Alcohol Involvement in Texas Driver Fatalities: Accident Reports Versus Blood Alcohol Concentration

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ABSTRACT

The extent of alcohol involvement among driver fatalities has been difficult to estimate from subjective, nonquantitative sources such as accident reports. Compared in this paper are estimates from two data sources of the proportion of driver fatalities in which the driver is legally intoxicated: accident reports and toxicological reports [i.e., reports of blood alcohol concentration (BAC)]. On the basis of 1,260 driver fatalities in Texas for which BAC test results were available, 51 percent of the drivers were legally intoxicated as defined by a BAC greater than or equal to 0.10 percent blood alcohol by volume. Accident reports for these same driver fatalities reported alcohol as a contributing factor in the accident in only 20 percent of the fatalities. Of the legally intoxicated driver fatalities identified by the BAC tests, 68 percent of the corresponding accident reports did not indicate alcohol as a contributing factor in the accident. Descriptive statistics based on BAC results by age and sex of the driver and time and date of the accident are reported. The underreporting rate of alcohol involvement is also described by age and sex of the fatally injured driver and by investigating officer [i.e., local police versus department of public safety (DPS)]. The findings emphasize the need for better quality data on alcohol involvement in traffic accidents.

Although alcohol involvement in fatal accidents has been shown to be related to driver blood alcohol level [it has been estimated that more than 50 percent of all fatal collisions involve alcohol (1)], the extent of this involvement has been difficult to quantify. Previous studies that have relied on accident report data have been criticized for potentially low estimates of actual alcohol involvement (2). These studies have relied on data that are basically subjective, that is, the police officer's assessment of whether or not alcohol was involved. Further, these assessments suffer because they are categorical (yes or no) and may lack consistency as a result of the format of the accident report. Also, a fear of involvement in civil suits may result in reluctance on the part of the investigating officer to cite alcohol as a contributing factor unless a driving while intoxicated (DWI) charge is filed.

A highly reliable estimate of the extent of alcohol involvement can be obtained from blood alcohol concentration (BAC) measured on the drivers of all vehicles involved in accidents. This variable is nonsubjective and quantitative. Unfortunately, this information is not easily attainable. It is seldom available for the driver who survives the accident and it is not always available for the fatally injured driver. Several reasons for the lack of BAC data on fatally injured drivers are (a) lack of legislation requiring a postmortem BAC test on fatally injured drivers, (b) lack of facilities and medical examiners to perform BAC tests, or (c) an excessive amount of time having elapsed between the time of the accident and the time of death or autopsy.

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In the United States, 35 states currently have laws that require postmortem BAC tests to be conducted on drivers who are fatally injured in motor vehicle accidents (3). Table 1 gives some general information on the number of drivers tested for blood alcohol content and the results of these tests for selected states, as well as a nationwide estimate. Two of the states listed in Table 1, New Jersey and Rhode Island, require postmortem BAC tests, whereas in Virginia and Maine the tests are often performed, but are not mandatory. Even in those states where such tests are required, testing falls short of 100 percent; however, the percentage of drivers tested in each state is higher than the national rate. Therefore, the data from these states should reflect a much more realistic picture of the extent of alcohol involvement in traffic fatalities.

The higher percentages of positive BAC test results for the selected states in Table 1 also are supported by Fatal Accident Reporting System (4) data on driver fatalities in 15 states that routinely perform BAC tests. It is estimated that 80 to 90 percent of all fatally injured drivers in these states are tested, and the results show that in 1982, 48 percent had a blood alcohol concentration of 0.10 percent or more.

The Texas Department of Public Safety (DPS) recognizes that driving-while-intoxicated fatalities may indeed be underreported; the department published the following statement in its 1982 annual report, Motor Vehicle Traffic Accidents (5):

> Accidents in which DWI was reported as a factor do not tell the whole story. As Texas has no law requiring chemical tests on drivers in fatal accidents, it is possible that many injured or deceased drivers who were driving while intoxicated were not reported as DWI.

TABLE 1 Results of BAC Tests Nationwide and in Selected States for 1982 (*4-8*)

	United States	Percent	Virginia	Percent	New Jersey	Percent	Maine	Percent	Rhode Island	Percent
Total number of driver fatalities	24,690		500		524		109		63	
Total number of drivers tested	16,050	65	425	85	453	86	83	76	61	97
Test results										
Positive BAC (≥0.10)	6,907	43	195	46	270	60	43	52	30	49
Negative BAC (<0.10)	6,489	40	222	52	183	40	40	48	31	51
Unknown	2,654	17	8	2	0	0	0	0	0	0

Source: New Jersey State Police Accident Unit.

Although Texas does not perform BAC tests by statute, 10 counties (Bexar, Dallas, El Paso, Galveston, Harris, Johnson, Nueces, Tarrant, Travis, and Wichita) in the state do employ full-time medical examiners who routinely investigate all fatalities, including traffic fatalities. Although these 10 counties constitute a small percentage of the total area of the state of Texas (3.5 percent), they represent more than one-half of the state's population (51.8 percent) and contain all of the major cities in the state. They also represent 37 percent of the state's driver fatalities for 1983.

A comparison of BAC tests results and reporting practices in other states, especially those states that require BAC tests, would provide extremely useful data; however, such studies have been virtually nonexistent. Thus the main purpose of this study is to compare medical examiners' findings with the investigating officers' conclusion of alcohol as a contributing factor according to the accident reports for 1,260 fatally injured drivers. Results of these comparisons are used to estimate the underreporting of accidents in which alcohol is a contributing factor. However, this study is descriptive rather than inferential in nature. No attempt is made to generalize the results based on this sample of fatally injured drivers to total fatal accidents or alcohol-involved accidents in general.

METHODOLOGY

Information from two major data sources was merged to provide the necessary information for matching BAC with the accident report data. BAC is measured in percentage terms by volume; that is, a BAC of 0.10 means one tenth of one percent alcohol in the blood by volume. A driver whose BAC is greater than or equal to 0.10 is considered legally intoxicated or is said to be driving while intoxicated.

BAC data were obtained from 9 of the 10 medical examiners in the counties that routinely perform postmortem BAC tests. These data contained minimal information concerning the accident itself and identified fatally injured victims by case number, name, age, and sex. The only accident information generally available was the date, and sometimes the time, of the accident.

Extensive accident information regarding accident, occupant, and vehicle characteristics was available from the Texas accident data file originally supplied by the Texas Department of Public Safety. Records in this file do not, however, provide the name of the fatally injured person. After matching the age, sex, and date of accidents from the medical examiners' records to the same information on the accident records, the BAC for each case could be compared to the entry in the corresponding accident report that cited whether or not, in the opinion of the investigating officer, alcohol was believed to have been a contributing factor in the accident.

The BAC data were obtained manually from the medical examiners' files. In general, the data collection involved a two-stage procedure. First, driver fatalities were identified from hand-recorded log books maintained at the respective county morgues. All information on the data collection form, except BAC, was recorded. The case number obtained from the log book was then matched with the files maintained in the medical examiner's toxicology lab, and the BAC test results were recorded.

In the nine counties for which BAC test results were available, data were collected on all driver fatalities occurring between January 1, 1983 and December 31, 1984. (Note: Some counties also submitted data for previous years, namely: Johnson and Travis for 1981, and Johnson, Travis, Tarrant, and Wichita for 1982. The 42 matched records for these years are included in this study, as well. Because of the descriptive nature of the analysis, the inclusion of these additional records is not believed to bias the sample.)

COMPARISON OF BAC TEST RESULTS AND ACCIDENT REPORTING PRACTICES

Table 2 gives the distribution of the 1,260 fatally injured drivers for which BAC test results were matched with the reporting officer's assessment of whether or not alcohol use (on the part of the deceased) contributed to the accident. Because a BAC test result of 0.10 percent or more is considered legal intoxication, BAC results were grouped as less than 0.10 percent (within the legal limit) and greater than or equal to 0.10 percent (legally intoxicated, or DWI) by volume.

Two categories of potential disagreement exist between alcohol involvement as reported on the accident report and the BAC test result. These are represented by the off-diagonal cells in Table 2. One category of disagreement contains those cases in which the driver's BAC did not exceed the legal limit, yet alcohol was cited as a contributing factor in the accident. The second category contains those cases in which the driver was DWI, yet alcohol was not cited as a contributing factor in the accident. This second category represents the larger percentage of disagreement between these sources. In Table 2, only 7 percent of the 618 drivers whose BAC did not exceed the legal limit had alcohol cited as a contributing factor in their accidents. The accident reports indicate that only 249 (20 percent) of the drivers were alcohol impaired, whereas in actuality 642 (51 percent) of the fatally injured drivers were DWI.

A statistical test of the hypothesis that the proportion of alcohol-involved driver fatalities from accident reports is equal to the proportion of DWI drivers based on BAC test results is rejected ($p < .0001$). The statistical test used was the test of equality of two proportions using the normal approximation to the binomial (Z-test).

TABLE 2 BAC Test Results by Alcohol as a Contributing Factor

BAC Test	Alcohol Contributing Factor: No	Yes	Total
BAC <0.10	573 (0.93)	45 (0.07)	618 (0.49)
BAC ≥0.10	438 (0.68)	204 (0.32)	642 (0.51)
Total	1,011 (0.80)	249 (0.20)	1,260

Based on these results, it can be expected that of every 100 fatally injured DWI drivers, only 32 of their accident reports will show alcohol as a contributing factor. Of every 100 accidents in which the driver was fatally injured, only 20 of those accident reports will show alcohol involvement when, in actuality, 51 of the drivers in these fatal accidents were DWI.

DESCRIPTIVE PROFILE OF DRIVERS AND ACCIDENTS ACCORDING TO BAC

An analysis of the 1,260 driver fatalities also revealed that the average BAC value was 0.114 percent. In other words, the average level of blood alcohol content of the total sample of fatally injured drivers exceeded the legal limit of 0.10 percent. The average BAC for those driver fatalities in which the driver had a BAC in excess of 0.10 percent was 0.211, twice the legal intoxication limit. Eighty percent (1,011) of the 1,260 accident reports did not cite alcohol as a contributing factor; however, the average BAC value for those 1,011 drivers was 0.096 percent, which is extremely close to the legal intoxication value.

Driver Age

Inspection of the BAC value by age group (Table 3) revealed that the category with the highest average BAC value (0.135) was the 26 to 30 year old age group. Only three of the age groups had average BAC values below the legal limit: those drivers aged 65 and over (0.021), those 18 and under (0.063), and those in the 41 to 64 year age group (0.095).

TABLE 3 Age Distribution of Driver Fatalities

Age	Driver Fatalities	Mean BAC	Proportion of BAC ≥0.10	Mean of BAC ≥0.10
≤15	57	0.063	0.28	0.194
19-20	125	0.109	0.52	0.191
21-25	309	0.124	0.61	0.194
26-30	242	0.135	0.58	0.222
31-40	254	0.129	0.55	0.225
41-64	207	0.095	0.40	0.224
≥65	59	0.021	0.10	0.199
Unknown	7	—	—	—

The 21 to 25 year olds had the highest proportion of fatalities involving legally intoxicated drivers (61 percent), followed by the 26 to 30 year olds (58 percent). Although the 65 and over age group had the lowest average BAC value and the smallest proportion of fatalities involving legally intoxicated drivers, they still had an average BAC of 0.199 for those persons who were DWI--almost twice the legal limit.

Sex of Driver

A significantly higher proportion of male driver fatalities than female had BAC values above the 0.10 percent limit. For males, 55 percent of their driver fatalities were the result of DWI, compared with 32 percent of all female driver fatalities (Table 4). The average BAC values were 12 percent among males and 7 percent among females.

TABLE 4 BAC Test Results by Sex of Driver Fatality

BAC Test	Male	Female	Total
BAC <0.10	455 (0.45)	160 (0.68)	615 (0.49)
BAC ≥0.10	563 (0.55)	77 (0.32)	640 (0.51)
Total	1,018 (0.81)	237 (0.19)	1,244[a]

[a] Sex of driver was unrecorded on 16 accident reports for which BAC test results were available.

Time of Day

Legally intoxicated drivers account for a significant proportion of total driver fatalities between the hours of 11:00 p.m. and 3:00 a.m. Figures 1 and 2 show the hourly fatal accident frequencies for drivers with BACs less than 0.10 percent and greater than or equal to 0.10 percent, respectively. Note that the hourly distributions are fairly uniform for BAC values of less than 0.10 percent, indicating that the probability of a fatal accident occurring at any given hour is the same among driver fatalities in which the driver was not legally intoxicated. However, the proportion of fatalities among DWI drivers is substantially higher between the hours of 11:00 p.m. and 3:00 a.m. when 70 percent of the drivers in these accidents had BAC values in excess of 0.10 percent. These results are also consistent with the national trend reported in the 1982 Fatal Accident Reporting System overview (4).

Day of Week

More than 50 percent of the fatally injured drivers involved in accidents on Sunday, Saturday, and Thursday were DWI (see Table 5). Although the highest average BAC value occurred on Sunday (0.13), it is interesting that the average values were above the legal limit on all days except Monday (0.09).

UNDERREPORTING OF ALCOHOL INVOLVEMENT BY SELECTED VARIABLES

Driver Age

Table 6 gives a summary of the findings of the comparison of BAC values with reported alcohol involvement by age. The column labeled "Percent Alcohol Involvement" is the percentage of driver fatalities in that age group whose accident reports list alcohol involvement. These percentages are noteworthy because they are the figures most often used in policy decision making and reported in accident statistics. However, the column labeled "Percent BAC ≥ 0.10" is the actual percentage of DWI driver fatalities in that age group, based on BAC test results. These percentages represent the true extent of alcohol involvement in this data set.

The discrepancies between these two sets of figures are quite large (Table 6). For example, only 23

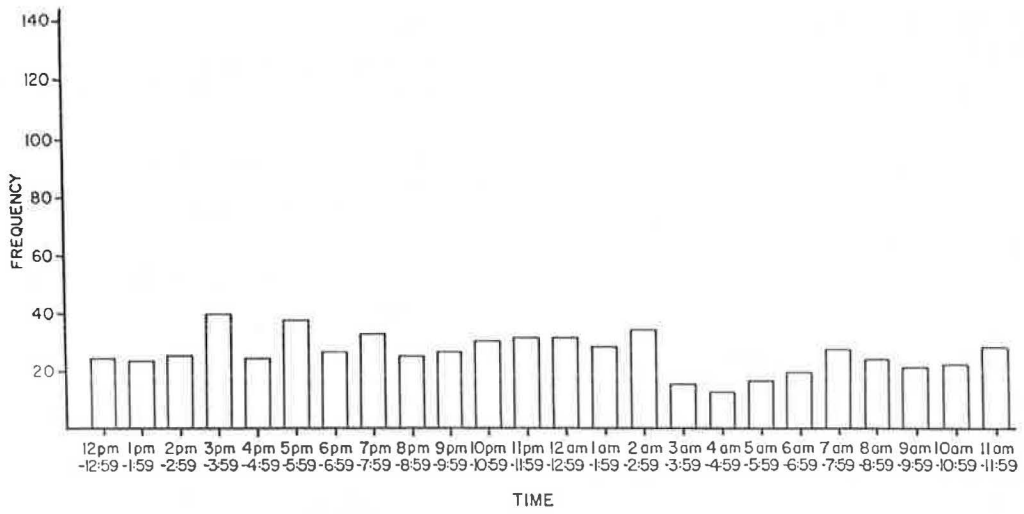

FIGURE 1 Non-DWI driver fatalities by time of day.

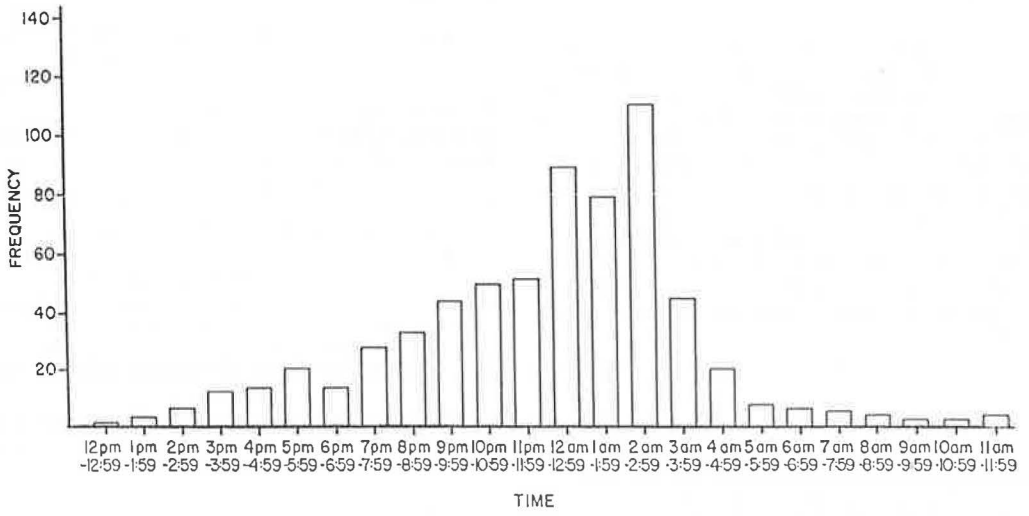

FIGURE 2 DWI driver fatalities by time of day.

TABLE 5 Driver Fatalities by Day of Week

Day	Total	Percent BAC ≥0.10	Average BAC
Sunday	177	59	0.13
Monday	161	42	0.09
Tuesday	163	45	0.10
Wednesday	145	49	0.11
Thursday	141	53	0.12
Friday	211	49	0.11
Saturday	256	56	0.12
Unknown	6	–	–

TABLE 6 BAC Test Results and Reported Alcohol Involvement by Age of Driver

Age	Percent Reported Alcohol Involvement	Percent BAC ≥0.10
≤18	14.0	28.1
19-20	23.2	52.0
21-25	22.0	60.5
26-30	24.4	57.9
31-40	18.9	55.1
41-64	15.9	40.1
≥65	3.4	10.2

percent of the 125 driver fatalities in the 19 to 20 year age group had alcohol cited as a contributing factor on the accident reports, whereas in actuality, 52 percent of these drivers were DWI. In the 21 to 25 year age group, only 68 of the 309 fatally injured drivers (22 percent) had reports in which alcohol was cited as a contributing factor, but 61 percent (187 drivers) were found to be legally intoxicated.

Underreporting rates did not vary significantly by either the age or the sex of the fatally injured drivers.

Investigating Officer

As can be seen in Table 7, a large difference in the underreporting rate existed between local police officers and the Texas Department of Public Safety officers. DPS officers failed to cite alcohol as a contributing factor for 30 percent of the DWI drivers, whereas local police failed to note alcohol involvement on the accident reports of 76 percent of the DWI drivers.

Conversely, DPS had a higher overreporting rate than did the local police officers. DPS officers cited alcohol as a contributing factor for 15 of the

TABLE 7 BAC Test Results by Alcohol as a Contributing Factor for Accidents Investigated by DPS Officers Versus Local Police Officers

	Alcohol Contributing Factor		
BAC Test	No	Yes	Total
DPS Officers			
BAC <0.10	75 (0.83)	15 (0.17)	90 (0.46)
BAC ≥0.10	32 (0.30)	75 (0.70)	107 (0.54)
Total	107 (0.54)	90 (0.46)	197
Local Police Officers			
BAC <0.10	498 (0.94)	30 (0.06)	528 (0.50)
BAC ≥0.10	406 (0.76)	129 (0.24)	535 (0.50)
Total	904 (0.85)	159 (0.15)	1,063

90 (17 percent) fatally injured drivers whose BACs did not exceed the legal intoxication limit. Local police officers, on the other hand, noted alcohol involvement for non-DWI drivers only 30 times out of 528 (6 percent). This finding suggests that DPS officers may be more willing than their local police counterparts to report alcohol as a contributing factor in a driver fatality. This conclusion is also supported by the statistic that whereas DPS officers cited alcohol as a contributing factor in 46 percent of the driver fatality accidents they investigated, local police officers noted alcohol as a contributing factor in only 15 percent of their corresponding accident reports.

ESTIMATION OF THE DEGREE OF ALCOHOL INVOLVEMENT IN DRIVER FATALITIES

Estimation of the degree of alcohol involvement in driver fatalities is a difficult problem. In order to obtain this estimate, it is necessary to obtain alcohol content information on all drivers involved in an accident resulting in a fatality, not just driver fatalities. Unfortunately, this information is not generally available. The nonfatal driver is seldom tested for alcohol content, and even if tested, the results are not easily attainable.

Attempting to estimate the degree of alcohol involvement in driver fatalities by using only information based on the blood alcohol content of driver fatalities is difficult because of the amount of missing data and the few counties in which BAC tests are performed. Although an exact estimate of the proportion of driver fatalities in which the driver is legally intoxicated is not available because of these problems, upper and lower bound estimates are available based on the reported data. Of the 781 driver fatalities reported in the 10 counties in 1983, at least 260 had BACs equal to or in excess of the legal limit of 0.10, that is, at least 33 percent of the drivers were legally intoxicated. If all of the driver fatalities for which BAC results are unknown were legally intoxicated, this proportion could be as high as 68 percent. This may be an unrealistic upper bound; however, because the true proportion of driver fatalities that involved alcohol lies within this wide range the need for mandatory BAC test requirements is emphasized to enable a more precise estimation of the extent of the alcohol problem. Based on the 516 BAC test results for 1983, 50.4 percent of the driver fatalities tested for BAC were legally intoxicated. Whether this estimate of the true proportion is biased upward or downward cannot be determined from the data in this study, but it is known that the true proportion cannot exceed 68 percent or be less than 33 percent of all driver fatalities in the 10 counties studied.

CONCLUSIONS

The extent of alcohol involvement in driver fatalities is not adequately represented by the reporting of alcohol as a contributing factor on accident reports. The actual percentage of DWI drivers among the 1,260 driver fatalities examined in this study was considerably higher than the percentage of accident reports that cited alcohol as a contributing factor in those same accidents (51 percent versus 20 percent, respectively). Among the DWI driver fatalities, 68 percent of the accident reports did not cite alcohol as a contributing factor in the accident.

BAC test results appear to be the only data source for accurately estimating the proportion of DWI driver fatalities. This information exists for only a small proportion of driver fatalities in Texas (37 percent). An accurate statewide estimate of the number of DWI driver fatalities will not be possible until more data on BAC test results are available throughout the state.

It is hoped that the results of this study emphasize the need for more complete information on alcohol involvement than is currently available. Such information is essential for effective countermeasure evaluation of highway safety programs. For example, the fact that legally intoxicated drivers account for a significant proportion of total driver fatalities between the nighttime hours of 11:00 p.m. and 3:00 a.m. suggests that the nighttime driver population may consist of a larger proportion of DWI drivers than the daytime driving population. If this is true, the evaluation of any countermeasure based on nighttime accident frequencies risks being confounded with the DWI problem. Reliable and complete BAC test results could provide information that would be useful in evaluating such countermeasures independent of the effect of alcohol as a contributing factor.

The only way to measure the full extent of drunk driving and the effect of various countermeasures designed to reduce alcohol-related accidents is to record a BAC for every driver involved in a traffic accident or killed in one. Even further insights into the economic and social costs of drinking and driving would be gained if BAC data for fatally injured passengers and pedestrians could be obtained. The availability of such data would greatly facilitate the development of reliable and valid estimates of the extent of alcohol involvement at the state and national levels.

ACKNOWLEDGMENTS

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REFERENCES

1. J.C. Fell. Alcohol Involvement in Traffic Accidents. NHTSA, U.S. Department of Transportation, 1982.
2. R.J. Macdonald. An Issue Paper on DWI Policy. Traffic Safety Section, Texas State Department of Highways and Public Transportation, Austin, July 1, 1982.
3. Digest of State Alcohol-Highway Safety Legislation. 2nd ed., DOT-HS-806-480. NHTSA, U.S. Department of Transportation, 1983.
4. Fatal Accident Reporting System 1982. DOT-HS-

806-566. NHTSA, U.S. Department of Transportation, May 1984.
5. Motor Vehicle Traffic Accidents 1982. Texas Department of Public Safety, Austin.
6. Medico-Legal Bulletin. Office of the Chief Medical Examiner, Virginia State Health Department, Vol. 33, No. 2, March-April 1984.
7. Annual Report 1982. Office of the Chief Medical Examiner, Rhode Island Department of Health, Providence.
8. Annual Report 1982. Office of the Chief Medical Examiner, Augusta, Maine.

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Problems of Combination Trucks on Wet Pavements: An Accident Analysis

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ABSTRACT

A study of wet-pavement truck accidents was carried out for over-the-road trucks authorized by the Interstate Commerce Commission (ICC). The study was based on accident data from the Bureau of Motor Carriers Safety (BMCS) for 1979 through 1981. The analysis was limited to truck accident involvements on four-or-more-lane highways in Texas. Discrete-multivariate methods were used for the analysis. The analysis indicates that empty trucks show up to three times higher propensity for single-truck accident involvements (run-off-road, jackknife, overturn, and separation of units) on wet pavements than do loaded trucks. The ratios of wet-pavement to dry-pavement accident involvements were found to be influenced by the following factors: empty/loaded, truck type, and accident type, but not by day/night. The ratio of single-truck accident involvements on wet pavements to those on dry pavements was found to be much higher for empty trucks than for loaded trucks, after adjusting for truck type. Heavy-truck involvements in multivehicle collisions were used as a comparison group. These findings appear to strongly support the prediction by Horne and the laboratory study conducted by Ivey, that truck tires can hydroplane at highway speeds when the trucks are empty or lightly loaded.

The purpose of this paper is to identify possible causes of combination-truck accidents that result from loss of control. In particular, an in-depth analysis of past accident experience of empty combination trucks in wet conditions will be carried out. The data source for this investigation is the Bureau of Motor Carriers Safety (BMCS) file for the Interstate Commerce Commission [(ICC) authorized)] carriers.

INTRODUCTION

Combination truck accidents that result from loss of control are complex phenomena. They are usually the result of failures in the system comprising vehicle, roadway, driver, visibility, and environmental characteristics, as well as chance. Although theoretical work on vehicle dynamics, laboratory simulation, and vehicle testing have greatly enhanced the knowledge about the factors that lead to lack of stability of trucks in wet conditions, past accident records of these heavy trucks have not been thoroughly analyzed to provide evidence in support of these theories.

Ivey et al. (1) reported that the following elements, independently or interactively, had been identified in past studies as possible causes of combination trucks losing control in wet conditions:

1. Low tire pavement friction,
2. Brake system characteristics,
3. Speed,
4. Reduced visibility, and
5. Hydroplaning.

Loss of control of combination trucks may result in reported accidents such as jackknife, overturn, run-off-road, and separation of units. These four

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