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Publication of this paper sponsored by Committee on Motorist Services.

Comparison of Truck and Passenger-Car Accident Rates on Limited-Access Facilities

WARREN S. MEYERS

A lack of verifiable exposure data (vehicle miles of travel) for passenger cars and trucks has made comparisons of their accident rates suspect. Such comparisons are particularly important at this time because of the current trend toward longer and heavier trucks that travel alongside smaller and lighter automobiles. In response to the weaknesses in the existing accident-rate data, a nationwide survey of accident rates was made of the 1976 through 1978 accident experience for 34 limited-access facilities. These included 21 toll expressways and turnpikes and 13 bridges and tunnels for which accurate exposure figures could be obtained. The results show that fatal accident rates for light and heavy trucks on expressways were significantly greater than that for passenger cars: the rate for light trucks was 135 percent greater than that for passengers cars and that for heavy trucks was 110 percent greater. The injury accident rate for light trucks was 55 percent greater than that for passenger cars, whereas the injury accident rate for heavy trucks was 37 percent higher compared with that for passenger cars. The overall expressway accident rates for light and heavy trucks exceeded that for passenger cars by 72 percent and 58 percent, respectively. For the bridges and tunnels, overall accident rates for light and heavy trucks were seven and four times greater than that for the average passenger car.

The American Automobile Association (AAA) Foundation for Traffic Safety and the Automobile Club of New York undertook a study of the accident potential of the big truck and its impact on the safety of motorists. The study was conducted in part because of motorists' long-standing concern about the safety of the big truck. Motorists report that they are intimidated by the size of many trucks and alarmed by the wind forces created when the large rigs pass their cars on the highway. They also complain that many trucks tailgate on the highway.

Based on the record, the motorists' concern would appear to be justified. Consider, for example, the fact that for every truck driver who dies in a collision with a passenger vehicle, 32 automobile occupants are killed (1).

In addition, prevailing statistics indicate that trucks are increasingly involved in fatal accidents. In 1975, for example, trucks that had gross vehicle weights of more than 10 000 lb accounted for 1 in 16 vehicles involved in a fatal accident. By 1978, these trucks were involved in 1 of 12 fatal accidents (2).

It became rather evident from a review of the truck safety literature that the information available on the accident-involvement rates of large trucks was relatively limited, highly suspect, and unsuitable to factually establish the magnitude of the truck safety problem.

The major weakness found was the difficulty in obtaining accurate and verifiable measures of exposure by federal and state agencies. Because the practice in determining the relative safe operating experience of different types of vehicles in the traffic stream is to present the accident experience in terms of an exposure rate [the number of vehicle miles of travel (VMT)], the data available were inconclusive since they are based on estimates of vehicle exposure, not factual recordings.

For example, a review of the accident rates published by the National Highway Traffic Safety Administration (NHTSA), derived from the Fatal Accident Reporting System (FARS) data, demonstrated these concerns. Although the number of persons killed in car or truck accidents is accurately tallied and probably represents the most reliable figures available on fatal truck accidents, the exposure information used to calculate the fatal accident rates for cars and trucks was based on gross estimates of mileage. These were derived from such types of data as regional gasoline sales, vehicle registrations, and national studies of driving habits. This type of situation is recurring and accordingly renders much of the currently available highway accident-rate information unsuitable to formulate the basis for any discussion of the impact of trucks on highway safety.

A review of the truck accident data collected by the Bureau of Motor Carrier Safety also revealed problems. Their accident records are limited to the self-reporting by regulated carriers involved in interstate commerce, whereas the experience of unregulated intrastate trucks is overlooked and not represented in the bureau's accident statistics.

As a result, the consensus of the literature search was that the problem with the data available from the federal government and other agencies is that the information provided on exposure--the potential for an accident--was largely an estimate made without adequate data. The problem of big-truck safety could not then be effectively approached until it could be factually established that the big truck is actually disproportionately involved in traffic accidents. In other words, in order to gain support for improving the safety of the big truck, it must first be documented that the big truck is in fact unsafe.

In an effort to provide national statistics, the AAA foundation called on local AAA clubs to assist in the collection of exposure and accident data for controlled-access facilities for which the on and

Table 1. Expressway and turnpike overall accident rates.

	Accident Rate/100 Million VMT[a]								
	Passenger Cars			Light Trucks			Heavy Trucks		
Facility	1976	1977	1978	1976	1977	1978	1976	1977	1978
California									
Interstate 15	N/A	50.0[b]	–	N/A	48.0[b]	–	N/A	88.0[b]	–
Florida									
Florida's Turnpike	47.6	64.4	81.2	67.5	33.0	85.3	106.5	66.0	111.7
Airport Expressway	172.3	228.8	292.6	208.6	489.2	359.6	1725.8	2329.6	3249.0
East-West Expressway	187.6	214.7	216.1	201.5	251.2	167.2	1389.9	1900.3	1157.8
Everglades Parkway	537.2	595.3	682.7	350.9	443.1	359.1	236.6	292.7	520.5
West Dade Expressway	45.2	63.1	60.3	30.0	45.1	23.9	41.1	35.4	66.9
Illinois Turnpike	174.4	192.6	N/A	380.2	368.5	N/A	129.7	135.8	N/A
Kansas Turnpike	94.2	116.2	127.8	270.0	316.1	365.7	162.2	180.8	205.1
Kentucky									
Bluegrass Parkway	92.5	114.7	84.5	195.4	215.4	180.4	130.9	123.3	81.3
Cumberland Parkway	52.2	66.0	90.6	59.3	170.3	74.5	65.6	35.8	51.3
Daniel Boone Parkway	195.6	119.3	220.3	242.7	255.0	420.2	136.4	155.8	145.4
Green River Parkway	90.0	117.6	106.1	36.8	186.7	103.5	52.0	106.6	107.4
Purchase Parkway	114.2	121.9	118.9	323.0	196.8	174.7	107.8	146.7	68.1
Mountain Parkway	104.2	122.5	107.9	331.4	447.2	377.9	206.5	182.9	121.2
Pennyrile Parkway	192.6	195.4	216.1	324.5	228.6	304.7	88.3	267.0	208.2
Western Kentucky Parkway	94.6	103.1	106.8	131.2	169.9	220.4	83.3	151.6	111.6
Ohio Turnpike	N/A	112.4	109.5	N/A	225.6	238.1	N/A	207.8	197.1
New Jersey Turnpike	61.6	72.5	69.4	–[c]	–[c]	–[c]	165.0[c]	201.2[c]	234.7[c]
New York State Thruway		107.0[d]			88.0[d]			221.8[d]	
Pennsylvania Turnpike	63.9	76.1	88.3	–[c]	–[c]	–[c]	37.0[c]	42.5[c]	47.2[c]
West Virginia Turnpike	97.1	128.0	105.0	851.6	376.7	530.3	71.4	174.7	241.5

Note: N/A = not available.
[a]Includes property-damage, injury, and fatal accidents.
[b]1977 and 1978 data were combined and are listed under 1977.
[c]Light and heavy truck data were combined.
[d]1976, 1977, and 1978 data were combined.

off movements of vehicles (both passenger cars and trucks) were documented by toll-collection records. By using a controlled environment, both the exposure and accident experience could be accurately determined for all vehicles on the highway; a valid comparison of the safety record of the various types of road users was thereby produced.

The subsequent response by AAA clubs provided data on the VMT and the number of accidents for each vehicle class for highways, bridges, and tunnels across the country; this study encompassed a representative mix of rural and urban facilities from almost every region of the United States.

STUDY METHOD

The data used in the foundation's study were obtained from agencies responsible for the day-to-day operations of controlled-access toll highways, bridges, and tunnels. As mentioned previously, controlled-access toll facilities were used because the on and off movements of all vehicles are precisely known and because of the assured availability of accurate accident statistics.

The total VMT on a highway represents what is commonly referred to as exposure, and when these historical mileage data are related to the number of vehicles involved in accidents, the resulting expression is a vehicle accident involvement rate, that is, the number of vehicles in accidents for a specified distance of travel.

For purposes of this study and consistent with accepted practices, accident rates are expressed as the number of vehicle accident involvements per 100 million VMT.

The accident information provided the number of vehicles by type that used the facility, their exposure, the number of vehicles involved in accidents, and the type of accident (whether they involved property damage, resulted in injuries, or produced a fatality). The data covered the years 1976 through 1978.

The three broad categories of vehicles investigated were passenger cars, light trucks (those that weighed 10 000-26 000 lb), and heavy trucks (vehicles more than 26 000 lb).

The overall accident rates reported in this study include property-damage, injury, and fatal accidents. In the calculation of the injury accident rate, accidents that involved both injuries and fatalities were included.

The accident data provided in Tables 1-4 permitted an analysis of 2.3 billion vehicle trips that covered 49.1 billion vehicle miles and 73 500 truck and passenger-car accident involvements.

The accident rates for controlled-access highways were evaluated separately from those for bridges and tunnels because of suspected differences in traffic operating characteristics between the two types of facilities. As a result, the conclusions of the study are based primarily on information from the controlled-access highways because the exposure information was predominantly for that type of facility (91.2 percent of the exposure was for expressways versus 8.8 percent for bridges).

RESULTS

Because the data collected and analyzed in connection with this report were based on reasonably accurate exposure and accident data, the conclusions that have been drawn would likewise have greater accuracy than many of the statistics that have been reported in the past.

The analysis shows that, for whatever reason, light and heavy trucks are disproportionately involved in traffic accidents as compared with passenger cars.

The fatal accident rates for controlled-access expressways are provided in Figure 1 and show that the fatal accident rates for light and heavy trucks were significantly greater than that for passenger cars. On the average, light trucks were involved in 2.35 times more fatal accidents than were passenger cars for the same distance traveled. Heavy trucks were also found to be overinvolved; there were 2.10 times more fatal accidents for heavy trucks than for passenger cars for the same exposure.

Table 2. Expressway and turnpike injury accident rates.

Facility	Accident Rate/100 Million VMT[a]								
	Passenger Cars			Light Trucks			Heavy Trucks		
	1976	1977	1978	1976	1977	1978	1976	1977	1978
California									
Interstate 15	[Data provided did not include specific information on injury accidents.]								
Florida									
Florida's Turnpike	17.9	24.0	29.0	20.5	18.1	16.1	31.9	19.9	37.2
Airport Expressway	74.9	85.4	115.9	94.8	139.8	205.5	246.5	582.4	0.0[b]
East-West Expressway	66.3	72.5	74.3	52.6	91.4	83.7	198.6	532.9	463.1
Everglades Parkway	212.6	239.5	319.8	184.3	175.4	127.7	84.7	128.8	178.8
West Dade Expressway	17.5	22.5	22.9	4.3	14.1	4.3	6.9	10.1	14.9
Illinois Turnpike	48.5	52.3	N/A	86.1	87.1	N/A	30.8	28.4	N/A
Kansas Turnpike	42.5	50.5	52.4	109.7	128.1	108.6	56.2	76.0	78.6
Kentucky									
Bluegrass Parkway	31.2	40.4	16.0	65.1	123.1	30.1	20.2	47.4	45.1
Cumberland Parkway	18.3	24.5	22.7	59.3	42.5	0.0	43.7	17.9	51.3
Daniel Boone Parkway	65.2	63.3	96.0	80.9	0.0	224.1	0.0	72.2	66.1
Green River Parkway	24.7	33.6	17.1	36.8	0.0	34.5	31.2	26.7	49.6
Purchase Parkway	14.8	36.1	63.5	107.8	98.4	87.3	26.9	62.9	0.0
Mountain Parkway	45.9	49.5	40.4	165.7	201.3	133.4	82.6	77.0	30.3
Pennyrile Parkway	81.4	64.6	68.6	144.2	65.3	60.8	40.8	102.7	44.0
Western Kentucky Parkway	27.5	30.9	35.4	18.7	34.0	50.9	36.4	40.4	31.2
Ohio Turnpike	N/A	40.8	36.3	N/A	91.2	67.6	N/A	67.2	62.1
New Jersey Turnpike	23.6	24.5	24.4	–[c]	–[c]	–[c]	55.0[c]	66.2[c]	71.7[c]
New York State Thruway		26.0[d]			19.0[d]			54.8[d]	
Pennsylvania Turnpike	25.2	25.1	26.6	–[c]	–[c]	–[c]	38.8[c]	45.0[c]	50.0[c]
West Virginia Turnpike	40.4	73.4	50.4	310.9	235.4	85.4	46.1	85.4	120.8

Note: N/A = not available.
[a]Includes injury and fatal accidents.
[b]Data provided are questionable.
[c]Light and heavy truck data were combined.
[d]1976, 1977, and 1978 data were combined.

Table 3. Expressway and turnpike fatal accident rates.

Facility	Accident Rate/100 Million VMT[a]								
	Passenger Cars			Light Trucks			Heavy Trucks		
	1976	1977	1978	1976	1977	1978	1976	1977	1978
California									
Interstate 15	N/A	4.0[a]	–	N/A	3.2[a]	–	N/A	8.0[a]	–
Florida									
Florida's Turnpike	0.3	0.7	1.3	2.0	0.0	4.6	1.0	1.4	3.2
Airport Expressway	2.6	1.8	2.5	0.0	0.0	0.0	0.0	0.0	0.0
East-West Expressway	0.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Everglades Parkway	3.1	4.5	6.3	0.0	0.0	16.0	4.7	17.6	15.8
West Dade Expressway	0.4	0.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Illinois Turnpike	0.9	1.2	N/A	2.5	1.4	N/A	1.1	0.9	N/A
Kansas Turnpike	2.7	1.7	2.3	5.9	8.5	7.9	0.0	8.7	2.3
Kentucky									
Bluegrass Parkway	1.1	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0
Cumberland Parkway	2.6	4.9	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Daniel Boone Parkway	2.6	7.3	10.9	0.0	0.0	56.0	0.0	0.0	13.2
Green River Parkway	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.8
Purchase Parkway	0.0	0.0	4.0	0.0	0.0	87.3	0.0	0.0	0.0
Mountain Parkway	1.0	4.0	3.8	0.0	22.4	44.5	0.0	9.6	0.0
Pennyrile Parkway	12.5	1.4	0.0	0.0	0.0	0.0	13.6	0.0	0.0
Western Kentucky Parkway	2.8	2.8	2.1	0.0	17.0	0.0	0.0	0.0	0.0
Ohio Turnpike	1.0	1.2	0.8	0.0	3.0	1.0	3.0	3.9	2.0
New Jersey Turnpike	0.6	0.5	0.4	–[b]	–[b]	–[b]	3.0[b]	2.2[b]	2.7[b]
New York State Thruway		1.0[c]			1.0[c]			2.8[c]	
Pennsylvania Turnpike	0.3	0.5	1.0	–[b]	–[b]	–[b]	1.8[b]	2.5[b]	2.8[b]
West Virginia Turnpike	6.7	12.5	11.0	13.5	94.2	32.5	11.5	2.0	29.8

Note: N/A = not available.
[a]1977 and 1978 accident data were combined and are listed under 1977.
[b]Light and heavy truck data were combined.
[c]1976, 1977, and 1978 accident data were combined.

The dramatically disproportionate involvement of light and heavy trucks in fatal accidents can be attributed to the fact that when big trucks were involved, the results unfortunately were not just property-damage accidents but instead fatal accidents.

As shown in Figure 2, light trucks were involved in 1.55 times more injury accidents than were passenger cars, whereas heavy trucks were involved in 1.37 times more injury accidents than were passenger cars.

The overall accident-involvement rate presented in Figure 3 shows that, compared with passenger cars, light and heavy trucks were involved in 1.72 and 1.58 times more accidents, respectively, than were cars. Light trucks and heavy trucks were thus involved in 72 and 58 percent more accidents, respectively, than were passenger cars for the same distance traveled under the same driving conditions.

Figure 4 shows that, whereas all trucks account for only 20.3 percent of the highway exposure (a product of the number of vehicles and the miles they

Table 4. Bridge and tunnel overall and injury accident rates.

Facility	Passenger Cars 1976	Passenger Cars 1977	Passenger Cars 1978	Light Trucks 1976	Light Trucks 1977	Light Trucks 1978	Heavy Trucks 1976	Heavy Trucks 1977	Heavy Trucks 1978
Bridge and Tunnel Overall Accident Rate/100 Million VMT[a]									
California									
Carquinez Bridge, Solano County	189.1	127.9	168.2	0.0	378.5	1383.6	838.9	1355.0	1500.6
Golden Gate Bridge, San Francisco	155.3	178.7	170.8	849.8	951.5	1267.9	4732.8	3702.7	4481.4
San Francisco-Oakland Bay Bridge	191.4	186.3	200.0	202.0	80.3	316.8	2543.6	2893.6	2360.5
San Mateo Bridge	78.5	74.1	85.1	243.9	548.5	172.5	1058.8	1074.8	945.7
Delaware									
Delaware Memorial Bridge	117.7	95.8	99.4	408.1	302.1	626.6	170.7	205.0	214.2
Florida									
Warren Bridge	361.8	511.1	632.3	206.2	873.4	292.2	429.6	315.4	519.0
Maryland									
Baltimore Harbor Tunnel	379.3	276.9	274.6	–[b]	–[b]	–[b]	1316.7[b]	897.5[b]	886.4[b]
New York									
Bronx Whitestone Bridge	N/A	225.0	233.0	N/A	3864.0	3017.0	N/A	4147.0	4049.0
George Washington Bridge	861.0	1054.0	1057.0	2690.0	3368.0	3024.0	2238.0	3316.0	3121.0
Throgs Neck Bridge	N/A	186.0	172.0	N/A	1155.0	858.0	N/A	2826.0	1982.0
Triborough Bridge	N/A	253.0	242.0	N/A	2381.0	2379.0	N/A	3036.0	2933.0
Verrazano Narrows Bridge	N/A	187.0	199.0	N/A	1564.0	1516.0	N/A	1554.0	2938.0
Virginia									
Chesapeake Bay Bridge and Tunnel	101.4	159.6	161.5	–[b]	–[b]	–[b]	188.1[b]	283.5[b]	325.6[b]
Bridge and Tunnel Injury Accident Rate/100 Million VMT									
California									
Carquinez Bridge, Solano County	55.9	64.0	44.9	0.0	0.0	691.8	0.0	338.7	300.1
Golden Gate Bridge, San Francisco	29.3	34.8	38.6	255.0	173.0	338.1	364.1	0.0	344.7
San Francisco-Oakland Bay Bridge	68.3	70.6	72.0	40.4	40.2	79.2	514.8	661.8	442.6
San Mateo Bridge	36.7	25.5	36.8	0.0	274.2	86.3	302.5	286.6	337.7
Delaware									
Delaware Memorial Bridge	26.4	23.3	24.5	N/A	151.1	289.2	22.2	29.3	35.7
Florida									
Warren Bridge	99.5	163.9	273.7	0.0	249.5	146.1	0.0	0.0	0.0
Maryland									
Baltimore Harbor Tunnel	83.3	65.3	68.3	–[c]	–[c]	–[c]	246.1[c]	180.2[c]	123.6[c]
New York									
Bronx Whitestone Bridge	N/A	53.0	73.0	N/A	601.0	670.0	N/A	444.0	675.0
George Washington Bridge	105.0	121.0	136.0	247.0	124.0	182.0	90.0	104.0	96.0
Throgs Neck Bridge	N/A	43.0	42.0	N/A	495.0	241.0	N/A	491.0	375.0
Triborough Bridge	N/A	78.0	68.0	N/A	729.0	870.0	N/A	479.0	800.0
Verrazano Narrows Bridge	N/A	54.0	54.0	N/A	512.0	497.0	N/A	473.0	1079.0
Virginia									
Chesapeake Bay Bridge and Tunnel	40.6	61.4	61.4	–[c]	–[c]	–[c]	47.0[c]	87.2[c]	101.7[c]

Note: N/A = not available.
[a]Includes property-damage and injury accidents.
[b]Light and heavy truck data were combined.
[c]Light and heavy truck data were combined.

Figure 1. Fatal accident rates for controlled-access expressways.

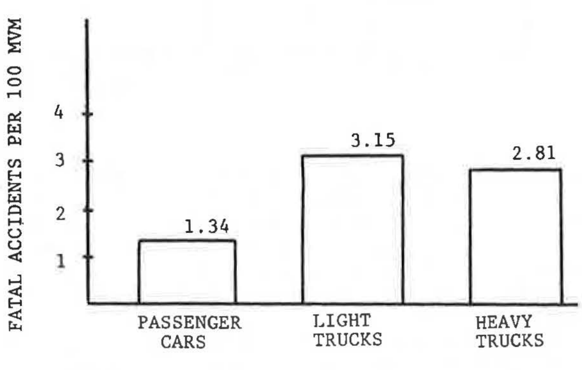
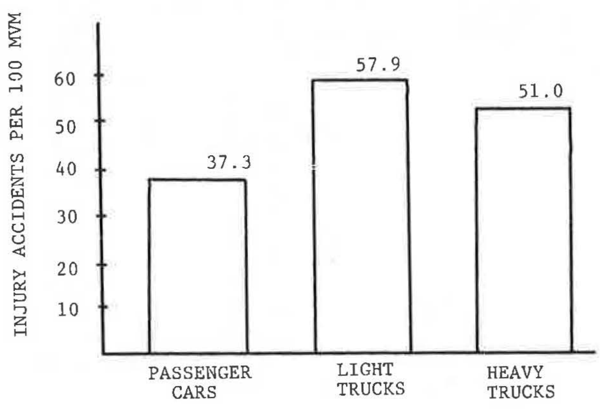


Figure 2. Injury accident rates for controlled-access expressways.



traveled), they represented 35.3 percent of the vehicles involved in fatal accidents.

Moreover, Figure 5 shows that, although light and heavy trucks made up 29 percent of all the vehicles involved in accidents, they were involved in more than one-third of the fatal accidents.

The analysis also showed that, although 1 in 85 car accidents is fatal, 1 in 63 heavy-truck accidents results in a fatality. This suggests the effect of a truck's substantially greater size and weight on accident severity.

The number of trucks involved in fatal accidents was also found to have risen disproportionately when compared with increases reported for truck exposure. This is shown in Figure 6, which illustrates that between 1976 and 1978, truck exposure increased

Figure 3. Overall accident rates for controlled-access expressways.

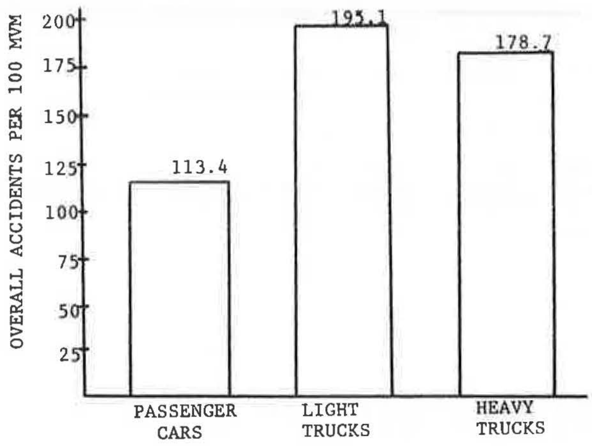


Figure 4. Fatal truck accidents in relation to vehicle exposure.

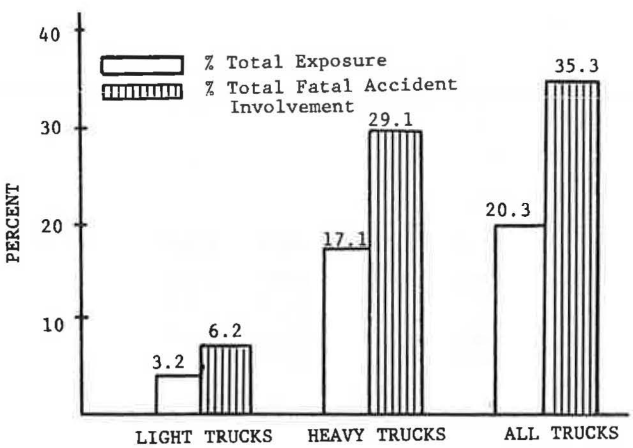
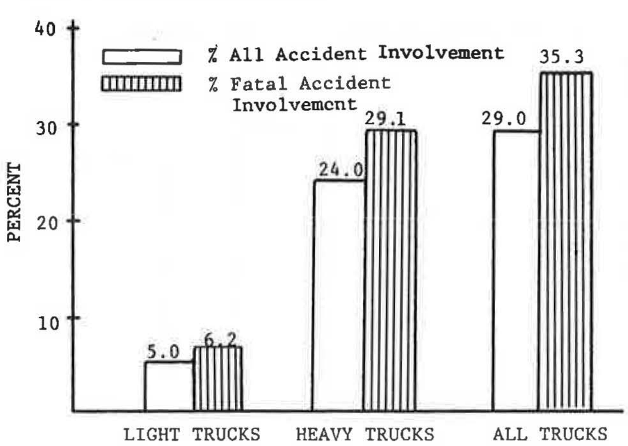


Figure 5. Fatal truck accidents in relation to all truck accidents.



by 58 percent, whereas fatal truck accidents on the highways studied increased by a staggering 96 percent.

Accident rates for the toll bridges and tunnels in the study are provided in Figure 7 and show that the differences in the overall accident rates for light and heavy trucks compared with those for the

Figure 6. Changes in truck accident involvement, 1976-1978.

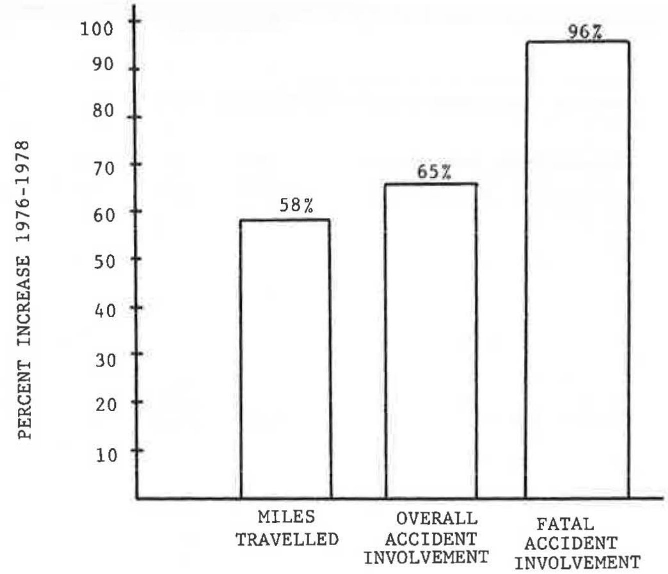
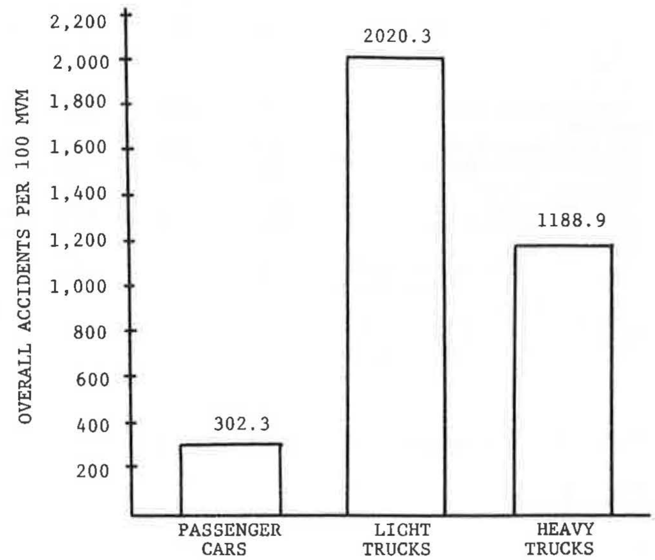


Figure 7. Overall accident rates for bridges and tunnels.

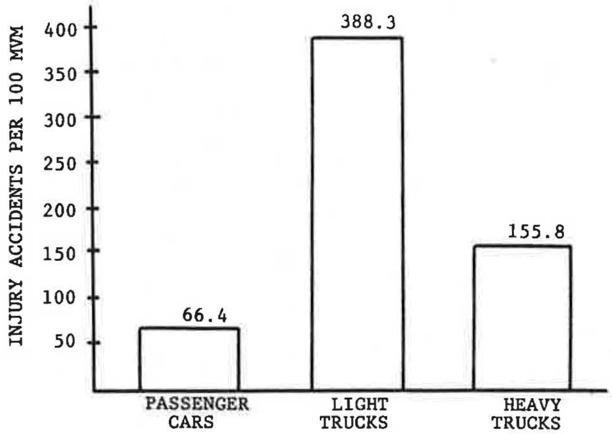


passenger cars were even greater than those for expressways. On the average, light trucks were involved in 6.7 times more accidents than were passenger cars for the same distance traveled. Heavy trucks were found to be involved in 3.9 times as many accidents as were passenger cars for the same exposure.

As shown in Figure 8, light trucks were involved in 5.8 times more injury accidents than were passenger cars for the bridges and tunnels, whereas heavy trucks were involved in 2.3 times the number of injury accidents for the same distance traveled.

The overall bridge and tunnel accident rates for light and heavy trucks were 10.4 and 6.7 times greater, respectively, than those for expressways. The accident rate for passenger cars for bridges and tunnels was, on the other hand, only 2.7 times greater than that for expressways.

Figure 8. Injury accident rates for bridges and tunnels.



SUMMARY

The findings may be summarized as follows:

1. The fatal accident rate of trucks is more than two times greater than the accident rate for passenger cars for the same exposure on the highway.
2. Other accident rates for light and heavy trucks, which include injury and property-damage accidents, are also disproportionately greater compared with those for passenger cars for the same distance traveled under identical conditions.
3. Big trucks are involved in a significantly greater share of fatal accidents than might be expected for their mileage and population on the highway.
4. A substantially higher number of truck accidents result in a fatality than do passenger-car accidents, which suggests that the trucks' size and weight influence accident severity.
5. As the VMT of the big truck increases, there has been a disproportionate increase in fatal truck accident involvements.
6. Although trucks now account for 20 percent of the vehicle exposure on expressways and turnpikes, they are involved in 35 percent of the fatal accidents. On some major thoroughfares, such as the Pennsylvania, Ohio, and New Jersey Turnpikes, about 50 percent of all fatal accidents involve a truck.

CONCLUSIONS

This study presents, perhaps for the first time, accident rates based on accurate exposure data that document the serious overinvolvement of trucks in traffic accidents. The results are based on accident and exposure data that have been provided for facilities that make up what are generally regarded as the nation's safest highways.

Although the study obviously can only account for the traffic mix as it currently prevails, the situation can only be expected to worsen as the disparity between weight and size of the passenger car and the truck continues to increase.

Unfortunately, there is every indication that the future will present a bleak picture for the motoring public. Because of the concern about fuel economy, automobiles are getting smaller and lighter, whereas trucks are getting bigger and heavier.

In addition to the growing disproportion in size and weight of the traffic mix, the number of large vehicles in the traffic stream has grown rapidly in recent years. In 1977, trucks carried three times the number of ton miles of intercity freight as they did in 1950 (3).

As a result, all this would seem to indicate that as far as big-truck safety is concerned, the worst is yet to come.

ACKNOWLEDGMENT

I would like to express appreciation to the AAA Foundation for Traffic Safety for developing and coordinating this project; to the following AAA clubs who participated in the collection of accident information: Automobile Club of Kansas, Automobile Club of Maryland, Automobile Club of New York, Automobile Club of Oklahoma, Automobile Club of Rhode Island, Automobile Club of Southern California, California State Automobile Association, Chicago Motor Club, Delaware Motor Club, East Florida Division AAA, Hoosier Motor Club, Louisville Automobile Club, Maine Automobile Association, Ohio Automobile Club, Pennsylvania AAA Federation, Tidewater Automobile Association, and West Virginia State Association; and to Paul Petrillo and Richard Newhouse for their counsel and support.

Discussion

John Brennan

The stated purpose of the paper presented by Meyers of AAA was to determine whether large trucks were involved in a disproportionate number of accidents. At the outset, Meyers criticized the practice of using estimated vehicle miles as opposed to known levels of exposure for each vehicle group in question. Thus the AAA foundation set out to collect actual numbers of vehicle miles and accident occurrences. From that point on, the Meyers study appears to rely on selective, incomparable, and even estimated data.

By confining the inquiry to toll roads, Meyers focuses on only one particular roadway type. Originally, 52 facilities were to be analyzed, and these were broken down into expressway, turnpike, bridge, and tunnel facilities. However, the objectivity of the data from 18 facilities was questionable and as a result not used. From the remaining 34, Meyers narrowed the analysis to 21 facilities after excluding bridges and tunnels due to their operational uniqueness. Beyond asserting that the original 52 facilities encompass a representative mix of highways in rural and urban areas, the degree to which these remaining 21 road segments represented the situation on all toll roads, let alone all roadways, was not examined.

Some criticisms of Meyers' study result from our effort at the American Trucking Associations (ATA) to trace through the data selected for the study and to validate the conclusions. In the course of this checking, we contacted each of the toll facilities recognized in the Meyers study. The Illinois State Toll Highway Authority wrote us that they had given the AAA figures that were used to calculate accident rates. However, the Illinois authority was unclear as to how their figures could be used to calculate accident rates for specific vehicle classes because Illinois does not collect vehicle miles by various classes of vehicles. Similarly, the New York State Thruway Authority responded to our inquiry with a copy of their letter to the Automobile Club of New York that stated that their data-collection system precludes determination of vehicle mileage by vehicle type or class.

Even for toll facilities that did record miles by vehicle class, the data were presented only in the form of accident rates. By banning the actual numbers from the study, Meyers' position might be misleading interpretations of the accident situation. An example of this is illustrated by the results Meyers cited for the Bluegrass Parkway in Kentucky (Table 3). The only fatal accident rate for trucks for that facility was 10.1/100 million VMT in 1976. Yet, that rate is based on one fatal truck accident for 9 934 306 VMT. This single accident was the only fatal heavy-truck accident on that facility during the three years covered by the study. In addition, 6 of the 21 turnpikes had no fatal truck accidents during any of the three years.

Given the facts in our discussion, the heavy-truck accident situation does not appear to compare with Meyers' study. In our opinion, the conclusions reached in Meyers' study are not representative of the heavy-truck accident situations throughout the country.

Author's Closure

This study was undertaken to make comparisons of the accident rates of trucks and passenger vehicles traveling under the same conditions on the same highways. Further, in order to get actual mileage figures and avoid any criticism that has been made in the past, toll-road information was collected from a total of 54 turnpike, bridge, and tunnel facilities because of the accuracy in the statistics available from these types of facilities from the standpoint of miles traveled, accidents, and types of vehicles on the road. The data were refined to 21 turnpikes and 13 bridge and tunnel facilities in order to meet the criteria of having unchallengeable mileage and accident data for cars and trucks.

The American Trucking Associations has repeatedly scoffed at statistics provided by the Bureau of Motor Carrier Safety and other state and federal agencies on the basis that the fatal accident rates do not consider the true exposure of trucks accurately. It is their contention that trucks travel more than cars and that estimates of miles traveled based on gasoline sales, vehicle registrations, and travel characteristics do not accurately reflect the situation that prevails.

As far as data collection is concerned, no estimates were made in the study--all rates were determined from actual mileage figures and accident data provided by the reporting agencies. The toll authorities were specifically requested to provide the number of vehicles of each class involved in property-damage, injury, and fatal accidents as well as the miles they traveled. In this connection, in correspondence dated May 16, 1980, from their traffic engineer, the Illinois State Toll Highway Authority provided the actual number of VMT and the number of vehicles involved, by type, in fatal, injury, and property-damage accidents from which accident rates reported in my paper were determined. In essence, the Illinois State Toll Highway Authority complied with the request for specific information as described previously.

Similarly, in the case of the New York State Thruway Authority, a special printout that provided the volumes of each vehicle class that traveled from interchange to interchange for both directions of the toll-ticket portion of the Thruway was obtained. The traffic volumes between interchanges were multiplied by the exact distance between each two interchanges, which provided a measure of the VMT for each vehicle class. The procedure was successively repeated for the entire length of the toll-ticket portion of the Thruway until a total measure of VMT for each vehicle class was obtained.

One indication that the data used were not selectively chosen is the fact that on six of the turnpikes included in the study, no fatal accidents were reported for trucks and the fatal accident rates for trucks were (as might be expected) zero. However, it is important to note that the inclusion of these six facilities did not significantly change the overall outcome of the study because the truck mileage for these six facilities represented only 3.8 percent of the total truck exposure for all turnpikes.

Accident and fatality rates are commonly accepted measures by the engineering community for comparisons of accident involvement. This practice relates the number of accident involvements by type for a specified distance of travel, generally 100 million VMT. The study abided by that practice and presented truck as well as passenger-vehicle accident experience expressed as a rate in order to permit direct comparisons of the accident involvement for the two types of vehicles.

In short, this study is based on accident rates calculated on actual miles traveled (not estimates) for trucks and passenger vehicles for the same highway environment.

Discussion

Paul Ross

Meyers calculates the truck accident rates on 34 toll facilities for which the VMT by each type of vehicle are quite accurately known. This calculation shows that trucks are involved in a greater percentage of the accidents than their proportion of the total VMT, from which the conclusion is drawn that trucks have a greater accident risk than do other vehicles.

This conclusion seems valid if only single-vehicle accidents are reported, since the exposure of vehicles to single-vehicle accidents is clearly proportional to their miles of travel. However, Meyers is silent as to accident type and it is not unreasonable to assume that all accidents--single-vehicle and multiple-vehicle--are included. The exposure of vehicle types to multiple-vehicle accidents is not proportional to their VMT as may be seen by a simple example.

We take the distribution of VMT as given in Figure 4, namely, 3.2 percent light trucks and 17.1 percent heavy trucks, which leaves 79.7 percent non-trucks. Assume that all vehicle types are identical in accident potential. With two-vehicle accidents, we would expect the 3.2 percent of the light-truck traffic to hit another light truck 3.2 percent x 3.2 percent = 0.10 percent of the time. Similarly a light truck should hit a heavy truck 3.2 percent x 17.1 percent = 0.547 percent, and light trucks should be hit by heavy trucks in 17.1 percent x 3.2 percent = 0.547 percent of the two-vehicle accidents. The total number of accidents involving light trucks and heavy trucks should be about 1.09 percent of all two-vehicle accidents. Similarly, if we allow for the times that a light truck hits one of the 79.7 percent of the vehicles that are not trucks or is hit by one of these vehicles, we should expect about 5.10 percent of all two-vehicle accidents to involve a light truck and a nontruck in one way or another. The total involvement of light trucks in two-vehicle accidents should be about 6.29 percent, which is not significantly different from the 6.2 percent of fatal accidents reported in the paper but somewhat greater than the 5.0 percent of all accidents actually attributed to light trucks.

There is a general formula for the expected distribution of types in n-vehicle collisions. If A, B, C, ... represents vehicle types and a, b, c, ... represents their relative proportions in the traffic stream, the expected fraction of collisions of vehicle types XYZ ... is the coefficient of XYZ ... when the expression $(aA + bB + cC + \ldots)^n$ is multiplied out. If we work out the expected distribution of two-vehicle accidents by using the VMT distribution given in Figure 4, we get the following:

Vehicles in Accident	Distribution (%)
Light truck-light truck	0.10
Light truck-heavy truck	1.09
Light truck-nontruck	5.10
Heavy truck-heavy truck	2.92
Heavy truck-nontruck	27.26
Nontruck-nontruck	63.52

We see that light trucks, heavy trucks, and nontrucks should be expected to be involved in 6.29, 31.27, and 95.88 percent, respectively, of all two-vehicle accidents. Meyers reports that light trucks were actually involved in 6.2 percent of the fatal accidents and 5.0 percent of all accidents; heavy trucks were involved in 29.1 percent of the fatal accidents and 24.0 percent of all accidents. If all the accidents involved two vehicles, it would appear that trucks are not significantly different from other vehicles in their fatal accident experience and are better than other vehicles for nonfatal accidents. However, a firm conclusion on this subject cannot be reached without knowing what proportion of the accidents were single-vehicle, two-vehicle, three-vehicle accidents, etc.

Accident rates cannot be compared (except for single-vehicle accidents) simply on the basis of VMT, since this always overstates the accident rates of individual components of the traffic stream, especially those components that constitute very small proportions of the traffic stream. For example, suppose that ordained ministers drove about 1 percent of the total vehicle miles. Then they can be expected to be involved in almost 2 percent of the two-vehicle accidents. If in fact ordained ministers were involved in only 1.5 percent of all two-vehicle accidents, it would indicate exceptionally safe behavior on their part. A comparison on the basis of VMT would, nevertheless, make it appear that ordained ministers were 50 percent more dangerous than average drivers.

Author's Closure

With regard to Ross's assumption that "all vehicle types are identical in accident potential," this is, unfortunately, a research-classroom type of supposition. The condition assumed does not exist on the road: All vehicles have varying steering, braking, and other operational characteristics and not every driver has the same driving proficiency. Further, it is generally recognized that statistical probability theory should not be used as a substitute for factual data.

On the other hand, Ross may have been misled by the labeling of Figures 4 and 5 in the preprint paper. I hope that any misunderstanding has been corrected by the refined labeling of Figures 4 and 5 in this paper and that this will show more adequately that the comparisons in these figures are for the percentage of vehicles actually involved in the fatal accidents.

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Publication of this paper sponsored by Committee on Transportation System Safety.

Relationship of Accident Frequency to Travel Exposure

WERNER BRÖG AND BERND KÜFFNER

An attempt is made to determine the accident risk for persons who use various modes of transportation. The number of persons injured or killed in traffic not only is calculated in proportion to the total population but also is related to three different factors that pertain to travel exposure: the number of trips made, the number of kilometers traveled, and the amount of time spent traveling. The results of a survey done in the Federal Republic of Germany in 1976 (KONTIV) were the data base. The survey technique is shown that was applied to use data on the behavior of individuals on random sampling days to determine yearly values for traffic exposure. The accident rates for different modes vary according to the factors used to determine traffic exposure. Thus, by using kilometers traveled, the accident risk is least for persons who travel by car. However, by using number of trips made and time spent traveling, the accident risk is least for pedestrians. The evaluation shows that the individual accident rate does not give a complete and accurate picture of accident risk. Only the combined analysis of all three accident rates can do this. An increased international exchange of data and experiences that pertain to this subject would be desirable.

In transportation safety research, it is very important to identify the accident risks for specific