INTRODUCTION

Women's roles in the United States have undergone dramatic changes in the past two decades. This paper will examine trends in driver licensing, arrests for drinking and driving, total and single vehicle accidents and blood alcohol levels in fatalities to determine if concurrent changes in the drinking driving patterns of women have occurred.

BACKGROUND

In the United States, women's participation in the labor force increased dramatically between 1970 and 1980, rising to 45 million for women, a 44 percent increase, compared to 61 million, a 23 percent increase for men (1). Similar changes have occurred in North Carolina, the tenth most populous state, located in the southeastern United States in an area known as the "Sunbelt". The rise of business and commerce in this area has produced shifts in types of employment available and in labor force characteristics. Representative of this shift is the change in the proportion of women who work outside the home and who are heads of households. In North Carolina, the proportion of woman heads of families increased by fifty-five percent from 1970 to 1980, going from 153,410 to 237,832 (2).

The median income of women in the United States is about sixty percent that of men (3). Nonetheless, an increase in the number of women working suggests that their work-related driving exposure may be increasing and also that they may have more disposable income, a factor which influences automobile purchases as well as other exposure factors.

Driving Exposure

Perhaps as a result of these changing social factors, the driving exposure rates and driving patterns of women are changing. Both nationally and statewide the number of licensed women drivers is growing. In 1969, there were 45 million licensed women drivers in the United States (4). This number rose to 71 million in 1983, representing a 58 percent increase. The number of men drivers grew during the period to 76 million, a 30 percent increase. North Carolina experienced even greater increases during the 1969-1983 period, with 71 percent and 39 percent increases for women and men, respectively. By 1985, near parity...
existed between the sexes in North Carolina, with women making up 49 percent of the licensed drivers and men comprising 51 percent.

Accidents and Fatalities

The substantial increase in the proportion of licensed drivers who are women may reflect only one aspect of changes in driving exposure. Traditionally, women drive less, particularly at night, and are inexperienced drivers; and inexperience is associated with poorer driving performance. McCormack (5) cited inexperience with nighttime driving as a factor in the increased likelihood of A/R crashes for newly divorced or separated women. Carlson (6) found that drinking women, even at lower breath alcohol concentrations (BAC's), were more frequently involved in crashes than drinking men and attributed the higher risk of women to their inexperience with driving. In the Grand Rapids study, Borkenstein (7) indicated that women who drank were at a greater risk of being involved in an accident than men. He reported that at a BAC > 0.08 mg/1 the risk of a crash doubled for men while the risk rose 4.5 times for women.

In addition to the effect of inexperience, alcohol may have differential effects on women and men, due to the physiological factors of body composition and hormonal levels (8). Some studies suggest that significant differences exist between the sexes in alcohol metabolism and the intoxication levels reached, given a specified dose of alcohol. For example, Jones and Jones (9) found that under controlled conditions varying hormonal levels experienced during the menstrual cycle affected BAC and ethanol metabolism. These potentially differential physiological effects, combined with driving inexperience, could play an even larger role in driving performance.

The National Safety Council(10), in determining driver safety by exposure to risk, established that the overall risk of an accident has decreased since 1958 to about 200 accidents per ten million miles. In 1984 accident rates based on accidents per ten million miles driven were similar for women (190) and men (192).

Traffic fatalities in the United States have declined in recent years despite increased numbers of drivers, vehicles, and miles driven. The 1984 fatality rate per 100,000 licensed drivers was 28.1 compared with a rate of 49.4 in 1969 (11). However, there were 5.2 percent more fatal accidents in 1984 than in 1983. The rate for men increased 4.4 percent, but the rate for women increased 8.6 percent, with especially high increases in the over-64 age group (16 %), the 25-34 group (12%), and the 35-44 group (11%).
Traffic Law System Biases

With the exception of fatalities, data on drinking and driving are subject to potential enforcement bias. For example, Vingilis (12) in examining differences in the screening of drivers for impairment in Toronto, Canada, found that women and younger drivers were overrepresented among those stopped for testing compared to those actually charged with impairment. She postulated two explanations: young police officers may find it less threatening to ask young drivers or women than to ask older men to submit to breath tests, and women and young people have less tolerance for alcohol and may actually be more impaired. On the other hand, there is evidence that women who drink have been shielded by society. For example, Argeriou (13) found that women are less likely than men to be arrested for DWI unless they physically or verbally abuse the enforcement officer.

There is additional information suggesting that women receive differential treatment by the court system. Popkin, Stewart and Lacey (14) examined factors related to DWI conviction. With no previous DWI convictions, women had lower probabilities of being convicted than men; with one previous DWI conviction, they had about the same probability; and with two or more convictions, women were more likely to be convicted.

METHODS

Data Sources - Data were derived from the N.C. Driver History File, the N.C. Traffic Accident File, and the N.C. Medical Examiner File. In this study the assessment of alcohol-involvement is based on the officer's judgment using the following alcohol classifications: not stated, no drinking or drugs, drinking--impaired, or drinking--impairment unknown.

N.C. Driver History File. This file contains licensing information on four million N.C. drivers. It also contains a confidential subfile referred to as RATERS (Rehabilitation, Alcohol Test Evaluation and Retrieval System) that includes information on all alcohol related (A/R) driving arrests, e.g., arresting agency, BAC level, previous DWI arrests, disposition of case by the judicial system, sanctions applied. Data presented in this paper cover DWI arrests over a period of nine years.

Medical Examiner File. This file includes information on most persons fatally injured in motor vehicle accidents. Blood alcohol information is obtained for all persons aged 15 and above, unless the test would not be valid, e.g., if several hours have elapsed between injury and death.
RESULTS

Arrests for Drinking and Driving.

Arrest data for the years 1976 through 1984 were examined for this analysis. In Figure 1, which shows DWI arrest rates for the licensed driver population, males continue to account for the bulk of DWI arrests. There were 63,982 DWI arrests in 1976; and while this number increased to 71,921 in 1984, the actual rate of DWI per licensed driver decreased from 19.4 per thousand drivers to 18.1 per thousand licensed drivers for an 8.8 percent decrease, while the rates for females increased 42.9 percent, from 2.8 to 4.0. In 1983, North Carolina enacted its Safe Roads Act which replaced old DWI laws with a single comprehensive law. The effects of this law may be observed during the period 1982-1983 when publicity surrounding the new law peaked.

BAC levels of those arrested for DWI reflect a similar decrease, with the rates of those having a BAC > 0.09 mg/l declining from 12 to 11 per thousand licensed drivers. The rate for males decreased 11 percent, from 20 to 18, while the rates for females increased by 35 percent, from 1.7 to 2.3. Thus, while many more males continue to be arrested for DWI, women account for a larger proportion of DWI arrests, and more women exceed the legal BAC level of 0.09 mg/l.

Fatally Injured Drivers

While DWI arrest data are an important indicator of drinking and
driving, they may be influenced by enforcement bias. However, the involvement of alcohol in fatal crashes provides unbiased data. Figure 2 shows that female driver fatalities increased during the period, with females comprising 18.5 percent of fatalities in 1978 and almost 23 percent in 1984.

![Figure 2. Trend in female driver fatalities](image)

This increase may be indicative of the increased driving exposure of women. Medical examiner data were available for 1979-1984, with BAC's available on over 81 percent of all fatally injured drivers. (BAC's were not available for 22.3 percent of female drivers and 18.6 percent of male drivers.) There were no dramatic changes in the BAC levels of fatally injured men and women over the six-year period. In that period, there were 6034 crashes in which the driver was fatally injured; of these, 1218 or 20.9 percent were female. Of the 946 women tested, 224 or 23.7 percent had a BAC >0.09 mg/1. One hundred ten (49.1 percent) of the 224 had a BAC >0.18 mg/1. Of the 3919 male drivers tested, 1860 or 47.5 percent had a BAC >0.09 mg/1 and of these 934 of 50.2 percent had a BAC >0.18 mg/1.

**Crash Involved Drivers**

Crash data were examined for the years 1976, 1980 and 1985. Table I presents crash frequencies and crash rates per thousand licensed drivers for each year. The total number of accidents in North Carolina increased from 237,195 in 1976 to 259,620 in 1985. However, the increase in the number of licensed drivers resulted in an actual reduction in crash rates from 76.1 in 1976 to 68.0 in 1985. A dramatic
TABLE I.
NUMBER OF CRASHES AND CRASH RATES* FOR 1976, 1980 AND 1985

<table>
<thead>
<tr>
<th>Number &amp; (Rate)</th>
<th>1976</th>
<th>1980</th>
<th>1985</th>
<th>% Change 1976-1985</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>237125 (76.1)</td>
<td>236987 (70.6)</td>
<td>259620 (68.0)</td>
<td>-19.6%</td>
</tr>
<tr>
<td>Males</td>
<td>159725 (90.7)</td>
<td>158497 (82.4)</td>
<td>164758 (79.5)</td>
<td>-12.3%</td>
</tr>
<tr>
<td>Females</td>
<td>77470 (50.5)</td>
<td>78490 (44.4)</td>
<td>94862 (48.0)</td>
<td>-5.0%</td>
</tr>
<tr>
<td>A/R Crashes</td>
<td>19485 (5.9)</td>
<td>23651 (6.4)</td>
<td>16602 (4.1)</td>
<td>-30.5%</td>
</tr>
<tr>
<td>Males</td>
<td>17624 (10.0)</td>
<td>20793 (10.8)</td>
<td>14233 (6.9)</td>
<td>-31.0%</td>
</tr>
<tr>
<td>Females</td>
<td>1861 (1.2)</td>
<td>2859 (1.6)</td>
<td>2369 (1.2)</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

* Per thousand drivers

decrease was observed in the male accident involvement rate, from 90.7 in 1976 to 79.5 in 1985. Female rates decreased minimally from 50.5 in 1976 to 48.0 in 1985. Table I also shows that alcohol involvement in crashes has declined from 1976, when officers indicated an A/R crash rate of 5.9, to 4.1 in 1985, a 30.5 percent decrease. Male representation in this group decreased during the period by 31 percent while females experienced essentially no change.

Table II shows the number of single vehicle (SV) crashes and crash rates by sex for the three above-mentioned periods. Here the

TABLE II

<table>
<thead>
<tr>
<th>Number of SV Crashes (Rate)</th>
<th>1976</th>
<th>1980</th>
<th>1985</th>
<th>% Change 1976-1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>24900 (14.1)</td>
<td>26786 (13.9)</td>
<td>24447 (11.8)</td>
<td>-16.3</td>
</tr>
<tr>
<td>Females</td>
<td>7249 (4.7)</td>
<td>8313 (4.7)</td>
<td>9208 (4.7)</td>
<td>0.0</td>
</tr>
</tbody>
</table>

| Number of SV Nighttime Crashes | 13749 (4.2) | 15565 (4.2) | 13197 (3.3) | -21.0% |
| Males                        | 11533 (6.6) | 12728 (6.6) | 10289 (5.0) | -24.2 |
| Females                      | 2216 (1.4)  | 2837 (1.6)  | 2908 (1.5)  | +7.0  |

| Number of A/R SV Crashes | 9216 (2.8) | 11607 (3.1) | 8469 (8.3) | -25.0% |
| Males                     | 8368 (4.8) | 10246 (5.3) | 7272 (3.5) | -26.0 |
| Females                   | 848 (0.6)  | 1361 (0.8)  | 1197 (0.6) | 0.0   |

*Rate per thousand drivers
involvement rate of females in SV nighttime crashes increased by 7 percent between 1976 and 1985 although males experienced a 21 percent decrease during the same period. Likewise, males decreased their A/R SV crash involvement rate by 25 percent for the period while the rate for females remained unchanged. A similar pattern is seen in multi-vehicle crashes, where A/R crash rates for male drivers decreased by 36 percent during the period and females decreased by only 14 percent.

SUMMARY AND CONCLUSIONS

Examination of crash and arrest data suggest that women are experiencing greater exposure to the hazards of drinking and driving. The data on alcohol arrests strongly support this contention. While the vast majority of alcohol arrests are still accounted for by male drivers in the time period examined (1976-1984), DWI arrest rates for men decreased by 8.8 percent while those for women increased by 42.9 percent! This may be indicative of an erosion in enforcement bias toward women.

To eliminate any potential effects of enforcement bias, BAC results from deceased drivers were analyzed. While analysis showed an increase in the proportion of women among fatally injured drivers, it did not indicate any increase in the proportion of alcohol-related fatalities among women. Men drivers were much more likely to have BAC's of 0.10 mg/1 or higher (46.5 percent compared to 23.7 percent for women). However, of drivers at or above 0.10 mg/1 women were just as likely to have BAC's >0.18 mg/1 (47.5 percent compared to 50.2 percent for men).

Analyses of crash data suggest that more women are driving. While men show a dramatic decrease in crash rates per thousand drivers, women show almost no reduction at all. Furthermore, women account for an increased proportion of A/R crashes. Their involvement in SV nighttime crashes has likewise increased, as has their involvement in single vehicle A/R crashes. Thus, it appears that women are increasingly combining driving with drinking. While the emphasis on drunk driving enforcement has been associated with a decrease in drinking and driving for men, the changing driving patterns of women may be countering a similar reduction in women's drinking and driving.

Because of the evidence that women are increasingly combining alcohol and driving, special programs designed specifically for women are needed in order to combat what appears to be a growing highway safety problem. Such needs include an examination of the implications of increasing numbers of women being sent to jail and/or losing their licenses as mandatory sanctions. Research is urgently needed on the
effects of alcohol on the driving performance of women. Use of such information in formulating public policy as well as public information and education campaigns would be useful in combating the influence of liquor industry commercials which have targeted women in their marketing campaigns.

In the United States women often assume responsibility as the designated drivers. If it takes less alcohol for them to become legally intoxicated, such information should be included on the widely used, 'male' derived BAC consumption charts. These findings indicate the vital importance of additive research on the differential effects of alcohol on women and the usefulness of such information to the practitioner, as well as to the general driving public and society at large.

REFERENCES