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# Women, Alcohol, and Traffic Safety

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# WOMEN, ALCOHOL, AND TRAFFIC SAFETY

We have heard reports about women's increasing presence in motor vehicle fatalities and dangerous driving. According to data from the National Highway Traffic Safety Administration (1995), between 1975 and 1994 the number of male drivers in fatal crashes dropped from 45,084 to 39,739, a drop of almost 12 percent. During the same period, women drivers in fatal crashes increased from 9,356 to 13,430, an increase of 43.5 percent (National Highway Traffic Safety Administration, 1995). It is understandable that these numbers caused alarm.

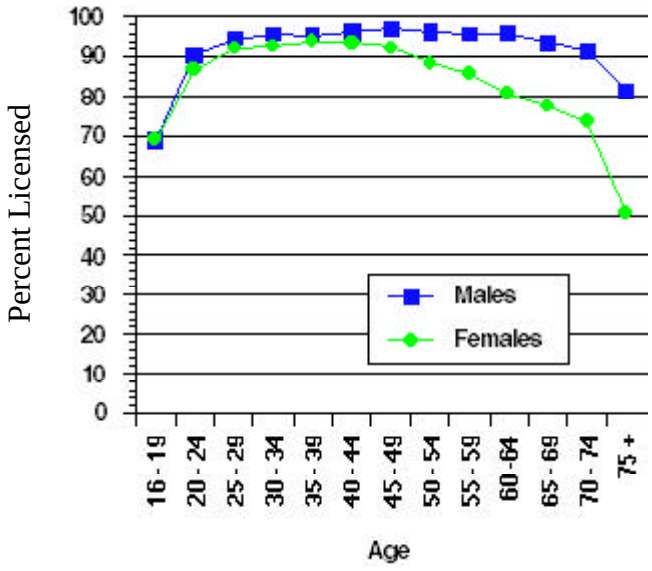
What is happening with women? The role of women in our society, and particularly their role in relation to transportation, has changed dramatically over the past two and a half decades. Changes that affect women and transportation include changes in driving behavior, changes in crash involvement, changes in alcohol use and alcohol-related crash involvement, demographic changes, and differences in alcohol's impact on women.

## CHANGES IN DRIVING BEHAVIOR

### LICENSURE RATE

Women are increasing their rate of driver licensure, so that they are rapidly approaching that of men (Figure 1, Massie and Campbell, 1993). Furthermore, they are now as likely as men to acquire license as early as the law allows. While the number of licensed drivers increased for both sexes between 1975 and 1994, the increase for men was 26 percent, but the increase for women was 45 percent (Massie and Campbell, 1993). It can be seen in Figure 1 that up until the mid-40s, women are holding license at about the same rate as men. The discrepancy seen in the later ages is undoubtedly a cohort effect, that is, as today's population becomes older, the higher rates of licensure for women will persist into the older years.

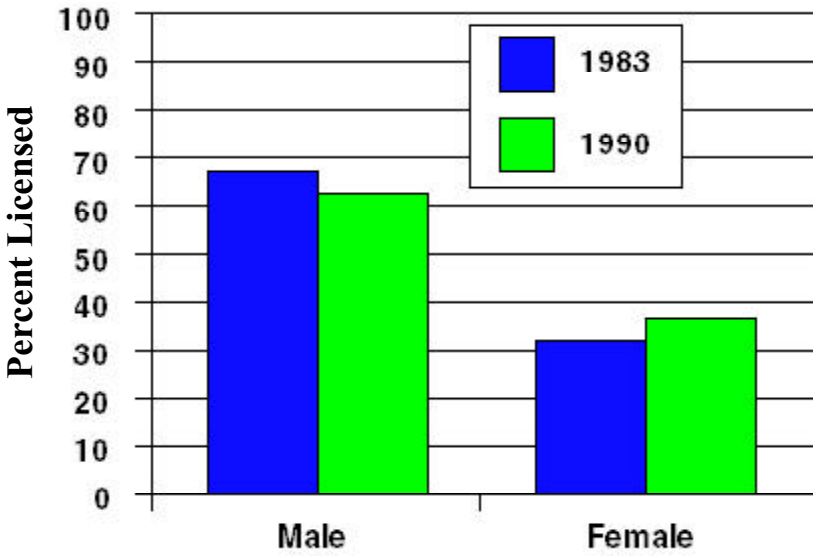
**Figure 1**
Percent of population holding driver license, by age and sex



### MILEAGE DRIVEN

While women still do not drive as many miles as men, they are increasing their mileage, as well as their proportion of the total mileage accumulated (Figure 2, Massie and Campbell, 1993).

**Figure 2**
Proportion of annual mileage accumulated by gender, 1983 vs. 1990,
from Nationwide Personal Transportation Surveys.




### TIMES AND PLACES DRIVEN

Women are also driving at times and places previously dominated by male drivers, namely, at night, on weekends, around entertainment establishments, and on long trips. Women account for the major changes in travel behavior occurring in the U.S. today (Pisarski, 1992).

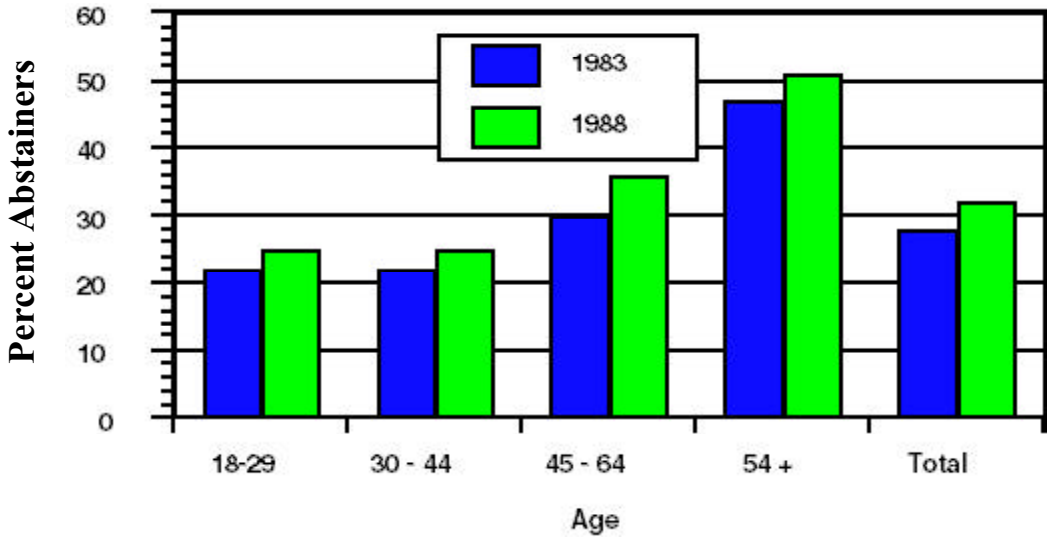
## CHANGES IN CRASH INVOLVEMENT

Not surprisingly, as women increase their presence in the driving population, they have also increased their crash involvement. As mentioned earlier, the increase in crashes has been much greater for women than for men. However, the increase has not been consistent across crash types. Women are disproportionately increasing their involvement in fatal crashes. Figure 3 shows the changes in the male-to-female ratio of crashes per 100,000 licensed driver, by type of crash, between 1988 and 1994 (National Highway Traffic Safety Administration, 1995).

First, it can be seen that for all crash types, men have higher rates relative to women, based on number of licensed drivers. However, it is also evident that from 1988 to 1994 this ratio changed fairly little for property damage and injury crashes. In contrast, for fatal crashes, the ratio dropped in this time interval, indicating that women have increased their involvement in this type of crash relative to their total crash involvement. Unfortunately, valid data for injury and property damage crashes are not available prior to 1988, but for fatal crashes, data are available since 1975. Roughly

speaking, in 1975 men had about four fatal crashes for every one involving a woman driver. That ratio is now somewhat less than three fatal crashes for every one involving a woman driver.

**Figure 3**
Male-to-Female Ratio of Crashes Per 100,000 Licensed Driver,
by Type of Crash, 1988 and 1994.




## CHANGES IN ALCOHOL USE

There have been changes in alcohol use over the last decades. Figures 4 and 5 show the prevalence of abstinence in the U.S. for men and women in 1983 and 1988.

Abstainers included three groups, namely, 1) lifetime abstainers, who had consumed fewer than 12 drinks in a lifetime; 2) former drinkers, who consumed 12 or more drinks in one or more years, but no drink in the past year; and, 3) infrequent drinkers, those who drank less than 0.01 oz. daily in the past year (National Institute on Alcohol Abuse and Alcoholism, 1994).

Drinkers were classified into three groups, namely, 1) light drinkers, who consume about 1 to 13 drinks per month; 2) moderate drinkers, who consume about 4 to 13 drinks per week; and 3) heavier drinkers, who consume about 2 or more drinks per day or 14 or more drinks per week. Figures 6 and 7 show the proportion of drinkers who are classified as heavy drinkers, by age. It needs to be underscored that the percentages for heavy drinkers are based on the drinking population only (National Institute on Alcohol Abuse and Alcoholism, 1994).

First, it can be seen that for all age groups, and for both years, women have higher rates of abstinence (Figures 4 and 5). Second, it is also evident that abstinence has increased over the time frame examined. This time frame coincides with the intensified involvement of citizen action groups in addressing the problem of drunken driving. However, it should be noted that for both sexes, significant proportions still fall into the moderate and heavier drinking categories (Figures 6 and 7). In fact, women age 65 and older are the only group that does not show a decrease in the proportion of drinkers categorized as heavy.

**Figure 4**
Prevalence of Abstinence in U.S. Population, 1983 - 1988, Males

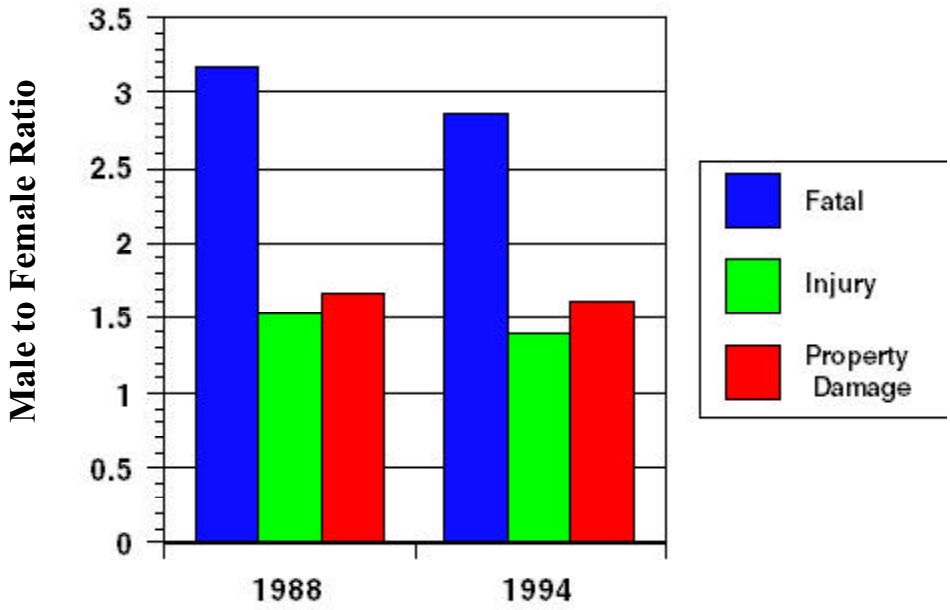
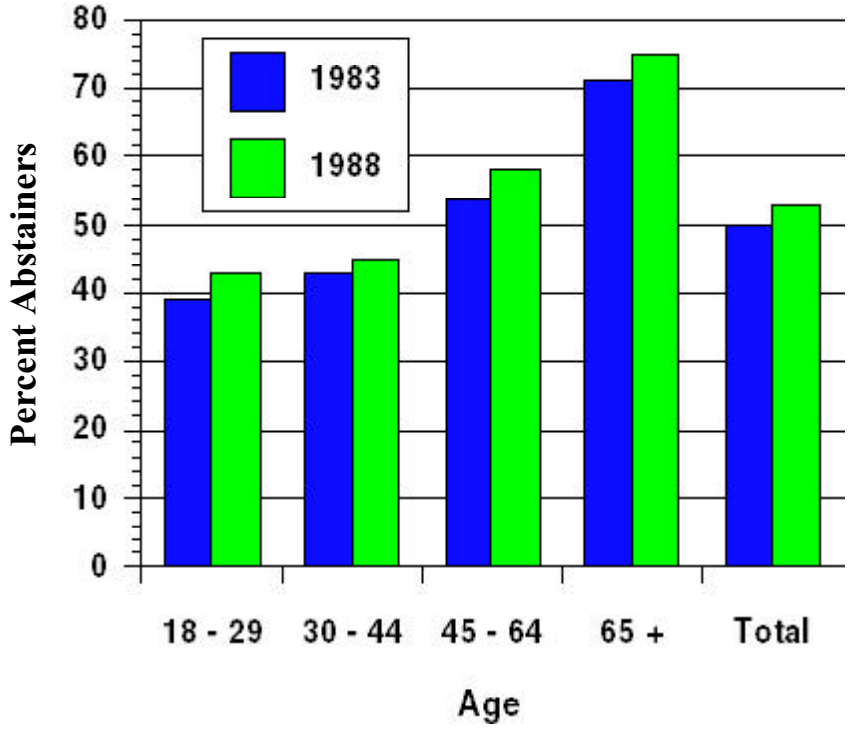



**Figure 5**
Prevalence of Abstinence in U.S. Population, 1983 - 1988, Females.



## CHANGES IN ALCOHOL-RELATED CRASH INVOLVEMENT

In contrast to these figures showing increases in abstinence and decreases in heavy drinking, in the late 1980s there were numerous reports from around the world stating that women were a growing menace on the highway where alcohol was concerned. Indeed, the data show that, in the U.S., between 1982 and 1994, women increased from 12.9 percent of the drinking drivers (any measurable alcohol) in fatal crashes to 15.2 percent. For drivers with blood alcohol concentrations (BACs) of 0.10 percent or higher, in fatal crashes, the increase was from 12.3 percent of all drunken drivers to 14.6 percent (National Highway Traffic Safety Administration, 1995). Such changes were being reported worldwide. Increases in the rate or proportion of women drinking drivers have been reported from Canada (Beirness, 1989), Finland (Pikkarainen and Penttila, 1989), Germany (Puschel, Janssen, Schmutte, and Jansen, 1989; Freudenstein and Schmidt, 1989; Erkens, 1989), New Zealand (Bailey, 1989), Sweden (Jones, Holmgren, and Andersson, 1989), and the U.S. (Popkin, 1991; Yu, Essex, and Williford, 1992).

As in the case of total fatal crashes, men account for by far the largest proportion of alcohol-related arrests and crashes. Women, however, are an increasing proportion of the total drinking-driving problem. Figure 8 shows total alcohol-involved drivers in fatal crashes by sex, for 1982 through 1994.

**Figure 6**
Prevalence of Drinkers Categorized as Heavy, 1983-88, Males.

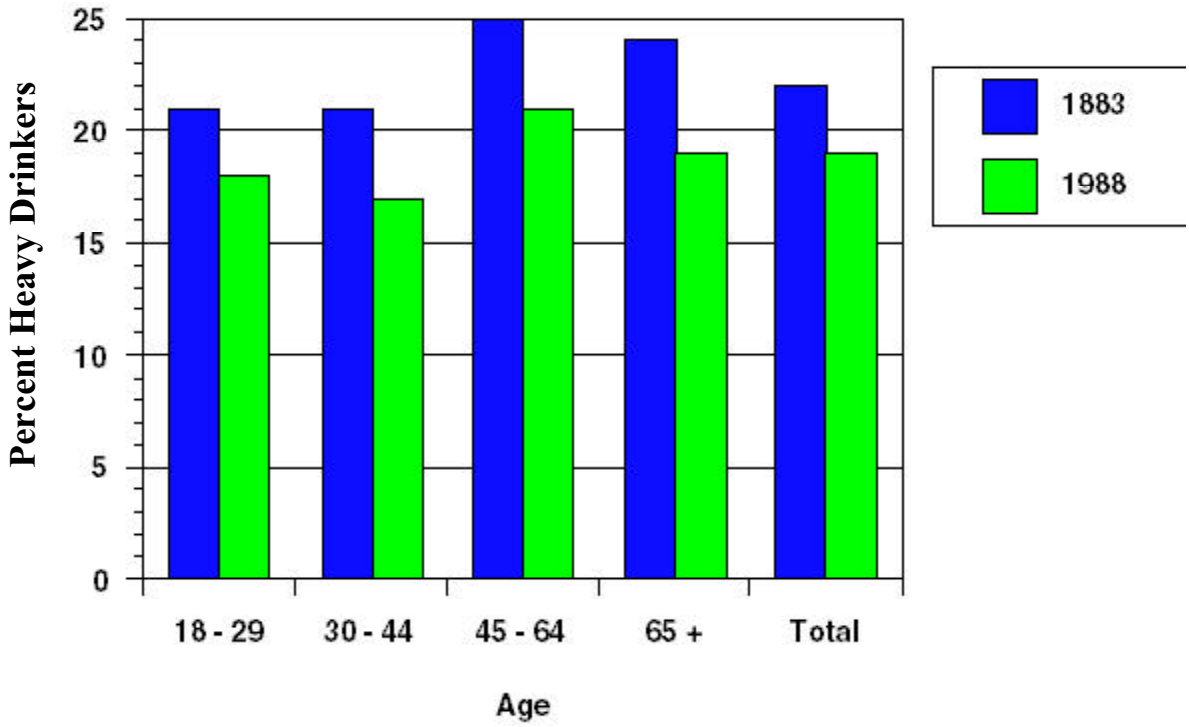
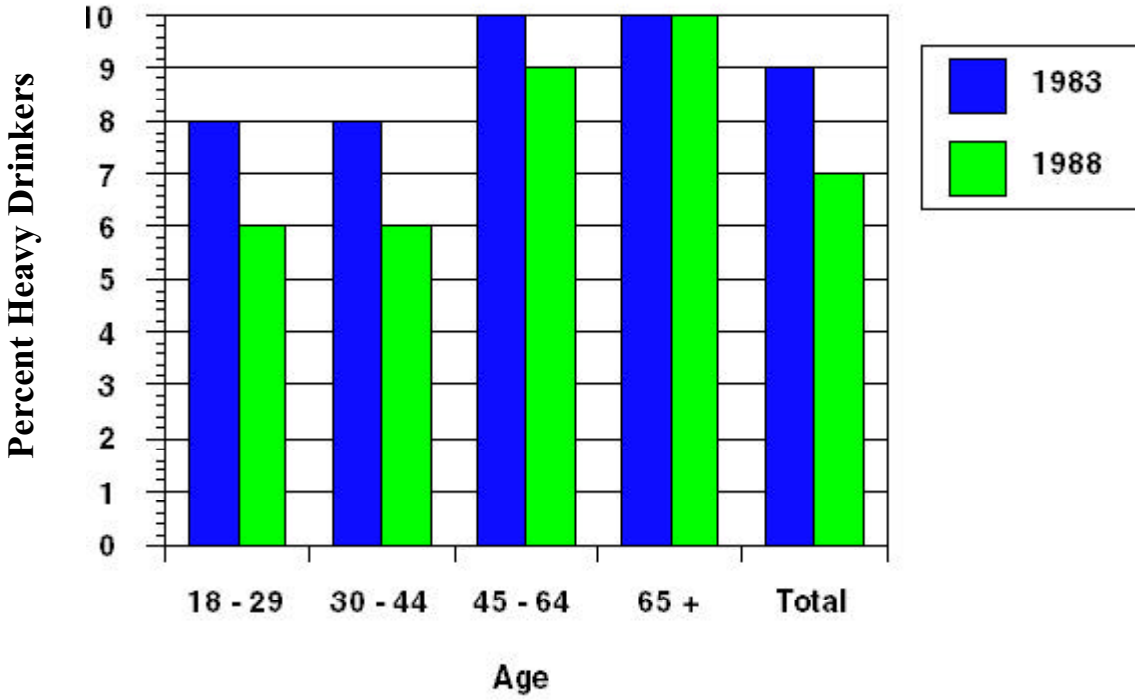


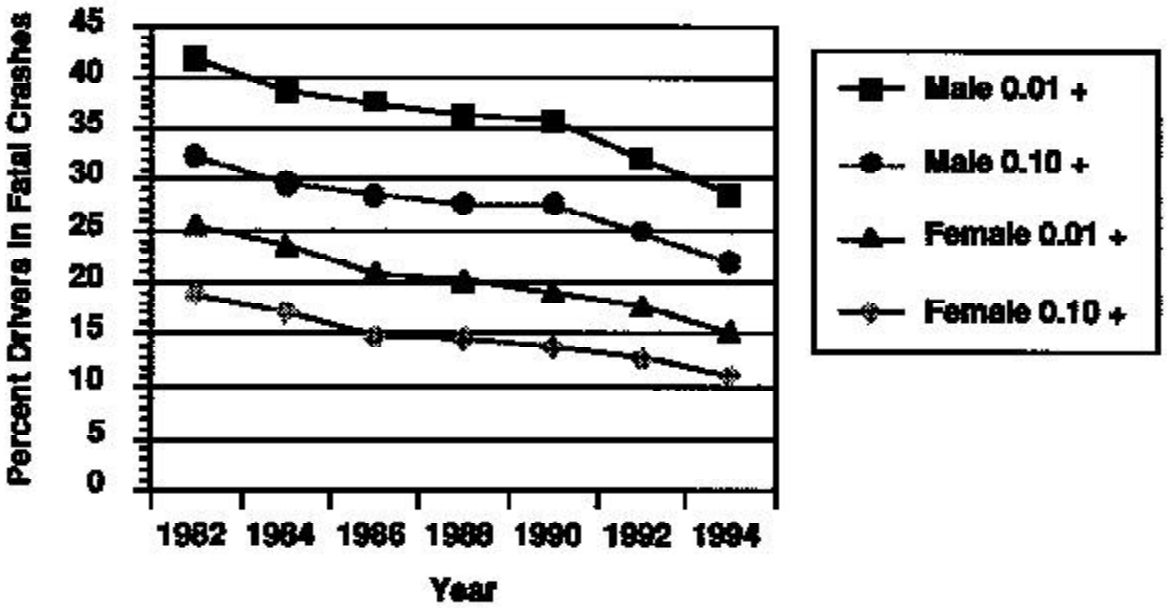
**Figure 7**
Prevalence of drinkers categorized as heavy, 1983 - 1988, Females.




In response to an intensified concern about drinking and driving, with numerous corresponding measures to reduce the combination, alcohol-related fatal crashes have dropped dramatically for both men and women. Several other points should be made about this figure. First, from 1982 through 1994, of those drivers who tested positive for alcohol, for both sexes, about three-fourths were at 0.10 percent BAC, the legal limit in most states, or higher. This ratio has not changed appreciably from 1982 to 1994. Thus, it appears that, of those drivers who do drive after drinking and are involved in fatal crashes, most have been drinking heavily. Nevertheless, the total numbers are lower (National Highway Traffic Safety Administration, 1995).

Somewhat less obvious from this figure is that, from 1982 to 1994, women have increased as a proportion of total drinking drivers. This increase is what has led to the growing concern about women's drinking and driving. However, these reports need to be interpreted with caution. For both men and women, alcohol-related fatal crashes have decreased, not only in number, but also in proportion of all fatal crashes. As reported earlier, women have greatly increased their numbers in total fatal crashes, while men have actually shown a marked decrease. Consequently, even though fatal crashes involving alcohol have dropped for women, and have dropped as a proportion of their total crashes, because of the changes in the number of total crashes for the two sexes, women show an increase as a proportion of all alcohol-related crashes. However, when alcohol-related crashes are examined as a proportion of total fatal crashes, women have actually shown greater relative decreases than have men (Fell, 1987; Waller and Blow, 1995).

**Figure 8**
Percent of Drivers in Fatal Crashes Testing Positive for Alcohol, by Sex, 1982 - 1994.




## DEMOGRAPHIC CHANGES

Several demographic changes that have special relevance for women's travel behavior and their likelihood of being involved in an alcohol-related crash are discussed briefly below.

### PARTICIPATION IN LABOR FORCE

Women's entrance into the labor force has increased, so that they will account for about 47 percent of the total labor force in the year 2000 (Fullerton, 1989). Married women have been a significant part of this change. Fewer than one-third of married women were in the work force in 1960, but now most women, about 60 percent by 1990, and even those with young children, are employed.

The change in job status has also provided women with greater control over resources than was previously the case. While women still receive lower pay than men, their economic independence has increased. Women now account for about half of all new vehicles sold (Belton, 1992).

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## AGE OF MARRIAGE, RATE OF DIVORCE

Another major change affecting women and transportation is the increase in age of marriage, as well as in the rate of divorce. Both these factors, in combination with higher rates of employment, have led to greater independence for women, with accompanying transportation requirements. They now account for about half of all new cars sold. Based on data from the Nationwide Personal Transportation Survey, single mothers make more vehicle trips than comparable married women (Rosenbloom, 1994). Although women drive fewer miles than men, they make more trips per day. It also appears that the travel behavior of women is more affected by variables other than their household income or whether they hold a driver license. For example, single mothers make more trips by automobile than almost any other group. If a mother is paying a dollar for every minute she is late to pick up a child at nursery school, she can hardly afford to be waiting for the bus.

The number and ages of children markedly affect the number of trips made by women, while travel patterns for the man of the house remain relatively unchanged in relation to children (Rosenbloom, 1994).

## GRAYING OF AMERICA

Another demographic phenomenon that has special relevance for women is the graying of America. On the whole, women live longer than men. Thus, even if the husband has been the primary driver, women are likely to find themselves in that position. With increasing age, the ratio of women to men increases.

With increasing age, the probability of no longer qualifying for driver licensure also increases. But loss of licensure does not mean that transportation needs cease. The increasing elderly population in need of transportation services will be composed primarily of women. Furthermore, for the first time in history, more of these elderly are living in the suburbs than in the cities. These are the women who married after World War II and populated the newly built suburbs. They raised their families, and the children grew up and left home. The spouse died, so that these suburbs are populated with adults living alone in single family dwellings. This situation poses unprecedented problems for the design of adequate public transit systems. By far the largest proportion of the elderly who will confront transportation problems will be women. furthermore, for the first time in history, more of these elderly are living in the suburbs than in the cities. These are the women who married after World War II and populated the newly built suburbs. They raised their families, and the children grew up and left home. The spouse died, so that these suburbs are populated with adults living alone in single family dwellings. This situation poses unprecedented problems for the design of adequate public transit systems. By far the largest proportion of the elderly who will confront transportation problems will be women.

## WOMEN AND ALCOHOL

Another major issue associated with the aging population, and the increasing proportion of women in that population, relates to alcohol. At the present time, drinking and driving is not a major problem among older drivers. As shown in Figures 4 and 5, the older population drinks less than younger cohorts. However, it is important to recognize certain generational differences. Older drivers today grew up during Prohibition and the Great Depression, times that were characterized by very low per capita consumption of alcohol. Women, particularly, were unlikely to drink, especially in certain regions of the country.

In the 1960s major social changes occurred. The Constitution was amended to lower the age of majority to 18. Most states subsequently lowered to 18 the drinking age for any alcoholic beverages. At the same time, the women's movement was growing stronger, and with increasing economic and social independence, there were marked changes in women's use of alcohol. This phenomenon has been reflected in the growing presence of women in the drinking driving population.

Longitudinal studies indicate that drinking patterns characteristic of middle age may be maintained into later years to a greater extent than previously thought. In an NIAAA Report to Congress (National Institute on Alcohol Abuse and Alcoholism, 1994), it is reported that

> drinking patterns of middle age may be maintained into older age to a greater extent than previously appreciated and...some of the changes in drinking observed among the elderly may reflect those taking place in society as a whole rather than being an age-specific effect (p. 23).

Cross-sectional studies had shown that older people drink less, and it was assumed that drinking patterns change over the life spectrum. To some extent that is true, but the longitudinal studies suggest that cohort differences may translate into subsequent differences in the drinking behaviors of the elderly.

This phenomenon has special significance for women for several reasons. First, it is well established that as BAC increases, crash risk increases at an accelerating rate (Figure 9, Borkenstein, Crowther, Shumate, Ziel, and Zylman, 1964). Second, even in the absence of alcohol, older drivers are at higher risk of crash based on miles driven (Figure 10, Peck and Romanowicz, 1993/1994). Third, it is well established that older people are more susceptible to the impairing effects of alcohol, and, fourth, women appear to be more impaired by alcohol than men.

**Figure 9**
Relative probability of causing a crash as a function of
Blood Alcohol Concentration (BAC).

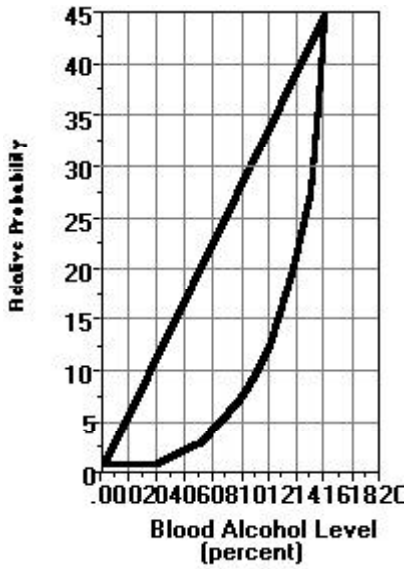
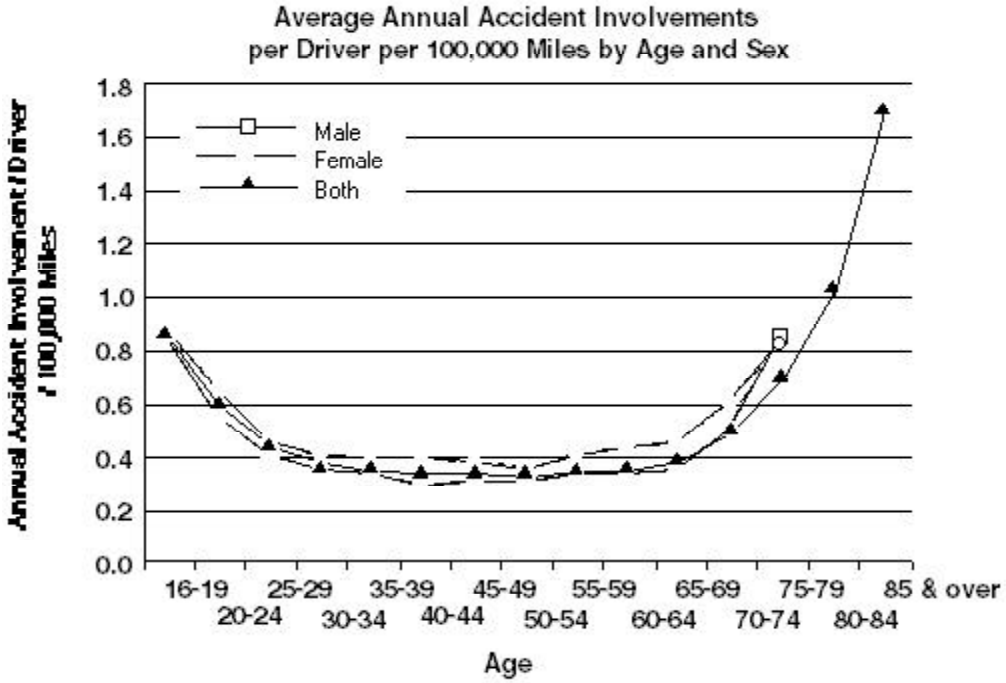



**Figure 10**
Annual Crash Rates based on Mileage Driven, by Age and Sex.
(Peck and Romanowicz, 1993/1994).



## AGING AND ALCOHOL CRASH RISK

For a given weight, an older person will reach a higher BAC than a younger person. Presumably this is related to the changes in the fat-to-muscle ratio that occurs with increasing age. As we age, we lose muscle, and muscle has a much higher proportion of water than does fat. Alcohol is water soluble, so when muscle is replaced with fat, there is less water in which to distribute the alcohol. The result is a higher BAC.

There is also evidence that the greater impairing effects of alcohol in the elderly is more than just this difference in alcohol absorption. It appears that at a given BAC, the older driver is at higher risk of crash than other drivers at the same BAC (National Highway Traffic Safety Administration, 1985).

## WOMEN AND CRASH RISK

Like the elderly, women reach a higher BAC from a given amount of alcohol, taking body weight into account. Women also have a higher fat-to-muscle ratio and, hence, less water in which to absorb the alcohol. Women also appear to metabolize alcohol differently when the alcohol is consumed orally. Because of the metabolic differences, they absorb the alcohol more quickly and reach a higher BAC (Frezza, Di Padova, Pozzato, et al., 1990).

There is also evidence that, at a given BAC, women are at higher risk of crash than men. This phenomenon was first reported in 1964 in a classic study establishing relative risk of crash as a function of BAC (Borkenstein, Crowther, Shumate, et al., 1964). At that time, the sex differences were attributed to the relative inexperience of women in driving. However, subsequent studies have confirmed the earlier findings (Carlson, 1972; Zador, 1991). While women still drive fewer miles than men, they drive much more than they did previously, and they should be through the steepest part of the learning curve (Waller and Blow, 1995).

The sex differences in crash risk are dramatic. For teenage drivers at BACs between 0.05 percent and 0.09 percent (legal levels in most states), the relative risk of being in a fatal single vehicle crash is more than 18 for males and over 54 for females. For drivers age 21 through 24, the corresponding figures are 11.8 for males and over 35 for females. For drivers age 25 and over, the ratios are 8.6 for males and 25.5 for females. In every age group, women experience a much higher crash risk than do men (Zador, 1991). Figure 11 illustrates these relative differences. Although not quite so dramatic, similar gender differences are seen at higher BAC levels.

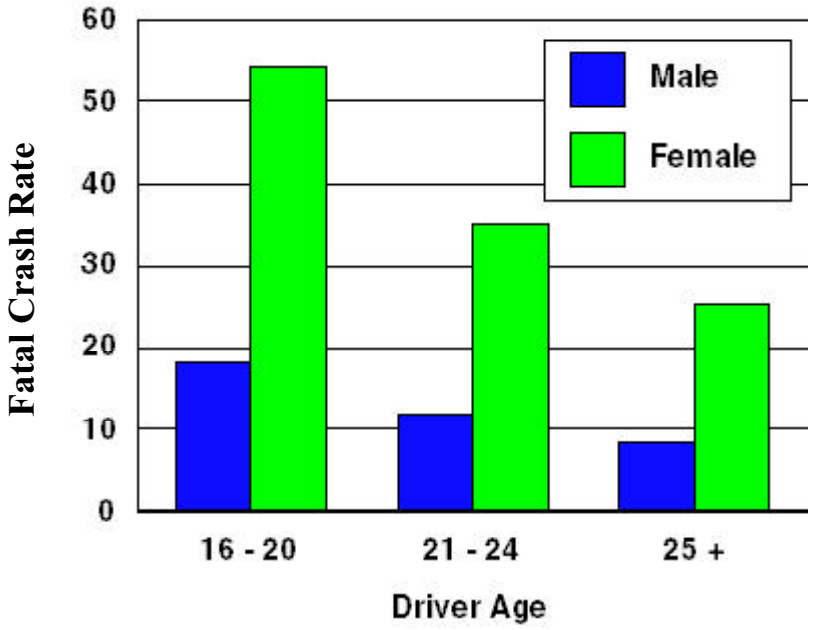
In controlled laboratory studies involving tasks unrelated to driving, there is also some evidence that women may be more impaired by a given BAC. One study using simulated traffic signs presented on slides found that alcohol affects the ability to detect the presence or absence of a sign, and that the performance of females is more impaired than that of males (Avant, 1990).

Thus, women will reach higher BACs and experience greater impairment as their drinking behaviors approach those of men.

## WOMEN MORE VULNERABLE TO BIOMEDICAL DAMAGE

Even in the absence of alcohol, in a crash of specified dimensions, women have a higher probability of being seriously or fatally injured (Partyka, 1984; Evans, 1988, 1991). It is not entirely clear why this is so, especially since for most health problems, women are more robust and more likely to survive.

**Figure 11**
Relative risk of fatal single vehicle crash at BAC 0.05 - 0.09 percent compared to zero alcohol.




Women are also more vulnerable to the harmful effects of alcohol, in that they experience biomedical damage as a result of consuming less alcohol over a shorter period of time than is true for men (Blume, 1982). It is known that chronic use of alcohol can cause liver damage that, in turn, can interfere with the body's recovery from injury (Sherlock, 1988). It can also affect wound healing (Benveniste and Thut, 1981).

While prolonged heavy use of alcohol clearly leads to reduced bone strength, increasing the probability of fracture from a given traumatic impact (Saville, 1975; Peng, Garner, Frye, and Crenshaw, 1982), there is some controversy about the effects of moderate alcohol consumption on bone mass. A prospective study of over 84,000 women found that moderate use of alcohol was associated with an increased risk of both hip fractures and forearm fractures (Hernandez-Avila, Colditz, Stampfer, et al., 1991), and other studies have shown a relationship between alcohol consumption and reduced bone mass (Stevenson, Lees, Devenport, et al., 1989; Leino, Jarvisalo, Impivaara, and Kaitsaari, 1994; Sowers, Wallace, and Lemke, 1985). Other studies suggest that moderate alcohol consumption is associated with increased bone mass (Gavaler and Van Thiel, 1992; Felson, Zhang, Hannan, et al., 1995). One study concludes that alcohol has a harmful effect for premenopausal women but a positive effect for postmenopausal women (Laitinen, Valimaki, and Keto, 1991). Of course, the evidence on drinking patterns indicates that alcohol consumption is greater among the former group. To the extent that alcohol compromises bone strength, because women have smaller bones to start with, they will be more vulnerable to injury in a crash of specified dimensions.

## ALCOHOL AND INJURY

Alcohol is related to injury in at least three ways. First, it affects judgment. Second, it impairs psychomotor performance. Third, it increases the extent of injury resulting from a given impact.

### JUDGMENT

Alcohol affects judgment, but it appears to do so differentially for men and women. Men are less likely to perceive an increased crash risk as a result of alcohol (Martens, Ross, and Mundt, 1991; Mundt, Ross, and Harrington, 1992; Agostinelli and Miller, 1994). These differences may be a recognition on the part of women of the greater impairing effects of alcohol experienced by them.

### PSYCHOMOTOR PERFORMANCE

While alcohol affects the psychomotor performance of both men and women, the latter appear to be more impaired by alcohol in performing psychomotor tasks (Waller and Blow, 1995). They are clearly at higher crash risk at a given BAC.

### INJURY

Once a crash occurs, the drinking driver has a higher probability of serious or fatal injury than the sober driver. This potentiating effect of alcohol on injury has been demonstrated clearly in controlled laboratory studies based on animal models (Liedtke and DeMuth, 1975; Nicholas and DeMuth, 1980; Gettler and Allbritten, 1963; Flamm, Demopoulos, Seligman, et al., 1977; Brodner and Van Gilder, 1981; DeCrescito and Demopoulos, 1974; Anderson, 1986; Waller, Hansen, Stutts, and Popkin, 1986). Although human subjects cannot be used in such controlled studies, the motor vehicle crash provides a model for an injury type occurring in large numbers and for which there are independent measures, albeit rough measures, of the physical forces involved. The overall difference is about two-fold, that is, in a given crash, the drinking driver is about twice as likely to be seriously injured or killed as the sober driver, but for some crash types the difference is more than four-fold (Waller, Stewart, Hansen, Stutts, Popkin, and Rodgman, 1986).

## SUMMARY

At the present time, relatively little is known about women, alcohol, and driving. The vast majority of studies on both alcohol and driving have been based on male subjects, usually young. Women pose special problems in controlled alcohol research, in that alcohol appears to have differential effects as a function of the menstrual cycle. It is not surprising that there is a paucity of good research.

Nevertheless, with the markedly changed roles of women in our society, and their growing transportation needs, women need to be given greater consideration, and to do so will require a more solid knowledge base. Several areas in particular need to be addressed.

First of all, there needs to be greater societal recognition of the many roles that women fill. For most women today, transportation is an essential component for meeting their responsibilities. While society fully expects, even demands, that women meet these responsibilities, e.g., child care, elder care, chauffeuring family members to appointments and lessons, grocery and other shopping, etc., virtually nothing is done to facilitate these functions. It is remarkable how well women have managed in the face of societal indifference.

Second, the transportation community itself needs to consider women in their planning process. Throughout most of the history of transportation, trips have been defined by tabulating vehicles and vehicle occupancy at specified locations. Conclusions are usually that most trips involve one vehicle and one occupant. However, their calculations do not register the trip linking, that is, the errands run along the way that often entail dropping off other occupants. While it may be true that the driver arrives at the workplace as the single occupant, women have often chauffeured other family members to other locations prior to the final trip segment that is observed. Solutions based on such observations are usually inappropriate.

There are other reasons women may need a car. When children are in school, a parent may get a call at any time saying a child is sick and needs to be picked up. Even though such calls may be rare, their possibility often dictates that flexible transportation be available immediately.

Third, public transit needs to become more flexible and safer. For this to occur, women engaged in real life activities and familiar with the transportation problems encountered by women need to be part of the transportation planning process. Parents are often fearful for their children to use public transport because of the situations encountered on buses and in terminals. Safety and security are essential if public transit is to succeed.

Fourth, women need to be better informed regarding the use of alcohol and how it affects them, both physiologically and behaviorally. Most women do not recognize the harm they can inflict on themselves and others through irresponsible use of alcohol, nor do they realize the greater vulnerability they experience compared to men.

Fifth, vehicle design needs to pay greater attention to women, and particularly older women. Bucket seats are comfortable, but ingress and egress are difficult for older occupants. Security is also a growing issue, especially for women and the elderly. Most car phones purchased by women and the elderly are for security purposes rather than for routine communication.

Occupant restraints pose special problems for women. Seat belts, especially in the back seat, can be major challenges for anybody, but particularly for older occupants. Occupant restraints never considered the special configurations of women. They were designed primarily to protect young healthy males in frontal collisions. There is no question but that they are remarkably effective in providing occupant protection. However, with an aging population, there are more side collisions. Furthermore, the shoulder belt that may provide protection for the young healthy male may break the ribs of the elderly occupant, which in turn may puncture the lungs.

Air bags pose special problems for women and the elderly, as well as children. No child under the age of 12 should be in the front seat of a vehicle with a passenger side air bag. The safest location is in the back seat with a belt on, even if it is just a lap belt. In this country, manufacturers are required to provide an air bag that will protect an unbelted male occupant of average size (National Transportation Safety Board, 1996; Ferguson, Braver, Greene, and Lund, 1996). When this requirement was implemented, belt usage was around 20 percent. It is now around 70 percent, but the force of the air bag is still greater than required for properly belted occupants. Smaller occupants, sitting closer to the wheel, and older occupants, frailer and more vulnerable to injury, are especially at risk.
Most of the driver fatalities caused by air bag deployments have been women, and especially older women. Vehicle modifications are needed that enable the smaller driver to reach the controls while maintaining a safe distance from the steering wheel. And of course the safety belt should always be used.

There is another aspect of occupant restraints that has received essentially no attention. With an aging population, we have more frail elderly, mostly women, who need transportation. These persons are especially vulnerable to injury, even from a sudden stop that engages the belt. Most frail elderly are cared for by families and transported in family vehicles. Yet no attention has been given to the special restraint needs of this growing population.

We need to reconsider occupant restraint systems in light of the changing population, with more women driving vehicles and more elderly occupants.

Women are a major and essential part of our expanding society. Yet their needs have scarcely been addressed in driving and transportation. They need to be better informed, and, in turn, the transportation community needs to pay more attention to them as consumers, but more importantly, as essential participants in, and contributors to, society.

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