were analyzed. Demographic variables (gender, race/ethnicity, educational level), seatbelt use, driving exposure and drinking and driving behaviors were compared between the two groups.

Drivers were divided into two age groups, 16-29 and 30-64. The two age groups were analyzed separately because the NSDDAB over-sampled people age 16-29 in order to get large enough numbers in this age group. Although each of the two age groups sampled would be representative of that age group in the population, combining the two samples would produce a single sample that might not be representative of the entire population age 16-64.

C. Analytical methods

Variables in NMFS-FARS, NRS, and NSDDAB were reviewed to determine which variables would be used for analysis, based upon their importance and consistency across the data sets, and then were reconstructed in order to have cells with sufficient numbers of cases.

1. Cross tabulations

Cross tabulations were prepared to analyze each of the variables in relation to driver responsibility or being killed in a crash. The number of individuals and percent distribution in each driver category were presented for each variable. (For example, for drivers who were killed in multi-vehicle crashes and not at fault, 67% were male and 33% were female.) Chi-square tests were used to determine whether the percent distribution of any variable under investigation was significantly different among groups of drivers examined.

2. Logistic regression

Logistic regression was used to further determine the relationship. Logistic regression is a technique that allows us to consider a number of variables at the same time in order to determine the effect of each one while controlling for the others. It is used to explore the relationships between independent (predictor) variables, such as drinking and driving, age and gender of drivers, etc., and outcome variables, such as driver fatality. When a variable measured essentially the same thing as other variables, it was omitted from the regression analysis. For example, the variable 'drinking level,' which was a combination of drinking quantity and frequency, was omitted from analyses that included quantity and frequency as separate variables. Odds ratios (ORs) of being in single-vehicle crashes, at-fault multi-vehicle crashes, or killed in crashes were estimated using logistic regression. (Odds ratios indicate the likelihood of an event occurring given a certain condition, compared with another condition. An odds ratio of 1 would mean that there is no difference between the groups being compared.) The 95% confidence intervals were calculated; these indicate the range within which the true odds ratios would be found 95% of the time. SPSS was used for the analyses.

3. Variable definitions

Drinking level was determined by combinations of drinking quantity and frequency. A "heavier drinker" was defined as a person who drank 14 or more drinks per week; a "moderate drinker" as one who drank 4 to 13 drinks per week; a "light drinker" as one who drank up to 3 drinks per week; an infrequent drinker" as one who drank less than once a month, and a "non-drinker" as one who did not drink at all (Li et al. 1994, Stinson et al, 1990).

CAGE scores were calculated from the 4 CAGE questions: whether the decedent had ever felt he/she should **C**ut down on drinking, been **A**nnoyed by criticism, felt **G**uilty about drinking, or had an "**E**yeopener" drink first thing in the morning. Each positive response adds 1 to the score. A CAGE of 2 or more is considered an indication of alcohol abuse or dependency (Ewing, 1984).

Questions related to problem driving behaviors, other problem behaviors, depression, and attitudes toward aggressive behavior were summarized into 4 scores. The scores, developed by the authors on the basis of face validity, reflected the severity and frequency of a given behavior. Questions referred to the last year of life.

A problem driving behavior score was the sum of the following: 1 point for driving faster than other drivers; 1 point each for answering often/sometimes to questions about cutting in front of other cars, driving 10+ mph over the speed limit, making illegal U-turns, tailgating, driving through red lights, driving through stop signs, switching back and forth quickly between lanes. Questions referred to the last year of life.

A problem behavior score, based on the last month of life, was the sum of the following: 1 point for answering often/sometimes for temper tantrums; 1 point each for answering rarely/often/sometimes to questions about violent threats or attempts, property destruction, community complaints, bizarre behavior.

A depression score, based on the last month of life, was the sum of the following: 2 points each for talking about taking one's own life; often/sometimes crying for long periods; often wishing to die; and 1 point each for often/sometimes feeling worthless, often/sometimes having sleep problems; rarely crying for long periods; sometimes/rarely wishing to die; gaining or losing weight.

An attitude toward aggressive behavior score was the sum of the following: 1 point each for answering not wrong/a little bit wrong for the following: fighting, damaging property, using insulting language.

IV. RESULTS

A. NMFS-FARS *Single-vehicle drivers and multi-vehicle and at-fault vs. not-at-fault drivers*

There were 1,121 drivers from the 1993 National Mortality Followback Survey successfully linked with drivers in the Fatality Analysis Reporting System. Six of the 1,121 drivers were excluded from the study because there was no information to indicate their at-fault status. Of the remaining 1,115 drivers, 189 (17%) were assigned as not-at-fault in multi-vehicle crashes, 384 (34%) as at fault in multi-vehicle crashes, and 542 (49%) were in single-vehicle crashes.

1. Cross tabulation results

Appendix B, Table 1 provides the numbers and percentages for each variable analyzed.

Drivers involved in single-vehicle crashes were younger, more likely to be male, less likely ever to have been married, and had less education than either at-fault or not-at-fault drivers involved in multi-vehicle crashes. No significant differences among the three groups of drivers were observed for region of residence, employment status, or reported cognitive functioning.

The three groups of drivers (in single-vehicle and at-fault or not-at-fault multi vehicle crashes) differed significantly in their drinking practices. Fifty-one percent of the drivers killed in single-vehicle crashes drank at least once a week compared with 31% of drivers at fault in multi-vehicle crashes and 22% of drivers not at fault in multi-vehicle crashes. A similar pattern was observed

for their drinking quantity: 28% of drivers in single-vehicle crashes usually had 5 or more drinks per occasion compared with 11% and 6% in the other two groups (Figure 1). Drivers killed in single-vehicle crashes were also more likely to be considered by their next-of-kin to have been problem drinkers at some time in their lives (25% compared with 10% and 7% for each of the

FIGURE 1. USUAL QUANTITY OF ALCOHOL CONSUMED BY FATALLY INJURED DRIVERS BY TYPE OF CRASH

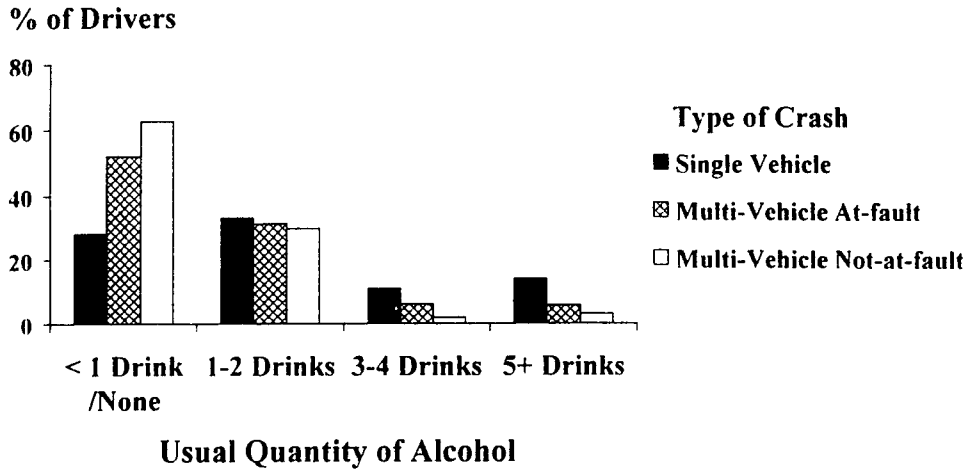
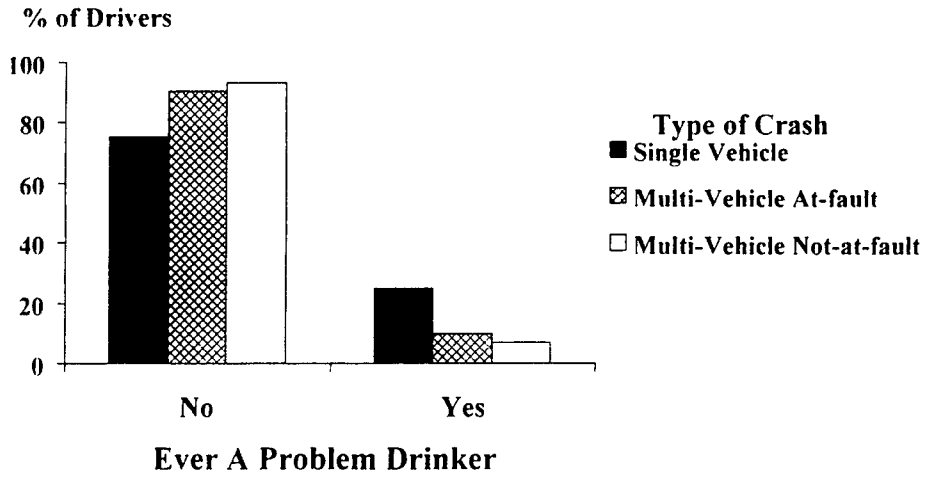


FIGURE 2. PERCENT OF DRIVERS WHO WERE EVER PROBLEM DRINKERS BY TYPE OF CRASH

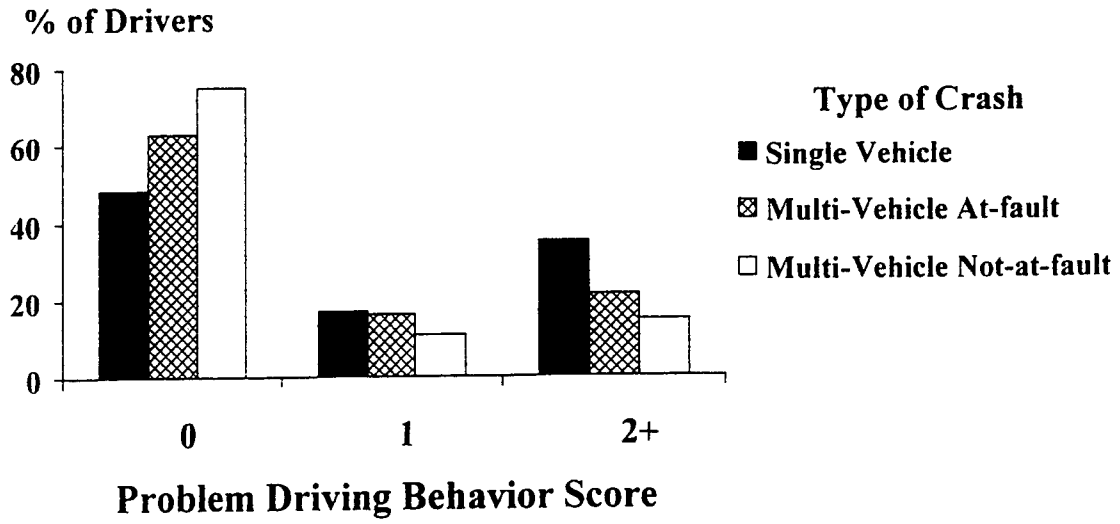


other two groups) (Figure 2) or to have CAGE summary scores of 2 or higher (23% compared with 13% and 8% for the other two groups). A CAGE score of 2+ is indicative of alcohol dependence, so the similarity to next-of-kin responses about problem drinking was expected.

The results also show that drivers in single-vehicle crashes and those at fault in multi-vehicle crashes drank and drove more often than not-at-fault drivers. Twenty-six percent of the drivers killed in single-vehicle crashes had driven after drinking at least once a week compared with 11% of the drivers at fault in multi-vehicle crashes and 4% of the drivers not at fault.

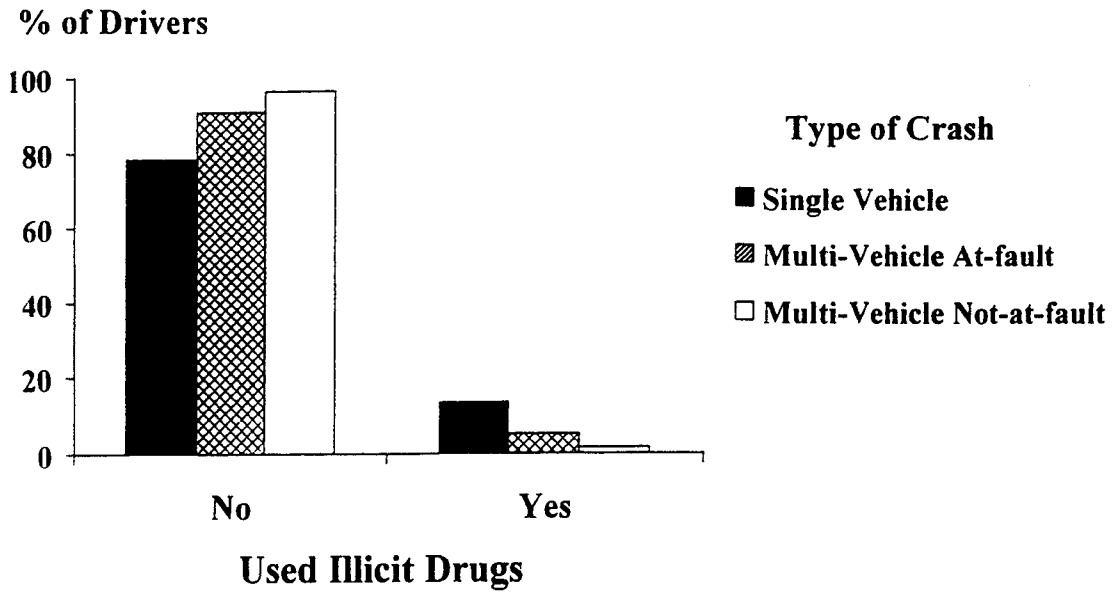
Drivers killed in single-vehicle crashes were more likely to have committed unsafe driving practices than drivers killed in multi-vehicle crashes (Figure 3). For drivers killed in multi-vehicle crashes, at-fault drivers were more likely than not-at-fault drivers to have unsafe driving practices: the single-vehicle and at-fault drivers reportedly were less likely to wear a seat belt, and were more likely to drive fast, pass in no passing zones, cut in front of another car, drive through yellow lights, etc., in their last year of life than the not-at-fault drivers.

FIGURE 3. PERCENT OF DRIVERS WITH PROBLEM DRIVING BEHAVIORS BY TYPE OF CRASH



Drivers killed in single-vehicle crashes were also more likely to have exhibited problem behaviors in their last year of life, have emotional problems in their last month of life, or have poor attitudes: 18% of drivers killed in single-vehicle crashes had a problem behavior score of 2 or higher, compared with 7% of the drivers at fault in multi-vehicle crashes and 4% of the drivers not at fault. Thirteen percent of drivers in single-vehicle crashes were reported to have used illicit drugs during their last year of life, compared with 5% and 2%, respectively, of the other two groups (Figure 4).

FIGURE 4. PERCENT OF DRIVERS WHO USED ILLICIT DRUGS IN LAST YEAR OF LIFE BY TYPE OF CRASH



The three groups also differed in the time of crash and in the type of vehicle they were driving. Forty-seven percent of single-vehicle crashes occurred between 10 PM and 6 AM compared with 16% and 21% for at-fault and not-at-fault multi-vehicle crashes, respectively. Single-vehicle and at-fault drivers in multi-vehicle crashes were less likely to have been driving motorcycles compared with not-at-fault drivers. Drivers in single-vehicle crashes were more likely to have been driving pickup trucks than the other two groups of drivers.

Drivers who were at fault in multi-vehicle collisions generally occupied an intermediate position between drivers in single-vehicle crashes and not-at-fault drivers in multi-vehicle collisions - i.e., the percentage that drank heavily, drove after drinking, etc., was less than that for drivers in single-vehicle crashes and more than that for not-at-fault drivers in multi-vehicle collisions. This suggests that, because there were other drivers involved in the multi-vehicle crashes who may have been at least partly responsible, the drivers categorized as "at fault" in the multi-vehicle crashes were somewhat less responsible for their crashes than drivers in single-vehicle crashes.

2. Logistic regression results

Odds of being at fault in multi-vehicle fatal crashes. The cross tabulation results presented in Appendix B, Table 1 described the characteristics of the drivers, with each of the factors considered *separately*. When all the variables were considered *together* (Table 2), only the type of vehicle was significantly related to being at fault in multi-vehicle crashes: motorcycle drivers were less likely to be at fault compared with car drivers (OR: 0.36; 95% CI: 0.20-0.66). (This is interpreted as: the risk of being at fault in a multi-vehicle crash is 36% as great for a motorcycle driver as for a car driver; chances are 95% that the actual risk is between 20% and 66%.)

TABLE 2: LOGISTIC REGRESSION MODEL: FATALLY INJURED VS. NOT-AT-FAULT DRIVERS

Odds that a Fatally Injured Driver Was Killed in an At-Fault or Single-vehicle Crash

	Multi-vehicle at fault vs. not at fault		Single-vehicle vs. Multi-vehicle not at fault	
Variables	Odds Ratios	95% CI	Odds Ratios	95% CI
Time of Crash				
6 AM to 6 PM[1]	-		-	
6 PM to 10 PM	0.58	(0.34-0.99)	1.09	(0.63-1.90)
10 PM to 6 AM	0.54	(0.31-0.93)	2.54	(1.50-4.01)
Type of Vehicle				
Cars[1]	-		-	
Vans	0.59	(0.21-1.65)	2.06	(0.76-5.58)
Utility	0.30	(0.09-1.05)	0.96	(0.37-2.52)
Pickup	1.05	(0.53-2.10)	2.28	(1.17-4.46)
Motorcycle	0.27	(0.14-0.53)	0.48	(0.24-0.94)
Seat Belt Use				
Always[1]	-		-	
Most of the time	1.59	(0.87-2.90)	2.09	(1.13-3.86)
Sometime	1.30	(0.63-2.69)	1.44	(0.70-2.97)
Rarely/Never	1.06	(0.54-2.11)	1.92	(0.99-3.73)
Usual Drinking Quantity				
<1 drink[1]	-		-	
1-4 drinks	1.27	(0.76-2.11)	2.12	(1.28-3.51)
5+ drinks	2.12	(0.82-5.45)	3.06	(1.24-7.58)
Drinking and Driving				
Not drinking & driving[1]	-		-	
< once a week	1.28	(0.61-2.71)	1.15	(0.56-2.37)
At least once a week	2.62	(0.86-7.95)	2.87	(0.99-8.35)
Using illicit Drugs				
No[1]	-		-	
Yes	1.91	(0.39-9.46)	4.19	(0.94-18.55)
Problem Driving Score				
0[1]	-		-	
1	1.78	(0.96-3.27)	1.91	(1.01-3.62)
2+	1.57	(0.87-2.82)	2.39	(1.33-4.29)

1. Reference group

The odds ratio for being at fault was highest for drivers drinking and driving at least once a week compared with not drinking and driving, but was not significant, 2.62 (95% CI: 0.86-7.95) since the 95% confidence interval includes 1. Other variables had odds ratios in the expected direction (e.g., an OR of 2.1 for usually having 5+ drinks per occasion) but did not reach statistical significance due in part to the small number of not-at-fault drivers.

Odds of being in a single-vehicle crash. Table 2 includes the variables that were statistically significant with regard to the likelihood of being in a single-vehicle crash when considering all of the variables together as independent variables, as well as variables of borderline significance. None of the demographic variables was significantly related to occurrence of single-vehicle

crashes after adjustment for the other factors. Crashes between 10 PM and 6 AM, pickup trucks, illicit drug use, less frequent seatbelt use, greater drinking quantity, drinking and driving, and a problem driving score of 2 or higher were the variables most strongly associated with the occurrence of fatal single-vehicle crashes.

B. NMFS-FARS vs. NRS *Fatally injured vs. roadside survey drivers*

There were 83 fatally injured drivers with valid alcohol information from the National Mortality Followback Survey - Fatality Analysis Reporting System linked file whose crashes occurred between 10 PM and 3 AM on Friday or Saturday night. These 83 drivers were compared with the 5,894 drivers surveyed at those hours in the 1996 National Roadside Survey whose breath alcohol concentration (BAC) results were obtained and converted to BACs.

1. Cross tabulation results

Appendix B, Table 2 provides the numbers and percentages for each variable analyzed.

Compared with drivers in the roadside survey, drivers killed in crashes were significantly younger, more likely to be male (83% vs. 68%), less likely to be African American (8% vs. 15%), more likely to be Hispanic (18% vs. 9%) (Figure 5), and have less education. No significant differences between the two groups were observed for employment status.

FIGURE 5. PERCENT OF DRIVERS IN EACH RACIAL GROUP FATALLY INJURED VS. ROADSIDE SURVEY DRIVERS,WEEKEND NIGHTS

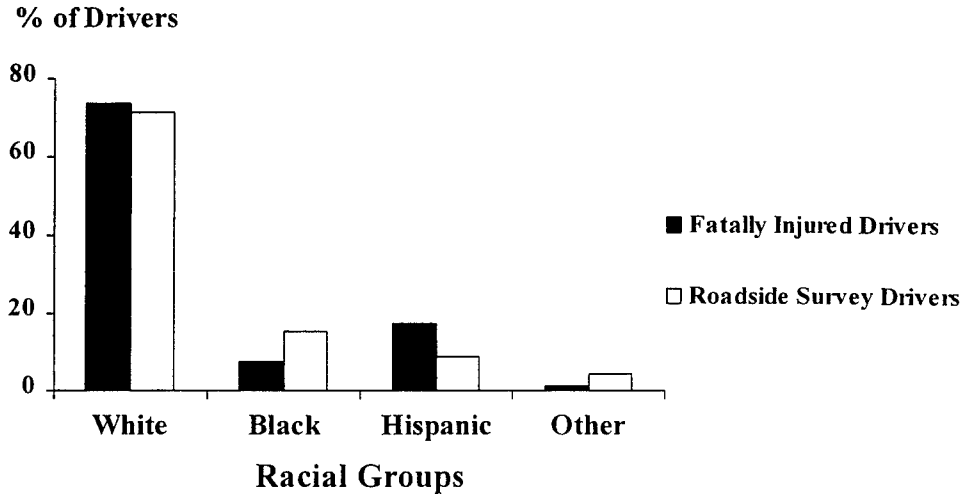
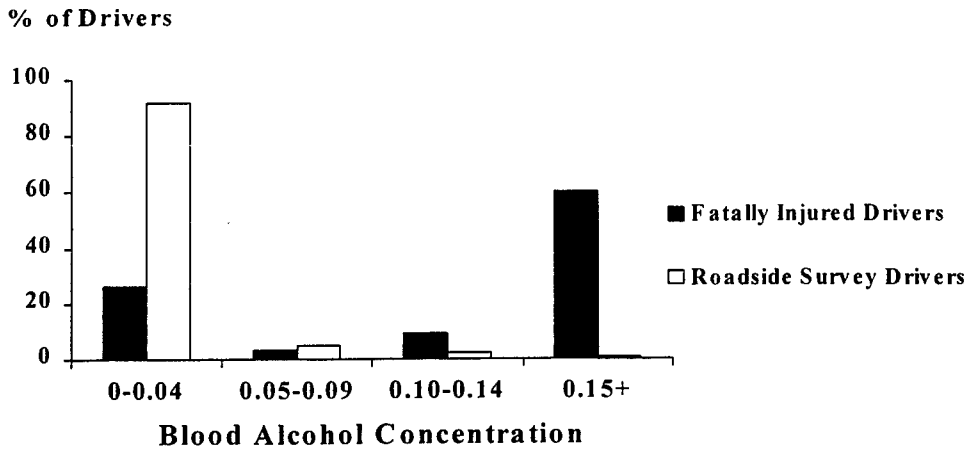


FIGURE 6. PERCENT OF DRIVERS
WITH EACH BLOOD ALCOHOL CONCENTRATION
FATALLY INJURED VS. ROADSIDE SURVEY DRIVERS,WEEKEND NIGHTS



The two groups differed significantly with regard to BAC, seat belt use, number of passengers, and the type of vehicles they drove. Sixty percent of the fatally injured drivers had a BAC of 0.15% or higher compared with 1% of drivers surveyed (Figure 6). (This was the largest difference found in any comparison in the study.) Only 14% of the drivers in crashes were using both shoulder and lap belts when the fatal crash occurred, but 74% of the surveyed drivers were fully restrained (Figure 7). Drivers involved in fatal crashes were less likely to have passengers than drivers surveyed. Fatally injured drivers also were more likely to have been driving pickup trucks than the surveyed drivers (28% vs. 12%). The fatally injured drivers were more likely to be coming from a restaurant or bar than surveyed drivers (26% vs.11%). Trip destinations did not differ between the two groups.

FIGURE 7. PERCENT OF DRIVERS USING RESTRAINTS
FATALLY INJURED VS. ROADSIDE SURVEY DRIVERS,WEEKEND NIGHTS

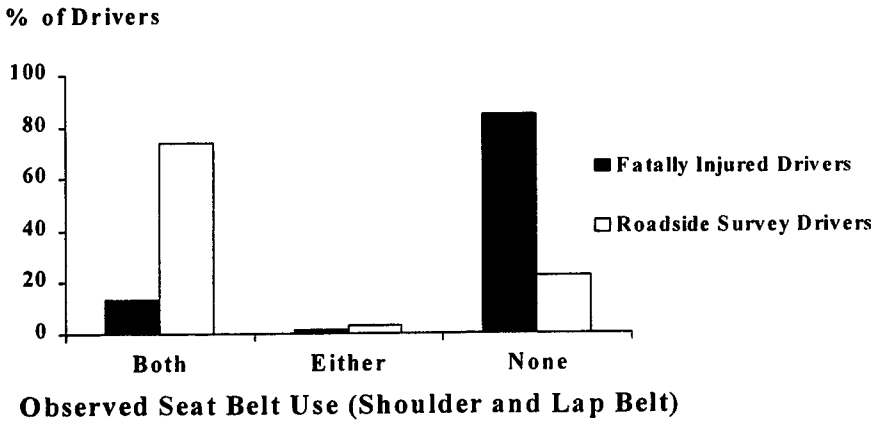


Table 3. LOGISTIC REGRESSION MODEL: FATALLY INJURED DRIVERS VS. ROADSIDE SURVEY; ODDS OF DRIVER FATALITY

Variables	Odds Ratios	95% CI
Race/ethnicity		
Non-Hispanic White[1]	-	
Non-Hispanic Black	0.20	(0.07-0.58)
Hispanic	0.92	(0.42-2.02)
Other	0.76	(0.09-6.27)
Education		
More than high school[1]	-	
High school graduate	1.54	(0.77-3.09)
Less than high school	4.56	(2.17-9.57)
BAC		
BAC 0-0.049[1]	-	
BAC 0.05-0.099	1.83	(0.52-6.48)
BAC 0.10+	64.20	(33.56-122.80)
Seat Belt Use		
Shoulder and lap belt[1]	-	
Shoulder or lap belt only	9.78	(1.14-83.85)
None	12.84	(6.02-27.38)
Region		
Northeast[1]	-	
Midwest	2.13	(0.78-5.84)
South	4.95	(1.86-13.19)
West	4.16	(1.52-11.41)
Where They Were Coming From		
Home[1]	-	
Friend	0.30	(0.12-0.76)
Restaurant/Bar	1.26	(0.50-3.19)
Other	0.63	(0.28-1.44)

1. Reference group

2. Logistic regression results

Considering all of the variables together as independent variables and driver deaths as the outcome variable yields the multi-variate logistic regression results shown in Table 3. Educational level, race/ethnicity, region, BAC, seat belt use and where they were coming from

were significant predictors of drivers being killed in crashes. Drivers living in the Northeast were less likely to be fatally injured than were drivers living elsewhere. The odds of being fatally injured were much lower for blacks than whites, when all other variables were controlled (OR=0.2, CI=0.07-0.58). The over-representation of Hispanics among fatalities noted in the cross tabulation results was not seen when other variables were adjusted for in the regression analysis. The most outstanding predictors of driver fatality were a BAC of 0.10% or higher (OR=64.2, CI=33.6-122.8) and non-use of seat belts (OR=12.8, CI=6.0-27.4).

C. NMFS-FARS vs. NSDDAB *Fatally injured vs. telephone survey drivers*

The NMFS-FARS linked database was compared with the 1993 National Survey of Drinking and Driving Attitudes and Behavior. Differences between the two sources were sought for variables common to both databases. Demographic variables (gender, race/ethnicity, educational level), seatbelt use, driving exposure and drinking behaviors were compared for the two groups.

There were 962 fatally injured drivers from the NMFS-FARS linked file who were ages 16-64; 438 were ages 16-29 and 524 were 30-64. They were compared with 1,662 individuals ages 16-29 and 1,708 individuals ages 30-64 who were surveyed in the NSDDAB and who reported that they had ever driven. The two age groups were analyzed separately because the NSDDAB over-sampled persons ages 16-29.

1. Cross tabulation results

Appendix B, Table 3 provides the numbers and percentages for each variable analyzed.

For the younger age group (ages 16-29), drivers killed in crashes were significantly more likely to be male (77% vs. 52%), to be Hispanic (15% vs. 10%), and to have only a high school education (73% vs. 51%) than surveyed drivers. The two groups also differed significantly in their reported annual miles traveled, seat belt use, CAGE scores, frequency of having 5 or more drinks and frequency of drinking and driving. The fatally injured drivers were more likely to have traveled between 5,000 and 9,999 miles annually (32% vs. 11%) and less likely to have traveled more than 20,000 miles (9% vs. 27%) compared with surveyed drivers (Figure 8).

Drivers in the fatal group also were reportedly less likely than the surveyed drivers to have used seatbelts or to have consumed alcohol before driving at least once a week. Compared with the surveyed drivers, they more often consumed 5 or more drinks per occasion.

In general, similar differences were observed for the older age group (ages 30-64). The racial differences were somewhat more pronounced, with the Hispanics comprising 15% of the fatally injured drivers vs. 5% of the surveyed drivers (Figure 9). Other racial differences seen in this comparison are unlike those seen in the comparison with roadside-surveyed drivers (Figure 5): black drivers were somewhat less common in the telephone survey than among fatally injured drivers, but they were twice as common in the roadside survey group as among fatally injured drivers. The reason for this difference is not known but may be related to the fact that the roadside survey data are specific to weekend nights.

The most notable finding in the older age group was in CAGE scores: only 3% of the surveyed drivers had CAGE scores of 2+, indicative of alcohol dependence, compared with 23% of fatally injured drivers (Figure 10).

FIGURE 8. PERCENT OF DRIVERS IN EACH MILEAGE GROUP FATALLY INJURED VS. TELEPHONE SURVEY DRIVERS, AGE 16-29

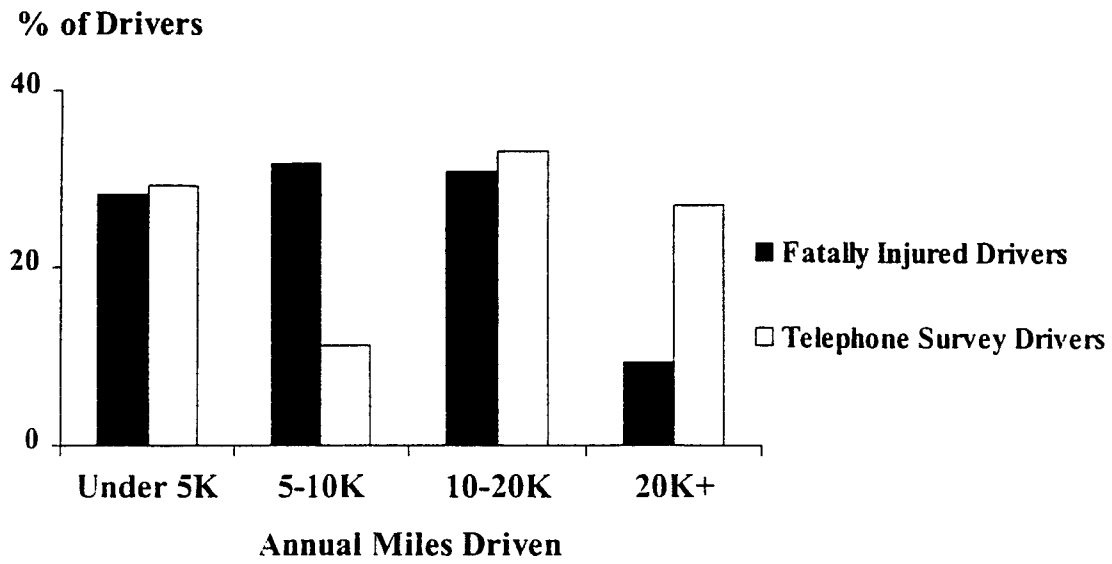


FIGURE 9. PERCENT OF DRIVERS IN EACH RACIAL GROUP FATALLY INJURED VS. TELEPHONE SURVEY DRIVERS, AGE 30-64

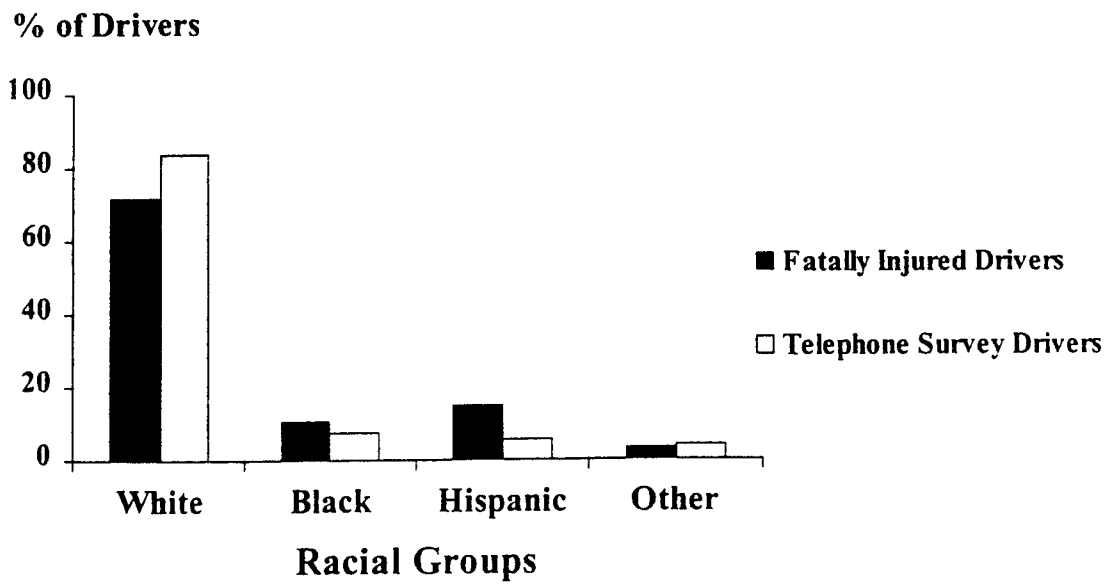
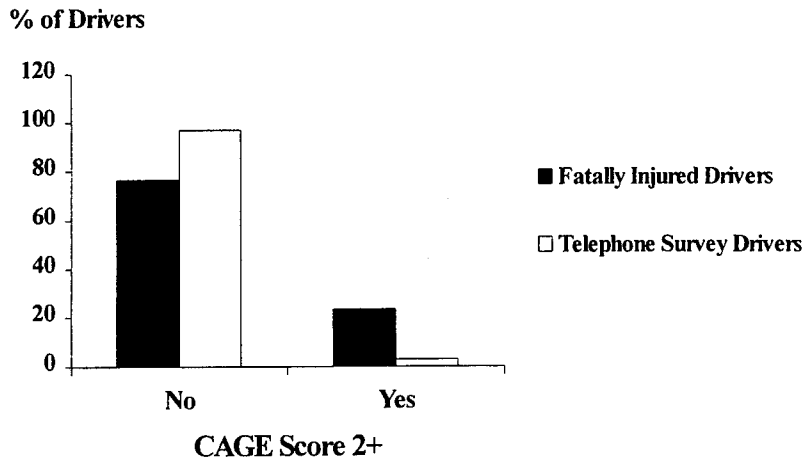


FIGURE 10. PERCENT OF DRIVERS IN EACH CAGE SCORE GROUP
FATALLY INJURED VS. TELEPHONE SURVEY DRIVERS, AGE 30-64



2. Logistic regression results

When considered together as independent variables in the multi-variate logistic regression, all variables analyzed except the CAGE scores significantly influenced the likelihood of driver fatalities for both 16-29 and 30-64 age groups (Table 4). For the older drivers, the problem drinking indicated by CAGE scores was significantly related to an increased risk of being killed in a crash, but there was no difference for the younger drivers after controlling for other factors. For both age groups, fatal injury was more likely among drivers who were male, Hispanic, had no education beyond high school, drove 5,000-9,999 miles annually, or did not regularly wear a seat belt. For both age groups, having 5 or more drinks at least once a week and drinking and driving at least once a week were associated with increased odds of driver fatality.

TABLE 4: LOGISTIC REGRESSION MODEL: FATALLY INJURED DRIVERS VS NSDDAB TELEPHONE SURVEY; ODDS OF DRIVER FATALITY

	Age 16-29 (N=1655)		Age 30-64 (N=1818)	
Variables	**Odds Ratios**	**95% CI**	**Odds Ratios**	**95% CI**
Gender				
Female[1]	-		-	
Male	2.05	(1.45-2.88)	1.95	(1.41-2.72)
Race/Ethnicity				
Non-Hispanic White[1]	-		-	
Non-Hispanic Black	0.96	(0.55-1.69)	0.95	(0.52-1.72)
Hispanic	1.59	(1.02-2.47)	2.15	(1.27-3.64)
Other	0.51	(0.21-1.25)	1.66	(0.83-3.34)
Education				
More than high school[1]	-		-	
High school or less	1.95	(1.39-2.74)	2.16	(1.61-2.90)
Annual Miles				
Under 5,000[1]	-		-	
5,000-9,999	3.10	(2.03-4.74)	1.66	(1.04-2.66)
10,000-19,999	0.87	(0.57-1.32)	0.85	(0.55-1.29)
20,000 or more	0.28	(0.16-0.49)	0.60	(0.37-0.97)
Seat Belt Use				
Always[1]	-		-	
Most of the time	1.61	(1.07-2.41)	1.19	(0.79-1.79)
Sometime	1.64	(0.99-2.71)	1.78	(1.12-2.84)
Rarely/Never	1.30	(0.78-2.17)	2.41	(1.58-3.67)
Five or More Drinks at One Time				
Less than once a week[1]	-		-	
At least once a week	3.56	(2.11-6.00)	3.61	(2.06-6.30)
CAGE Scores				
0-1[1]	-		-	
2 or more	0.72	(0.40-1.28)	4.50	(2.75-7.35)
Drinking and Driving				
Less than once a week[1]	-		-	
At least once a week	3.83	(1.80-8.16)	2.86	(1.54-5.34)

1. Reference group

V. SUMMARY AND DISCUSSION

While a great deal is already known about fatal crashes, less has been known about the drinking histories and other characteristics of the fatally injured drivers. The National Mortality Followback Survey provided information on the recent and lifetime experiences and behaviors of fatally injured drivers. In particular, a great deal of information was provided about their drinking histories. Background information from the relatives of these drivers, analyzed using logistic regression methods, made it possible to quantify the importance of various risk factors while controlling for other possible risk factors. The three components of the study all made use of NMFS-FARS data and each yielded major findings:

A. Research limited to fatally injured drivers in the NMFS-FARS database showed that when all factors are controlled for, the risk of being killed in a single-vehicle crash (compared with being killed in a multi-vehicle crash in which one is not at fault) is:

- almost 3 times as great for drivers who drink and drive weekly, compared with those who do not drink and drive,
- 3 times as great for drivers who usually have five or more drinks per occasion, compared with those who do not drink,
- 4 times as great for those who used illicit drugs compared with those who did not, and
- more than twice as great for drivers who had a history of problem driving, compared with those drivers who did not.

In general, the effect of alcohol and other factors was more pronounced in single-vehicle crashes than in multi-vehicle-at-fault crashes. The drivers killed in single-vehicle crashes were the most likely to have high scores for problem drinking, problem driving, and other problem behaviors and low seat belt use, and to have been considered by their next-of-kin to have been problem drinkers. Use of illicit drugs was not common but was reported by relatives of 13% of drivers in single-vehicle crashes, 5% of drivers at fault in multi-vehicle collisions, and 2% of drivers not at fault in multi-vehicle collisions.

B. Comparisons with roadside survey data revealed that on Friday and Saturday nights, the likelihood of becoming a fatally injured driver is:

- 64 times as high if a driver has a BAC of 0.10% or higher, compared with drivers with BACs of zero to 0.04%,
- 13 times as high if a driver uses neither lap nor shoulder belts, compared with drivers who use both,
- 5 times as high for whites as for blacks,
- Almost 5 times as high for drivers with less than a high school education, compared with those with more than a high school education, and
- Almost 5 times as high for drivers living in the or West or South, compared with drivers living in the Northeast.

C. Comparisons with responses to the telephone survey indicate that drivers ages 30-64 are 4.5 times as likely to be fatally injured if they are alcohol dependent, based upon CAGE scores. For the average driver age 16-64, the likelihood of becoming a fatally injured driver is:

- More than three times as great if they have five or more drinks per occasion at least weekly, compared with those who do so less than once a week,
- About three times as great for those who drink and drive at least once a week, compared with those who do so less than once a week,
- More than twice as great for those who rarely or never used seat belts,
- Twice as great for males as for females,
- Twice as great for Hispanics as for non-Hispanic whites
- Twice as great for those who lack education beyond high school compared with those with more than a high school education, and
- More than twice as great for those who drove 5,000-9,9999 miles annually compared with those who drove <5000 miles annually.

All three analyses emphasize the increased risk associated with alcohol use. Figure 11 shows the effect of alcohol on the odds of being a fatally injured driver is especially great when comparing fatally injured drivers with drivers stopped for roadside surveys. A possible explanation is that some intoxicated drivers may be able to avoid police checkpoints, which would cause the roadside survey results to underestimate alcohol involvement, thus increasing the observed odds ratio. The effect of alcohol is least evident in multi-vehicle crashes, since even crashes in which the fatally injured driver is at fault may involve partial responsibility of other drivers in the same crashes.

FIGURE 11. ODDS OF BEING A FATALLY INJURED OR AT-FAULT DRIVER IN RELATION TO BAC

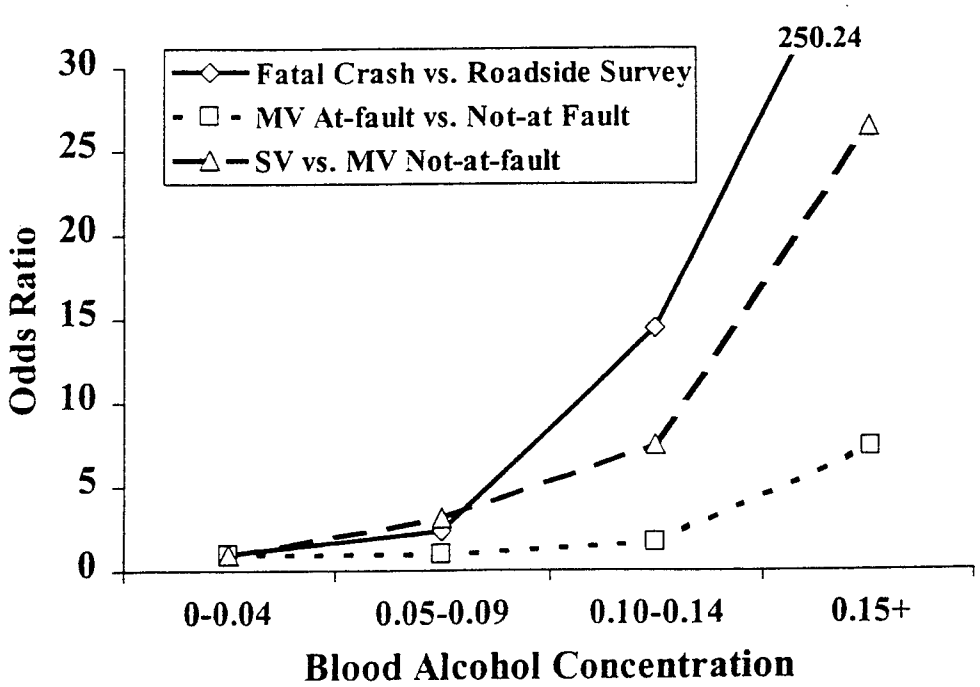


Table 5 summarizes the driver characteristics that are most predictive of drivers being in crashes in which they are killed, when other risk factors are adjusted for. For each of the three components of the research, the table ranks the factors by odds ratios, so that the most important, with the highest odds ratio, is first.

Some variables appear in more than one section of the table, with somewhat different interpretations. For example, when compared with drivers who reportedly drank little or nothing, drivers whose relatives said they typically had 5+ drinks per occasion were 3.1times as likely to have been killed in a single-vehicle crash; and drivers who had 5+ drinks at least weekly were 3.6 times as likely to be in a crash in which they were fatally injured as those who did not. The table omits the findings regarding drivers ages 16-29 because results of that analysis (Table 4) were generally consistent with results for drivers ages 30-64, except that CAGE scores are lower in younger drivers, who are less likely to have developed alcohol dependence.

This research reinforces the results of other research on fatal crashes. For example, males are at greater risk than females (per 10,000 drivers) of being killed in crashes (Li et al., 1998), which is consistent with our results for drivers killed in single-vehicle crashes. Our finding that on weekend nights, drivers with a BAC of 0.10% or higher have a 64-fold risk of being killed in a crash is consistent with Zador et al. (1999), even though the number of fatally injured drivers in the present study was much smaller.

Results of the three components of this research consistently indicate that the primary predictor of drivers' involvement in crashes in which they are killed is alcohol, reflected in either BAC at death or a history of alcohol consumption and drinking practices. This is true even after adjusting for demographic and other important factors in the logistic regression analyses. Histories of alcohol consumption, alcohol dependence, and drinking and driving practices were not determined for roadside survey respondents and therefore their relative importance could not be measured for that component of the study.

Non-use of restraints is also highly predictive of involvement in a driver-fatal crash. Such other factors as male gender, less than high school education, residence in the South or West, Hispanic ethnicity, and nighttime increase the risk of a fatal crash and are therefore relevant to preventive measures. Their independent effects are revealed by this research, but do not negate the importance of alcohol. In other words, the involvement of alcohol in the fatal crash of a poorly educated male driver from a southern state is probably not explained by his or her demographic characteristics, since the analyses adjust for gender, education, and region as well as other factors.

A new finding was that drivers whose annual mileage is between 5,000 and 10,000 miles are at increased risk of fatal crashes, and those who drive 20,000 miles or more are at decreased risk. Both roadside and telephone surveys showed that seat belt use, a crash phase variable, greatly influences the likelihood of crash survival, even when the pre-crash variables are adjusted for.

TABLE 5: MAJOR DETERMINANTS OF DRIVER FATALITIES RANKED BY ODDS RATIOS

Type of analysis and variable	Odds Ratio	Confidence Interval
Single-vehicle vs. not-at-fault multi-vehicle crash		
Use of illicit drugs	4.2	0.9-18.6
Usually drinking 5+ drinks per occasion	3.1	1.2-7.6
Drinking and driving at least weekly	2.9	1.0-8.4
Crash time 10 PM - 6 AM	2.5	1.5-4.0
Problem driving score	2.4	1.3-4.3
Usually drinking 1-4 drinks	2.1	1.3-3.5
Driving a pickup truck at time of crash	2.3	1.2-4.5
Rarely/never using a seat belt	2.0	1.0-3.7
Fatally injured vs. roadside survey drivers (Friday and Saturday nights)		
BAC 0.10+	64.2	33.6-122.8
Seat belts not worn	12.8	6.0-27.4
White vs. black	5.1	1.7-14.8
South vs. Northeast	5.0	1.9-13.2
Less than high school education	4.6	2.2-9.6
West vs. Northeast	4.2	1.5-11.4
Fatally injured vs. telephone survey drivers ages 30-64		
Cage score 2+ (alcohol dependent)	4.5	2.8-7.4
Drinking 5+ drinks per occasion at least weekly	3.6	2.1-6.3
Drinking and driving at least weekly	2.9	1.5-5.3
Rarely/never using- seat belt	2.4	1.6-3.7
High school or less education	2.2	1.6-2.9
Hispanic vs. non-Hispanic white	2.2	1.3-3.6
Male vs. female	2.0	1.4-2.7
Annual mileage 5,000-9,999 vs.<5,000	1.7	1.0-2.7

VI. CONCLUSIONS

A driver's drinking practices are highly predictive of involvement in a fatal crash. In particular, having a BAC of 0.10% or higher, drinking and driving at least once a week, usually drinking 5 or more drinks per occasion, being alcohol dependent, and prior use of illicit drugs are strong risk factors. Any one of these factors increases a driver's risk of a fatal crash about three-fold and having a BAC of 0.10% or higher on a weekend night may increase the risk more than 60-fold. Drivers with more than one of these risk factors no doubt have even greater increases in their risk of involvement in fatal crashes.

The strength of these findings underscores the need to intensify efforts to identify and influence drivers whose drinking practices greatly increase the likelihood that they and others will be injured or killed. This does not imply, however, that drivers at lower risk should be ignored. Such drivers comprise most of the driving public and collectively account for a large number of crashes, even if they are at less risk individually. All drivers who drink to excess, even rarely, place themselves, their passengers, and others at unacceptable risk of death or injury.

Adjustment for all major variables made it possible to determine that the demographic characteristics most predictive of a driver's being killed in a crash are male gender, Hispanic ethnicity, residing in the South or West, and having only a high school education or less. The findings suggest that it would be appropriate to target these groups with a variety of injury prevention strategies, including any proven behavioral-change interventions related to drinking habits.

On Friday and Saturday nights, a driver who does not use a seat belt has a 13-fold risk of being killed in a crash. This finding, while based upon data specific to Friday and Saturday nights, is no doubt relevant to other times. If adequately publicized, the information has the potential to increase seat belt use among high-risk people. Greater enforcement of seat belt use laws can also be expected to reduce deaths.

This research combines what is learned from police reports of fatal crashes with the wealth of information provided by relatives of drivers killed in the crashes. The resulting insight into the lives of the deceased – especially their alcohol-related behaviors – has been compared with what living drivers revealed through roadside and telephone surveys. The product is a comprehensive look at fatally injured drivers and the ways in which they differ from drivers who are more representative of the driving public.

VII. REFERENCES

Baker SP. Analysis of drivers in the National Mortality Followback Survey and the Fatality Analysis Reporting System. NTS-01-8-05307. U.S. Department of Transportation 1999.

Baker SP, Braver ER, Chen LH, Pantula JF, and Massie D. Motor vehicle occupant deaths among Hispanic and Black children and teenagers. Arch Pediatr Adolesc Med 1998;152:1209-12.

Baker SP, O'Neill B, Ginsburg MJ, and Li G. The Injury Fact Book (2nd edition). New York: Oxford University Press 1992.

Bell NS, Amoroso PJ, Yore MM, Smith GS, and Jones BH. Self-reported risk-taking behaviors and hospitalization for motor vehicle injury among active duty army personnel. Am J Prev Med 2000;18:85-95.

Bradley K, Bush K, McDonell M, Malone T, and Fihn S: Screening for problem drinking: Comparison of CAGE and AUDIT. J Gen Intern Med 1998;13:379-388.

Braver ER. Race, Hispanic origin, and socioeconomic status in relation to motor vehicle occupant death rates and risk factors among adults. Washington DC: Insurance Institute for Highway Safety 2001.

Brewer RD, Morris PD, Cole TB, Watkins S, Patetta MJ, and Popkin C. The risk of dying in alcohol-related automobile crashes among habitual drunk drivers. N Engl J Med 1994;331:513-7.

Centers for Disease Control (CDC). Wonder data program [database online]. Available at http://wonder.cdc.gov/mortsql.shtml. Accessed March 9, 2001.

Ewing JA. Detecting alcoholism. The CAGE questionnaire. JAMA 1984;252 (14):1905-7.

Foss RD, Beirness DJ, and Sprattler K. Seat belt use among drinking drivers in Minnesota. Am J Public Health 1994; 84(11):1732-7.

Haddon W Jr. The changing approach to the epidemiology, prevention, and amelioration of trauma: The transition to approaches etiologically rather than descriptively based. AJPH 1968; 58:1431-8.

Holubowycz OT and McLean AJ. Demographic characteristics, drinking patterns and drink-driving behavior of injured male drivers and motorcycle riders. J Stud. Alcohol 1995; 56:513-21.

Insurance Institute for Highway Safety. Motorists in four countries cite different reasons for buckling up. Status Report 1999; 34(7):6.

Insurance Institute for Highway Safety. Fatality Facts: Elderly. Available at: http://www.highwaysafety.org/safety_facts/fatality_facts/elderly.htm. Accessed October 27, 2000.

Jones RK and Lacey JH. Alcohol highway safety problem update. Washington, DC: US Department of Transportation 1998.

Laberge-Nadeau C, Maag U, and Bourbeau R. The effects of age and experience on accidents with injuries: should the licensing age be raised. Accid Anal Prev 1992; 24(2):107-116.

Li G, Baker SP, and Frattaroli S. Epidemiology and prevention of traffic-related injuries among adolescents. Adolescent Medicine: State of the Art Reviews 1995; 6(2):135-51.

Li G, Baker SP, Langlois JA, and Kelen GD. Are female drivers safer? An application of the decomposition method. Epidemiology 1998; 9:379-84.

Li G, Smith GS, Baker and SP. Drinking behavior in relation to cause of death among U.S. adults. Am J Public Health 1994; 84(9):1402-6.

Massie DL, Campbell KL, and Williams AF. Traffic accident involvement rates by driver age and gender. Accid Anal Prev 1995; 27(1):73-87.

Matteucci RM, Holbrook TL, Hoyt DB, and Molgaard C. Trauma among Hispanic children: A population-based study in a regionalized system of trauma care. Am J Public Health 1995; 85:1005-1008.

National Highway Traffic Safety Administration. National Survey of Drinking and Driving Attitudes and Behavior: 1993. Washington, DC: US Department of Transportation 1994.

National Highway Traffic Safety Administration. Traffic Safety Facts 1998. Washington, DC: US Department of Transportation 1999.

Niemcryk SJ, Kaufmann CR, Brawley M, and Yount SI. Motor vehicle crashes, restraint use, and severity of injury in children in Nevada. Am J Prev Med. 1997;113:109-114.

Moskowitz H and Fiorentino D. A review of the literature on the effects of low doses of alcohol on driving-related skills. Washington, DC: US Department of Transportation 2000.

Shope JT, Waller PF, and Lang SW. Adolescent driving: gender differences. UMTRI research review 1996; 27(1): 1-12.

Stinson FS, Parrish K, and Noble J. Alcohol consumption in a 1986 sample of deaths. Alcohol Health Res World. 1990;14:154-162.

US Department of Health and Human Services. Health of our nation's children, series 10: data from the national health interview survey no. 191. (PHS 95-1519) Washington, DC: U.S. Government Printing Office; 1994.

Viano DC. Restraint effectiveness, availability and use in fatal crashes: implications to injury control. J. Trauma 1995;38:538-46.

Voas RB, Wells JK, Lestina DC, Williams AF, Greene MA. Drinking and driving in the United States: the 1996 National Roadside Survey. Accid Anal Prev 1998;30:267-75.

Williams AF. Nighttime driving and fatal crash involvement of teenagers. Accid Anal Prev 1985;17(1): 1-5.

Williams AF. Magnitude and Characteristics of the young driver crash problem in the United States. Arlington, VA: Insurance Institute for Highway Safety 1995.

Williams AF and Karpf RS. Teenage drivers and fatal crash responsibility. Law & policy 1984; 6(1):101-13.

Zador PL, Krawchuk SA, and Voas RB. Alcohol-related relative risk of driver fatalities and driver involvement in fatal crashes in relation to driver age and gender: an update using 1996 data. J Stud Alcohol 2000;61:387-95.

APPENDIX A. Driver-Level Factors

"At fault" was defined as having one or more driver-level factors in FARS based on codes 20-59 in the following list.

00='None'	37='High Speed Chase'	68='Splash,Spray'
01='Drowsy, Asleep'	38='Failure to Yield'	69='Inadeq Defroster'
02='Ill, Blackout'	39='Failure to Obey'	70='Inadeq Lights'
03='Emotional'	40='Around Barrier'	71='Obstruct Angles'
04='Drugs-Medication'	41='Fail to Obs Warn'	72='Rear Mirrors'
05='Other Drugs'	42='Fail to Signal'	73='Other Mirror'
06='Inattentive'	43='Wrong Signal'	74='Head Seat belts'
07='Wheelchair'	44='Driving too Fast'	75='Impr Windshield'
08='Paraplegic'	45='Under Min Speed'	76='Other Obstruct'
09='Previous Injury'	46='Speed Changes'	77='Crosswind'
10='Deaf'	47='Wrong Lane Turn'	78='Truck Wind'
11='Other Physical'	48='Othr Improp Turn'	79='Slippery Surface'
12='Dead Fetus'	49='Phys Rest comply'	80='Flat Tire'
19='Invalid License'	50='Wrong Way'	81='Debris in Road'
20='Veh Unattended'	51='Wrong Side of Rd'	82='Rut in Road'
21='Improper Loading'	52='Op Inexperience'	83='Animal'
22= 'Improper Towing'	53='Unfamiliar w/Rd'	84='Vehicle in Road'
23='Improper Lights'	54='Stopping in Rd'	85='Phantom Vehicle'
24='W/O Req Equip'	55='Underride Truck'	86='Pedestrian'
25='Unlawfull Noise'	56='Low Tire Pressur'	87='Water,Snow,Oil'
26='Improper Tailing'	57='Locked Wheel'	89='Haul Hazmat Impr'
27='Impr Lane Change'	58='Over Correcting'	90='Hit and Run'
28='Run Off Rd/Lane'	59='On/Off Mov Veh'	91='Homocide'
29='Driving Shoulder'	60='On/Off Stop Veh'	92='Other Violation'
30='Imp Entry/Exit'	61='Weather'	93='Cellular Phone'
31='Impr Start/Back'	62='Glare'	94='Fax Machine'
32='Open Veh Closure'	63='Curve,Hill,etc'	95='Computer'
33='Prohibited Pass'	64='Bldg,Billboard'	96='Navigation Sys'
34='Pass Wrong Side'	65='Tree,Plants'	97='2-Way Radio'
35='Pass Insuff Dist'	66='Moving Vehicle'	98='Head-up Display'
36='Erratic/Reckless'	67='Parked Vehicle'	99='Unknown'

APPENDIX B

APPENDIX B, TABLE 1. FATALLY INJURED SINGLE-VEHICLE AND AT-FAULT VS. NOT-AT-FAULT DRIVERS

Variables	Multi-Vehicle Crashes				Single-vehicle Crashes	
	Not-at-fault		At-fault			
	N	%	N	%	N	%
Demographic Variables						
Age **						
Under 21	21	11.1%	53	13.8%	97	17.9%
Age 21-29	43	22.8%	79	20.6%	145	26.8%
Age 30-39	32	16.9%	71	18.5%	126	23.2%
Age 40-49	28	14.8%	42	10.9%	79	14.6%
Age 50-59	20	10.6%	36	9.4%	36	6.6%
Age 60+	45	23.8%	103	26.8%	59	10.9%
Total	189	100.0%	384	100.0%	542	100.0%
Gender*						
Male	127	67.2%	270	70.3%	435	80.3%
Female	62	32.8%	114	29.7%	107	19.7%
Total	189	100.0%	384	100.0%	542	100.0%
Race/ethnicity**						
Non-Hispanic White	139	79.9%	266	74.3%	394	76.7%
Non-Hispanic Black	15	8.6%	39	10.9%	50	9.7%
Hispanic	13	7.5%	43	12.0%	55	10.7%
Other	7	4.0%	10	2.8%	15	2.9%
Total	174	100.0%	358	100.0%	514	100.0%
Education**						
Less than high school	42	23.6%	92	24.9%	146	28.3%
High school graduate	61	34.3%	150	40.5%	225	43.6%
More than high school	75	42.1%	128	34.6%	145	28.1%
Total	178	100.0%	370	100.0%	516	100.0%
Employed						
Yes	125	69.1%	258	68.8%	374	71.6%
No	56	30.9%	117	31.2%	148	28.4%
Total	181	100.0%	375	100.0%	522	100.0%
Marital Status**						
Married	86	47.3%	158	41.9%	178	33.8%
Widowed	12	6.6%	34	9.0%	22	4.2%
Divorced	24	13.2%	65	17.2%	80	15.2%
Separated	5	2.7%	5	1.3%	25	4.7%
Single	55	30.2%	115	30.5%	222	42.1%
Total	182	100.0%	377	100.0%	527	100.0%
Region						
Northeast	18	9.5%	42	10.9%	57	10.5%
Midwest	44	23.3%	93	24.2%	117	21.6%
South	84	44.4%	165	43.0%	237	43.7%
West	43	22.8%	84	21.9%	131	24.2%
Total	189	100.0%	384	100.0%	542	100.0%

Appendix B, Table 1, Continued

Variables	Multi-Vehicle Crashes				Single-vehicle Crashes	
	Not-at-fault		At-fault			
	N	%	N	%	N	%
Drinking Variables						
BAC**						
BAC 0-0.049	114	89.1%	194	70.3%	160	39.0%
BAC 0.05-0.099	5	3.9%	8	2.9%	22	5.4%
BAC 0.10-0.14	4	3.1%	11	4.0%	42	10.2%
BAC 0.15+	5	3.9%	63	22.8%	186	45.4%
Total	128	100.0%	276	100.0%	410	100.0%
Drinking Quantity and Frequency**						
Heavier drinker	7	4.7%	37	11.7%	96	23.8%
Moderate drinker	11	7.3%	25	7.9%	73	18.1%
Light drinker	22	14.7%	58	18.3%	85	21.1%
Infrequent drinker	71	47.3%	116	36.6%	82	20.3%
Non-drinker	39	26.0%	81	25.6%	67	16.6%
Total	150	100.0%	317	100.0%	403	100.0%
Drinking Frequency**						
Every day	8	4.7%	15	4.3%	54	11.7%
3-6 times a week	6	3.5%	30	8.5%	71	15.4%
1-2 times a week	23	13.5%	62	17.7%	111	24.0%
1-3 times a month	23	13.5%	47	13.4%	77	16.7%
< 1 times a month	71	41.8%	116	33.0%	82	17.7%
Non-drinker	39	22.9%	81	23.1%	67	14.5%
Total	170	100.0%	351	100.0%	462	100.0%
Usual Drinking Quantity**						
5+ drinks	10	6.0%	37	10.8%	121	27.9%
3-4 drinks	3	1.8%	21	6.1%	48	11.1%
1-2 drinks	49	29.5%	106	31.0%	143	32.9%
< 1 drink (including non-drinker)	104	62.7%	178	52.0%	122	28.1%
Total	166	100.0%	342	100.0%	434	100.0%
Frequency of Having 5+ Drinks Last Year**						
3-7 times a week	5	3.0%	19	5.7%	60	13.9%
1-2 times a week	4	2.4%	18	5.4%	58	13.5%
1-3 times a month	1	0.6%	13	3.9%	32	7.4%
< 1 time a month (including never)	157	94.0%	286	85.1%	281	65.2%
Total	167	100.0%	336	100.0%	431	100.0%
Frequency of Drinking and Driving Last Year**						
>= 1 times a week	5	3.9%	28	11.3%	89	26.1%
1-3 times a month	6	4.7%	19	7.7%	37	10.9%
2-11 times a year	7	5.5%	18	7.3%	32	9.4%
only once	2	1.6%	3	1.2%	12	3.5%
Not drinking and driving	107	84.3%	180	72.6%	171	50.1%
Total	127	100.0%	248	100.0%	341	100.0%

Appendix B, Table 1, Continued

Variables	Multi-Vehicle Crashes				Single-vehicle Crashes	
	Not-at-fault		At-fault			
	N	%	N	%	N	%
Cage Scores 2+**						
Yes	14	8.0%	46	12.8%	110	22.9%
No	161	92.0%	314	87.2%	371	77.1%
Total	175	100.0%	360	100.0%	481	100.0%
Ever Problem Drinker-Entire Life**						
Yes	12	6.7%	35	9.6%	120	24.5%
No	167	93.3%	330	90.4%	369	75.5%
Total	179	100.0%	365	100.0%	489	100.0%
Driving Variables						
Number of Passengers						
No passengers	124	66.7%	277	74.7%	382	71.5%
One passenger	37	19.9%	65	17.5%	106	19.9%
Two or more passengers	25	13.4%	29	7.8%	46	8.6%
Total	186	100.0%	371	100.0%	534	100.0%
Time of Crash**						
10 PM to 5:59 AM	39	20.6%	61	16.0%	250	47.4%
6 PM to 9:59 PM	38	20.1%	67	17.5%	94	17.8%
6 AM to 5:59 PM	112	59.3%	254	66.5%	183	34.7%
Total	189	100.0%	382	100.0%	527	100.0%
Type of Vehicle**						
Car	121	67.2%	286	76.7%	289	55.5%
Van	8	4.4%	11	2.9%	23	4.4%
Utility	7	3.9%	5	1.3%	36	6.9%
Pickup	15	8.3%	41	11.0%	122	23.4%
Motorcycle	29	16.1%	30	8.0%	51	9.8%
Total	180	100.0%	373	100.0%	521	100.0%
Total Miles Driven Last Year						
Under 5000	31	21.2%	82	28.0%	116	29.2%
5000-9999	42	28.8%	89	30.4%	99	24.9%
10000-14999	33	22.6%	60	20.5%	73	18.4%
15000-19999	20	13.7%	30	10.2%	53	13.4%
>= 20000	20	13.7%	32	10.9%	56	14.1%
Total	146	100.0%	293	100.0%	397	100.0%
Wore Safety Belt Last Year**						
Always	107	66.5%	186	57.2%	173	38.8%
Most of the time	22	13.7%	54	16.6%	99	22.2%
Some of the time/Rarely/Never	32	19.9%	85	26.2%	174	39.0%
Total	161	100.0%	325	100.0%	446	100.0%
Problem Driving Behavior Score**						
0	125	74.9%	219	62.9%	230	48.2%
1	18	10.8%	56	16.1%	80	16.8%
2+	24	14.4%	73	21.0%	167	35.0%
Total	167	100.0%	348	100.0%	477	100.0%

Appendix B, Table 1, Continued

Variables	Multi-Vehicle Crashes				Single-vehicle Crashes	
	Not-at-fault		At-fault			
	N	%	N	%	N	%
Where They Were Coming From**						
Home	62	43.1%	91	30.1%	87	21.6%
Friend	21	14.6%	61	20.2%	108	26.9%
Restaurant/Bar	3	2.1%	15	5.0%	66	16.4%
Other	58	40.3%	135	44.7%	141	35.1%
Total	144	100.0%	302	100.0%	402	100.0%
Behaviors and Attitudes						
Problem Behavior Score**						
0	149	85.6%	296	81.1%	336	68.4%
1	18	10.3%	45	12.3%	67	13.6%
2+	7	4.0%	24	6.6%	88	17.9%
Total	174	100.0%	365	100.0%	491	100.0%
Attitudes Toward Aggression Score**						
0	163	93.7%	329	89.4%	403	81.9%
1	6	3.4%	26	7.1%	45	9.1%
2+	5	2.9%	13	3.5%	44	8.9%
Total	174	100.0%	368	100.0%	492	100.0%
Depression Score**						
0	155	86.1%	304	80.4%	406	77.5%
1	16	8.9%	52	13.8%	55	10.5%
2+	9	5.0%	22	5.8%	63	12.0%
Total	180	100.0%	378	100.0%	524	100.0%
Used Illicit Drugs Last Year**						
Yes	3	1.6%	19	5.0%	71	13.3%
No	181	96.3%	347	90.8%	418	78.3%
DK	4	2.1%	16	4.2%	45	8.4%
Total	188	100.0%	382	100.0%	534	100.0%
Cognitive Functioning						
Trouble Understanding						
Yes	3	1.7%	12	3.2%	24	4.6%
No	178	98.3%	364	96.8%	498	95.4%
Total	181	100.0%	376	100.0%	522	100.0%
Trouble Remembering						
Yes	1	0.6%	5	1.3%	17	3.3%
No	178	99.4%	370	98.7%	505	96.7%
Total	179	100.0%	375	100.0%	522	100.0%
Trouble Recognizing						
Yes	2	1.1%	6	1.6%	11	2.1%
No	178	98.9%	368	98.4%	510	97.9%
Total	180	100.0%	374	100.0%	521	100.0%

* Chi-square Test P value < 0.05

** Chi-square Test P value < 0.01

APPENDIX B, TABLE 2: NATIONAL ROADSIDE SURVEY VS. FATALLY INJURED DRIVERS 10 PM-3 AM FRIDAY & SATURDAY NIGHTS

Variables	NRS Drivers		Fatally Injured Drivers	
	N	%	N	%
Age *				
Under 21	964	16.4%	20	24.1%
Age 21-29	1827	31.0%	26	31.3%
Age 30-39	1394	23.7%	25	30.1%
Age 40+	1709	29.0%	12	14.5%
Total	5894	100.0%	83	100.0%
Gender**				
Male	3975	68.2%	69	83.1%
Female	1855	31.8%	14	16.9%
Total	5830	100.0%	83	100.0%
Race/ethnicity**				
Non-Hispanic White	4157	71.4%	59	73.8%
Non-Hispanic Black	880	15.1%	6	7.5%
Hispanic	522	9.0%	14	17.5%
Other	261	4.5%	1	1.3%
Total	5820	100.0%	80	100.0%
Education**				
Less than high school	736	12.6%	27	34.2%
High school graduate	1709	29.3%	32	40.5%
More than high school	3384	58.1%	20	25.3%
Total	5829	100.0%	79	100.0%
Employment Status				
Employed	4717	81.2%	63	78.8%
Unemployed	1092	18.8%	17	21.3%
Total	5809	100.0%	80	100.0%
Region**				
Northeast	1459	24.8%	7	8.4%
Midwest	1330	22.6%	20	24.1%
South	1779	30.2%	31	37.3%
West	1326	22.5%	25	30.1%
Total	5894	100.0%	83	100.0%
BAC **				
BAC 0-0.049	5396	91.6%	22	26.5%
BAC 0.05-0.099	313	5.3%	3	3.6%
BAC 0.10-0.149	136	2.3%	8	9.6%
BAC 0.15+	49	0.8%	50	60.2%
Total	5894	100.0%	83	100.0%

Appendix B, Table 2, Continued				
Variables	**NRS Drivers**		**Fatally Injured Drivers**	
	N	**%**	**N**	**%**
Observed Seat Belt Use**				
Shoulder and Lap Belt	4247	74.1%	10	13.5%
Shoulder/Lap Belt Only	190	3.3%	1	1.4%
None	1298	22.6%	63	85.1%
Total	5735	100.0%	74	100.0%
Number of Passengers*				
No passengers	2616	47.6%	52	62.7%
One passenger	1954	35.6%	18	21.7%
Two passengers	493	9.0%	6	7.2%
Three or more passengers	432	7.9%	7	8.4%
Total	5495	100.0%	83	100.0%
Type of Vehicle**				
Car	4313	74.4%	47	62.7%
Pickup	714	12.3%	21	28.0%
Van	339	5.8%	1	1.3%
Utility	434	7.5%	6	8.0%
Total	5800	100.0%	75	100.0%
Where They Were Coming From**				
Home	879	15.0%	13	19.7%
Friend	1657	28.4%	13	19.7%
Restaurant/Bar	621	10.6%	17	25.8%
Other	2684	46.0%	23	34.8%
Total	5841	100.0%	66	100.0%
Where They Were Going				
Home	4084	70.0%	44	64.7%
Friend	791	13.6%	7	10.3%
Restaurant/Bar	191	3.3%	3	4.4%
Other	768	13.2%	14	20.6%
Total	5834	100.0%	68	100.0%

* Chi-square Test P value < 0.05

** Chi-square Test P value < 0.01

APPENDIX B, TABLE 3. FATALLY INJURED DRIVERS VS. NSDDAB TELEPHONE SURVEY

Variables	Aged 16-29					Aged 30-64				
	Drinking & Driving Telephone Survey		NMFS-FARS			Drinking & Driving Telephone Survey		NMFS-FARS		
	N	%	N	%	P-Value *	N	%	N	%	P-value *
Demographic Variables										
Gender										
Male	856	51.5%	335	76.5%	< 0.001	868	50.8%	395	75.4%	< 0.001
Female	806	48.5%	103	23.5%		840	49.2%	129	24.6%	
Total	1662	100.0%	438	100.0%		1708	100.0%	524	100.0%	
Race/ethnicity										
Non-Hispanic White	1242	75.0%	298	71.5%	0.003	1414	83.4%	298	71.5%	0.014
Non-Hispanic Black	164	9.9%	44	10.6%		125	7.4%	44	10.6%	
Hispanic	157	9.5%	62	14.9%		91	5.4%	62	14.9%	
Other	93	5.6%	13	3.1%		65	3.8%	13	3.1%	
Total	1656	100.0%	417	100.0%		1695	100.0%	417	100.0%	
Education										
<= High school	849	51.1%	309	73.0%	< 0.001	678	39.8%	312	62.7%	< 0.001
> High school	812	48.9%	114	27.0%		1027	60.2%	186	37.3%	
Total	1661	100.0%	423	100.0%		1705	100.0%	498	100.0%	
Marital Status										
Married	519	31.2%	74	17.2%	< 0.001	1196	70.4%	274	54.0%	< 0.001
Widowed	30	1.8%	0	0.0%		48	2.8%	16	3.2%	
Divorced	4	0.2%	20	4.7%		58	3.4%	133	26.2%	
Separated	53	3.2%	6	1.4%		201	11.8%	26	5.1%	
Single	1055	63.5%	329	76.7%		197	11.6%	58	11.4%	
Total	1661	100.0%	429	100.0%		1700	100.0%	507	100.0%	
Drinking Variables										
Cage Scores 2+										
Yes	114	6.9%	44	11.1%	0.004	48	2.8%	112	23.3%	< 0.001
No	1547	93.1%	352	88.9%		1656	97.2%	369	76.7%	
Total	1661	100.0%	396	100.0%		1704	100.0%	481	100.0%	
Drinking Frequency										
Every day	5	0.3%	14	3.7%	< 0.001	29	1.7%	53	11.3%	< 0.001
3-6 times a week	156	9.4%	35	9.3%		215	12.7%	64	13.6%	
1-2 times a week	238	14.3%	83	22.1%		197	11.6%	101	21.5%	
1-3 times a month	454	27.3%	78	20.8%		465	27.4%	61	13.0%	
< 1 time a month	318	19.2%	78	20.8%		280	16.5%	128	27.2%	
Non-drinker	489	29.5%	87	23.2%		513	30.2%	63	13.4%	
Total	1660	100.0%	375	100.0%		1699	100.0%	470	100.0%	

Appendix B, Table 3, Continued

Variables	Aged 16-29					Aged 30-64				
	Drinking & Driving Telephone Survey		NMFS-FARS			Drinking & Driving Telephone Survey		NMFS-FARS		
	N	%	N	%	P-value *	N	%	N	%	P-value *
Frequency of having 5+ Drinks										
3-7 times a week	22	1.3%	24	6.8%	< 0.001	11	0.6%	57	12.8%	< 0.001
1-2 times a week	49	3.0%	40	11.3%		28	1.6%	40	9.0%	
1-3 times a month	127	7.6%	22	6.2%		45	2.6%	22	5.0%	
< 1 time a month (including never)	1463	88.1%	268	75.7%		1618	95.1%	325	73.2%	
Total	1661	100.0%	354	100.0%		1702	100.0%	444	100.0%	
Frequency of Drinking and Driving										
>= 1 times a week	23	1.4%	33	9.9%	< 0.001	31	1.8%	85	19.5%	< 0.001
1-3 times a month	84	5.1%	23	6.9%		82	4.9%	33	7.6%	
2-11 times a year	304	18.4%	26	7.8%		327	19.5%	28	6.4%	
only once	67	4.1%	8	2.4%		85	5.1%	9	2.1%	
Not drinking and driving	1173	71.0%	242	72.9%		1155	68.8%	280	64.4%	
Total	1651	100.0%	332	100.0%		1680	100.0%	435	100.0%	
Usual Drinking Quantity										
5+ drinks	197	11.9%	50	14.4%	< 0.001	66	3.9%	83	18.5%	< 0.001
3-4 drinks	353	21.3%	32	9.2%		240	14.1%	46	10.2%	
1-2 drinks	598	36.1%	125	36.0%		863	50.7%	148	33.0%	
< 1 drink (including non-drinker)	510	30.8%	140	40.3%		532	31.3%	172	38.3%	
Total	1658	100.0%	347	100.0%		1701	100.0%	449	100.0%	
Driving Practice										
Safety Belt Use										
Always	1087	65.4%	161	45.2%	< 0.001	1175	68.8%	219	48.8%	< 0.001
Most of the time	280	16.9%	81	22.8%		256	15.0%	79	17.6%	
Sometimes	143	8.6%	55	15.4%		138	8.1%	54	12.0%	
Rarely/Never	151	9.1%	59	16.6%		138	8.1%	97	21.6%	
Total	1661	100.0%	356	100.0%		1707	100.0%	449	100.0%	
Annual Miles Driven										
Under 5,000	424	29.1%	90	28.2%	< 0.001	273	17.4%	82	21.2%	< 0.001
5,000-9,999	161	11.1%	101	31.7%		216	13.7%	88	22.7%	
10,000-19,999	478	32.9%	98	30.7%		653	41.5%	147	38.0%	
20,000 or more	392	26.9%	30	9.4%		431	27.4%	70	18.1%	
Total	1455	100.0%	319	100.0%		1573	100.0%	387	100.0%	

*The P-value is the probability that our observed value would occur when there is actually no difference between the groups being compared.