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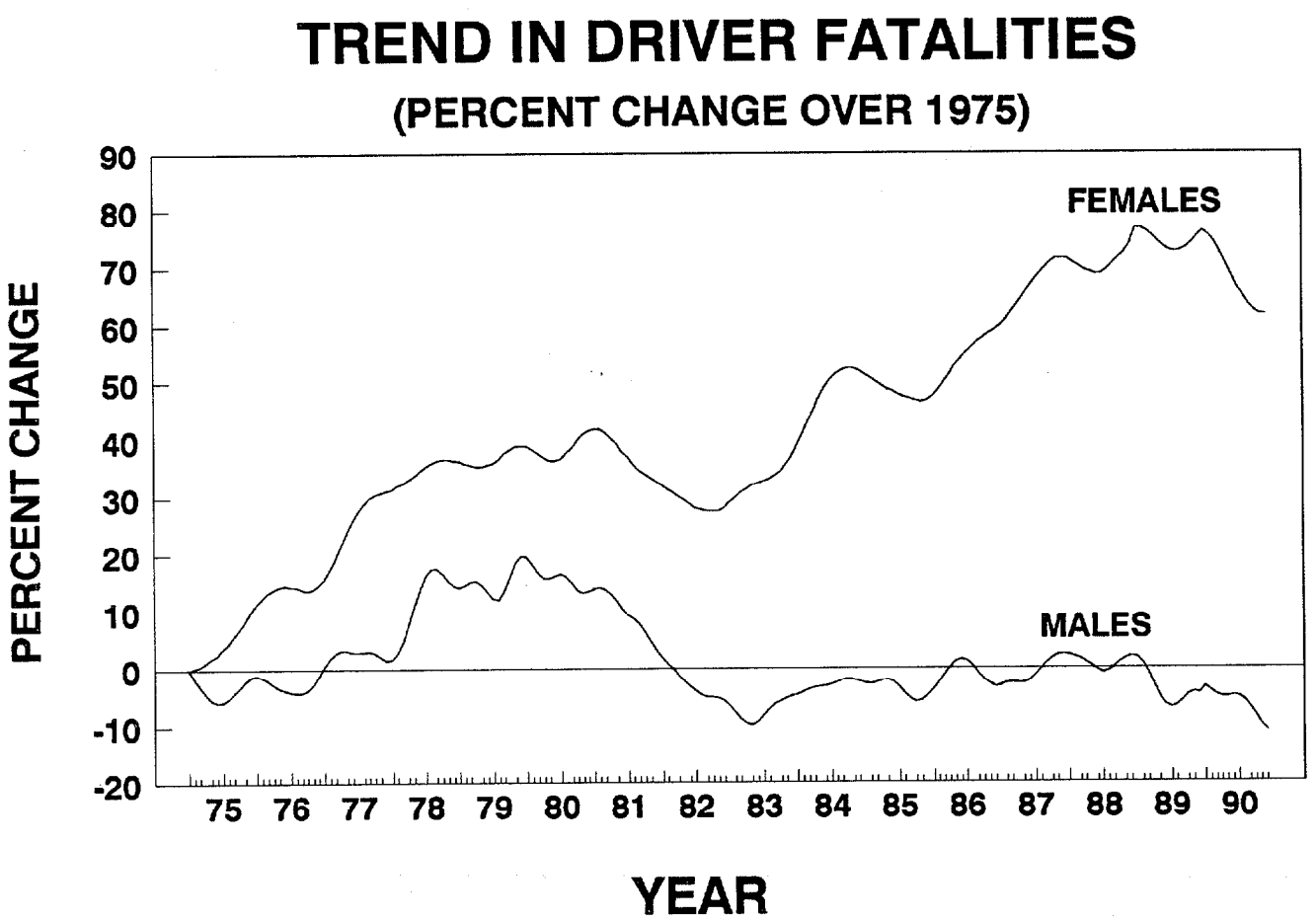
Female Drivers in Fatal Crashes

Recent Trends



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16. Abstract

This Report focuses on the recent trends in female driver fatalities relative to their male counterparts. The period in question is between 1975 and 1990, during which female driver fatalities have risen by 65 percent relative to male drivers. In an attempt to examine the underlying reasons for the 65 percent relative increase, and estimate their contribution to the overall change, the study utilizes a number of pertinent statistics on both male and female drivers.

The report concludes that the 65 percent relative increase for female drivers was due to the combined effect of a 12.6 percent relative increase in their number of licensed drivers, a 23.7 percent relative increase in their average annual travel, and an 18.2 percent relative increase in their fatality rate per miles driven.

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Female Drivers in Fatal Crashes
Recent Trends

by

Ezio C. Cerrelli

National Highway Traffic Safety Administration

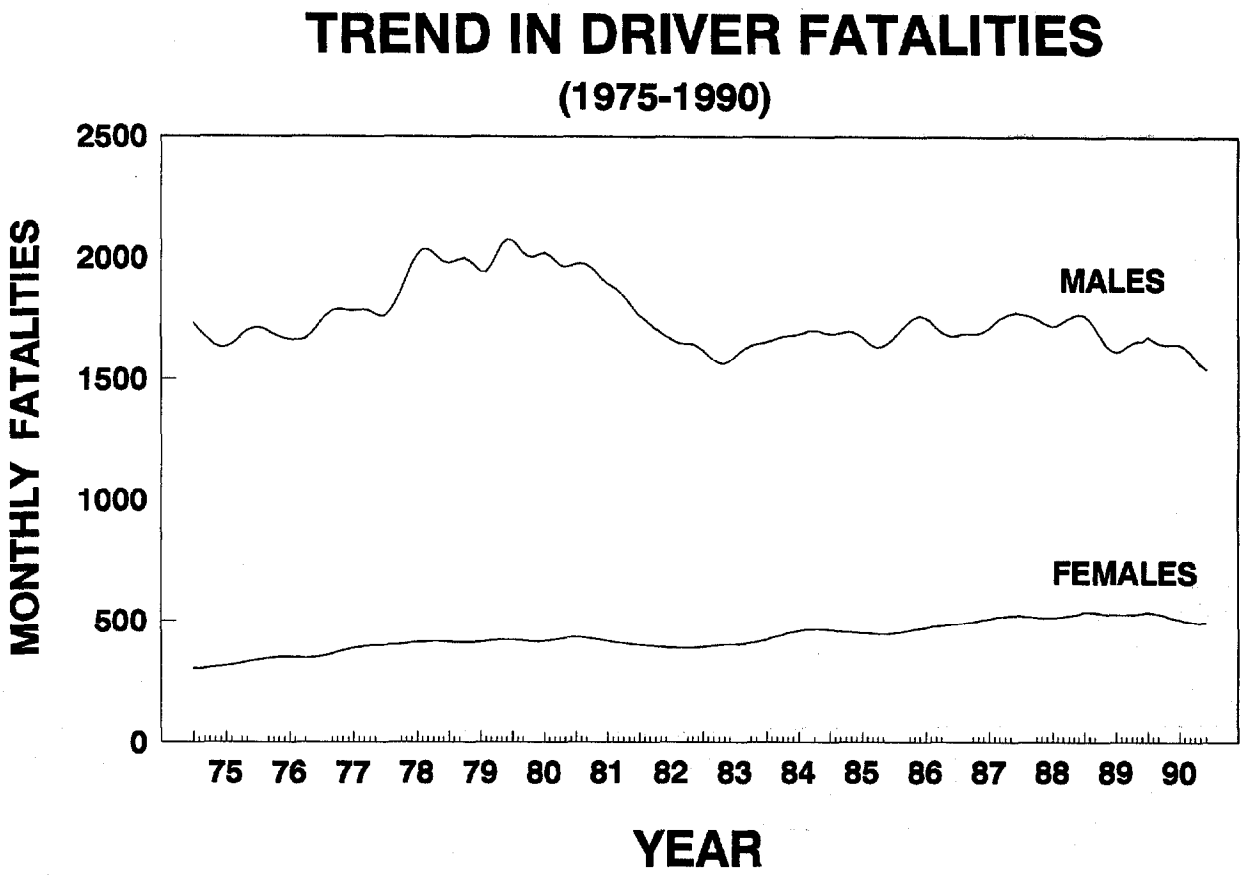
Trends in Driver Fatalities

The number of female driver fatalities has historically been much lower than the number of male driver fatalities. Although females continue to be underrepresented among the fatally injured driver population, statistical data on fatal crashes in the United States reveal that the number of female driver fatalities has been increasing steadily since 1975, while male driver fatalities have remained at about the same level. 1975 is the first year nationwide data were available through the Fatal Accident Reporting System (FARS), a data base sponsored and managed by the National Highway Traffic Safety Administration (NHTSA).

The national records show that, between the years 1975 and 1990, the number of female drivers who died in traffic accidents increased from 3,776 to 6,131. This increase of 62.4 percent for female driver fatalities is compared to the 1.3 percent decrease in male driver fatalities, from 19,840 in 1975 to 19,573 in 1990. Relative to male drivers, the increase in female driver fatalities is calculated at approximately 65 percent (1.624/.987) over the 15 year period.

The trend lines developed for both male and female driver fatalities for the period 1975-1990, shown in Figure 1, are based on national fatality counts contained in FARS. These trends show that while the fatality count for male drivers in 1990 is 1 percent below the level of 1975, even though some higher counts were registered during the intervening years, the trend for female drivers shows a steady increase during the entire period, with the 1990 value being over 62 percent higher than in 1975. In addition, Figure 1 shows that female drivers account for a relatively small portion of the total number of driver fatalities, 16 percent in 1975 and 24 percent in 1990.

FIGURE 1

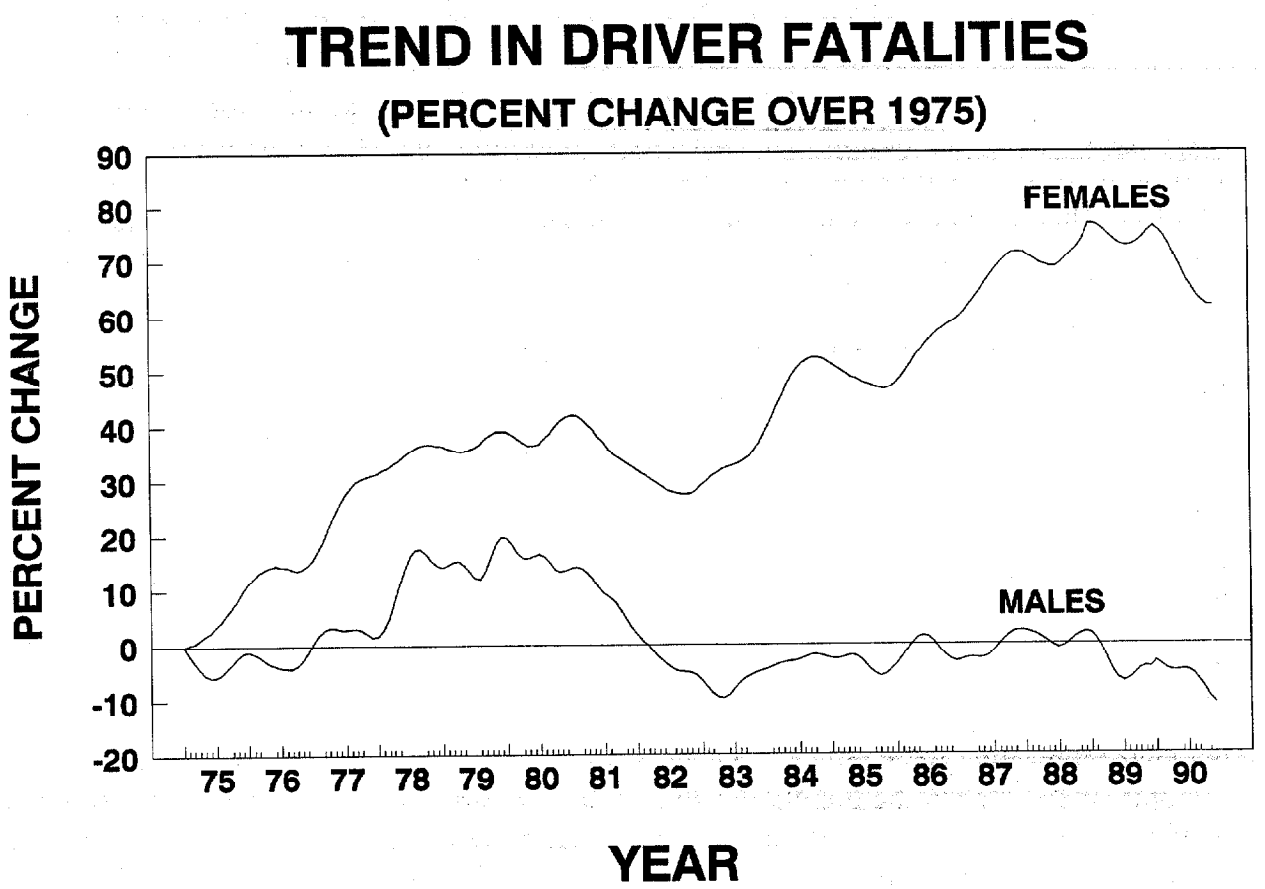


The changes that have occurred in the number of fatalities experienced by male and female drivers are made more evident in Figure 2 which presents the ratio of male and female driver fatality counts for each year to the corresponding counts in 1975.

Figure 2 clearly shows that the changes in female driver fatalities are quite different than those for male drivers. One may assume that the increase in female driver fatalities is a reflection of the risk-taking behavior of female drivers. However, such an assumption can be misleading.

Many factors influence the trend in driver fatalities, including the amount and type of motor vehicle travel, the number of people of each sex in the population, the number and age of people who are licensed to drive a motor vehicle, the inherent risk associated with highway travel, and how the risk of travel varies by the characteristics of the driver, by the location, and by the time of day.

FIGURE 2



This study analyzes the trend in female driver fatalities, relative to their male counterparts, for the purpose of examining the underlying reasons for the changes, and to estimate the contribution of various factors to the overall changes. The study utilizes a number of pertinent statistics on both male and female drivers, such as driver licensing and annual travel. The study also analyzes the ratio of female to male driver fatalities and estimates the contribution of these factors to the overall changes.

Factors in Driver Fatalities

Among the many factors affecting the number of reported driver fatalities are four that have greater importance: Population, Driver Licensing, Motor Vehicle Travel, and Fatality Risk.

It is logical to expect that appreciable shifts in the male-female composition of the general population and the population of licensed drivers would result in commensurate changes in the proportions of male and female drivers who are victims of motor vehicle crashes. At the same time changes in the driving habits of drivers of each sex and changes in the fatality risk level associated with different uses of motor vehicles will also result in shifts in the sex composition of fatally injured drivers.

The following sections of the report will focus on the above-mentioned four factors. These sections will provide detailed information on the changes that have taken place in each factor during the 1975-1990 period, and relate these changes to the reported shift in the sex composition of fatally injured drivers.

Population

One factor logically associated with the change in driver fatalities of each sex is the number of people of each sex in the population and the associated changes over time. One question is "did the female component of the US population grow so disproportionately as to explain the increase in driver fatalities?".

Census population data for the period 1975-1990 show that the proportion of males and females in the population is almost equal, approximately 1.06 females for each male and this ratio has not changed appreciably during this period. The fact that the composition of the population does not reflect either the male-female proportion of the driver fatalities or the changes that are occurring over time indicates that population data do not explain the significant increase in the number of fatal involvements for female drivers. Therefore, population composition should not be considered a significant factor.

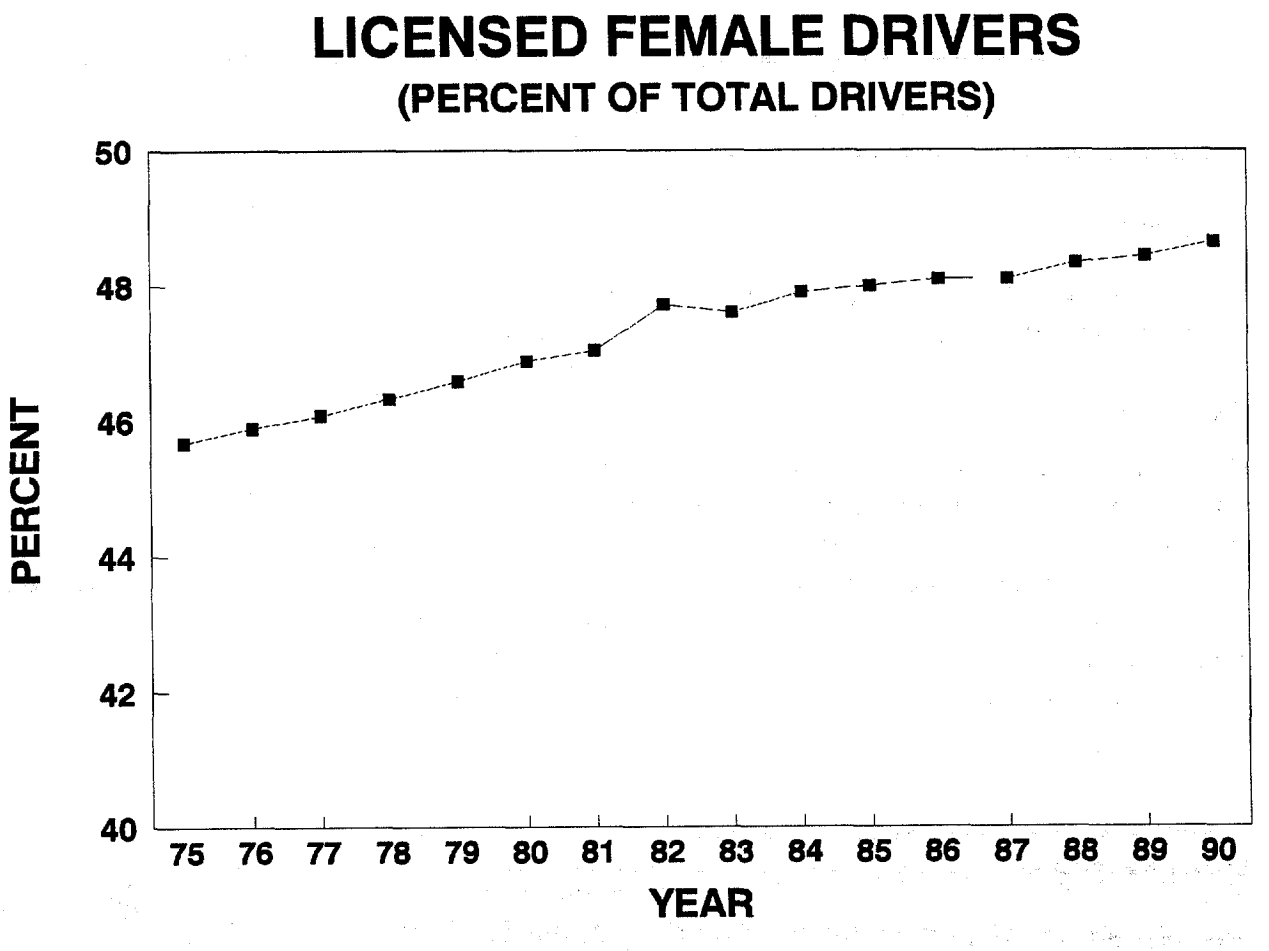
Driver Licensing

To understand better the changes in driver fatalities, this section focuses on the population of licensed drivers, particularly the changes in the number of male and female drivers. Figure 3 presents the proportion of female licensed drivers for the period 1975-1990, and indicates that the proportion of licensed female drivers has increased from 46 to 49 percent during this period. The increase in the number of licensed drivers during this period was 37 percent for females and 21.7 percent for males. Relative to males, the number of female licensed drivers increased by 12.6 percent over the 1975-1990 period. While substantial, this

difference is not large enough to account fully for the changes in driver fatalities recorded during the same period, i.e., a 62.4 percent increase for female drivers and a 1.3 percent decrease for male drivers. However, it does explain some of the changes.

The number of licensed drivers, both sexes combined, has a high positive correlation ($r = 0.996$) with the number of drivers involved and killed in traffic crashes. Between 1975 and 1990 the number of licensed female drivers increased from approximately 59 million to approximately 81 million, a 37 percent increase; for males the increase was 21.7 percent. The difference in the growth rate for the two sexes has had an effect on their respective driver fatality trends.

FIGURE 3



A driver fatal involvement is an involvement in a crash in which someone, not necessarily the driver, is killed. The ratio of driver fatal involvements to the number of licensed drivers is used frequently to assess the risk level associated with drivers of specific age-sex groups when driving a motor vehicle.

FIGURE 4

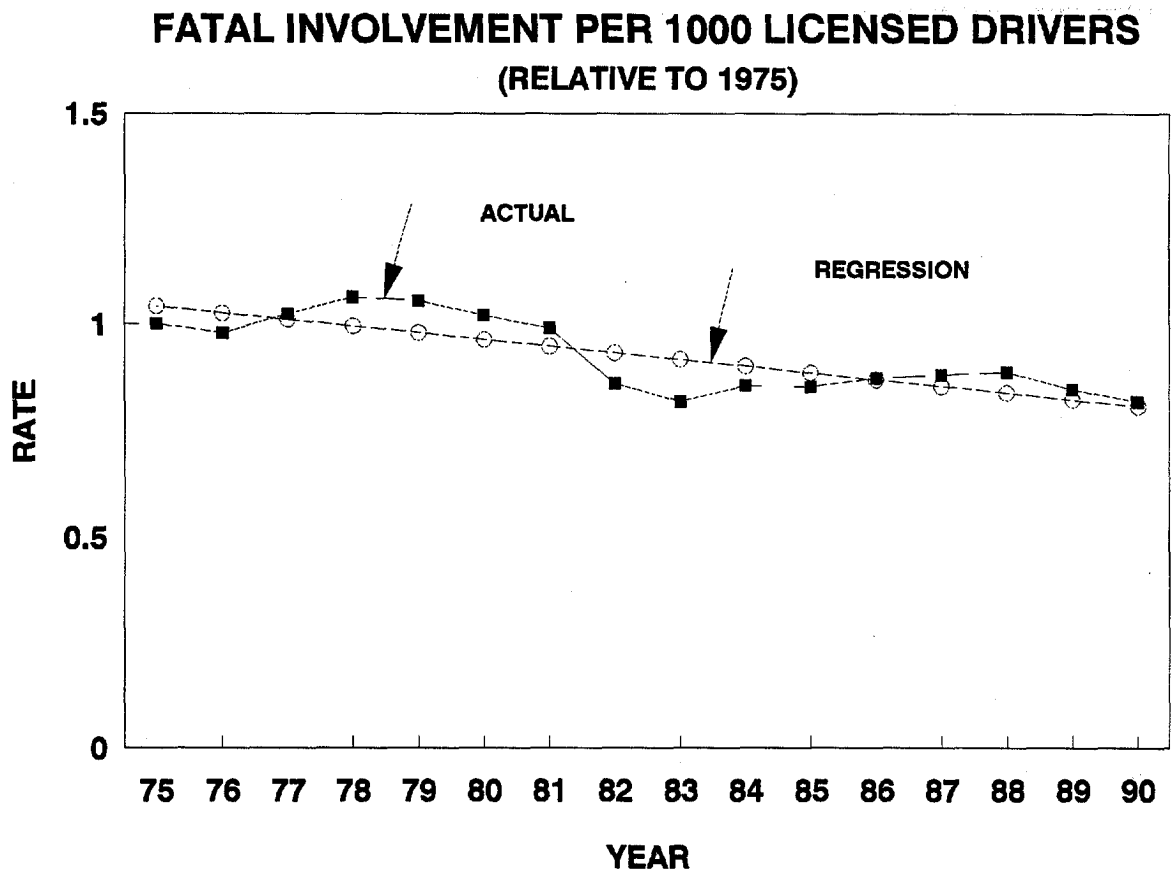
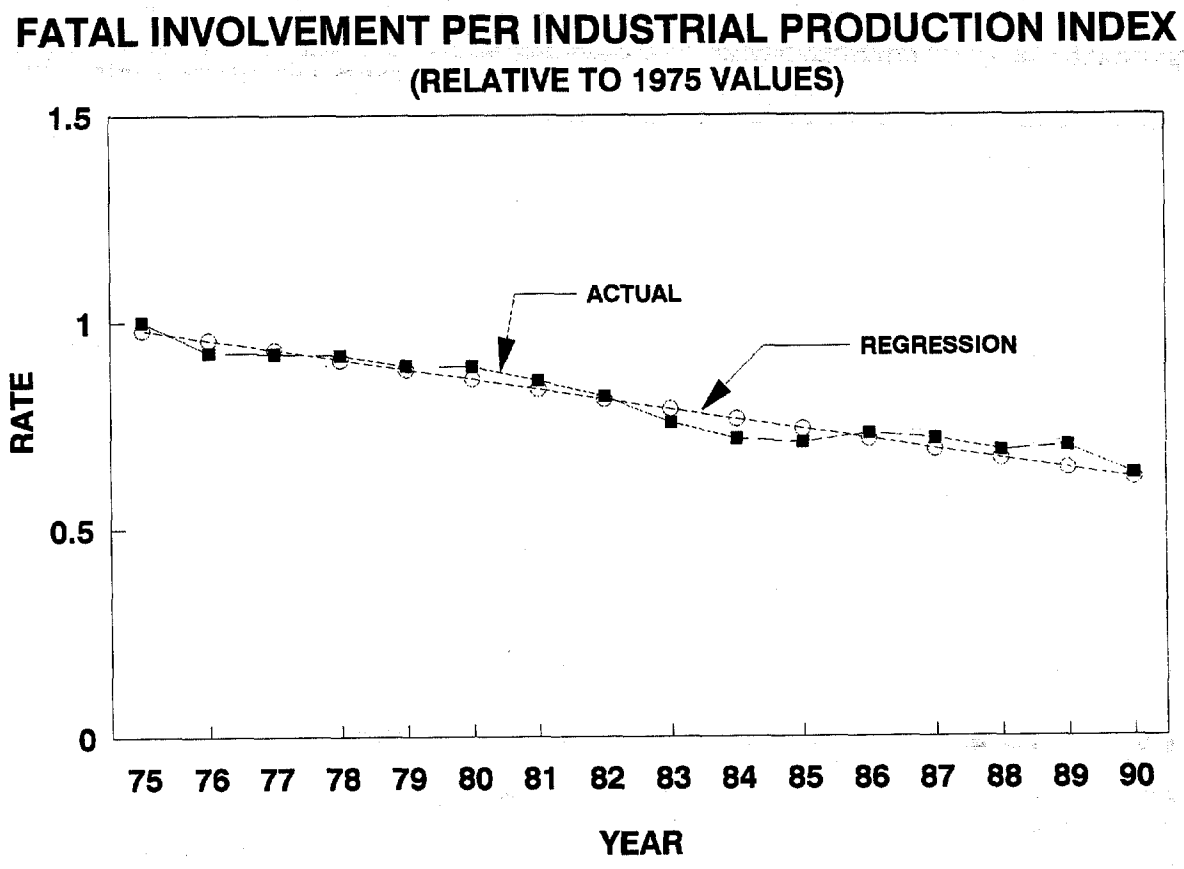


Figure 4 shows how the fatal involvement rate per licensed driver has changed relative to the 1975 value. The regression line that best fits the data is also shown. The downward slope in the regression line indicates that the fatal involvement rate is decreasing over time. The same graph shows that at times the actual value of the rate is higher or lower than the regression line, thus showing a weaker than generally expected relationship between the two sets of values ($R^2 = 0.574$). In other words, the changes in the number of licensed drivers, during the 15 year period have resulted in similar, but not almost identical, changes in the number of drivers involved in fatal crashes.

It is not surprising to find this less than perfect relationship between driver licenses and fatal involvements if we take into account that, while a driver is likely to retain his or her license status over time, the amount of driving done by the average driver is affected by prevailing conditions such as the status of the national economy and other economic factors. It is for this reason that rates on a per licensed driver basis are not the most reliable measure when assessing changes in the level of risk over time.

In the estimation of fatal involvements, one economic factor has closer relationship with fatal crashes than the number of licensed drivers.

FIGURE 5



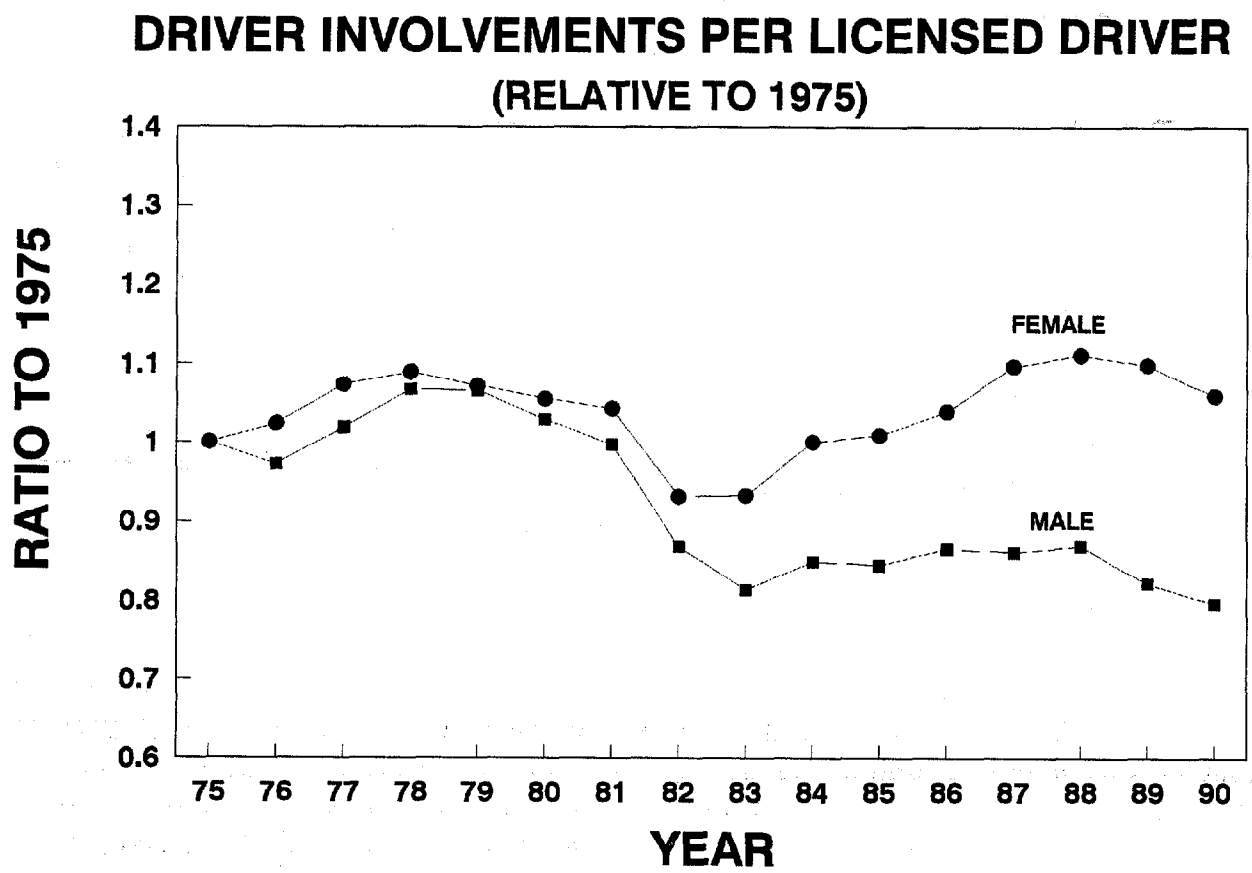
This factor is the Industrial Production Index (IPI) which demonstrates a high correlation (r = 0.999) with the number of drivers involved in fatal crashes. Figure 5 displays the number of fatal involvements per unit of production index, normalized by the 1975 value of that ratio. The chart indicates that this national economic index is a better predictor of the total number of fatal involvements ($R^2 = 0.937$) than the number of licensed drivers. An explanation for this phenomenon is that, although there are small variations in the number of licensed drivers, the demand of the average driver for the amount and type of travel may be sensitive to variations in this economic index. Amount and type of total travel are

directly related to the occurrence of traffic fatalities. The regression line in Figure 5 follows a downward slope which reflects the continuous reduction in the risk associated with motor vehicle travel for all drivers combined.

Available data on driver licenses and fatal crashes show a definite pattern in the change in fatal involvement and fatality rates for male and female drivers. The changes in fatal crash involvement rate do not differ appreciably among male and female drivers until the early 1980's. From the early 1980's, fatal involvement rates per licensed driver have increased for female drivers and decreased for males

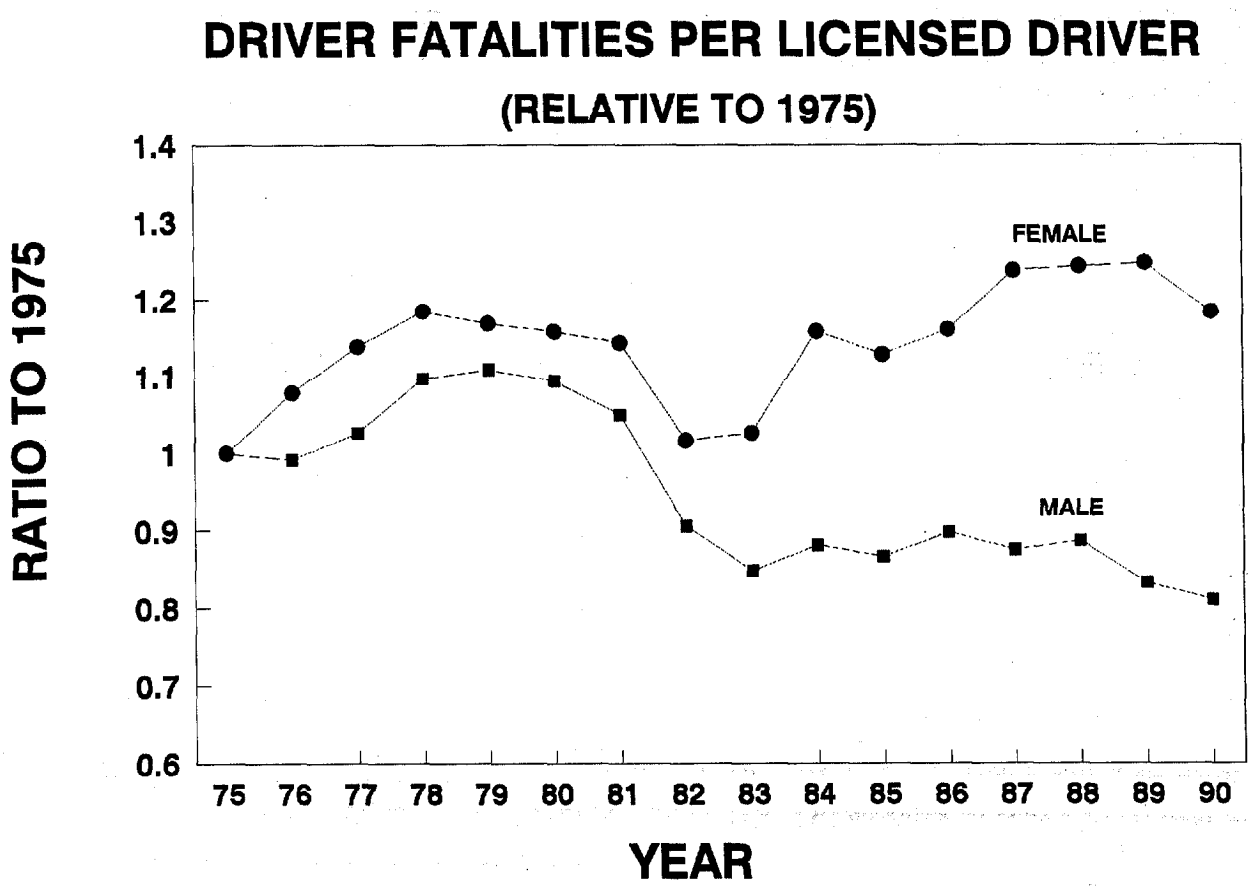
Figure 6 reflects the changes in the fatality rates relative to 1975 and more clearly illustrates the changing risk of fatality experienced by male and female drivers. The data clearly show that the rate for male drivers has declined by approximately 19 percent during the 1975-1990 period, while the same rate has increased by approximately 18.5 percent for female drivers. The same data show that, relative to male drivers, the risk for a licensed female driver to be killed in a motor vehicle crash has increased by approximately 46 percent between 1975 and 1990.

FIGURE 6



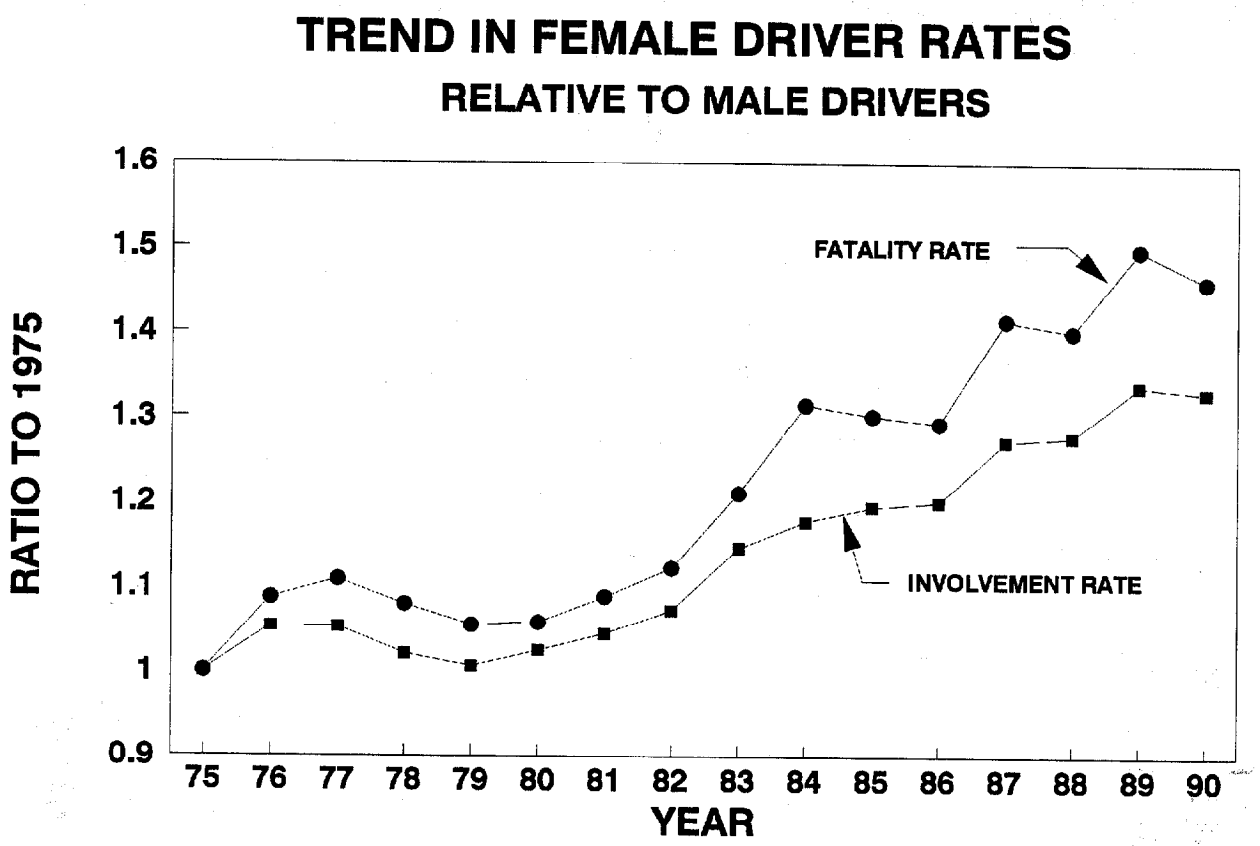
Although the trend in driver involvement and fatality rates follow a very similar pattern, the differences between males and females are more pronounced for the fatality rates (Figure 7). In this figure male drivers show a 10 percent increase in the rate during the late 70's, a subsequent steep decline, leveling off, and reaching a 19 percent decline by 1990. In contrast, female drivers show a 20 percent increase for the late 70's, followed by a temporary decline, and ending with a continuous rise since 1982. The fatality rate per licensed driver for female drivers in 1990 was about 20 percent higher than in 1975 .

FIGURE 7



Another and more revealing way to study changes in female driver rates is comparing these changes to the corresponding changes for male drivers. Female to male changes for both involvement and fatality rates are shown in Figure 8. The involvement rate shows a steady increase since 1979 with some fluctuations during the previous four years. The trend is an indication that a licensed female driver is more likely to be involved in a fatal crash relative to a licensed male driver, specifically 33 percent more likely in 1990 than she was in 1975.

FIGURE 8



The fatality rate curve in Figure 8 shows a similar pattern with higher ratios. This curve demonstrates that (1) the probability of a female licensed driver dying in a traffic crash has increased by 46 percent, relative to a male licensed driver, since 1975; and (2) a female driver involved in a fatal crash has experienced an increased probability of suffering a fatal injury, since 1975.

The increase in the probability of fatal injury associated with a fatal crash appears to be the result of additional changes in the driving characteristics of female drivers, i.e., type of collision, higher impact speeds, etc.. Drivers involved in single-vehicle fatal crashes and at higher impact speeds have a higher probability of being killed than those involved in multi-vehicle crashes or at lower impact speeds.

The high correlation between licensed drivers and driver fatalities suggests that the recorded change in the number of licensed drivers may have partially contributed to the 65 percent relative increase in female driver fatalities. This study will determine the extent of the contribution.

Figure 9 shows the reported number of male and female licensed drivers for the period. Two lines are also shown in Figure 9. The first line represents the annual ratio of female to male licensed drivers. The other line is the regression line for the ratio. The linear regression line fits the data very well ($R^2 = 0.96$). It shows less than a one percent annual increase in the ratio of female to male licensed drivers. Overall, the number of licensed female drivers increased by 12.6 percent relative to male drivers during the 1975-1990 period.

Figure 9

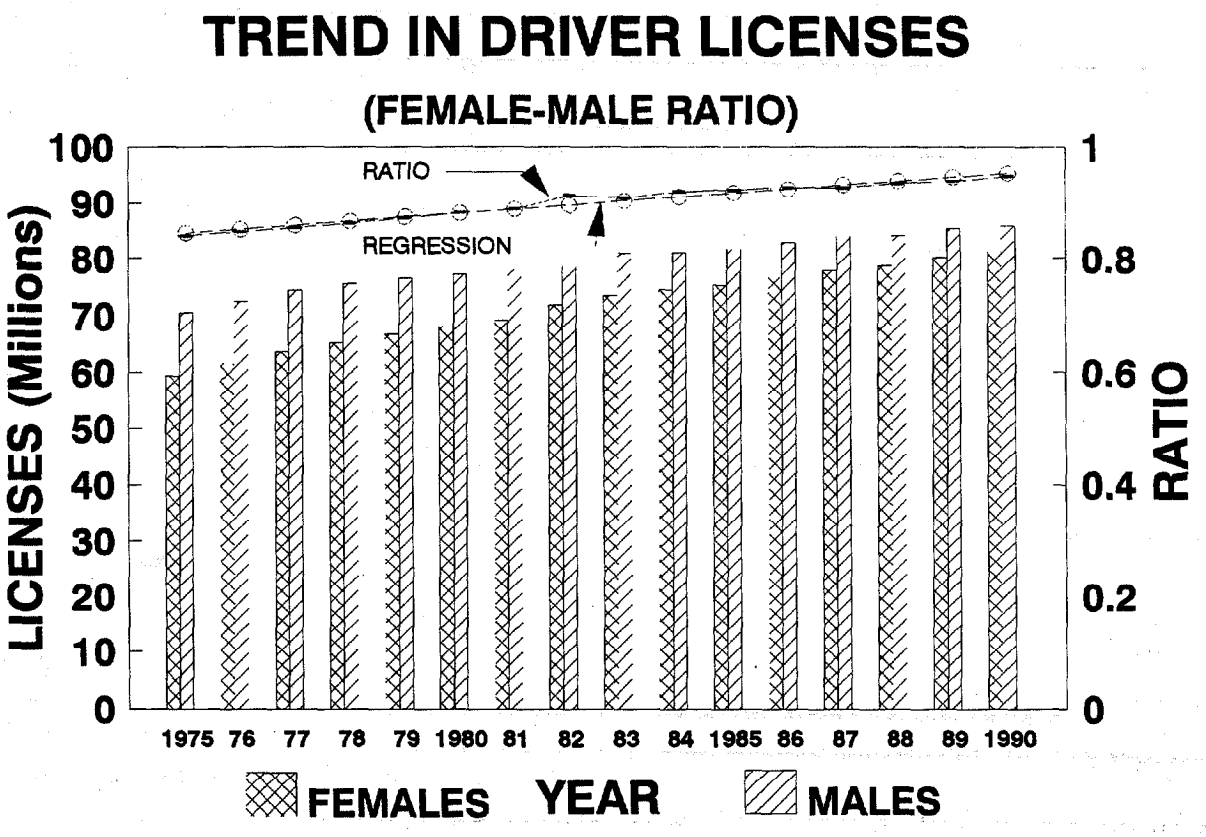
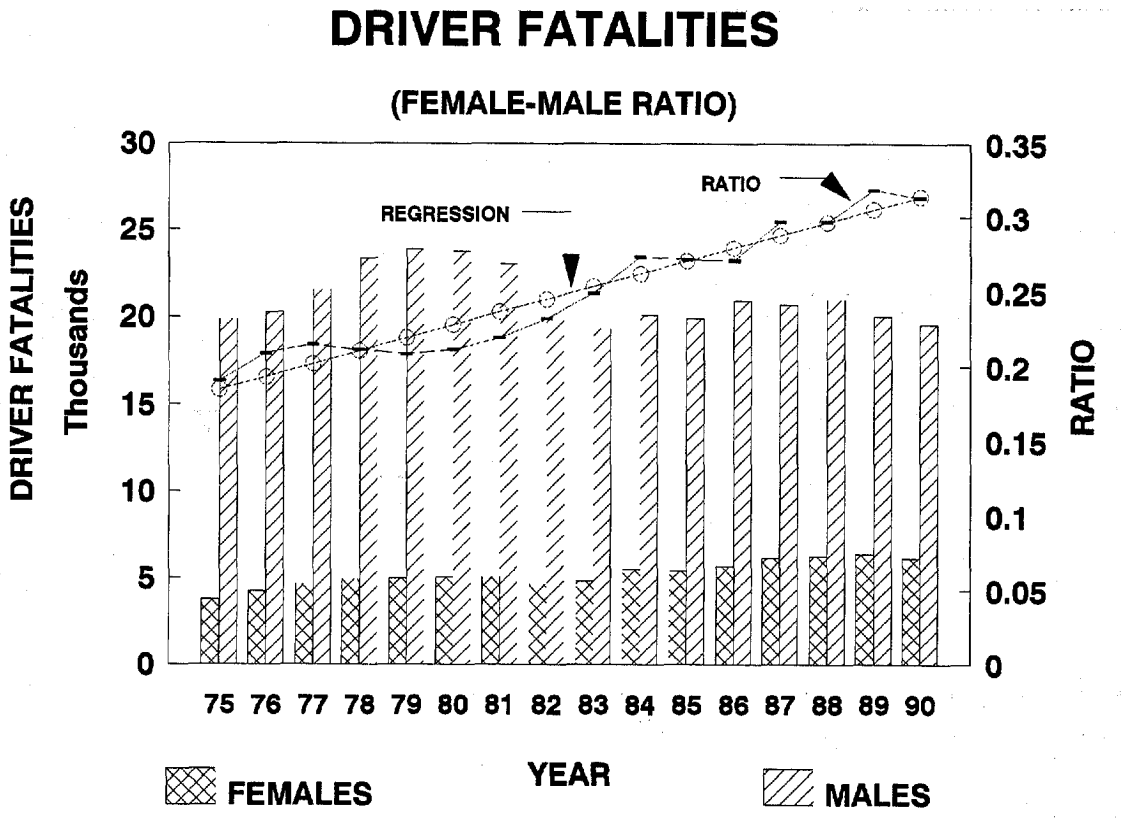


Figure 10 focuses on driver fatalities. It shows the actual number of female and male driver fatalities, the female to male ratio, and a regression line that represents the ratios. Based on the regression line, the female to male fatality ratio shows a continuous increase of approximately 4.3 percent per year, since 1975.

FIGURE 10



The regression line fits the fatality ratio quite well, with an $R^2 = 0.935$. If the annual increase in this ratio was the same as the increase in the ratio of licensed drivers, the logical conclusion would be that the increase in the number of female driver fatalities was due to the changes in the number of licensed drivers. However, Figure 9 shows that this is not the case. The increase in the ratio of driver fatalities was approximately 4.3 percent per year while the increase for the ratio of licensed drivers was less than 1 percent per year. Therefore, driver license changes can only partially explain the increase in female driver fatalities, relative to male driver fatalities.

Based on the relative increase (12.6 percent) in the number of licensed female drivers and the relative increase (46 percent) in the fatality rate per licensed female driver, the following conclusion can be reached. The total 64.6 percent relative increase in female driver fatalities is the result of the combined effect (product) of the 12.6 percent relative increase in female driver licenses and the 46 percent relative increase in the fatality rate per licensed driver for females.

Table A summarizes the data on driver licenses and the changes that occurred between 1975 and 1990.

TABLE A

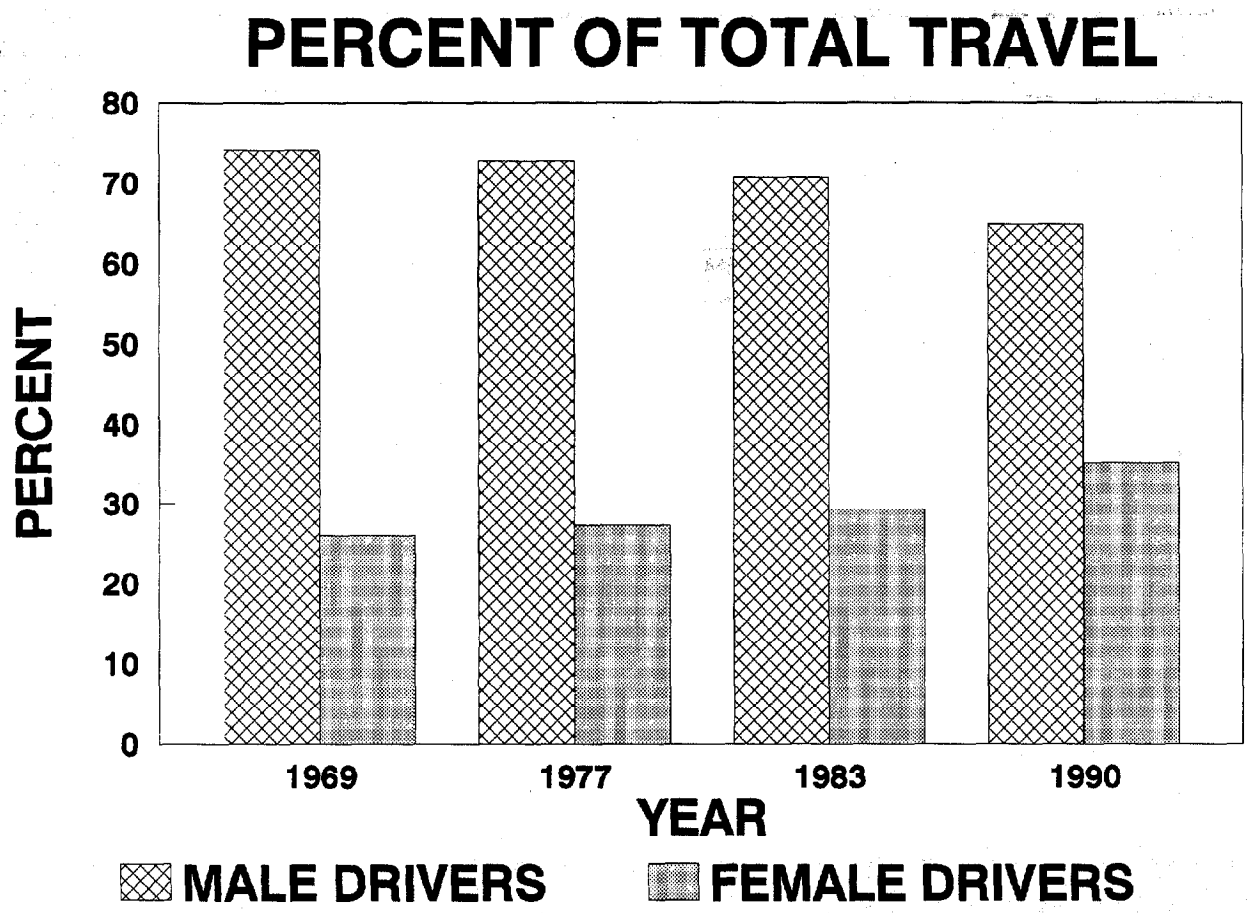
TOTAL LICENSED DRIVERS (in Thousands)							
	1975			1990			1975-1990
DRIVER AGE GROUP	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	RATIO CHANGE (PERCENT)
16-19	5,276	6,419	0.822	4,336	4,913	0.883	7.4%
20-24	8,266	9,367	0.882	8,093	8,804	0.919	4.2%
25-29	7,912	8,824	0.897	9,656	10,239	0.943	5.2%
30-34	6,312	7,014	0.900	10,071	10,507	0.959	6.5%
35-39	5,234	5,822	0.899	9,371	9,683	0.968	7.7%
40-44	4,788	5,444	0.880	8,295	8,610	0.963	9.5%
45-49	4,809	5,569	0.864	6,378	6,642	0.960	11.2%
50-54	4,684	5,508	0.850	5,108	5,376	0.950	11.7%
55-59	3,967	4,858	0.817	4,582	4,855	0.944	15.6%
60-64	3,214	4,158	0.773	4,497	4,738	0.949	22.8%
65-69	2,354	3,255	0.723	4,109	4,266	0.963	33.2%
70+	2,469	4,267	0.579	6,725	7,159	0.939	62.3%
TOTAL	59,285	70,505	0.841	81,221	85,792	0.947	12.6%

Travel and Fatality Rates

The amount of motor vehicle travel, expressed in Vehicle Miles of Travel (VMT) measures the driver's exposure to the risk of a fatal injury. This risk varies considerably for each driver age-sex group, vehicle type, environmental characteristics, and the combination of these factors. Unfortunately, estimates of motor vehicle travel are not available at this level of detail. Some estimates of travel by driver age-sex are available through the National Personal Transportation Survey (NPTS) but are quite limited.

The results of these NPTS surveys indicate that female drivers accounted for 26.8 percent of the 1969 travel, 27.6 percent in 1977, and 29.3 percent in 1983, and 35 percent in 1990. (Figure 11)

FIGURE 11



During the period 1969 to 1990, total motor vehicle travel on the nation's highways has increased by 121 percent, with an estimated increase of 200 percent for female drivers in comparison to a 94 percent estimated increase for male drivers.

To focus on the 1975-1990 period, the report must rely on some estimates of travel for each age-sex group of drivers for 1975. These estimates, developed in this report, are based on the available NPTS survey data and the FHWA reported estimate of total travel for 1975. Based on these data, NHTSA estimates that total travel for female drivers increased by 120 percent between 1975 and 1990, in comparison to a 58 percent increase for male drivers. (Refer to page 25 for more details on estimation)

Total travel for each age-sex group of drivers represents the product of the number of licensed drivers in the group times the average annual miles of travel performed by these drivers. Therefore changes in total travel represent the combined effect of changes in both the number of licensed drivers in the group and their average annual travel.

Questions remain as to why there was a 46 percent increase in the fatality rate of female licensed drivers relative to male licensed drivers. The answer may be provided by relative changes in driving exposure of female drivers. Increases in the amounts of travel performed by female drivers, relative to male drivers, under riskier conditions would result in a relative increase in the number of female driver fatalities. No data are available on the type of travel performed by drivers of both sexes, such as day-night, rural-urban, high speed-low speed roads, but estimates of travel by age and sex of the driver are available for those years in which a National Personal Transportation Survey (NPTS) is conducted. These are national surveys sponsored by the Department of Transportation. NPTS surveys were conducted in 1969, 1977, 1983, and 1990.

The estimates provided by the NPTS surveys conducted in 1969, 1977, 1983. and 1990 are reflected in the charts presented in Figures 12 and 13.

FIGURE 12

AVERAGE ANNUAL TRAVEL FOR MALE DRIVERS
(PER LICENSED DRIVER)

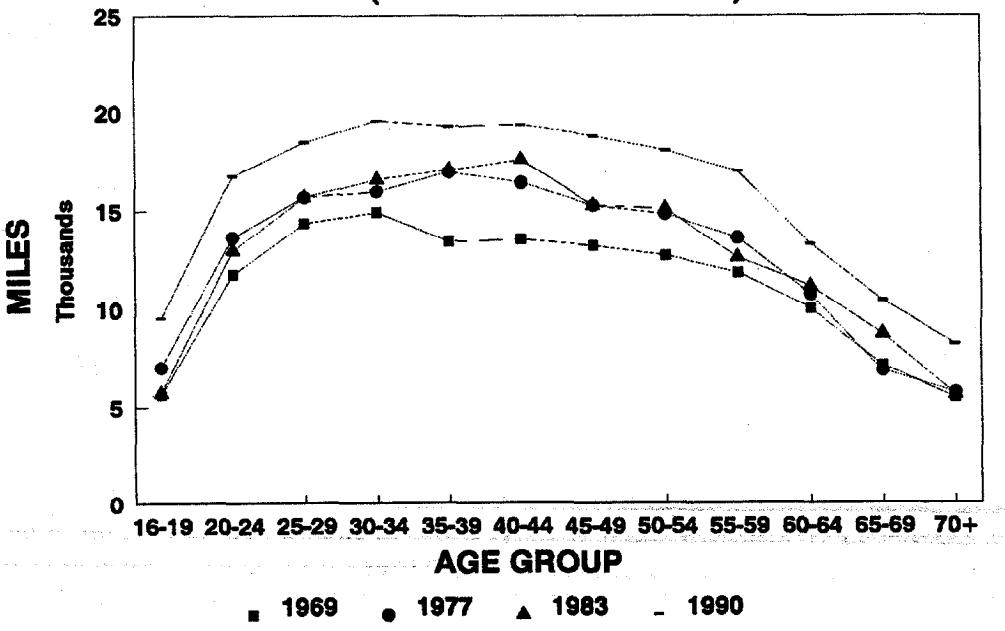
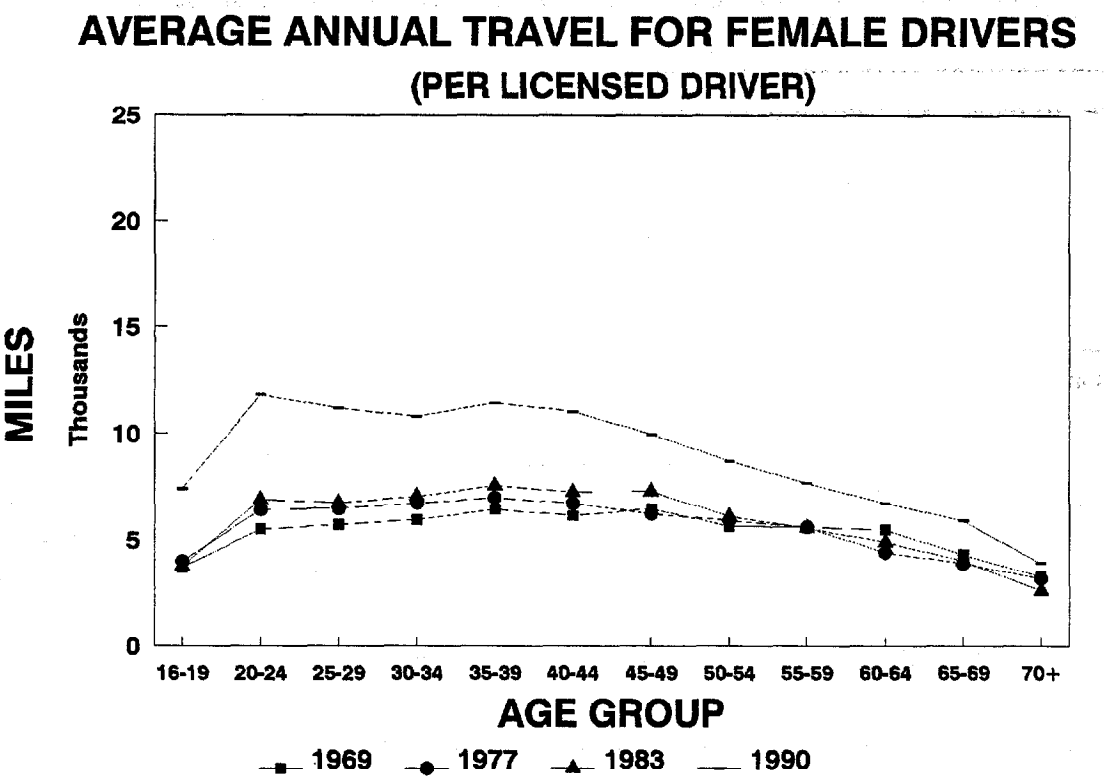


FIGURE 13



It is evident from these data that the amount of annual travel varies appreciably, depending on both the age and the sex of the licensed driver. On the average, male drivers tend to drive twice as many annual miles as female drivers in the same age group. The highest total annual travel is for drivers between the ages of 25 and 50 and is gradually lower for drivers outside this range.

In addition, there are noticeable yearly changes , which do not appear to be the same for male and female drivers. The chart for male drivers indicates that the changes over time have been proportional across all age groups. The average annual travel has generally increased in each age group approximately at the same rate as the total travel for all male drivers combined. However, female drivers show much larger increases in the average annual travel for those drivers between the ages of 20 and 54 when compared to the other age groups.

By combining the estimates of average annual travel with the number of licensed drivers, the total annual travel performed by male and female drivers in each age group can be estimated. Such estimates provide a better basis for assessing the fatality risk for male and female drivers of various age groups, and how this risk has changed over time.

The data on the number of licensed drivers of each age-sex group, for the four years of NPTS surveys, are presented in Figures 14 and 15. As shown previously, large changes have occurred in the number of licensed drivers during these four years. These changes were different for the two sexes and among the various age groups.

Figure 14

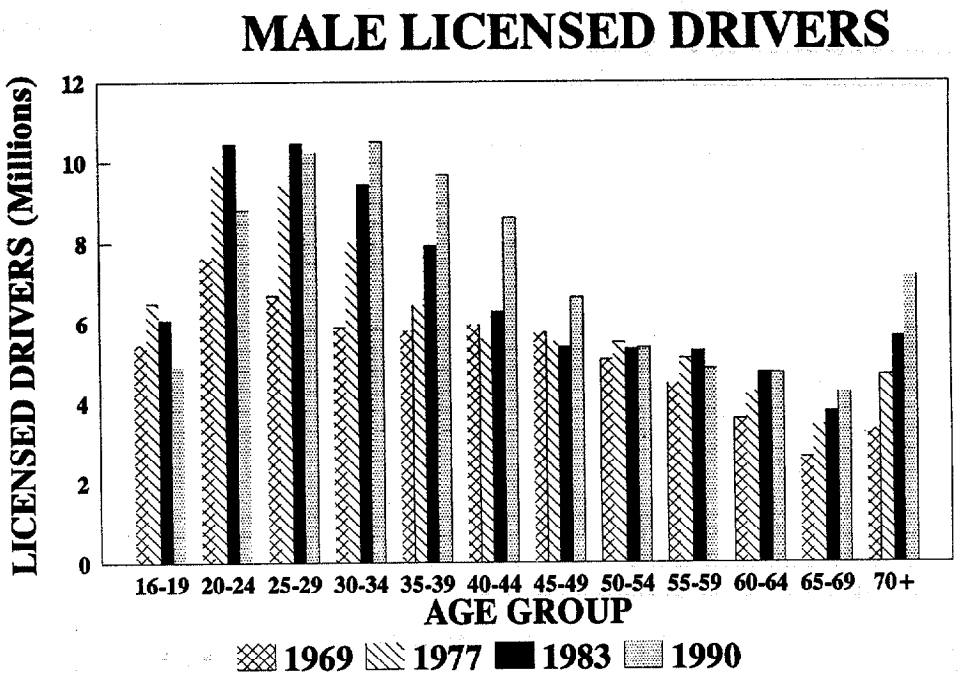
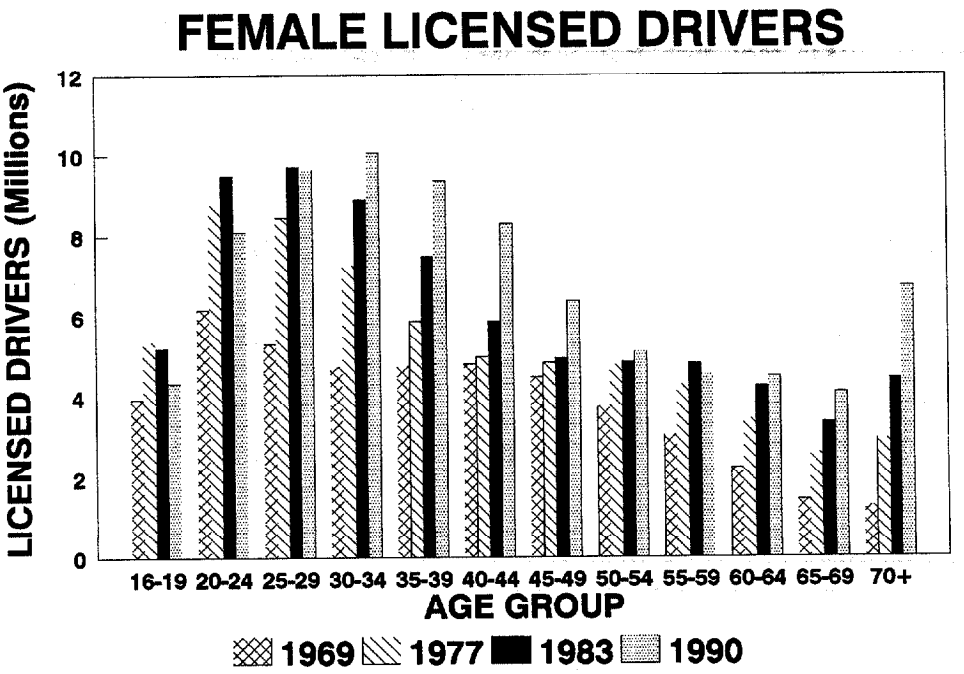
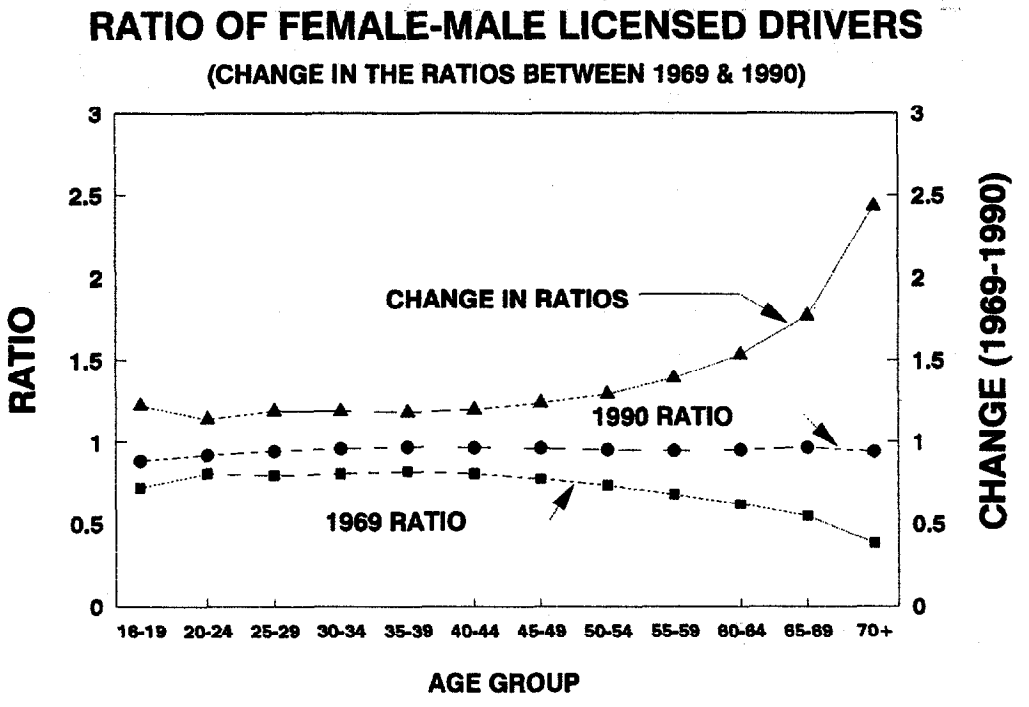


Figure 15



The information contained in the two previous figures allow the computation of the ratio of female to male driver licenses for the various age groups and for the four specified years. Figure 16 displays the ratio for both 1969 and 1990 and shows that the ratio has increased for all age groups, with the older groups experiencing much larger changes. The additional curve in Figure 18 indicates that between 1969 and 1990 the ratio increased by a factor of 1.2 for younger drivers and by 2.5 for the oldest group.

Figure 16



The estimates of the total travel performed by each age-sex group of drivers combines the driver licensing data with the NPTS estimates of average annual travel by age and sex of driver. The product of the estimated average annual travel and the number of licensed drivers in each group of drivers, for each year, provides the estimate of total travel for each age-sex group of drivers.

Figure 17 and Figure 18 present a graphic display of these travel estimates for male and female drivers.

Figure 17

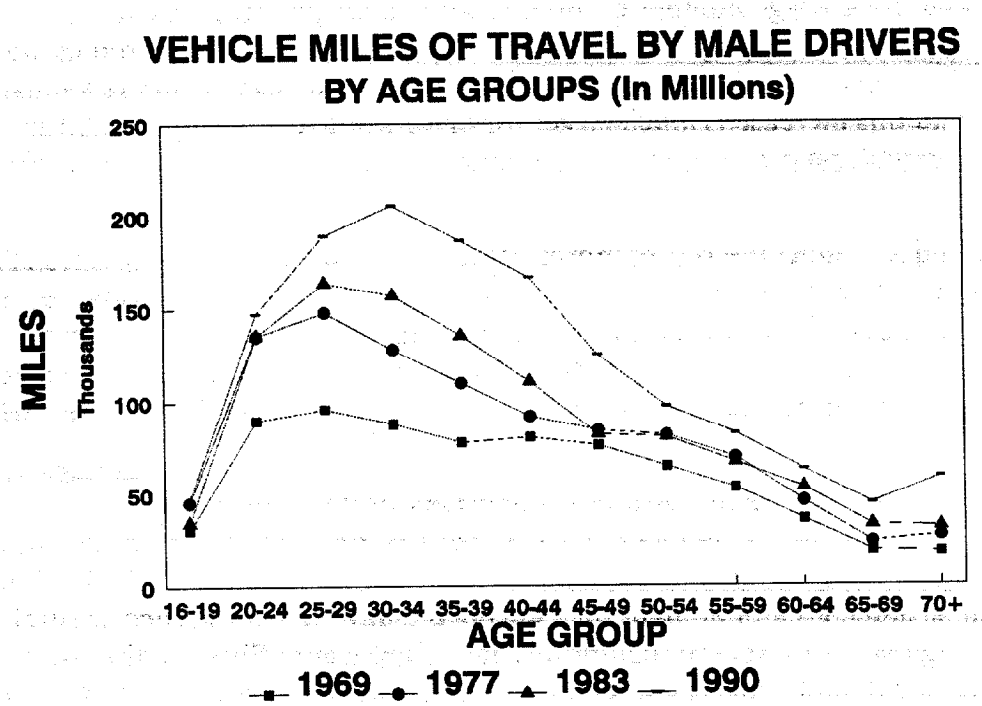
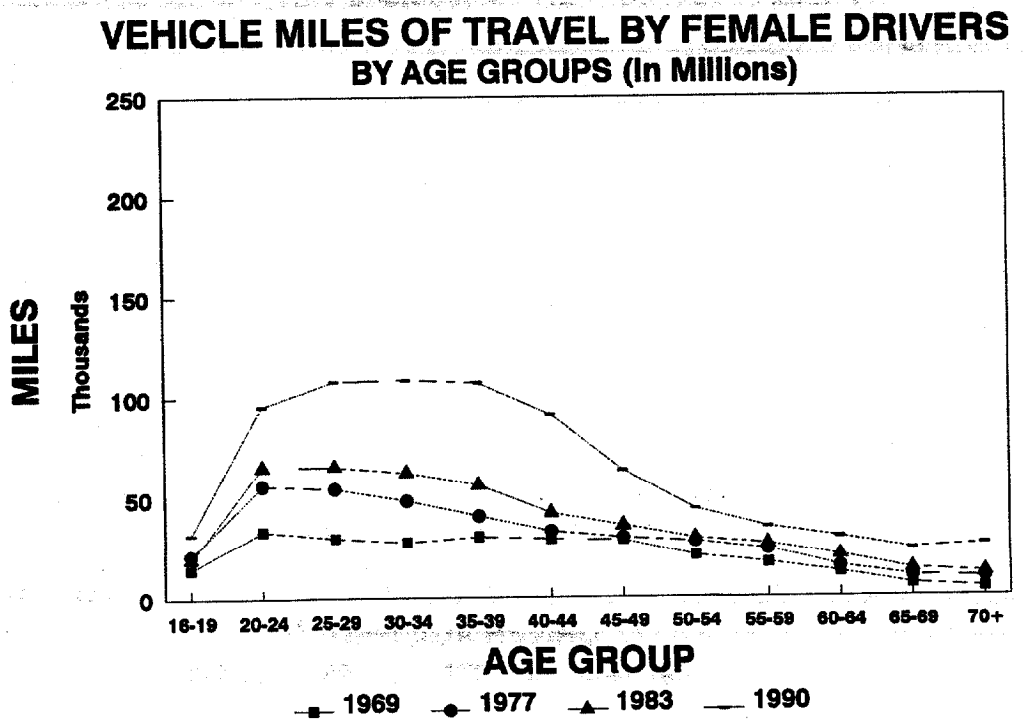


Figure 18



The data presented in these figures are based on both the number of licensed drivers in each age group and the average number of miles that the average driver in each group travels annually. These charts display the combined changes which have occurred in the number of licenses and average annual travel. There has been a large increase in the annual travel for both sexes and this increase is much larger for drivers between the ages of 20 and 50. It appears that females have experienced a greater percentage increase in miles driven during the 1969 to 1990 period than males.

Figures 19 and 20 reflect the risk of motor vehicle-related fatalities for drivers of specific age-sex groups. The risk is measured in driver fatalities per mile driven and represents the ratio of the number of driver fatalities, in each group, and their estimated annual travel expressed in 100 million miles. This rate is quite useful in assessing the overall safety performance of driver groups. However, it is only an average measure of the performance under all possible driving conditions combined.

In assessing the fatality risk by age and sex of driver, better measures could be obtained if the estimated total travel done by each driver age-sex group were further classified by location, time of day and weather conditions. It is known that the risk of a fatal injury, per mile driven, is much greater at night than during the day. Location, such as rural or urban, the type of highway, and weather conditions have significant effects on the risk of a fatal accident. Unfortunately, this classification of travel data is not available at the national level, severely limitating the scope of any driver age study in the areas of crash and fatality risks.

Figure 19

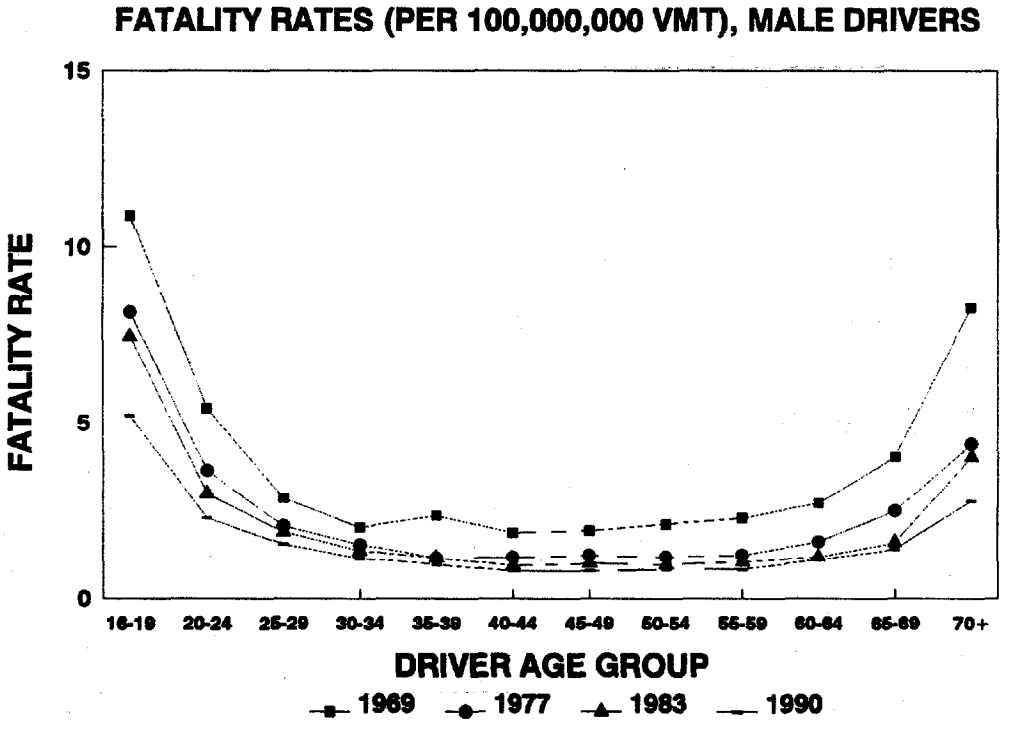
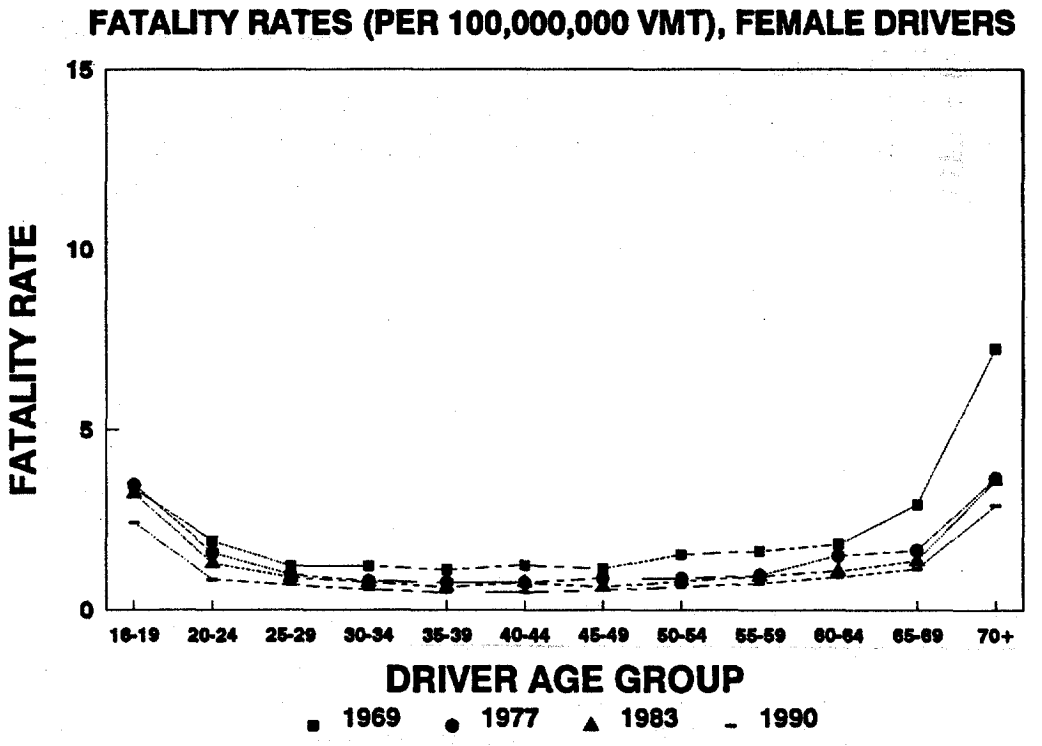


Figure 20



The data in Figures 19 and 20 demonstrate the similarities and the differences in the fatal crash experience of male and female drivers. The similarities are that there is a general trend of higher rates for drivers under 25 and those over 65, and that fatality rates generally have declined for all age groups in both sexes from 1969 to 1990. Male and female drivers differ in the actual fatality rates with rates for males being much higher than for females. The extent of the changes that have occurred since 1969 also differ.

These changes are easily discerned by combining rates for male and female drivers on the same chart. Figure 21 presents the two rate curves for the year 1969, while Figure 22 does the same for 1990.

Figure 21

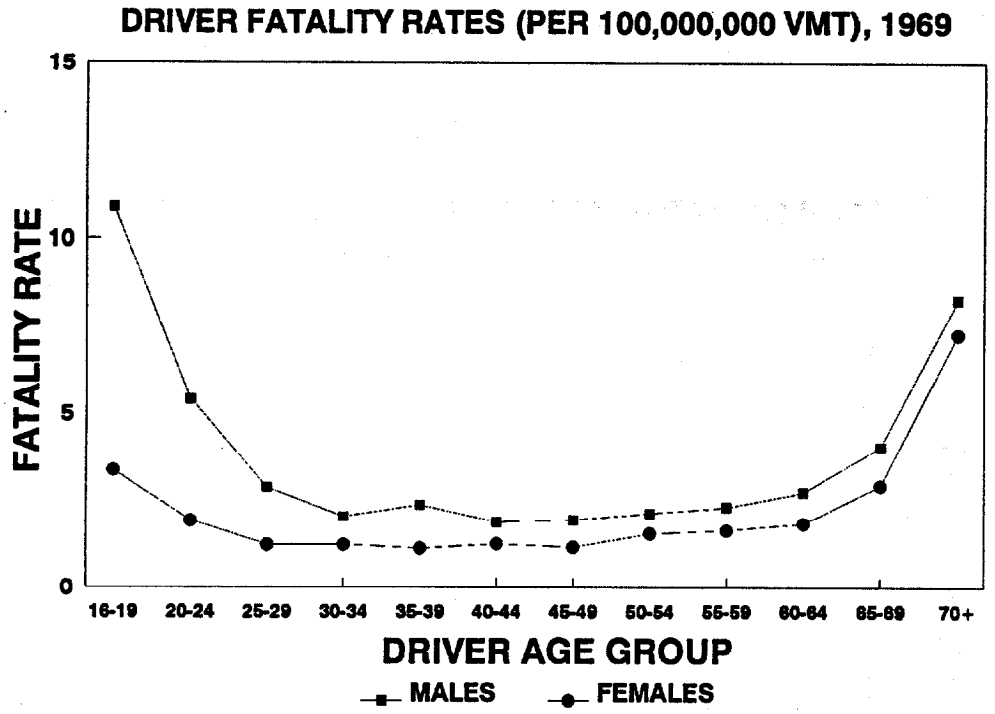
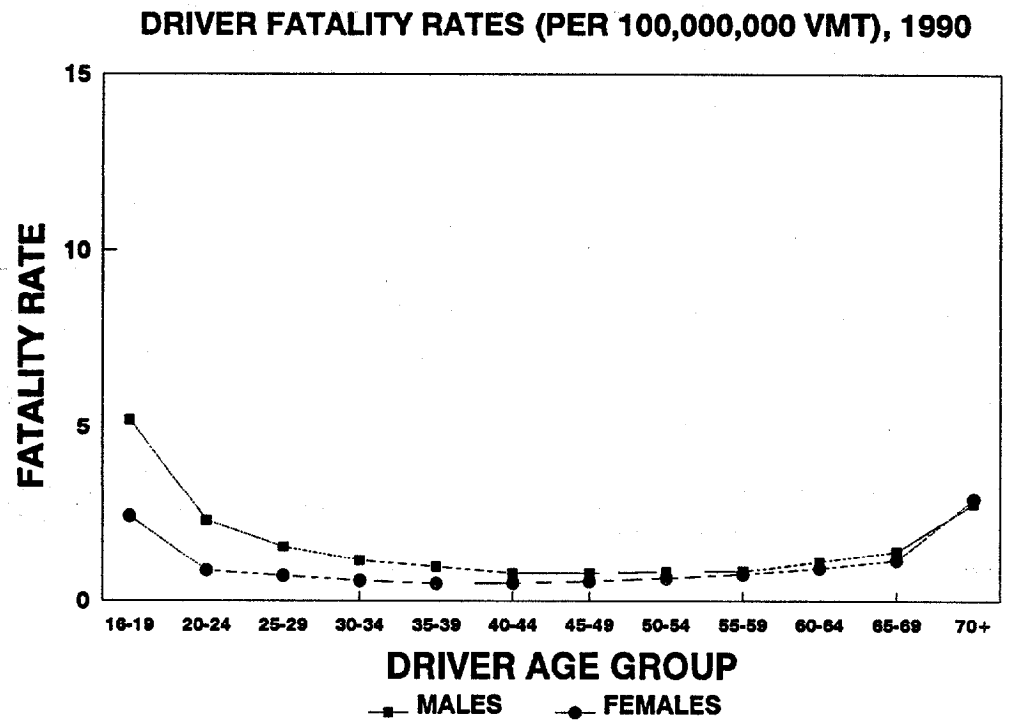


Figure 22



These charts reflect the trend of higher fatality rates for males, but also reveal that the changes (reductions), for 1969 to 1990, in fatality rates have been much larger among males during this period. The effect of these changes has been to appreciably reduce the difference in rates between male and female drivers in the younger age groups, and almost eliminate the small differences that existed in the rates for older drivers.

Figure 23

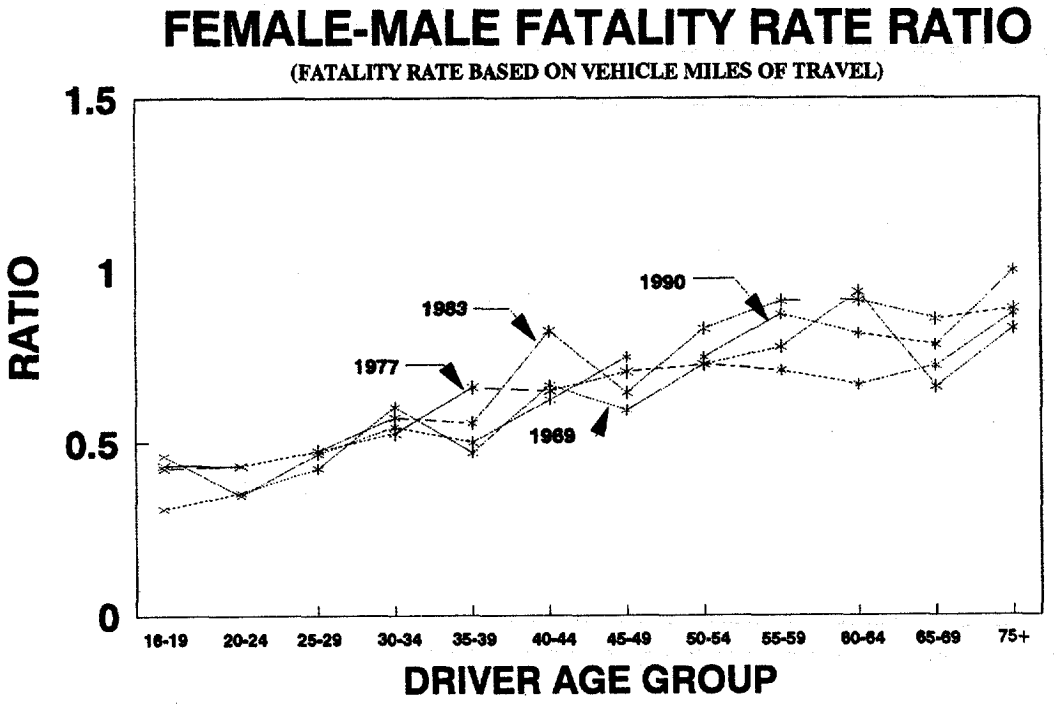


Figure 23 is based on the same fatality rate data. The female-male ratio of the fatality rates for various age groups are plotted together. Generally, the ratio increases from approximately 0.5 for the youngest group to about 1.0 for the oldest. The annual variations in the ratio for individual age groups do not appear to follow any specific pattern. The graph shows that female drivers in the youngest group are half as likely to be killed in a crash, per mile driven, than their male counterpart. However, the risk of a fatality for female drivers in the oldest group is the same as for male drivers in the oldest group. This relationship appears to be a linear function of age and has changed slightly over time.

It is important to note that although there has been a large increase in the number of female driver fatalities, relative to males, the fatality risk, as measured by the driver fatlity rate per 100,000,000 miles driven, has decreased for both male and female drivers during the 1975-1990 period. The data on travel indicate that, if the fatality risk per unit travel had remained at the 1975 level, the expected number of male and female driver fatalities in 1990 would have been 29,536 and 8,162, respectively. The reported number of driver fatalities in 1990 (19,573 for males and 6,131 for females) is much lower for both sexes and indicates a significant lowering of the risk of travel during the 1975-1990 period for both male and female drivers.

Assessment of changes in driver fatalities

To assess the effect of changes in driver licenses and annual travel on the female-male fatality ratios, one must first estimate the expected NPTS total travel for 1975. This can be done by using the historical relationship between the NPTS reported figures and those published by the Federal Highway Administration (FHWA) for those years in which surveys were conducted. Total NPTS travel for 1975 is estimated at 1,244,200 million vehicle miles. NPTS travel is limited to personal travel while the FHWA estimate includes commercial travel.

Based on data from the available NPTS surveys, female drivers accounted for approximately 28 percent of the total travel in 1975. This percentage accounts for an estimated 348,430 million miles of travel in 1975 for female drivers vs. 895,760 million miles for male drivers. By assuming a linear progression between the 1969 and the 1990 figures, the same survey data provides an estimate of the 1975 average annual travel for each age-sex group of drivers.

The product of the estimated 1975 average annual travel for each age-sex group and the reported number of licensed drivers in the same age-sex groups results in an estimate of total travel performed by each age-sex group in 1975. Table B contains the estimates of average annual travel for 1975 and 1990 while Table C contains the estimates of the total travel performed by each age-sex group of drivers.

The availability of these travel estimates enables one to calculate the 1975 driver fatality rate, per 100,000,000 miles of travel, for each age-sex group of drivers and determine what changes have occurred in the fatality risk of male and female drivers between 1975 and 1990.

In Table C, the 1975-1990 ratio change, represents the relative increase in the risk of a fatality to female drivers, in each age group, resulting from the combined increases in the number of licensed drivers and the average annual travel.

TABLE B

AVERAGE ANNUAL MILES DRIVEN BY AGE-SEX GROUPS							
	1975			1990			1975-1990
DRIVER AGE GROUP	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	RATIO CHANGE (PERCENT)
16-19	4,184	6,617	0.632	7,387	9,543	0.774	22.4%
20-24	6,423	12,952	0.496	11,807	16,784	0.703	41.9%
25-29	6,408	15,247	0.420	11,191	18,517	0.604	43.8%
30-34	6,444	15,957	0.404	10,785	19,592	0.550	36.3%
35-39	6,920	14,819	0.467	11,437	19,298	0.593	26.9%
40-44	6,632	14,917	0.445	11,021	19,396	0.568	27.8%
45-49	6,572	14,533	0.452	9,956	18,836	0.529	16.9%
50-54	5,725	13,980	0.409	8,693	18,081	0.481	17.4%
55-59	5,460	13,071	0.418	7,681	17,027	0.451	8.0%
60-64	5,119	10,740	0.477	6,706	13,308	0.504	5.7%
65-69	4,187	7,916	0.529	5,885	10,432	0.564	6.6%
70+	3,047	6,130	0.497	3,904	8,214	0.475	-4.4%
ALL AGES	5,877	12,705	0.463	9,438	16,497	0.572	23.7%

TABLE C

TOTAL ANNUAL MILES DRIVEN (in Millions)							
	1975			1990			1975-1990
DRIVER AGE GROUP	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	RATIO CHANGE (PERCENT)
16-19	22,077	42,474	0.520	32,030	46,885	0.683	31.4%
20-24	53,089	121,323	0.438	95,554	147,766	0.647	47.8%
25-29	50,702	134,543	0.377	108,060	189,596	0.570	51.2%
30-34	40,676	111,919	0.363	108,616	205,853	0.528	45.2%
35-39	36,218	86,277	0.420	107,176	186,863	0.574	36.6%
40-44	31,754	81,210	0.391	91,419	167,000	0.547	40.0%
45-49	31,606	80,934	0.391	63,499	125,109	0.508	30.0%
50-54	26,814	77,001	0.348	44,404	97,203	0.457	31.2%
55-59	21,661	63,498	0.341	35,194	82,666	0.426	24.8%
60-64	16,452	44,657	0.368	30,157	63,053	0.478	29.8%
65-69	9,857	25,766	0.383	24,181	44,503	0.543	42.0%
70+	7,522	26,156	0.288	26,252	58,806	0.446	55.2%
TOTAL	348,430	895,760	0.389	766,543	1,415,302	0.542	39.2%

Table D contains the reported number of driver fatalities for 1975 and 1990 and shows the relative changes that have taken place during this period. The structure of the table is similar to Table C with fatality counts replacing travel figures.

TABLE D

DRIVER FATALITIES BY AGE AND SEX (ACTUAL COUNTS)							
	1975			1990			1975-1990
DRIVER AGE GROUP	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	RATIO CHANGE (PERCENT)
16-19	556	3,483	0.160	775	2,434	0.318	99.5%
20-24	634	4,256	0.149	809	3,397	0.238	59.9%
25-29	456	2,780	0.164	756	2,925	0.258	57.6%
30-34	307	1,688	0.182	618	2,349	0.263	44.7%
35-39	267	1,263	0.211	515	1,791	0.288	36.0%
40-44	240	1,025	0.234	451	1,296	0.348	48.6%
45-49	239	986	0.242	350	970	0.361	48.9%
50-54	220	979	0.225	282	789	0.357	59.0%
55-59	208	827	0.252	261	679	0.384	52.8%
60-64	201	730	0.275	275	689	0.399	45.0%
65-69	167	621	0.269	277	623	0.445	65.3%
70+	281	1,202	0.234	762	1,631	0.467	99.8%
TOTAL	3,776	19,840	0.190	6,131	19,573	0.313	64.6%

Table E contains driver fatality rate, per 100,000,000 miles of travel for each age-sex group. The rates represent the ratio of the fatality counts contained in Table D and the travel totals contained in Table C. The last column in the table shows the relative change in the risk of a fatality for female drivers on a per mile driven basis. This rate is independent of any changes in the number of licensed drivers and the amount of travel.

For all female drivers combined, the fatality rate increased by 18.2 percent, when compared to male drivers. The change in rate is not uniform among all age groups with values exceeding 50 percent for teenage drivers and no change for drivers 30 to 40 years old.

TABLE E

DRIVER FATALITY RATE (per 100,000,000 miles of travel)							
	1975			1990			1975-1990
DRIVER AGE GROUP	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	FEMALE DRIVERS	MALE DRIVERS	FEM.-MALE RATIO	RATIO CHANGE (PERCENT)
16-19	2.52	8.20	0.307	2.42	5.19	0.466	51.8%
20-24	1.19	3.51	0.340	0.85	2.30	0.368	8.2%
25-29	0.90	2.07	0.435	0.70	1.54	0.453	4.2%
30-34	0.75	1.51	0.500	0.57	1.14	0.499	-0.4%
35-39	0.74	1.46	0.504	0.48	0.96	0.501	-0.4%
40-44	0.76	1.26	0.599	0.49	0.78	0.636	6.2%
45-49	0.76	1.22	0.621	0.55	0.78	0.711	14.5%
50-54	0.82	1.27	0.645	0.64	0.81	0.782	21.2%
55-59	0.96	1.30	0.737	0.74	0.82	0.903	22.5%
60-64	1.22	1.63	0.747	0.91	1.09	0.835	11.7%
65-69	1.69	2.41	0.703	1.15	1.40	0.818	16.4%
70+	3.74	4.60	0.813	2.90	2.77	1.047	28.7%
TOTAL	1.08	2.21	0.489	0.80	1.38	0.578	18.2%

The results presented in the five previous tables, A through E, are utilized in the formulation of Table F. In this table the overall percent change in female driver fatalities, for each age group, is partitioned into four components. For each age group and for the whole female driver population the table shows the contribution that changes in (1) driver licenses, (2) average annual travel; and (3) fatality risk have made to the changes in fatalities.

The results of the study lead to the conclusion that the sizable increase in female driver fatalities during the 1975-1990 period, the 65 percent increase for female driver fatalities when compared to male driver fatalities, was due to the relative increase in both total travel and driver fatality rate. The increase in total travel is estimated at 39.2 percent (Table C), the increase in driver fatality rate is estimated at 18.2 percent (Table E), while the total change reflects the combined effect (product) of these two changes

It is clear from this table that the effect of these factors was not the same across all age groups. Changes in driver licenses have been more pronounced for older female drivers, average annual travel show much larger increases among younger female drivers, and the fatality rate increased by over 50 percent among teenage female drivers and by an average of about 20 percent for female drivers over 50 years of age. Female drivers 20 to 45 years of age had no changes or small changes in the fatality rate.

Although the study provides a detailed documentation of the changes that occurred and estimates the individual contribution of three major factors to the increase in female driver fatalities, much remains to be learned as to the reasons for these changes and as to why these changes vary so much among the various age groups.

TABLE F

CONTRIBUTION TO CHANGES IN FEMALE DRIVER FATALITIES

(Percent)

DRIVER AGE GROUP	CONTRIBUTING FACTORS			COMBINED EFFECT (*)
	LICENSES	AVE.TRAVEL	FAT.RATE	
16-19	7.4%	22.4%	51.8%	99.5%
20-24	4.2%	41.9%	8.2%	59.9%
25-29	5.2%	43.8%	4.2%	57.6%
30-34	6.5%	36.3%	-0.4%	44.7%
35-39	7.7%	26.9%	-0.4%	36.0%
40-44	9.5%	27.8%	6.2%	48.6%
45-49	11.2%	16.9%	14.5%	48.9%
50-54	11.7%	17.4%	21.2%	59.0%
55-59	15.6%	8.0%	22.5%	52.8%
60-64	22.8%	5.7%	11.7%	45.0%
65-69	33.2%	6.6%	16.4%	65.3%
70+	62.3%	-4.4%	28.7%	99.8%
TOTAL	12.6%	23.7%	18.2%	64.6%

(*) COMBINED EFFECT (%)= ((1+ LICENSES/100) * (1+ AVE.TRAVEL/100) * (1+ FAT.RATE/100) - 1) * 100

Summary and Conclusions

The purpose of this study was to identify and explain the increases in the number of female driver fatalities during the 1975-1990 period, in comparison to minor changes for male drivers.

In the past, male driver fatalities have been a more common occurrence than female driver fatalities. During 1975, more than five times as many male drivers were killed in traffic crashes as female drivers. This ratio was reduced to approximately 3 to 1 in 1990. This information demonstrates that while male driver fatalities continue to be more common, female driver fatalities are increasing in both absolute and relative terms.

The use of population as an adjustment factor does not modify the general findings. Increases in the number of licensed drivers of each sex has explained some of the change in fatalities, but not all. The increase in the number of female licensed drivers has reduced the value of the ratio of male to female licenses from 1.2 in 1975 to 1.06 in 1990.

During the 1975-1990 period, the average rate for female drivers was 166 fatal involvements per million licensed drivers, in comparison to a rate of 600 for male drivers. Both rates varied during this period but with no clear pattern. The ratio of female to male rates increased steadily, especially during the 1980's (Figure 8). By 1990, the average female licensed driver had a 33 percent greater probability than in 1975 of being involved in a fatal crash, relative to the male driver.

Changes in actual travel have contributed to the male/female fatality changes. The NPTS surveys of 1969, 1977, 1983, and 1990 indicate that female drivers accounted for 26.8, 27.6, 29.3, and 35 percent of the motor vehicle travel during these respective years.

The same NPTS surveys provided the necessary data to estimate the average number of miles driven annually by each specified age-sex group of drivers. These estimates, combined with the data on driver licensing, were the basis for determining the total travel performed by each driver group in each of the four years. Fatality rates, based on miles of travel, were computed for each driver age-sex group and each year.

These fatality rates per 100,000,000 miles of travel demonstrate the differences and similarities between male and female drivers. The rates for male drivers are higher than for female drivers in every age group. Both sexes show higher rates for young and elderly drivers. Over time, fatality rates, with the exception of teenage female drivers, have been reduced across all age groups in both sexes.

The differences in the fatality rates per miles driven declined so significantly from 1969 to 1990 that the rate for drivers 40 or older is essentially the same for male and female drivers.

Once the changes in travel are identified, the 64.6 percent relative increase for female driver fatalities is not an alarming statistic. Because the large increase in female driver fatalities is well below the 120 percent increase in their estimated annual travel, one could conclude that current motor vehicle and traffic safety programs are yielding some benefits by reducing the risk of a female driver fatality per miles driven. At the same time, it is also true that the 29 percent reduction in the fatality rate per mile, over the same period, for female drivers is lower than the 38 percent reduction found for male drivers.

Finally, this study has shown that, although the relative increase in female driver fatalities was large in all age groups, varying from 36 to 100 percent increases, the individual contribution of the three major factors associated with the increase in female driver fatalities is different among the various age groups, making it difficult to reach specific conclusions for specific age groups. For all female drivers combined, the general conclusion is that the 64.6 increase in female driver fatalities, relative to males, was due to the combined (multiplicative) effect of three factors: a 12.6 percent relative increase in the number of licensed female drivers, a 23.7 percent relative increase in the average annual travel of female drivers, and an 18.2 percent relative increase in the fatality risk of female drivers.

The identification of those factors associated with the 18.2 percent relative increase in fatality risk is beyond the scope of this study. This issue is the focus of another study currently under way, the results of which will be presented in a separate report.

APPENDIX

(STUDY DATA)

DRIVER STATISTICS BY AGE AND SEX

LICENSED DRIVERS *(in Thousands)*

AGE GROUP	1969		1975		1977		1983		1990	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
16-19	5,466	3,945	6,419	5,276	6,487	5,360	6,066	5,227	4,913	4,336
20-24	7,636	6,165	9,367	8,266	9,914	8,772	10,442	9,506	8,804	8,093
25-29	6,686	5,309	8,824	7,912	9,429	8,454	10,463	9,735	10,239	9,656
30-34	5,892	4,748	7,014	6,312	8,023	7,282	9,468	8,923	10,507	10,071
35-39	5,810	4,763	5,822	5,234	6,471	5,882	7,946	7,503	9,683	9,371
40-44	5,968	4,809	5,444	4,788	5,592	4,976	6,279	5,878	8,610	8,295
45-49	5,769	4,475	5,569	4,809	5,533	4,843	5,394	4,964	6,642	6,378
50-54	5,085	3,744	5,508	4,684	5,500	4,782	5,352	4,855	5,376	5,108
55-59	4,485	3,053	4,858	3,967	5,112	4,300	5,301	4,825	4,855	4,582
60-64	3,594	2,227	4,158	3,214	4,278	3,440	4,759	4,252	4,738	4,497
65-69	2,636	1,439	3,255	2,354	3,434	2,616	3,770	3,374	4,266	4,109
70+	3,320	1,282	4,267	2,469	4,694	2,947	5,654	4,453	7,159	6,725
TOTAL	62,347	45,959	70,505	59,285	74,467	63,654	80,894	73,495	85,792	81,221

DRIVER STATISTICS BY AGE AND SEX

AVERAGE ANNUAL MILES PER LICENSED DRIVER

	1969		1975 (Estimated)		1977		1983		1990	
AGE GROUP	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
16-19	5,631	3,698	6,617	4,184	7,026	3,990	5,717	3,749	9,543	7,387
20-24	11,780	5,487	12,952	6,423	13,661	6,408	12,984	6,884	16,784	11,807
25-29	14,364	5,711	15,247	6,408	15,718	6,481	15,695	6,744	18,517	11,191
30-34	14,947	5,931	15,957	6,444	15,985	6,720	16,612	7,030	19,592	10,785
35-39	13,440	6,426	14,819	6,920	16,995	6,973	17,085	7,549	19,298	11,437
40-44	13,541	6,135	14,917	6,632	16,447	6,704	17,634	7,224	19,396	11,021
45-49	13,217	6,466	14,533	6,572	15,269	6,215	15,272	7,283	18,836	9,956
50-54	12,729	5,624	13,980	5,725	14,849	5,904	15,109	6,092	18,081	8,693
55-59	11,852	5,608	13,071	5,460	13,622	5,589	12,620	5,555	17,027	7,681
60-64	10,012	5,456	10,740	5,119	10,731	4,406	11,147	4,888	13,308	6,706
65-69	7,130	4,303	7,916	4,187	6,854	3,879	8,729	4,020	10,432	5,885
70+	5,467	3,282	6,130	3,047	5,740	3,184	5,616	2,605	8,214	3,904
ALL	11,721	5,585	12,705	5,877	13,316	5,856	13,426	6,136	16,497	9,438

DRIVER STATISTICS BY AGE AND SEX

TOTAL MILES DRIVEN *(in Millions)*

	1969		1975 (Estimated)		1977		1983		1990	
AGE GROUP	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
16-19	30,778	14,587	42,474	22,077	45,577	21,384	34,680	19,595	46,885	32,030
20-24	89,954	33,830	121,323	53,089	135,435	56,214	135,583	65,440	147,766	95,554
25-29	96,039	30,321	134,543	50,702	148,201	54,787	164,216	65,651	189,596	108,060
30-34	88,066	28,160	111,919	40,676	128,246	48,936	157,285	62,731	205,853	108,616
35-39	78,088	30,606	86,277	36,218	109,976	41,018	135,761	56,639	186,863	107,176
40-44	80,815	29,503	81,210	31,754	91,971	33,360	110,725	42,461	167,000	91,419
45-49	76,246	28,935	80,934	31,606	84,485	30,101	82,377	36,152	125,109	63,499
50-54	64,726	21,055	77,001	26,814	81,667	28,231	80,866	29,575	97,203	44,404
55-59	53,158	17,122	63,498	21,661	69,637	24,032	66,896	26,805	82,666	35,194
60-64	35,983	12,149	44,657	16,452	45,909	15,157	53,047	20,783	63,053	30,157
65-69	18,795	6,192	25,766	9,857	23,536	10,147	32,907	13,563	44,503	24,181
70+	18,150	4,207	26,156	7,522	26,945	9,383	31,755	11,600	58,806	26,252
TOTAL	730,799	256,667	895,760	348,430	991,585	372,750	1,086,098	450,995	1,415,302	766,543

DRIVER STATISTICS BY AGE AND SEX

PROPORTION OF TRAVEL BY SEX OF DRIVER

	1969		1975 (Estimated)		1977		1983		1990	
AGE GROUP	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
16-19	67.8%	32.2%	65.8%	34.2%	68.1%	31.9%	63.9%	36.1%	59.4%	40.6%
20-24	72.7%	27.3%	69.6%	30.4%	70.7%	29.3%	67.4%	32.6%	60.7%	39.3%
25-29	76.0%	24.0%	72.6%	27.4%	73.0%	27.0%	71.4%	28.6%	63.7%	36.3%
30-34	75.8%	24.2%	73.3%	26.7%	72.4%	27.6%	71.5%	28.5%	65.5%	34.5%
35-39	71.8%	28.2%	70.4%	29.6%	72.8%	27.2%	70.6%	29.4%	63.6%	36.4%
40-44	73.3%	26.7%	71.9%	28.1%	73.4%	26.6%	72.3%	27.7%	64.6%	35.4%
45-49	72.5%	27.5%	71.9%	28.1%	73.7%	26.3%	69.5%	30.5%	66.3%	33.7%
50-54	75.5%	24.5%	74.2%	25.8%	74.3%	25.7%	73.2%	26.8%	68.6%	31.4%
55-59	75.6%	24.4%	74.6%	25.4%	74.3%	25.7%	71.4%	28.6%	70.1%	29.9%
60-64	74.8%	25.2%	73.1%	26.9%	75.2%	24.8%	71.9%	28.1%	67.6%	32.4%
65-69	75.2%	24.8%	72.3%	27.7%	69.9%	30.1%	70.8%	29.2%	64.8%	35.2%
70+	81.2%	18.8%	77.7%	22.3%	74.2%	25.8%	73.2%	26.8%	69.1%	30.9%
ALL	74.0%	26.0%	72.0%	28.0%	72.7%	27.3%	70.7%	29.3%	64.9%	35.1%

DRIVER STATISTICS BY AGE AND SEX

DRIVER FATALITIES

	1969		1975		1977		1983		1990	
AGE GROUP	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
16-19	3,353	490	3,483	556	3,708	739	2,580	632	2434	775
20-24	4,856	646	4,256	634	4,937	888	4,061	851	3397	809
25-29	2,738	368	2,780	456	3,058	537	3,106	592	2925	756
30-34	1,779	343	1,688	307	1,954	393	2,143	490	2349	618
35-39	1,846	340	1,263	267	1,263	313	1,558	360	1791	515
40-44	1,507	367	1,025	240	1,074	252	1,019	321	1296	451
45-49	1,465	331	986	239	1,038	263	819	230	970	350
50-54	1,365	324	979	220	961	244	778	236	789	282
55-59	1,214	278	827	208	858	230	689	251	679	261
60-64	978	221	730	201	741	229	628	225	689	275
65-69	757	181	621	167	588	168	524	186	623	277
70+	1,499	305	1,202	281	1,184	343	1,279	417	1631	762
TOTAL	23,357	4,194	19,840	3,776	21,364	4,599	19,184	4,791	19,573	6,131

DRIVER STATISTICS BY AGE AND SEX

DRIVER FATALITY RATE *(per 100,000,000 VMT)*

	1969		1975 (Estimated)		1977		1983		1990	
AGE GROUP	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
16-19	10.89	3.36	8.20	2.52	8.14	3.46	7.44	3.23	5.19	2.42
20-24	5.40	1.91	3.51	1.19	3.65	1.58	3.00	1.30	2.30	0.85
25-29	2.85	1.21	2.07	0.90	2.06	0.98	1.89	0.90	1.54	0.70
30-34	2.02	1.22	1.51	0.75	1.52	0.80	1.36	0.78	1.14	0.57
35-39	2.36	1.11	1.46	0.74	1.15	0.76	1.15	0.64	0.96	0.48
40-44	1.86	1.24	1.26	0.76	1.17	0.76	0.92	0.76	0.78	0.49
45-49	1.92	1.14	1.22	0.76	1.23	0.87	0.99	0.64	0.78	0.55
50-54	2.11	1.54	1.27	0.82	1.18	0.86	0.96	0.80	0.81	0.64
55-59	2.28	1.62	1.30	0.96	1.23	0.96	1.03	0.94	0.82	0.74
60-64	2.72	1.82	1.63	1.22	1.61	1.51	1.18	1.08	1.09	0.91
65-69	4.03	2.92	2.41	1.69	2.50	1.66	1.59	1.37	1.40	1.15
70+	8.26	7.25	4.60	3.74	4.39	3.66	4.03	3.59	2.77	2.90
ALL	3.20	1.63	2.21	1.08	2.15	1.23	1.77	1.06	1.38	0.80