Gender Differences Among Young Drivers in the Association Between High-Risk Driving and Substance Use/Environmental Influences*

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ABSTRACT. Objective: The primary aim of this article is to assess young drivers' gender differences in the associations between substance use/environmental influences and high-risk driving behavior. **Method:** We determine the association of 12th-grade self-reported substance use/environmental influences with high-risk driving behavior as quantified by the number of offenses, serious offenses, crashes, and single-vehicle crashes on state driving records during subjects' (N = 3,607; 51% male) first 4 years of licensure. **Results:** The associations between high-risk driving and substance use/environmental influences were generally stronger among women than among men. When matched by substance-use profiles, women had fewer risky-driving incidents than men. **Conclusions:** The results indicate that young women who exhibit high-risk driving behavior deviate more from the general population of young women with respect to alcohol use, alcohol misuse, and marijuana use than high-risk-driving young men differ from other young men. In addition, findings indicate that even if young men and women were to eventually have equal levels of substance use, women would likely retain their lower-risk driving profiles. These findings suggest the need for (1) future research to understand the differential associations, and (2) prevention programs that consider these gender differences. (*J. Stud. Alcohol* **67:** 252-260, 2006)

MOTOR VEHICLE CRASHES ARE A MAJOR source of morbidity and mortality for young adults, accounting for nearly three quarters of U.S. unintentional injury deaths in 2002 among persons ages 15-24 (Centers for Disease Control and Prevention, 2005). Although traffic fatality rates in 2000 among persons ages 16-20 were considerably lower among women than men (18.4 vs 39.9 per 100,000), injury rates were more similar (2,970 vs 2,573 per 100,000) (National Highway Traffic Safety Administration [NHTSA], 2002). Women tend to have lower risk-taking profiles, particularly in regard to drinking and driving (Wells-Parker et al., 1996); however, the physiological effects of alcohol may differ by gender. In laboratory settings, women were far more affected than men, at moderate and high levels of blood alcohol concentration (BAC), when asked to respond to visual stimuli (Erwin et al., 1978) or to perform tasks requiring dexterity (Price et al., 1986). Carlson (1972) found that women with a high BAC (>.05%) were twice as likely as men to be involved in a crash. Yet Zador's (2000) updated estimates found that 16- to 20-year-old women had a lower fatality risk than men, at equal BAC levels.

Changing social norms may lead young women to do more high-risk driving (e.g., drink/driving), even as overall alcohol-related fatality rates decline. Although alcohol consumption has been generally declining since the early 1980s, the decline was more irregular and gradual for women than for men (Wilsnack, 1996). Popkin (1991) found that alcohol-related single-vehicle (SV) crashes declined for men in all age groups in North Carolina between the mid-1970s and the mid-1980s, but increased or had smaller declines for women, a trend not explainable by increased driving exposure. In Canada, the proportion of alcohol-impaired women drivers at roadside surveys increased from 6% in 1974 to 16% in 1986, and the proportion of alcohol-impaired women drivers in fatal crashes increased from 5% to 9% (Beirness, 1989). The Fatality Analysis Reporting System (NHTSA, 2005) showed a greater decline in the proportion of alcohol-related fatal crashes among women (from 26% to 14%; a decrease of 46%) than among men (from 42% to 26%; a decrease of 38%) between 1982 and 1998. This apparent contradiction with previous findings is explained by the dramatic increase in the *total* number of

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female drivers in fatal crashes of all types between 1982 and 1998, from 10,675 to 15,061, whereas the number of male drivers in fatal crashes during that period declined from 44,370 to 40,746 (NHTSA, 2005). This phenomenon has been detailed in Waller and Blow (1995) and Waller (1997), and is indicative of dramatic changes in women's driving habits and patterns (more total exposure, more late-night and other high-risk exposure) that continue to occur.

Risks of traffic offenses and vehicle crashes are correlated with substance use, poor performance in school, lack of parental involvement, and other risky behaviors (e.g., risky sexual behavior) (Arnett, 1998; Murray, 1998; Shope et al., 2001). Problem Behavior Theory research has shown that these behaviors are part of a common constellation, predicted by personality and perceived environment measures (Donovan, 1993; Jessor, 1987; Shope and Bingham, 2002). Little research has been done, however, to determine to what degree these associations may differ in men and women. Available studies suggest that such differences exist. Shope et al. (1996) found that family structure (living with both parents) and perceived parental attitudes (negative toward teens' drinking) at eighth grade were important predictors of first-driving-year crashes and offenses among 17-year-old boys, whereas peer attitudes and behavior were key predictors for equivalent girls. Lang et al. (1996) found that cigarette use was a key predictor of SV crashes during the first 2 years of driving among women, whereas availability of substances, driving frequency, alcohol misuse, and marijuana use were key predictors for men. Shope et al. (1998) found that, for women but not for men, alcohol misuse in high school predicted excess crash risk. Moore (1994) found that the Donovan Research Questionnaire (Donovan and Marlatt, 1982), developed to assess risky driving in men, was not effective in detecting elevated risk among a sample of underage DUI female offenders.

We consider whether young women who exhibit high-risk driving deviate more from other young women, with respect to substance use and related environmental factors, than high-risk-driving young men differ from other young men. We consider two questions: (1) whether the association between risky-driving and substance use/environmental influences is stronger in women than in men; and (2) whether women and men with similar levels of substance use also have similar offense and crash outcomes.

Method

Sample and design

Our sample is from a longitudinal study evaluating a school-based alcohol misuse prevention program. Self-administered survey data (demographic, substance use, and psychosocial), were collected from 12th graders ($N = 4,022$) in five southeastern Michigan public-school districts in the spring of 1991 and spring of 1992. All students were eligible and approximately 90% participated, with parental permission. The measures collected reflect the past-year or current situation of the students.

Most students obtain a license to drive in Grades 10 or 11. Beginning in 1992, names and birth dates were submitted to the Michigan Department of State annually, to obtain matched driver-history data. Subjects in these analyses were the 3,607 (90%) for whom the first 4 full years of driver history data were obtained (a period of time spanning high school and post-high school). They were 51% male, with mean (SD) license ages of 16.3 (0.8) and 16.4 (0.8) years for men and women, respectively (all with the same length of licensure).

Comparing our study subjects with all young Michigan drivers, we find that our subjects are reasonably representative of young drivers in the state, with respect to offense and crash profiles. In 1993, for example, 66% of 19-year-old male Michigan drivers had no offenses, 22% had one offense, and 12% had two or more offenses, compared with 67%, 21%, and 12%, respectively, of our 19-year-old male study subjects. Corresponding percentages for women were 82%, 14%, and 4% for 19-year-olds statewide, compared with 81%, 14%, and 5% for the study subjects (Michigan Department of State, 1994).

Measures. High-risk driving was assessed using data from Michigan driver license records. We used four objective measures from subjects' first 4 years of licensure: (1) total number of offenses, grouped into categories of 0, 1, 2, and 3 or more; (2) total number of "serious" offenses, grouped into categories of 0, 1, and 2 or more; (3) total number of vehicular crashes reported to the police, grouped into categories of 0, 1, and 2 or more; and (4) total number of SV crashes, grouped into categories of 0, 1, and 2 or more. (We refer to these outcomes generically as "incidents," below.) "Serious" offenses include those that (1) involved use of alcohol; (2) were classed as "serious" by the state of Michigan (e.g., reckless driving, vehicular homicide); (3) resulted in three or more points assigned to a driver's record (e.g., speeding in excess of 15 mph over the speed limit); or (4) involved nondriving drug offenses. Offense data were available only for offenses that resulted in convictions, but the original charge was used in these analyses, to avoid biases from any respondents whose resources might have allowed them to "plead down" to lesser charges. Only crashes reported to the police could be included. Although driving under the influence of alcohol or other substances would be indicative of high-risk driving behavior, the relative rarity among this age group of offenses or crashes that are noted as alcohol-related (3% of offenses and 2% of crashes) suggested we use more general measures of high-risk driving. As a consequence, we used serious offenses and SV crashes, both of which may be considered under volitional control, represent a deliberate attempt by drivers

to flout driving rules, and, hence, can be considered indicative of deliberate risk-taking or "high-risk" driving.

We also used three measures of substance use: alcohol, cigarettes, and marijuana. To assess frequency and quantity of alcohol use, separate items for beer, wine, and distilled spirits were used, adapted from Rachal and colleagues (1975; Campanelli et al., 1987; Shope et al., 1994). Frequency of alcohol use was asked for each: "How often have you had beer (wine, distilled spirits) in the past 12 months? Never, a few times a year or less, about once a month, about once a week, 3 or 4 days a week, or every day?" Quantity of alcohol use was also assessed separately for each (number of drinks added in parentheses): "When you drank beer (wine, distilled spirits) during the past 12 months, how many cans/bottles (glasses, drinks) did you usually have at one time? None, less than one, one, two, three or four, five or six, or seven or more?" Alcohol consumption was estimated by multiplying together the number of episodes/year by the number of drinks/episode. Annual number of drinks/year (plus one) was then log-transformed to reduce the skewness of responses. Use of marijuana and cigarettes is defined as once or more in the previous 12 months.

An alcohol-misuse index was constructed from nine questions regarding alcohol misuse in the past 12 months (Greenwald, 1982; Rachal et al., 1975, Shope et al., 1994): "How many times did you drink more than you planned to? Feel sick to your stomach after drinking? Get into trouble with your friends because of drinking? Have a friend of the same sex complain about your drinking? Have a friend of the opposite sex complain about your drinking? Have someone you were dating complain about your drinking? Get into trouble with your parents because of your drinking? Get into trouble with teachers, school counselors, or the principal because of your drinking? Get into trouble with the police because of your drinking?" Responses to and codes for frequency were: "never" (0), "once" (1), "two times" (2), or "three or more times" (3). The misuse index was constructed by summing the frequency codes for the nine questions, and adding 1; ranging from 1 to 28, this scale was then log-transformed to reduce skewness.

Three alcohol-related perceived environmental influences were considered. Peer involvement with alcohol was assessed using a scale constructed from the responses to the following three questions (scale codes in parenthesis): "How many of your friends drink alcohol when they are out with their friends: none (0), a few (1), some (2), most (3), or all (4)? How many of your friends have ever been in trouble because of drinking alcohol: none (0), a few (1), some (2), most (3), or all (4)? How often have your friends offered you a drink of alcohol: never (0), rarely (1), sometimes (2), often (3)?" The peer index was constructed by adding together the response codes; thus, the range was 0 to 11. Parental attitudes toward young people's alcohol use were assessed with the question, "How do your parents feel about kids your age drinking beer, wine, or distilled spirits? Do they think it is a very good idea, a good idea, neither a good nor a bad idea, a bad idea, or a very bad idea?" Responses were combined into a dichotomous measure: "disapprove" versus "indifferent/approve." Ease of access to alcohol was assessed with the question, "How easy would it be for you to get alcohol if you wanted it: very easy, pretty easy, pretty hard, or very hard?" Responses were combined into a dichotomous measure, "easy" versus "hard."

Survey and driver history data are given in Table 1, by gender and overall. Men had significantly higher rates of alcohol use and misuse, marijuana use, easy access to alcohol, and traffic incidents. Tables 2 and 3 give the means of alcohol use (in drinks/week), alcohol misuse, and peer

TABLE 1. Means and percentages for survey and driver history measures, by gender and overall (standard deviations in parentheses).

Measure	n^a	Women Mean (SD) or %	Men Mean (SD) or %	Total Mean (SD) or %
Survey measure				
No. drinks/week[b]	3,501	2.52 (6.17)	4.56 (9.16)	3.56 (7.90)
Alcohol misuse index[b]	3,543	2.42 (3.17)	3.00 (3.95)	2.71 (3.60)
Smoke cigarettes	3,450	46.7%	41.4%	44.3%
Smoke marijuana[c]	3,431	29.5%	33.2%	31.4%
Peer alcohol involvement index	3,210	5.07 (2.45)	5.23 (2.54)	5.15 (2.50)
Parents indifferent/approve teen alcohol use	3,533	11.9%	12.4%	12.2%
Easy access to alcohol[c]	3,551	89.6%	92.0%	90.8%
Driver history measures				
No. offenses[b]	3,607	0.92 (1.29)	2.02 (2.34)	1.47 (1.98)
No. serious offenses[b]	3,607	0.23 (0.53)	0.60 (0.97)	0.42 (0.81)
No. crashes[b]	3,607	0.54 (0.77)	0.77 (0.95)	0.66 (0.87)
No. SV crashes[b]	3,607	0.05 (0.23)	0.09 (0.31)	0.07 (0.27)

Notes: SV = single vehicle. [a]Smaller *n*'s reflect missing survey data; [b]gender difference significant at $\alpha = .01$; [c]gender difference significant at $\alpha = .05$.

TABLE 2. Means and percentages of subjects with 0, 1, 2, or ≥3 offenses during first 4 years of licensure, by gender and survey measure

	No. of offenses Mean or %							
	0		1		2		≥3	
Survey measure	Women (n = 889)	Men (n = 518)	Women (n = 478)	Men (n = 450)	Women (n = 210)	Men (n = 327)	Women (n = 187)	Men (n = 548)
No. drinks/week	1.85	3.42	2.56	3.85	3.06	5.22	4.95	5.86
Alcohol misuse index	1.91	2.41	2.84	2.76	2.78	3.22	3.35	3.63
Smoke cigarettes	43%	37%	46%	38%	51%	44%	61%	47%
Smoke marijuana	24%	27%	30%	31%	33%	35%	49%	40%
Peer involvement index	4.73	4.93	5.26	5.05	5.11	5.45	6.03	5.51
Parents indifferent/approve teen alcohol use	10%	12%	11%	11%	16%	17%	17%	15%
Easy access to alcohol	87%	90%	92%	92%	92%	93%	96%	95%

involvement and the percentages who have easy access to alcohol, use cigarettes, use marijuana, and have parent(s) indifferent to teen drinking, by gender and by the number of incidents in the first 4 years.

Data analysis. Statistical significance of differences between men and women with respect to substance use/misuse, environmental influences, and traffic incidents were assessed using nonparametric Wilcoxon rank sum tests (Sprent, 1990). To test the hypothesis that women who exhibit high-risk driving behavior deviate more from other women drivers, with respect to substance use/environmental influences, than high-risk driving men do from other men, we conducted analyses to address two research questions.

Question 1: Is the association between risky driving and substance use/environmental influences stronger in women than in men? We describe the analysis for offenses and use it for the other outcomes. For continuous variables, we conduct two-way analysis of variance (ANOVA) with number of offenses and gender as factors or categorical predictors. Dependent variables are log(number of drinks per year + 1), log(misuse index), and peer involvement. The hypothesis is tested by assessing the statistical significance of an interaction term between number of offenses and gender. Because number of offenses has ordered categories, we consider differences in the gender-specific dose-response relationship between number of offenses and each dependent variable. We compute a least-squares estimate of the slope,

TABLE 3. Means of subjects with 0, 1, and ≥2 traffic incidents during first 4 years of licensure, by gender and survey measure

	No. of incidents Mean or %					
	0		1		≥2	
Survey measure	Women	Men	Women	Men	Women	Men
No. of serious offenses	(n = 1,423)	(n = 1,137)	(n = 283)	(n = 448)	(n = 58)	(n = 258)
No. drinks/week	2.24	3.70	3.48	5.35	4.61	7.04
Alcohol misuse index	2.24	2.69	3.12	3.18	3.26	4.12
Smoke cigarettes	45%	38%	53%	43%	56%	54%
Smoke marijuana	28%	29%	35%	38%	44%	42%
Peer alcohol involvement index	4.96	5.04	5.43	5.39	5.77	5.73
Parents indifferent/approve teen alcohol use	12%	12%	10%	15%	21%	13%
Easy access to alcohol	89%	91%	93%	93%	93%	93%
No. of crashes	(n = 1,051)	(n = 905)	(n = 516)	(n = 602)	(n = 197)	(n = 336)
No. drinks/week	2.21	3.75	2.56	5.52	4.01	5.01
Alcohol misuse index	2.20	2.85	2.53	3.17	3.24	3.10
Smoke cigarettes	44%	36%	47%	44%	58%	50%
Smoke marijuana	27%	30%	31%	35%	39%	37%
Peer alcohol involvement index	4.91	5.17	5.21	5.39	5.47	5.11
Parents indifferent/approve teen alcohol use	11%	13%	13%	12%	12%	11%
Easy access to alcohol	89%	91%	90%	93%	95%	92%
No. single-vehicle crashes	(n = 1,677)	(n = 1,686)	(n = 85)	(n = 146)	(n = 2)	(n = 11)
No. drinks/week	2.51	4.50	2.33	5.33	13.60	3.12
Alcohol misuse index	2.40	3.00	2.73	2.99	4.24	3.36
Smoke cigarettes	46%	40%	55%	54%	100%	45%
Smoke marijuana	30%	32%	24%	43%	100%	45%
Peer alcohol involvement index	5.07	5.21	4.92	5.37	9.00	5.44
Parents indifferent/approve teen alcohol use	12%	12%	15%	12%	100%	10%
Easy access to alcohol	90%	92%	87%	93%	100%	100%

measuring linear association between number of offenses and the measure of interest within each gender: $S = (M, F)$. The gender-specific least-squares estimate of slope (expected change in response per unit increase in offense number) can be expressed as a linear combination of mean responses,

$$c^S = (-1.5\bar{y}_0{}^S - 0.5\bar{y}_1{}^S + 0.5\bar{y}_2{}^S + 1.5\bar{y}_3{}^S) / 4$$

where $\bar{y}_j{}^S$ is the mean response for the jth offense level for gender S. Thus, $c^F - c^M > 0$ supports the hypothesis that the association between traffic offenses and the predictor measure of interest is stronger in women than in men.

For dichotomous measures, 2×4 contingency tables are based on the same two factors, number of offenses and gender. The log-linear models (Agresti, 1990), which are analogs of ANOVA models for continuous variables, are used. Gender differences in the dose-response relationship between number of offenses and the odds of particular substance use (on a log scale) are assessed using a chi-square test. Both ANOVA and log-linear models are tested for goodness-of-fit for each outcome.

Question 2: Do men and women who share similar substance-use profiles have similar risky-driving profiles? We perform a matched analysis of outcomes after matching women and men on substance use. To match subjects, we first assign summary scores to men and women based on their codes for alcohol use, alcohol misuse, cigarette use, and marijuana use, and sum these to form an overall substance-use score, which is then rank-ordered. (This scoring system gives equal weights to each of the four substance measures. For this age group, the strategy seems reasonable, because use of any of these substances is illegal. Further, giving unequal weighting might introduce subjective elements into these scores, which might not have any empirical basis.) The rankings of these substance-use summary scores are then used to group subjects into 330 groups of 10 subjects each, the first consisting of ranks 1-9, the second of ranks 10-19, and so forth through ranks 3,290-3,297 (only 3,297 subjects had complete data for all four substance-use measures). This formed an m:n matching for men to women within each grouping, in which m + n = 10 (except for the first and last group, which contained nine and eight subjects, respectively).

We use a conditional logistic regression approach (Hosmer and Lemeshow, 1989) to estimate the association between number of traffic incidents and gender, conditional on male and female subjects having approximately the same level of substance use. In particular, we fit the model

$$\ln(p_{ji} / (1 - p_{ji})) = \alpha_i + \beta x_{ji}$$

where p_{ji} is the probability that the jth subject in the ith group is female, x_{ji} is number of offenses, $j = 1, \ldots, 10$, $i = 1, \ldots, 330$. The conditional likelihood constructed from the matched pairs (one woman and one man) on their substance use is independent of the nuisance parameters α_i and depends only on the value of β, a measure of association between number of offenses and gender for the same level of substance use. Thus, $\beta > 0$ indicates that women with similar substance-use profiles as men will have more offenses than men, $\beta < 0$ indicates that they will have fewer offenses than men, and $\beta = 0$ indicates that there is no association between gender and offenses after matching for substance use. An alternative is that $\exp(\beta)$ can be interpreted as an odds ratio for a woman having one more offense than a man, when both have similar substance use. Similar models to test the association between other traffic incidents and gender after matching for substance use are fit by replacing x_{ji} with the other outcomes.

Results

Question 1. The association between risky driving and substance use/environmental influences: Is it stronger in women than in men?

Substance use. Alcohol use tends to be positively associated in both genders with traffic incidents. For women, associations are significant for offenses, serious offenses, and crashes; for men, associations are significant for offenses and serious offenses (Table 4). These trends are all at least as strong in women as in men; the difference between men and women's associations is significant for crashes ($p = .011$). The mean log of alcohol use (drinks / yr + 1) was 3.50 among women with two or more crashes versus 2.74 among women with no crashes; equivalent means for men were 3.38 and 3.22.

Alcohol misuse tends to be positively associated in both genders with traffic incidents; associations are significant for women's offenses and crashes, and men's offenses and serious offenses. The only difference in the associations between men and women that was statistically significant was for crashes, in which case women had a stronger association ($p = .018$). The mean log of alcohol misuse among women with two or more crashes is 1.08, compared with 0.79 among women with none; the mean log of alcohol misuse was 0.98 among men with two or more crashes, compared with 0.91 among men with none.

Whether or not a subject used cigarettes is positively and significantly associated in both genders with traffic incidents, the exception being SV crashes among women. None of the associations was significantly different by gender.

Whether or not the subject used marijuana is positively and significantly associated for both genders with all traffic incidents except SV crashes among women. For offenses, this trend is stronger among women than among men ($p = .042$). For SV crashes, however, the trend is significantly stronger among men than among women ($p = .025$).

TABLE 4. Estimates of linear association between number of traffic incidents and substance use measures, by gender

Variable	Slope for women (c^F)	Slope for men (c^M)	Difference in slopes[a] (c^F-c^M)
Alcohol use			
No. of offenses	0.48 (0.33-0.62)[b]	0.39 (0.27-0.50)[b]	0.09 (–0.09-0.28)
No. of serious offenses	0.39 (0.08-0.70)[c]	0.40 (0.24-0.56)[b]	–0.01 (–0.36-0.33)
No. of crashes	0.38 (0.20-0.56)[b]	0.08 (–0.07-0.23)	0.30 (0.07-0.54)[c]
No. of SV crashes	1.53 (–0.08-3.15)	0.08 (–0.64-0.80)	1.46 (–0.31-3.23)
Alcohol misuse			
No. of offenses	0.14 (0.09-0.20)[b]	0.14 (0.10-0.18)[b]	0.00 (–0.07-0.07)
No. of serious offenses	0.11 (–0.01-0.22)	0.16 (0.09-0.22)[b]	–0.05 (–0.18-0.08)
No. of crashes	0.14 (0.07-0.21)[b]	0.04 (–0.02-0.09)	0.11 (0.02-0.19)[c]
No. of SV crashes	0.06 (–0.56-0.68)	0.01 (–0.25-0.28)	0.05 (–0.62-0.72)
	Slope of log-OR for women	Slope of log-OR for men	Difference in slopes
Use cigarettes			
No. of offenses	0.21 (0.11-0.30)[b]	0.15 (0.07-0.23)[b]	0.06 (–0.06-0.18)
No. of serious offenses	0.26 (0.07-0.45)[b]	0.29 (0.16-0.42)[b]	–0.03 (–0.26-0.20)
No. of crashes	0.24 (0.10-0.38)[b]	0.29 (0.17-0.42)[b]	–0.05 (–0.24-0.13)
No. of SV crashes	0.34 (–0.10-0.79)	0.43 (0.12-0.74)[b]	–0.08 (–0.62-0.46)
Use marijuana			
No. of offenses	0.33 (0.23-0.43)[b]	0.19 (0.11-0.28)[b]	0.14 (0.00-0.27)[c]
No. of serious offenses	0.33 (0.13-0.54)[b]	0.31 (0.17-0.45)[b]	0.02 (–0.22-0.27)
No. of crashes	0.27 (0.12-0.42)[b]	0.16 (0.03-0.29)[c]	0.12 (–0.08-0.31)
No. of SV crashes	–0.27 (–0.78-0.25)	0.42 (0.11-0.73)[b]	–0.69 (–1.29-–.08)[c]

Notes: SV = single vehicle; OR = odds ratio. [a]Difference in linear trends between women and men (95% confidence intervals for linear trend estimates and linear trend difference estimates in parentheses); [b]significant at $\alpha = .01$ level; [c]significant at $\alpha = .05$ level.

Environmental influences. Peer involvement with alcohol is significantly associated positively with all traffic incidents for women but only with offenses and serious offenses for men (Table 5). The trend is significantly stronger among women than men for crashes ($p = .020$), and marginally stronger among women than men for offenses ($p = .054$) and SV crashes ($p = .058$). The peer involvement with alcohol index averaged 6.03 for women with three or more offenses versus 4.73 for women with none, in contrast to 5.51 for men with three or more offenses versus 4.93 for men with none (Table 2). For women with two or more crashes, the mean peer index was 5.47 (9.00

TABLE 5. Estimates of linear association between number of traffic incidents and environmental influence measures, by gender

Variable	Slope for women (c^F)	Slope for men (c^M)	Difference in slopes (c^F-c^M)[a]
Peer alcohol involvement			
No. of offenses	0.47 (0.31-0.63)[b]	0.27 (0.14-0.40)[b]	0.20 (–0.00-0.41)
No. of serious offenses	0.41 (0.06-0.75)[c]	0.34 (0.16-0.52)[b]	0.06 (–0.32-0.44)
No. of crashes	0.28 (0.08-0.47)[b]	–0.03 (–0.19-0.14)	0.30 (0.05-0.56)[c]
No. of SV crashes	1.97 (0.23-3.70)[b]	0.11 (–0.70-0.93)	1.85 (–0.07-3.77)
	Slope of log-OR for women	Slope of log-OR for men	Difference in slopes
Parents' indifferent/ approve teen alcohol use			
No. of offenses	0.20 (0.07-0.34)[b]	–0.00 (–0.12-0.12)	0.20 (0.02-0.38)[c]
No. of serious offenses	0.12 (–0.16-0.40)	0.09 (–0.10-0.28)	0.03 (–0.31-0.37)
No. of crashes	0.07 (–0.14-0.27)	–0.11 (–0.30-0.08)	0.18 (–0.10-0.46)
No. of SV crashes	0.32 (–0.29-0.93)	–0.02 (–0.48-0.44)	0.34 (–0.43-1.10)
Easy access to alcohol			
No. of offenses	0.38 (0.20-0.57)[b]	0.16 (0.01-0.30)[c]	0.23 (–0.00-0.46)
No. of serious offenses	0.40 (0.02-0.77)[c]	0.16 (–0.09-0.41)	0.24 (–0.21-0.68)
No. of crashes	0.30 (0.05-0.54)[c]	0.08 (–0.15-0.30)	0.22 (–0.11-0.55)
No. of SV crashes	–0.28 (–0.93-0.37)	0.18 (–0.48-0.85)	–0.46 (–1.40-0.45)

Notes: SV = single vehicle; OR = odds ratio. [a]Difference in linear trend between women and men (95% confidence intervals for linear trend estimates and linear trend difference estimates in parentheses); [b]significant at $\alpha = .01$ level; [c]significant at $\alpha = .05$ level.

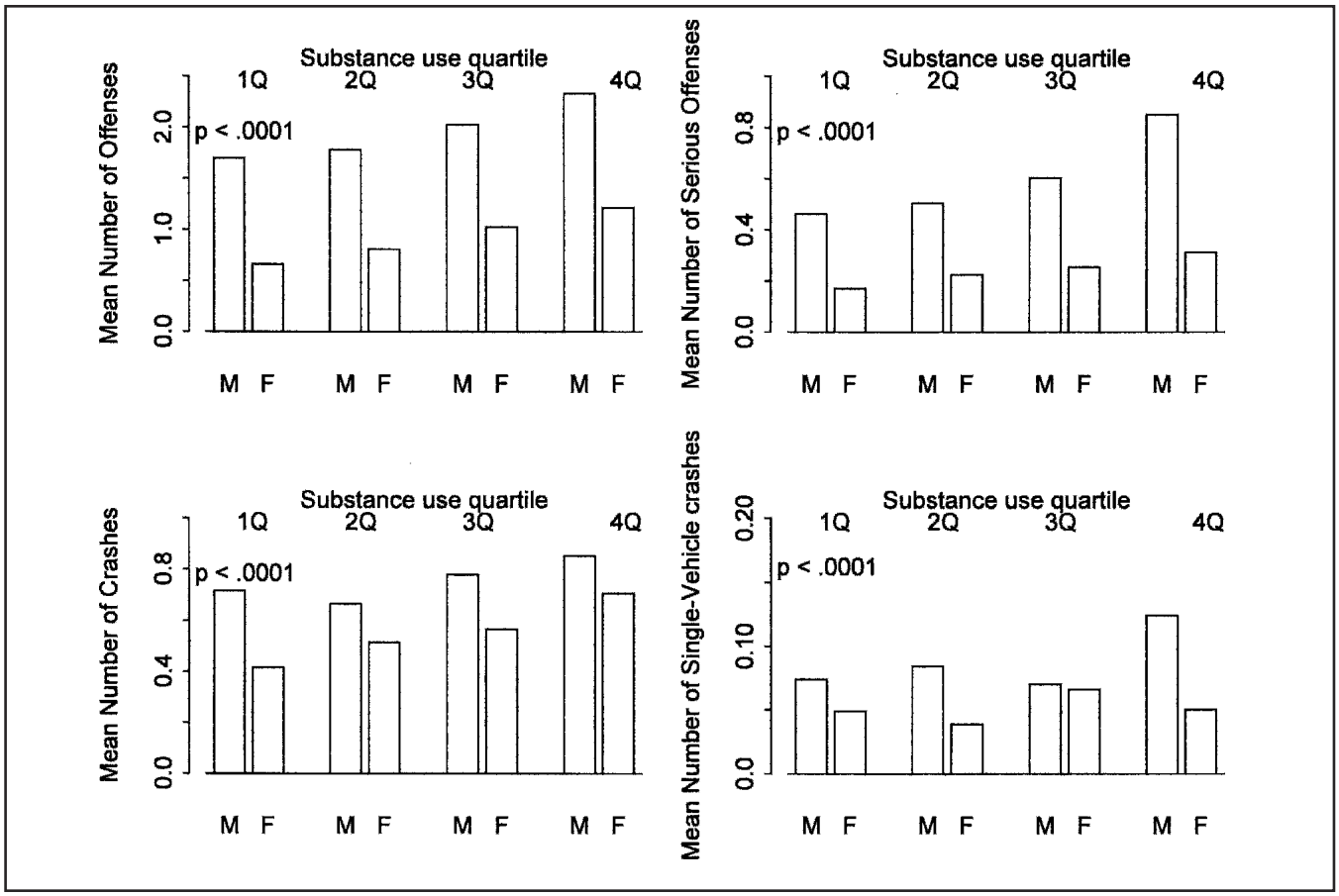

FIGURE 1. Mean number of offenses, serious offenses, crashes, and single-vehicle crashes during first 4 years of licensing, by substance-use quartile and gender. *P* values are for null hypothesis for which there is no gender difference after matching by substance-use profiles.

among women with two or more SV crashes) versus 4.91 for women with none (5.07 among women with no SV crashes). Among men, differences are smaller: a mean peer index of 5.11 for men with two or more crashes (5.44 with two or more SV crashes) versus 5.17 for men with none (5.21 with no SV crashes) (Table 3). Parental indifference toward teens' alcohol use was associated only with women's offenses, with a significant gender difference (p = .028). Easy alcohol access was significantly associated with women's offenses, serious offenses, and crashes; for men, it was associated with offenses. There were no significant gender differences.

Question 2. Do men and women who share similar substance-use profiles have similar driving profiles?

Figure 1 shows the mean number of traffic incidents for each quartile of subjects' substance use. The between-gender difference is pronounced, and at every level of substance use men exhibit higher levels of high-risk driving behavior than do women.

For the statistical analysis, a conditional logistic regression analysis was conducted to determine the log-odds that a subject was female given that the subject had x incidents of a given type relative to having x - 1 incidents of a given type, x = 1, 2, …, after matching for substance use. Based on this analysis, men are 48% more likely to have one more offense than women (OR = 1.48, 95% CI: 1.40-1.56) at a comparable level of substance use; twice as likely to have one more serious offense (OR = 1.97, 95% CI: 1.76-2.22); 34% more likely to have one more crash (OR = 1.34, 95% CI: 1.23-1.46); and 65% more likely to have one more SV crash (OR = 1.65, 95% CI: 1.24-2.18). These results show that women have less risky driving than men at similar substance-use levels.

Discussion

We examined our data to consider the hypothesis that young women who exhibit high-risk driving deviate more from the general population of young women in their substance use and related environmental influences than high-risk driving young men differ from other young men. It is well known that young women have lower rates of socially disapproved behaviors than young men (Farrow and Brissing, 1990). In our study also, women had lower levels

of alcohol consumption and alcohol misuse, less marijuana use, and less access to alcohol. Further, women had fewer traffic offenses, serious offenses, crashes, and SV crashes than men, during their first 4 years of licensure.

The response to our first research question is a qualified yes: there is a general pattern for associations between substance use/environmental influences and traffic incidents to be stronger among young women than among young men. There were significantly stronger associations between women's alcohol use/misuse and crashes, and their marijuana use and offenses, than among men. Only one substance-use association was found to be stronger in men than women: men who smoked marijuana during the past year were significantly more likely to be in SV crashes than women; however, very few women experienced an SV crash. In terms of environmental influences, there were statistically significant stronger associations among women for peer alcohol involvement and crashes, and for parental indifference to teen's drinking and offenses. There were also marginally stronger associations between peer alcohol involvement and offenses, as well as SV crashes, among women than among men. These findings are consistent with young women being more influenced by peers than young men (Lang et al., 1996; Shope et al., 1996). Although multiple comparisons were done, patterns of stronger associations among women are evident, and several associations are significantly stronger than associations among men. These results may indicate that women with more driving offenses or crashes are more nonnormative (compared with other women) with respect to substance use and related environmental influences than are men with more offenses or crashes (compared with other men). In response to our second research question, our analysis shows that women with substance-use levels similar to men's still had fewer offenses and crashes than their male counterparts. Their higher substance use did not appear to relate to more risky driving.

Our analyses have several limitations, chiefly a lack of exposure data (miles driven). All subjects were licensed for the same time period; however, it has been observed (Hu and Young, 1999) that young men drive more than young women, on average, for a given time period. Because our analyses focus on the difference in the association between substance use/environmental influences and traffic incidents among men and among women, young men driving more than young women would not have affected our results unless (1) there is a relationship between the predictors and miles driven and, (2) this relationship *differs* between men and women (both of which are quite unlikely). A second limitation is that a number of contrasts are considered. By chance, 5% will be significantly different from 0 at the $\alpha = .05$ level. Our main results, however, consider the interaction between men and women with respect to the association between the predictors and traffic incidents. Although we report 28 such interactions—one of which, on average, would be significant at the $\alpha = .05$ level, even if no gender differences in the relationships existed—the overall pattern of interactions should be considered, not single tests.

A third limitation is potential bias in self-reported substance use, which could possibly differ by gender, with men overreporting and women underreporting. If such a differential exists but is unrelated to traffic incidents, then it would have no effect on our analyses, because trends between predictor measures and traffic incidents would be unaffected. In the unlikely event that men with fewer traffic incidents overreported substance use relative to men with more incidents, however, and/or women with fewer traffic incidents underreported relative to women with more incidents, the association between substance use and traffic incidents would appear stronger in women than in men.

Last, we have used offenses and crashes recorded in driver-history records to identify incidents. To a certain extent, these are objective data, but reflect the likelihood of detection (particularly offenses) that could vary by individual characteristics not assessed. An Australian study 20 years ago found that men under 25 were overrepresented and women underrepresented in traffic law enforcement (Kirkham and Landauer, 1985). More recent or U.S.-based studies were not found. Crashes would be less likely than offenses to be underreported.

In summary, our first hypothesis is generally supported: high-risk driving young women do tend to deviate more from other women than high-risk driving men deviate from other men. Our second hypothesis—that men and women with similar substance-use profiles share similar high-risk driving profiles—is rejected. If the associations between substance use and traffic incidents found in this analysis were to remain constant, and the modest gender differences in substance use and environmental influences favoring women were to disappear because of changing social norms, we would still expect women to retain their lower-risk driving profiles. Future research is needed, however, to explain the differential associations by gender. Why are more substance use and high-risk driving so normative for men? Why, with women's changing social status, can substance use be high, but not driving risk? Similar analyses on younger cohorts might yield enlightening findings, although a study in Finland found similar male-female differences in crash patterns in 1984 and 2000 (Laapotti and Keskinen, 2004). Although few programs exist to prevent high-risk driving among youth, they are directed broadly, toward both genders together. Perhaps programs should target young men, as there is potential for making substantial change, or target subsets of young women who exhibit high substance use and negative environmental influences. The increasing ability to tailor interventions to individual characteristics could well utilize information from this study and others, to target individual lifestyle behaviors that lead to increased motor vehicle injuries and fatalities.

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