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Adolescent antecedents of high-risk driving behavior into young adulthood: substance use and parental influences

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Abstract

Driver history data, in combination with previously collected tenth-grade questionnaire data, for 4403 subjects were analyzed by Poisson regression models to identify the significant substance use and parental characteristics predicting subsequent high-risk driving of new drivers (starting at age 16) through age 23–24 years. Substance use (cigarettes, marijuana, and alcohol) reported at age 15 was shown to be an important predictor of subsequent excess risk of serious offenses and serious crashes for both men and women. In addition, negative parental influences (lenient attitudes toward young people's drinking; low monitoring, nurturance, family connectedness), were also demonstrated to increase the risk of serious offenses and serious crashes for both men and women.

Keywords: Adolescent risk factors; Young adult driving; Alcohol and other substance abuse; Parenting; Crashes; Offenses

1. Introduction

Injury, and motor vehicle injury in particular, is the major cause of death and disability among adolescents and young adults (Institute of Medicine, 1999; National Highway Traffic Safety Administration, 1998; Insurance Institute for Highway Safety, 2000). In order to develop appropriate interventions to prevent such losses, a better understanding of the factors that predispose young people to risky driving and motor vehicle crashes is needed.

Several previous studies of the correlates of young people's crashes or violations found these related variables — driving after drinking, hostility, and alienation from the educational system (Pelz and Schuman, 1973); personal maladjustment, social maladjustment, impulsivity, and information-processing deficiency (Mayer and Treat, 1977); risky driving, alcohol and drug use (Farrow, 1985); low school grades and educational achievement (Murray, 1998); lifestyle factors such as alcohol attitudes, use, and consequences (Beirness and Simpson, 1988); and a lifestyle profile characterized by alcohol use and different driving purposes among others (Gregersen and Berg, 1994). Self-reported drunk driving was found by Arnett (1990) to be related to sensation-seeking, thrill- and adventure-seeking, disinhibition, and boredom susceptibility, as well as a low expectation of negative consequences. Copeland et al. (1996) found self-reported driving after drinking to be related to being male, smoking cigarettes, having an offense on the driving record, engaging in frequent heavy drinking, and riding with drinking drivers. High-risk driving by young people has been categorized with other risk-taking behaviors, such as delinquency, precocious sex, drinking, and the use of drugs, and found to be correlated in studies of problem behavior theory (Wilson and Jonah, 1988; Jessor, 1987a,b, 1991; Jessor et al., 1991; Donovan, 1993).

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Very few longitudinal studies of the predictors of subsequent high-risk driving among young people have been conducted. Beirness and Simpson extended their lifestyle study and found that psychosocial and behavioral risk factors, particularly those that are alcohol-related, preceded crash involvement by up to three years (Beirness and Simpson, 1991; Simpson and Beirness, 1992, 1993). Karlsson and Romelsjo (1997) also found that early social and behavioral factors, including alcohol and other substance use, predicted men's subsequent drunk driving offenses. Begg et al. (1999) used injury crashes, non-injury crashes, and all crashes as separate outcome variables as of age 21, to study explanatory measures collected from 15- and 18-year-old youth. They found different significant predictors for different outcomes, and somewhat low odds ratios. Nevertheless, there were several significant measures predicting involvement in at least one type of crash: alcohol use, substance dependence, depression, conduct disorder, attention deficit disorder, physical activity, having a motorcycle license, and low levels of family involvement, spare time activities, and coping.

Previous studies by the authors on one longitudinal data set (different from the one presented herein) have reported significant eighth-grade (about age 13) predictors and twelfth-grade correlates (about age 17) of crashes and offenses in the first years of driving (Lang et al., 1996; Shope et al., 1996a,b, 1997). Although different variables were significant for young men than for young women, the important factors included family structure, propensity to use substances, parents' attitudes regarding young people's drinking, friends' substance use involvement, substance availability, substance use, school grades, and driving frequency.

Adolescent substance use, particularly alcohol, was a key correlate or predictor of high-risk driving in many of the studies noted above. Young peoples' substance use is well known to be influenced by various parental factors including family structure (Adlaf and Ivis, 1996; Hoffmann and Johnson, 1998); parenting behaviors (Jackson et al., 1997; Reifman et al., 1998); family bonding, closeness, or connectedness (Resnick et al., 1997; Forgays, 1998; Zhang et al., 1999); and parental attitudes and substance use (Windle, 1996; Jackson et al., 1997; Zhang et al., 1997, 1999). It is, therefore, reasonable to question the extent to which parental factors affect another adolescent problem behavior, that of high-risk driving. Carlson and Klein (1970) reported a positive correlation between fathers' and sons' traffic convictions. Ferguson et al. (1999) found that children's driving records in the first few years of licensure were related to the driving records of their parents. But no other parental predictors of young people's driving behavior were found in the literature search. This paper, therefore, reports on analyses to determine both the influences of substance use and parental factors on the high-risk driving of young people in their early years of licensure.

Extensive data collection during the evaluation of a school-based alcohol misuse prevention study provided predictor measures. Subsequent funding was obtained to study the driving behavior of these subjects. The availability of previous psychosocial and behavioral measures, as well as subsequent driving records, made it possible to answer the research question: What substance use and parental characteristics of surveyed high school students are significantly related to subsequent high-risk driving as recorded on state driver history records, during the first years of licensure and extending into young adulthood?

2. Methods

As part of the longitudinal evaluation of a school-based alcohol misuse prevention program (Shope et al., 1996), self-administered questionnaire data were collected from 6081 tenth-grade high school students (graduating classes of 1990 and 1991) in the fall of 1988 and the fall of 1989 in six southeastern Michigan public school districts. The questionnaire included demographic, substance use and parenting measures, as well as other psychosocial and behavioral variables not included in this report. The questionnaire data were treated confidentially, but individually coded with an identification number. Response rates ranged from 80 to 95% in each of the six school districts.

Beginning in 1992, students' names and birth dates were submitted to the Michigan Secretary of State's Office annually to obtain driver history data. Of the 6081 students with questionnaire data, 5349 (88%) eventually obtained a Michigan driver's license. Early driver history data were retained as later data were obtained and merged. Thus, complete information for each subject was available, including incidents that were subsequently purged from the state records. The driver history data, including individual-level offense and crash information, represented up to over 8 years of licensure per subject, and were complete through June of 1997.

For most students (5233 or 86.1%), the survey was completed before they turned 16 years of age and had obtained a driver's license, thus capturing their pre-driving experiences and providing useful predictors of subsequent driving behavior. The 848 subjects who were already driving at the time of the survey were not included in these analyses. Additionally, because one aim of these analyses was to examine the influence of parents on driving behavior, those subjects who reported that they did not live with either parent ($n = 98$) were also eliminated from further analyses. These exclusion criteria yielded a final sample size of 4403 subjects

that formed the basis for the results reported in this paper.

2.1. Measures

Two outcome variables, created from the driver history records, were thought to be indicative of deliberate, high-risk driving, rather than simply the inexperience or carelessness of a young, novice driver. *Number of serious offenses* was a count that included those offenses that were alcohol-related; speeding in excess of 15 miles per h over the speed limit; reckless driving, vehicular homicide, and other major offenses; and non-driving drug offenses. Typically, these offenses were assigned more points by the Secretary of State than less serious offenses (such as lesser speeding, no proof of insurance, license plate and vehicle offenses, and fraudulent identification, among others). *Number of serious crashes* was a count that included each individual subject's crashes that were alcohol-related, at-fault, or single-vehicle. Care was taken not to count the same crash more than once if it was included in more than one category.

Predictor variables from questionnaire data collected from the tenth-grade high school students included three demographic variables. *Age* at the time of the survey was considered in 1-year intervals. *Race* was reported by students as white, black, or other race, and subsequently collapsed to a dichotomous variable, white and other race. *Sex* was male or female.

Three variables that reflected substance use in the year previous to the survey were included in this analysis. *Cigarette and marijuana frequency* of use each ranged from 0 (none) to 5 (daily use). A single *alcohol use/misuse* measure was developed in order to group all subjects according to their tenth-grade drinking status. This measure was based on questionnaire items that related to the use of alcohol, as well as on items relating to alcohol misuse (ten items reflecting the negative consequences of drinking such as getting drunk, getting in trouble with someone, or having someone complain about their drinking). The measure had four categories (1) non-drinkers; (2) drinkers who reported no instance of alcohol misuse; (3) drinkers with some misuse (one instance of a consequence of drinking); and (4) drinkers with more misuse (more than one instance of a consequence of drinking).

Parental influence variables included measures of parental monitoring, parental nurturing, family connectedness, parental permissiveness, parents' attitude toward young people's drinking, and parents' drinking habits, all as perceived by the survey respondent. Based on previous research and on factor analyses of questionnaire items, these variables were created as scores. The respondent's living situation/family structure was also considered a parental influence variable.

Parental monitoring was a scaled variable ranging from 0 (no monitoring) to 12 (high monitoring). This variable was created using four survey items (McAlister, 1983; Dishion and Loeber, 1985) — 'How often do your parents know where you are when you are not in school?' 'How often do you follow your parents' teachings?' 'When your parents tell you to do something, how often do you obey?' 'Is it important for your parents to know where you are all the time?'

Parental nurturing was a scaled variable ranging from 0 (no nurturance) to 30 (high nurturance). This variable was created using seven survey items (Dishion and Loeber, 1985; White et al., 1985; Barnes and Windle, 1987) — 'How often do you share thoughts or feelings with your parents?' 'How often do you spend time with your parents?' 'When you do something well, how often do your parents give you praise or encouragement for what you do?' 'How often do your parents give you a hug, kiss, or a pat on the shoulder?' 'How often do you and your parents do things together that you all enjoy?' 'How often do your parents enjoy talking things over with you?' 'How often do your parents cheer you up when you're sad?'

Family connectedness was an ordinal variable ranging from 0 (not connected to family) to 3 (very connected to family). This variable was created using three items from the survey 'Who (parents or others) do you usually go to for help when you have a problem?' 'In general, are you more comfortable with your family or your friends?' 'How much do you rely on your parents for advice and guidance?' Respondents who always reported going to their parents for help on a problem, being more comfortable with parents, and relying on their parents for advice and guidance were characterized as 'very connected to family.' Conversely, those who did not report going to their parents for help on a problem, were more comfortable with others, and did not rely on parents for advice and guidance were characterized as 'not connected to family' with other responses falling in between.

Parental permissiveness was a scaled variable ranging from 0 (not permissive) to 12 (very permissive). This variable was created using four survey items (White et al., 1985): 'How often do your parents allow you to go out when you want to?' 'How often do your parents let you get away without doing work you have been told to do?' 'How often do your parents let you off easy when you do something wrong?' 'How often do your parents allow you to spend money you have earned on whatever you wish?'

Parents' attitudes toward young people's drinking was a scaled variable that ranged from a positive influence on the student, 0 (not lenient) to a negative influence on the student, 6 (very lenient). This variable was created from four separate survey items: 'How do your parents feel about kids your age drinking beer, wine, or hard

liquor?' 'How do your parents feel about kids your age getting drunk?' 'Do your parents allow you to drink alcohol at parties when they are present?' 'Do your parents allow you to drink alcohol at parties when they are not present?'

A measure of *parents' drinking habits* (as perceived and reported by the respondent) was based on two questionnaire items separately addressing mother's and father's frequency and quantity of alcohol consumption. This measure ranged from 0 (no drinking) to 6 (frequent heavy drinking). For the mother and father separately, results from the two questions, 'How often does your mother/father have a drink of alcohol?' (every day, 3–4 days a week, once a week, once a month, a few times a year, never) and 'When your mother/father drinks alcohol, how much does she/he usually drink?' (a little, some, a lot) were analyzed in bivariate frequency tables. Conjunctive analysis was used to create the resulting codes (Feinstein, 1996). For example, those parents who never drank were coded as 0. Those parents who drank every day or drank 'a lot' were coded as 3, with other responses falling in between. Mother's and father's consumption patterns were summed to create the final parents' drinking variable.

Family structure was based on a single item asking 'Which of your parents do you live with most of the time?' Possible responses included mother and father, parent and a step-parent, a single parent, or someone else. For modeling purposes, two indicator variables were created, and living with both parents served as the baseline category. The first indicator variable included those respondents who lived with a parent and step-parent. The second indicator variable included those respondents who lived with a single parent (mother or father). Those who did not live with a parent were dropped from further analyses as explained previously.

2.2. Data analysis

All analyses were sex-specific because of sex differences in rates of offenses and crashes, as well as because of the possibility that parental influences might have differential impacts by sex on high-risk driving. In order to assess the bivariate associations among the variables, Pearson's correlation coefficients between the substance use, parental influence, and driving variables were calculated for young men and women separately.

Poisson's regression analyses were conducted to identify significant substance use and parental antecedents of subsequent high-risk driving behavior, and were run in three steps. First, Poisson's regression was done on only the substance use variables for each driving outcome count measure. Second, Poisson's regression was done on only the parental influence variables for each driving outcome count measure. Third, Poisson's regression with all substance use and parental influence variables combined was done for each driving outcome count measure.

The final multivariate models, with all the substance use and parental influence variables included were used to calculate the predicted probabilities of having at least one serious offense or serious crash. Predicted probabilities were calculated for positive, average, and negative parental influences and separately for low, average, and high substance use. Joint predicted probabilities for these situations (e.g. positive parental influence and low substance use) were also calculated. Thus, predictive probabilities were calculated for ten separate situations and for each outcome variable (1) positive parental influence (values for parental influence variables were found at the 80th percentile and all other variables were set at mean values); (2) average parental influence (values for the parental variables were found at the 50th percentile and all other variables were set at mean values); (3) negative parental influence (values for parental influence variables were found at the 20th percentile and all the other variables were set at mean values); (4) high level of substance use (values for substance use variables were found at the 80th percentile and all other variables set at mean values); (5) average level of substance use (values for substance use variables were found at the 50th percentile and all others set at mean values); (6) low level of substance use (values for substance use variables were found at the 20th percentile and all the others set at mean values); (7) positive parental influence and low substance use; (8) positive parental influence and high substance use; (9) negative parental influence and low substance use; and (10) negative parental influence and high substance use.

All multivariate analyses were adjusted for age, race, and length of licensure. Age at the time of the survey was included in all modeling as a single, continuous variable. Race was included in all models as a single indicator variable with white as the baseline category. The varying lengths of licensure were incorporated as offset variables. Furthermore, all ordinal predictor variables were checked for linearity and as a result, marijuana frequency of use was included as two indicator variables, occasional use and frequent use, with no use serving as the reference category. In all models, two-way interactions were tested and deviance residuals were examined for outliers. Significant interactions were included in all models. Deviance residuals indicated that there were no serious departures from the observed data. All the computations were performed using SAS Version 6.0 for Windows (1995).

3. Results

Of the 4403 subjects included in these analyses, 47% were male, and 84.4% were white. The average age of obtaining a driver's license was 16.6 years, and the average length of licensure was 7.15 years (S.D. = 1.06, range = 0.02–8.61). The majority of subjects ($n = 3277$, 74.4%) had at least one offense on their driving record; 41.2% ($n = 1812$) had at least one serious offense; and 6.8% ($n = 301$) had at least one alcohol-related offense. The mean number of serious offenses among those who had serious offenses was 1.96 for young men and 1.38 for young women. Well over half the subjects ($n = 2561$, 58.2%) had at least one crash on their driving record; 21.3% ($n = 939$) had at least one at-fault crash; 10.7% ($n = 472$) had at least one single-vehicle crash; and only 2.6% ($n = 113$) had at least one alcohol-related crash, with 27.4% ($n = 1206$) having at least one of the three types of serious crashes. The mean number of serious crashes among those who had serious crashes was 1.33 for young men and 1.18 for young women (Table 1).

The means and standard deviations (S.D.) of the predictor variables are reported in Table 2, and the correlation coefficients among variables are reported in Table 3. In these bivariate analyses, for both men and women, the use of cigarettes, marijuana, and alcohol in tenth grade was significantly associated with subsequent serious offenses and crashes. Parental monitoring, nurturance, and family connectedness reported in the tenth grade of high school apparently protected both young men and women from concurrent involvement in substance use, as well as from subsequent serious offenses and crashes, with significant negative coefficients noted for all the correlations. Parental permissiveness was positively related to substance use for both young men and women (significant in all cases except young men's cigarette smoking). Parents' drinking was significantly and positively related to the use of all the three substances by both young men and young women, and interestingly, was associated with fewer serious offenses among young men, although more serious offenses

Table 1
Proportion and mean number (S.D.) of serious offenses and serious crashes by sex

	Young men ($n = 2071$)	Young women ($n = 2332$)	Total ($n = 4403$)
Proportion with at least one serious offense	54.0% $n = 1120$	29.7% $n = 692$	41.2% $n = 1812$
Proportion with at least one serious crash	33.0% $n = 684$	22.4% $n = 522$	27.4% $n = 1206$
Mean number of serious offenses among those who had a serious offense	1.96 (1.31) $n = 1120$	1.38 (0.78) $n = 692$	1.74 (1.17) $n = 1812$
Mean number of serious crashes among those who had a serious crash	1.33 (0.65) $n = 684$	1.18 (0.43) $n = 522$	1.27 (0.57) $n = 1206$

Table 2
Mean and S.D. for demographic, parental influence, and substance use variables from the tenth-grade questionnaire

	Young men			Young women		
	Mean	S.D.	*n*	Mean	S.D.	*n*
Demographics						
Age	15.67	0.47	2071	15.62	0.46	2332
Race (proportion other)	0.15	0.36	2039	0.16	0.37	2303
Parental Influence						
Living with both parents (proportion)	0.64	0.48	2049	0.63	0.48	2325
Living with a single parent (proportion)	0.22	0.41	2049	0.23	0.42	2325
Living with parent/step-parent (proportion)	0.14	0.35	2049	0.14	0.35	2325
Parental monitoring	9.33	2.35	2054	9.89	2.19	2322
Parental nurturing	18.84	6.88	2051	19.26	7.21	2325
Family connectedness	1.84	1.11	2037	1.83	1.14	2317
Parental permissiveness	8.30	1.98	2051	8.40	1.95	2323
Parents' lenient attitude re young people's drinking	1.05	1.43	1968	1.06	1.42	2210
Parents' drinking	2.19	1.56	1988	2.40	1.57	2247
Substance use/misuse						
Frequency of cigarette use	0.91	1.67	1913	1.28	1.85	2210
Frequency of marijuana use	0.47	1.11	1887	0.37	0.87	2192
Alcohol use/misuse	2.54	1.28	2032	2.67	1.24	2304

Table 3
Correlation coefficients among substance use, parental influence and driving variables

	Cigarette use	Marijuana use	Alcohol use	Serious offenses	Serious crashes
Young men					
Parental monitoring	−0.254	−0.311	−0.306	−0.089	−0.044
Parental nurturing	−0.255	−0.252	−0.229	−0.082	−0.060
Family connectedness	−0.243	−0.237	−0.249	−0.069	−0.060
Parental permissiveness	0.016[a]	0.101	0.141	0.032[a]	0.030[a]
Parents' drinking	0.090	0.092	0.248	−0.078	−0.034[a]
Parents' lenient attitude re drinking	0.125	0.165	0.283	0.039	0.048
Single parent	0.087	0.127	0.037[a]	0.035[a]	0.007[a]
Parent/step-parent	0.077	0.095	0.109	0.011[a]	0.038[a]
Serious offenses	0.127	0.110	0.103	1.000	0.280
Serious crashes	0.049	0.045	0.053	0.280	1.000
Young women					
Parental monitoring	−0.270	−0.314	−0.309	−0.115	−0.071
Parental nurturing	−0.225	−0.225	−0.216	−0.094	−0.096
Family connectedness	−0.234	−0.225	−0.232	−0.096	−0.088
Parental permissiveness	0.111	0.140	0.239	0.015[a]	−0.003[a]
Parents' drinking	0.077	0.127	0.253	0.046	0.037[a]
Parents' lenient attitude re drinking	0.203	0.206	0.293	0.034[a]	0.052
Single parent	0.073	0.063	0.039[a]	0.039[a]	0.006[a]
Parent/step-parent	0.103	0.091	0.117	0.051	0.056
Serious offenses	0.098	0.111	0.101	1.000	0.206
Serious crashes	0.052	0.071	0.081	0.206	1.000

[a] Not significant at the 0.05 level. All the other coefficients significant at ≤ 0.05 level.

among young women. Parents' lenient attitudes toward young people's drinking was significantly and positively associated with substance use for both men and women, serious offenses and crashes for men, and serious crashes for women. Living with a single parent was significantly associated with cigarette and marijuana use for both men and women. Living with a parent/step-parent was significantly associated with increased substance use for both men and women, and with increased serious offenses and crashes for women.

Results from multivariate analyses using Poisson's regression models are summarized in Tables 4 and 5. Because each of the ten predictor variables and four interaction terms was significant in at least one of the 12 models, all the variables and all the four interactions were included in each stage of the modeling process as covariates. In general, the subjects who reported more substance use had higher yearly rates of serious offenses and crashes than did those who reported less substance use. Higher levels of parental monitoring, nurturing, and family connectedness tended to lower the rates of serious offenses and crashes; more lenient parents' attitudes toward young people's drinking tended to raise the rates of serious offenses and crashes. Parental permissiveness was not a significant variable in any of the models, very likely because its contribution was adequately covered through the monitoring, nurturing, and family connectedness measures. One surprising finding among young men was that parents' drinking was related to fewer serious crashes and offenses.

To better understand the role of these predictors in predicting the rates of serious offenses and crashes, three scenarios were selected, representing positive, average and negative parental influences using 80th, 50th and 20th percentiles of the corresponding measures. In a separate analysis, three scenarios representing high, average and low levels of substance use were selected, again by using the 80th, 50th, and 20th percentiles. The estimated probabilities of having one or more serious offenses and serious crashes during the years since licensure were calculated for each of these scenarios and are given in Table 6. For instance, for a young man, the probability of a serious offense would be 58% if his parental influences had been positive, and 69% if not. The combined effect of level of parental influence and level of substance use was also investigated. For example, for a young man, the probability of a serious offense would be 50% if his parental influences had been positive and level of substance use had been low. In contrast, the probability of a serious offense for a young man with negative parental influences and high substance use would be 72%. All the estimated probabilities were obtained using the regression coefficients from the multivariate Poisson's regression analysis using all parental influence and substance use variables.

In general, young men had higher probabilities of having a serious offense or serious crash than women had, but this trend was most striking for the serious offense outcome variable. More positive parental influences and lower substance use were associated with

Table 4
Poisson's regression results, coefficients and S.E. for young men[a]

	Serious offenses						Serious crashes					
	β	S.E.	β	S.E.	β	S.E.	β	S.E.	β	S.E.	β	S.E.
Substance use												
Cigarette use	0.048	0.02[b]	–	–	0.063	0.02[b]	0.02	0.03	–	–	0.019	0.03
Occasional marijuana use	0.205	0.07[b]	–	–	0.200	0.08[b]	0.11	0.12	–	–	−0.016	0.13
Frequent marijuana use	0.173	0.10	–	–	0.100	0.11	0.12	0.16	–	–	−0.066	0.17
Alcohol use/misuse	0.060	0.02[b]	–	–	−0.103	0.06	0.03	0.03	–	–	0.183	0.10
Parental influences												
Parental monitoring	–	–	−0.035	0.01[b]	−0.028	0.01[b]	–	–	−0.006	0.02	−0.002	0.02
Parental nurturing	–	–	−0.015	0.01[b]	−0.026	0.02	–	–	−0.005	0.01	0.006	0.02
Family connectedness	–	–	0.031	0.04	−0.045	0.10	–	–	−0.066	0.06	0.003	0.16
Parents' drinking	–	–	−0.081	0.02[b]	−0.089	0.02[b]	–	–	−0.065	0.02[b]	−0.074	0.03[b]
Parents' leniency re drinking	–	–	0.045	0.02[b]	−0.147	0.05[b]	–	–	0.056	0.02[b]	0.162	0.07[b]
Single parent	–	–	0.041	0.06	0.099	0.07	–	–	0.036	0.09	0.025	0.11
Parent/step-parent	–	–	0.063	0.07	0.039	0.07	–	–	0.177	0.10	0.202	0.10[b]
Interactions												
Parent's leniency × alcohol	–	–	–	–	0.053	0.02[b]	–	–	–	–	−0.032	0.02
Single parent × cigarette use	–	–	–	–	−0.080	0.03[b]	–	–	–	–	0.013	0.05
Nurture × alcohol use/misuse	–	–	–	–	0.003	0.01	–	–	–	–	−0.005	0.01
Family connectedness × alcohol	–	–	–	–	0.039	0.03	–	–	–	–	−0.020	0.05

[a] All estimates are adjusted for age, race and length of licensure. Models were first run with only substance use measures, then with only parental influence measures, then with all measures.
[b] Significant at 0.05 level.

Table 5
Poisson's regression results, coefficients and S.E. for young women[a]

	Serious offenses						Serious crashes					
	β	S.E.	β	S.E.	β	S.E.	β	S.E.	β	S.E.	β	S.E.
Substance use												
Cigarette use	0.042	0.02	–	–	0.037	0.03	0.00	0.03	–	–	−0.024	0.03
Occasional marijuana use	0.301	0.10[b]	–	–	0.223	0.10[b]	0.22	0.12	–	–	0.179	0.13
Frequent marijuana use	0.189	0.16	–	–	0.127	0.17	0.24	0.21	–	–	0.069	0.23
Alcohol use/misuse	0.094	0.03[b]	–	–	0.043	0.10	0.11	0.04[b]	–	–	0.050	0.13
Parental influences												
Parental monitoring	–	–	−0.075	0.02[b]	−0.064	0.02	–	–	−0.030	0.02	−0.003	0.02
Parental nurturing	–	–	0.009	0.01	0.021	0.03	–	–	−0.008	0.01	−0.093	0.03[b]
Family connectedness	–	–	−0.132	0.06[b]	−0.197	0.17	–	–	−0.057	0.08	0.754	0.21[b]
Parent's drinking	–	–	0.033	0.02	0.024	0.02	–	–	0.015	0.03	0.013	0.03
Parent's leniency re drinking	–	–	0.001	0.02	−0.097	0.09	–	–	0.051	0.03	0.088	0.10
Single parent	–	–	0.214	0.08[b]	0.205	0.11	–	–	0.109	0.11	0.116	0.14
Parent/step-parent	–	–	0.229	0.09[b]	0.161	0.10	–	–	0.278	0.12[b]	0.207	0.12
Interactions												
Parent's leniency × alcohol	–	–	–	–	0.023	0.03	–	–	–	–	−0.012	0.03
Single parent × cigarette use	–	–	–	–	−0.030	0.04	–	–	–	–	−0.002	0.06
Nurture × alcohol use/misuse	–	–	–	–	−0.003	0.01	–	–	–	–	0.028	0.01[b]
Family connectedness × alcohol	–	–	–	–	0.031	0.05	–	–	–	–	−0.268	0.07[b]

[a] All estimates are adjusted for age, race and length of licensure. Models were first run with only substance use measures, then with only parental influence measures, then with all the measures.
[b] Significant at 0.05 level.

Table 6
Predicted probabilities for parental influence and substance use variables[a]

	Young men		Young women	
	Serious offenses (%)	Serious crashes (%)	Serious offenses (%)	Serious crashes (%)
Parental influence				
Positive influence	58.32	29.09	27.02	17.69
Average influence	61.67	31.11	29.56	18.84
Negative influence	68.83	45.70	42.59	30.20
Substance use				
Low use	55.44	33.34	27.68	18.35
Average use	61.34	34.75	30.63	21.60
High use	65.98	36.10	34.64	21.93
Parental influence and substance use				
Positive influence/low use	50.17	28.54	23.25	18.18
Positive influence/high use	62.04	29.60	29.11	16.16
Negative influence/low use	63.59	43.04	37.16	26.17
Negative influence/high use	71.82	47.95	45.21	31.55

[a] Estimates used to calculate the predicted probabilities above are adjusted for all other variables.

lower probabilities of having a serious offense or serious crash for both young men and women. The combined effect of having both negative parental influences and high substance use were associated with the highest probabilities of having a serious offense or serious crash. The predicted probabilities for the combined effect of level of parental influences and level of substance use also indicated that positive parental influences rather than low substance use had more of an effect on reducing the chance of being involved in a serious offense or serious crash.

4. Discussion

Significant amounts of risky driving behavior have occurred during the first several years of licensure of the study subjects. Young men were nearly twice as likely as young women to have had a serious offense and one and a half times as likely to have had a serious crash. These complete driving data, in combination with previous tenth-grade questionnaire data, enabled the identification of significant substance use and parental characteristics that predicted subsequent high-risk driving behavior into young adulthood for both young men and women.

Self-reported substance use at age 15 was an important predictor in Poisson's regression models of subsequent excess risk for both serious offenses and crashes, particularly for young women. Negative parental influences reported at age 15, such as low levels of parental monitoring, nurturance, and family connectedness, and high levels of parental leniency toward young people's drinking, were also important predictors of subsequent excess risk for both serious offenses and serious crashes for both men and women. When substance use and parental influences were included together in the regression models, different factors remained important for each sex. In predicting serious offenses among men, cigarette use, marijuana use, parental monitoring, and parental leniency regarding young people's drinking remained important. For women, marijuana use and parental monitoring remained significant in the full model. In predicting serious crashes, parents' influences remained the primary factor in the full models for both men and women.

The odd finding that among young men, offenses and crashes were *less* likely when they had reported more perceived parental drinking needs further exploration. Future analyses will examine that relationship in greater detail.

The study has several limitations as well as several strengths. The limitations include the fact that the questionnaire measures were necessarily limited to those addressed in the previous survey; no driving exposure data were available; and only state-recorded crashes and offenses, not any that were unreported, could be studied in these analyses. The study's driver history data, however, were more complete than the state's own records, in that the study data retained records of subjects' incidents over their entire Michigan driving career, whereas the state's records retain data from only the most recent years. Using driver history records, rather than self-reported driving incidents, provided consistency and standardization of those important outcome variables. While the study subjects were not drawn from a statewide sample, based on comparisons of the offense and crash rates to statewide data for this age group, they seem quite representative. Several of the study's features enhanced its generalizability; the

sample size was large, included a very large proportion of eligible students, and was drawn from public high schools. Other strengths of the study include the high match rate between subjects who completed questionnaires and subjects for whom Michigan driver history data were obtained, and the fact that the study was prospective. Questionnaire data were collected first; then driving records were obtained for all the newly licensed, young subjects in the time period following the questionnaire.

Few studies have been able to link previous questionnaire data with the subsequent driver history data of new, young drivers from adolescence into young adulthood to identify predictors of high-risk driving. In this paper, substance use reported at age 15 was shown to be an important predictor of subsequent high-risk driving through age 23–24 years. In addition, perceived parental influences, which others have shown to affect adolescent problem behaviors (Adlaf and Ivis, 1996; Windle, 1996; Jackson et al., 1997; Resnick et al., 1997; Forgays, 1998; Hoffmann and Johnson, 1998; Reifman et al., 1998; Zhang et al., 1999), were also demonstrated to affect high-risk driving. The highest rates of offenses and crashes may occur in the first year or two of driving, yet these predictors were significant when predicting over an average of 7 years of new, young driver licensure.

Substance abuse prevention among young people has been an important effort, and is worthy of being sustained and enhanced in order to reduce the consequences of substance use from all high-risk behaviors including motor-vehicle crashes. The study's new findings regarding the influence of perceived parenting characteristics on the high-risk driving of young people also strongly suggest the need for more support for parents regarding how to be effective in their parenting role. An enhanced and supported role for parents in young people's driving, especially in graduated licensing programs, would be recommended based on this study's results.

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