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Longitudinal examination of underage drinking and subsequent drinking and risky driving

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Abstract

Introduction—Alcohol use, alcohol misuse, and risky driving from adolescence into young adulthood were compared by drinking onset age.

Methods—Surveys were administered in Grades 5/6, 6/7, 7/8, 10, 12, and at approximately age 23. Participants were placed into Drinking Onset groups based on self-reported alcohol use frequency on the adolescent surveys. Driving records were examined in three age periods: under 21, 21–25, and 26+.

Results—The earliest drinking initiators reported higher alcohol use and misuse on each survey, and were more likely to have risky driving offenses before age 21 and to have alcohol driving offenses in all three age periods.

Discussion—The earliest drinking initiators engaged in risky drinking behavior and risky driving behavior that was consistently higher than those with later drinking initiation, beginning in adolescence and persisting well into young adulthood.

Keywords

Adolescent; Young Adult; Underage Drinking; Driving

1. Introduction

Despite a nationwide legal drinking age of 21, many adolescents in the United States begin drinking at much younger ages. In the 2005 Monitoring the Future study, 41% of 8th grade students had consumed an alcoholic drink (“not just a few sips”), and 20% had been drunk in their lifetime (Johnston, O’Malley, Bachman, & Schulenberg, 2006). In 1999, underage drinkers in the United States spent approximately \$22.5 billion to purchase alcohol (Foster, Vaughan, Foster, & Califano, 2003). Alcohol is a contributor to adolescent injury (Centers for Disease Control and Prevention [CDC], 2004), and has been associated with negative psychosocial outcomes (U.S. Department of Health and Human Services [USDHHS], 2000). The consequences of underage drinking (e.g., injury, violent crime, treatment for alcohol abuse), in the United States, cost an estimated \$53 billion in 1998 (Levy, Miller, & Cox, 1999). Injury, primarily from motor–vehicle crashes, continues to be the leading cause of death among adolescents and young adults in the United States (Hoyert, Kung, & Smith, 2005), and adolescents continue to have one of the highest motor–vehicle crash rates of all age groups (National Highway Traffic Safety Association [NHTSA],). Alcohol use further increases their crash risk. In 2004, 30% of 16–20–year–old drivers killed in motor–vehicle crashes had been

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drinking (BAC .01 or higher; NHTSA, 2006). A relationship between risky driving, defined as deliberately taking risks while driving, and other problem behaviors, such as problem drinking, has been found in adolescence (Jessor, 1987; Shope, Waller, & Lang, 1996; Vingilis & Adlaf, 1990) and in young adulthood (Donovan, 1993; Shope & Bingham, 2002). Risky driving and drinking/driving were both related to other problem behaviors in the latter two studies.

Nationally, alcohol use rates begin to rise in adolescence, peak around age 21, and remain high well into adulthood (Substance Abuse and Mental Health Services Administration [SAMHSA], 2003). The negative consequences associated with alcohol use also extend into adulthood. Among individuals ages 15–34, higher alcohol consumption patterns predict motor vehicle, work, and sports accidents (Wells & Macdonald, 1999). Young adult drivers, ages 21–34, have the highest rates of alcohol–involvement in fatal crashes (NHTSA, 2006). Despite the risks, teens and young adults continue to engage in drinking that puts themselves and others at great risk for harm. Learning more about lifetime drinking and related problem behaviors, such as risky driving and drinking/driving, is essential to the development of effective prevention programs. A growing body of literature has addressed the effect of early drinking on subsequent alcohol–related behavior.

Several cross-sectional, retrospective studies have found that the age at which a first, single alcoholic drink was consumed is associated with subsequent drinking behavior. Among high school senior drinkers, those who recalled drinking at the earliest ages reported greater alcohol abuse, alcohol misuse, alcohol consumption (frequency and quantity), and self-reported drinking/driving during their senior year (Gruber, DiClemente, Anderson, & Lodico, 1996). Adult drinkers who recalled having their first alcoholic drink before age 14 were more likely to have been diagnosed with alcohol abuse or dependence at some time during their lives (DeWitt, Adlaf, Offord, & Ogborne, 2000; Grant, 1998; York, 1995). The same relationship was reported for other alcohol–related behavior among adult drinkers – earlier onset of alcohol use (before age 14) was associated with self-reported adult alcohol-related injury (Hingson, Heeren, Jamanka, & Howland, 2000), physical fights after drinking (Hingson, Heeren, & Zakocs, 2001) and self-reported drinking/driving arrests and crashes (Hingson, Heeren, Levenson, Jamanka, & Voas, 2002).

Fewer studies have utilized longitudinal data to determine drinking onset age and examine subsequent alcohol-related behavior or risky driving outcomes. In those studies, earlier age of drinking onset was associated with: subsequent adolescent alcohol misuse (Hawkins et al., 1997); both alcohol consumption and problem drinking in young adulthood (Pedersen & Skrandal, 1998); a diagnosis of DSM-IV alcohol abuse or dependence by young adulthood (Guo, Collins, Hill, & Hawkins, 2000); self-reported young adult drinking/driving frequency and severity (Shope & Zakrajsek, 2002); and young adult weekly alcohol use, binge drinking, alcohol dependence, multiple alcohol problems, and a self-reported drinking/driving arrest by age 23 (Ellickson, Tucker, & Klein, 2003). Driving records have not previously been used to examine long-term risky driving outcomes of early drinking initiation in the United States. In a Finnish cohort, alcohol use reported at age 14 predicted a hospital-treated substance use disorder by age 31 and a recorded drinking/driving arrest by age 32 (Riala, Hakko, Isohanni, Jarvelin, & Rasanen, 2004). Crashes and non-alcohol–involved arrests have not been examined using driving records, nor has the timing of risky driving events within the period of ages 14–32.

This paper presents findings from analyses using longitudinal data to examine underage and young adult drinking and risky driving. Alcohol use and alcohol misuse from grade school through young adulthood were compared by drinking onset age to determine if those with earlier drinking initiation reported more risky drinking over time. Risky driving in specific age

periods from approximately age 16 through 30 was compared by drinking onset age using offenses and crashes from state driving records to determine if earlier drinkers were more likely to engage in risky driving, alcohol-related and/or non-alcohol-related, over time.

2. Method

2.1. Participants

Participants were 3,156 young adults, from the high school graduation classes of 1991 and 1992, who had participated in the longitudinal Alcohol Misuse Prevention Study (AMPS; Shope, Copeland, Maharg, & Dielman, 1996; Shope, Dielman, Butchart, & Campanelli, 1992) as adolescents, and had completed a telephone survey approximately 5 years after high school. Eligible participants had also been issued a Michigan drivers license and had an average first licensure age of 16.4 ± 0.9 years old. Those who participated in the young adult survey were predominantly white (85%, 6% Black, 2% Hispanic, and 7% Other) and 53% were women.

2.2. Procedure

An adolescent questionnaire (Adolescent Survey) was administered in school in six waves: Grade 5 (Class of 1992)/Grade 6 (Class of 1991); Grade 6 (Class of 1992)/Grade 7 (Class of 1991); Grade 7 (class of 1992)/Grade 8 (Class of 1991); Grade 10 Fall; Grade 10 Spring; and Grade 12 Spring. These written surveys were administered to all eligible students present on the survey dates, regardless of the number of previous Adolescent Surveys they had completed, allowing for continuous enrollment. From 1997–1998, approximately 5 years after high school, participants completed a computer-assisted telephone survey (Young Adult Survey) administered by the Survey Research Center at the University of Michigan Institute for Social Research (see Table 1 for a timeline of survey administration). Driving records were obtained annually from the Michigan Department of State and were assembled to create a driving history spanning from initial licensure through February 2004 (from approximately age 16 to age 30).

2.3. Measures

2.3.1. Drinking onset—Drinking Onset was determined from Adolescent Survey responses. In each survey, students reported “how often [they] had a drink of” beer, wine, or liquor. They were instructed that a “drink” of alcohol was more than just a taste (“Don’t count a sip or two you might have had. We want to know if you have had a beer, a glass of wine, a glass of liquor, or a drink with alcohol in it”). To measure onset of drinking behavior that was more frequent than simply experimentation or a first drink, for these analyses drinking was defined as consumption of an alcoholic drink on at least three occasions within the previous year.

Participant age on the Adolescent Survey when drinking was first reported determined Drinking Onset. Given the study design (Table 1), it was not feasible to treat Drinking Onset as a continuous variable. Instead, participants were assigned to one of five Drinking Onset categories: non-drinker (was a non-drinker through the Young Adult Survey); school non-drinker (was a non-drinker through the Grade 12 survey); Grade 12 onset (was a non-drinker through the Grade 10 survey); Grade 10 onset (was a non-drinker through the Grade 7/8 survey); or earliest onset (reported drinking on one of the 5th – 8th grade surveys). In others’ previous reports, different ages were used to represent the earliest onset of drinking, including, 10–12 (Gruber et al., 1996), under 13 (Pedersen & Skrondal, 1998), 11–14 (DeWitt et al., 2000), and age 14 (Grant, 1998; Hingson et al., 2000, 2002, 2001). Drinking Onset categories for this study’s participants were created after careful consideration of the categories used in these other studies, the design of this study, and the onset age distribution in these data. The earliest onset category in this study includes ages comparable to the groupings representing early drinking onset in most of the other studies listed above (i.e., under age 14).

2.3.2. Alcohol use—Alcohol frequency–quantity (AFQ) was calculated as a measure of the total amount of alcohol consumed that was reported in each survey. Adolescent AFQ was calculated using six items (beer frequency, beer quantity, wine frequency, wine quantity, liquor frequency, liquor quantity) according to the procedures described by Shope, Copeland, and Dielman (1994). The resulting AFQ provided an estimate of the number of drinks consumed per month; scores ranged from 0–638.

Young adult AFQ was calculated using two items. The responses to the frequency item (“How often do you have a drink containing alcohol?”) included never, once a month or less, 2–4 times a month, 2–3 times a week, and 4 or more times a week. Those responses were recoded to 0, 1, 3, 10, and 16 to represent a monthly count of drinking occasions. The responses to the quantity item (“How many drinks containing alcohol do you have on a typical day when you are drinking?”) included 1 or 2, 3 or 4, 5 or 6, 7 to 9, and 10 or more. Those responses were recoded to 1.5, 3.5, 5.5, 8, and 10, respectively. The recoded frequency and quantity values were multiplied resulting in a young adult AFQ measure of drinks per month; scores ranged from 0–160.

2.3.3. Alcohol misuse—Measures of alcohol misuse were included in each survey. In the Adolescent Survey, 10 items quantifying negative consequences from drinking alcohol comprised this measure. Participants were asked how many times in the past year they got drunk, drank more than planned, got sick, got into trouble with friends, got into trouble with their parents, got into trouble at school or work, got into trouble with the police, had a friend of the same sex complain about their drinking, or had a friend of the opposite sex complain about their drinking. Responses were on a four-point scale ranging from “Never” (0) to “Three or more times” (3), and were summed to create the adolescent alcohol misuse measure. This measure provides an estimate of the number of alcohol misuse incidents in the previous year (Shope et al., 1994); scores ranged from 0–30.

On the Young Adult Survey a six-item measure of Alcohol Misuse (adapted from Donovan, 1993) was used to quantify negative consequences from alcohol use. Participants were asked how many times in the past year they experienced a hangover, got sick, had trouble with a close friend or spouse, had trouble at work, had trouble with the police, or had any accidents. Responses were on a six-point scale and included “Never,” “Once,” “2–3 Times,” “4–5 Times,” “6–9 Times,” and “10+ Times.” These items were included in the Young Adult Survey to allow creation of an alcohol misuse measure comparable to the adolescent alcohol misuse measure, but with items adjusted slightly to be age appropriate. Responses were recoded to 0 (“Never”), 1 (“Once”), 2 (“2–3 Times”), and 3 (“4–5 Times” and higher) for greater consistency with the Adolescent Survey scale, and then summed to create an estimate of the number of alcohol misuse incidents in the previous year; scores ranged from 0–18.

2.3.4. Risky driving—State driving records were used to create four measures of risky driving: risky offenses, alcohol offenses, crashes, and alcohol crashes. Risky offenses were intended to capture deliberate risk-taking behavior and included the following: felonious driving, negligent homicide, manslaughter, murder, fleeing and eluding police, reckless driving, careless driving, drag racing, turfing, excessive speeding (15+ miles per hour over the speed limit), failure to stop when indicated, and improper passing. Conviction on any of those offenses resulted in assignment of three to six points on the driver’s record, which reflects the offense severity intended for this measure. Alcohol offenses were specific citations for operating a motor vehicle under the influence of alcohol. For all offenses, the original offense charged, rather than the final convicted offense, was used to ensure that offenses measured driving behavior and not the effect of legal strategy (i.e. plea bargains, reduced charges). Crashes were intended to capture crashes resulting from risky driving behavior and included at-fault (the driver was issued a traffic ticket) and single vehicle crashes. Alcohol crashes were

determined by the code “had been drinking,” which was in the driving record based on information provided in the crash report filed by the investigating police officer.

The project driving data contain records from when participants were approximately age 16 to age 30 (16.4 ± 0.9 to 30.4 ± 0.7 ; average length of licensure 14.0 ± 1.0 years). Risky offenses, alcohol offenses, crashes, and alcohol crashes were examined within three age periods: under age 21; ages 21–25; and from age 26 on. This distribution allowed investigators to compare risky driving among onset groups during distinctive periods (i.e., under age 21 when participants were new drivers, at their highest crash risk, legally not allowed to drink alcohol, and at high risk for alcohol-related harm; age 21–25 when participants were in early young adulthood and legally allowed to drink alcohol but still at high crash and alcohol-related harm risk; and age 26+ when participants had entered later young adulthood, a time when crash and alcohol-related harm risk decline but are still higher than older age groups). For these analyses, the driving measures were binary (0=no and 1=yes), recording the absence or presence of the respective risky driving event in the participants’ driving records during that age period.

2.3.5. Demographic items—Several items from the Young Adult Survey were used to compare demographic characteristics of the Drinking Onset groups including sex, race (white, black, hispanic, other), education level (less than HS diploma, HS/tech graduate, post HS education [some college, college degree, post-graduate education/degree]), and marital status (married, formerly married [separated, divorced, widowed], never married).

2.4. Data analysis

The school-based Adolescent Surveys were administered to all eligible students present on the survey dates, regardless of the number of previous Adolescent Surveys they had completed, allowing for continuous enrollment. Therefore, participants had different numbers of completed Adolescent Surveys and the surveys were completed in various combinations of Adolescent Survey dates. Participants with sufficient completed surveys to identify drinking onset ($n=1,738$) were assigned to a drinking onset category and were included in the analyses. Because onset of drinking is a key component of these analyses, only those participants with enough Adolescent Survey data to determine drinking onset were included in the analyses.

Differences between participants included ($n=1,738$) and excluded ($n=1,418$) from the analyses were compared for young adult demographics, young adult alcohol measures, and driving measures from all age periods using chi-square analysis, t-tests, and log-binomial regression. Included and excluded participants did not differ by sex, race, young adult survey age, marital status, education attainment, alcohol use, alcohol misuse, risky driving offenses during any age period, alcohol offenses during any age period, crashes before age 21, crashes from age 26 on, or alcohol crashes during any age period. Participants included in the analyses, however, were 1.3 times (95% CI 1.1–1.6) more likely to have had a crash from age 21–25.

All analyses were completed using SAS Release 9.1 (SAS Institute, Cary, NC). Chi-square analyses were performed to examine the relationship between Drinking Onset category and the demographic items. Measures from the Grade 10 Fall and Grade 10 Spring surveys were averaged to create overall Grade 10 scores. Differences in alcohol use and alcohol misuse between drinking onset groups were examined with analysis of variance (ANOVA) performed using PROC GLM in SAS. A log-binomial regression model, using PROC GENMOD in SAS, was used to compare drinking onset and the likelihood of having a risky offense, alcohol offense, crash, or alcohol crash during each of the three age periods. Risk ratios and 95% confidence intervals were calculated to compare the likelihood of each risky driving event by drinking onset. Log-binomial regression models were run for each drinking onset group relative to those who started drinking later or were non-drinkers (i.e., earliest onset relative to all other groups; Grade 10 onset relative to Grade 12 onset, young adult onset, and non-drinkers; Grade

12 onset relative to young adult onset and non-drinkers; young adult onset relative to non-drinkers).

Several subject characteristics including sex, race, education attainment, young adult marital status, and the age at which participants received their first drivers license were considered to determine if it was necessary to control for these characteristics in the log-binomial regression model. Sex and education attainment were the only measures significantly related to drinking onset group and the risky driving measures. Therefore, the regression analyses were controlled for sex and education attainment.

The two lowest education levels (less than HS diploma, HS graduate) were similarly related to the risky driving outcomes and both were different from the third education level (post HS education). Therefore, before entry in the log-binomial regression model, education level was collapsed into two groups: (a) less than HS diploma or HS graduate; and (b) Post HS education. Significance was set at $p < 0.05$ for all statistical tests.

Some participants ($n=298$) moved from Michigan during the study and their driving record ended before the study ended. Their ages ranged from 24 – 30 when their driving record ended. Because the exact date participants left the state could not be determined from the driving record, participants were excluded from the analyses for an age period if they had an incomplete driving record for that age period: no participants were excluded from analyses of the under age 21 period; 131 participants were excluded from analyses of the 21–25 age period; and 298 participants were excluded from the age 26+ period. When compared to participants with complete driving records, those who were lost to follow-up were more likely to be female ($df=1$, $X^2=98.3$, $p<0.0001$), to have been unmarried at the young adult survey ($df=2$, $X^2=14.1$, $p=0.0009$), and to have completed at least some education after high school ($df=2$, $X^2=17.0$, $p=0.0002$). They were less likely to have had a risky driving offense ($OR=0.60$, 95% CI .45–.80) or a crash ($OR=0.70$, 95% CI .51–.97) before age 21. For comparison purposes the analyses were also run with those participants included and neither the results nor the conclusions drawn from these analyses differed from that reported herein.

3. Results

3.1. Drinking onset groups

Drinking was defined as having an alcoholic drink on at least three occasions in the past year. Ninety percent of those included in the analyses reported drinking on at least one of the Adolescent Surveys. The largest percentage (58%) reported drinking on one of the 5th – 8th grade surveys and were placed in the earliest Drinking Onset group ($n=1,017$). Twenty-four percent first reported drinking on the 10th grade survey ($n=426$). Seven percent first reported drinking on the 12th grade survey ($n=126$). Four percent first reported drinking on the young adult survey and were placed in the school non-drinker group ($n=69$). Six percent were non-drinkers on every survey ($n=100$) and were placed in the non-drinker group.

Demographic characteristics of the Drinking Onset groups are presented in Table 2. The distribution across Drinking Onset groups differed significantly by sex ($df=4$, $X^2=24.1$, $p<0.0001$), race ($df=12$, $X^2=169.4$, $p<0.0001$), and education attainment ($df=8$, $X^2=48.3$, $p<0.0001$). The difference between men and women was mainly in the first two Drinking Onset groups: 63% of men were in the earliest and 19% were in the Grade 10 onset group; 55% of women were in the earliest and 29% were in the Grade 10 onset group. White participants and those not completing some education beyond high school were overrepresented in the earliest Drinking Onset group. There were no differences between Drinking Onset groups on their age at the young adult survey.

3.2. Alcohol use

Mean Alcohol Frequency–Quantity (AFQ) values and t-test/ANOVA results from comparisons across Drinking Onset groups are presented in Table 3. Post hoc comparisons via Tukeys HSD revealed that the differences were primarily between participants who started drinking earliest and the groups with later drinking onset. Those who started drinking earliest reported a higher AFQ over time persisting into young adulthood.

3.3. Alcohol misuse

Mean Alcohol Misuse values and t-test/ANOVA results from comparisons across Drinking Onset groups are presented in Table 3. Post hoc comparisons via Tukeys HSD revealed that those who started drinking earliest reported more alcohol misuse than all of the other Drinking Onset groups over time and that the difference remained in young adulthood.

3.4. Risky driving offenses

About half the participants (48%) had at least one risky offense in their driving history. The participants committed 1,534 risky offenses during the period studied (from approximately age 16 to age 30). Fifty percent of those offenses occurred before age 21; 33% occurred between age 21–25; and 17% of the risky offenses occurred from age 26 on. The distribution of participants with risky offenses in each age period by Drinking Onset is presented in Fig. 1a. The earliest Drinking Onset group was 1.2 times more likely than all other groups to have a risky offense before age 21 (95% CI 1.1, 1.4). Those with Grade 10 onset were 1.4 times more likely than those who started drinking later or were non-drinkers to have a risky offense before age 21 (95% CI 1.1, 1.9). There were no significant differences in the likelihood of having a risky offense during the older age period for any drinking onset group. The most common risky offenses committed involved speeding and careless driving. There were no differences among groups during any of the three time periods in the type of risky offense committed.

3.5. Alcohol offenses

Non-drinkers were included in this analysis because it was possible that they had alcohol-related events in their driving records despite not reporting drinking on the surveys. Eleven percent of the participants had at least one alcohol offense in their driving history. The participants committed 272 alcohol offenses from approximately age 16 to age 30. Thirty percent of the alcohol offenses occurred before age 21; 45% were between age 21–25; and 25% occurred from age 26 on. The distribution of participants with alcohol offenses in each age period by Drinking Onset is presented in Fig. 1b. The earliest Drinking Onset group was 2.2 times more likely than all other groups to have an alcohol offense before age 21 (95% CI 1.2, 3.9), 1.6 times more likely to have an alcohol offense between age 21–25 (95% CI 1.0, 2.4), and 2.8 times more likely to have an alcohol offense from age 26 on (95% CI 1.5, 5.3). Those with Grade 10 onset were 3.3 times more likely than those who started drinking later or were non-drinkers to have an alcohol offense between age 21–25 (95% CI 1.3, 8.6).

3.6. Crashes

Forty percent of the participants had at least one crash in their driving history. The participants were involved in 976 crashes during the period examined. Fifty percent of the crashes occurred before age 21; 33% were between age 21–25; and 17% occurred when the participants were age 26 on. The distribution of participants with crashes in each age period by Drinking Onset is presented in Fig. 1c. Differences in the likelihood of crash by drinking onset did not reach significance during any age period.

3.7. Alcohol crash

Three percent of the participants had at least one alcohol-related crash in their driving history. The participants were involved in 64 alcohol crashes during the period examined. Thirty-nine percent of the alcohol crashes occurred before the age of 21; 39% were between the ages of 21 and 25; and 22% occurred when the participants were 26 and older. The distribution of participants with alcohol crashes in each age period by Drinking Onset is presented in Fig. 1d. Differences in the likelihood of an alcohol crash by drinking onset did not reach significance during any age period. All the alcohol crashes observed, however, were in the driving records of participants who reported drinking earliest, by Grade 10, or by Grade 12.

4. Discussion

Fifty-eight percent of the participants had the earliest drinking onset, by Grade 7/8. Those who started drinking earliest reported significantly higher alcohol use and misuse over time. Those who started drinking earliest and those who started drinking by the 10th grade, were more likely to commit risky driving offenses before age 21. The earliest drinkers were also more likely to commit alcohol-related driving offenses before age 21. Further, the earliest drinkers continued to be more likely to commit alcohol-related driving offenses between age 21–25 and from age 26 on. Tenth grade initiators were also more likely to commit alcohol-related driving offenses between age 21–25 compared to later initiators and nondrinkers. There were no significant differences in the likelihood of crashes or alcohol-related crashes among Drinking Onset groups, however, all of the alcohol crashes were experienced in the records of participants who had started drinking by the end of high school.

Ninety percent of the participants had started drinking by the end of high school. This percentage and the 58% who were the earliest initiators are consistent with the 12th grade and 8th grade rates of lifetime consumption of an alcoholic drink from Monitoring the Future for the same years as these Adolescent Surveys (Johnston, O'Malley, Bachman, & Schulenberg, 2005). In the current study, however, underage drinking was defined as having a drink on three or more occasions in the past year. When examining drinking behavior among the underage drinkers, those who started drinking by Grade 7/8, the earliest drinkers, stood apart from the rest. Even as groups with later drinking onset started drinking, the earliest Drinking Onset group still reported on each survey more alcohol use than those with later initiation. A similar pattern was found for alcohol misuse. Again, even as later groups started drinking and alcohol use increased for all groups, those who started drinking earliest reported at each survey more alcohol misuse than the other groups.

Risky driving was assessed by examining offenses and crashes that were recorded in the participants' state driving records. As expected, all participants committed the highest percentage of risky offenses and were involved in the highest percentage of crashes before age 21. The increased likelihood of alcohol-related offenses for the earliest drinking initiators is consistent with other work using self-reported alcohol offenses (Ellickson et al., 2003; Hingson et al., 2002) and alcohol offenses from driving records (Riala et al., 2004), and expands on those findings by also demonstrating the increased likelihood of committing general risky offenses (not limited to alcohol offenses) for early drinking initiators. Further, by examining driving events in distinct age periods, we were able to show how group comparisons of the likelihood of offenses and crashes varied over time. The overall distribution of offenses and crashes across the age periods showed that the period before age 21 was particularly risky for all participants. This was not surprising, but these analyses further demonstrated that early drinking initiators are at especially high risk during the period before age 21, with an increased likelihood of risky offenses and alcohol offenses for those who initiated by Grade 7/8 and of risky offenses for those who initiated by Grade 10. For these early initiators, the increased driving risk persisted into young adulthood, with greater likelihood of alcohol-related driving

offenses from age 21 on for the earliest initiators and between age 21–25 for those who initiated by Grade 10. Clearly, injury prevention efforts for these groups of early drinkers are needed in adolescence and beyond, well into young adulthood.

The strongest association between age of drinking onset and risky driving was found when examining alcohol-related driving offenses. Because 90% of the participants had started drinking by the end of high school, most participants were drinkers for the majority of years when risky driving was examined. Given the higher alcohol use and misuse reported by the earliest drinking initiators, it is not surprising that they were also more likely to commit alcohol driving offenses, as alcohol consumption and alcohol-related problem behaviors such as drinking/driving are highly correlated (Donovan, 1993). The strength of these findings is impressive, however, given that the alcohol offenses represented citations from instances of drinking/driving that were actually caught by law enforcement. It has been found previously that drinking/driving arrest rates likely greatly underestimate actual drinking/driving behavior (Dellinger, Bolen, & Sacks, 1999; Liu et al., 1997).

There were no significant differences between Drinking Onset groups in the likelihood of having a crash. Most (50%) of the crash involvement occurred before age 21. Crash involvement among young drivers is not just attributed to risky driving behaviors but also to their young age and relatively inexperienced driving skills. It is possible that a binary outcome variable, indicating only crash involvement/non-involvement, does not fully allow differences in crashes to be detected.

The findings reported here should be considered within the context of several limitations. The measures related to alcohol consumption are based upon self-report survey data. While self-report data have generally been found to be a reliable and valid approach for obtaining information regarding alcohol-related behaviors when respondents are assured of their confidentiality, the findings may underestimate the actual involvement of the respondents in these behaviors, particularly among heavy drinkers (Dufour, 2001).

A further limitation is that other factors contributing to either drinking onset or the subsequent outcomes were not accounted for in these analyses. The association found in these analyses might be reflecting common factors contributing to both drinking onset and the outcomes, such as family history of drinking, social controls, or self efficacy (USDHHS, 2000). Similar items were measured by the study's questionnaires and will be examined in future analyses of the age of drinking onset with these data, as the striking difference between the earliest Drinking Onset group and all others suggests that factors other than just the age when drinking was initiated were involved. Future analyses also need to examine the role of gender in these findings. For instance, as shown in Table 2, important periods for drinking initiation varied between boys and girls.

One considerable strength of these analyses is the use of longitudinal data. Only group means of alcohol-related measures and risk ratios of risky driving events, however, were analyzed. Examining individual's alcohol use and risky driving trajectories from drinking initiation through the young adult survey (or even beyond with longer follow-up into young adulthood) would be more informative, particularly among the earliest initiators, and would likely yield additional useful findings for planning interventions. As others have suggested, the age of drinking onset itself may not be as significant as the patterns of drinking that emerge from that point forward (Guo et al., 2000; Labouvie, Bates, & Pandina, 1997). While this work provides insight into changes in drinking and related risky behaviors from adolescence into young adulthood, it does not address why adolescents begin drinking at such young ages. Greater understanding of the motivation behind underage drinking is essential to developing effective programs to delay this behavior and reap the protective benefits of less alcohol use.

5. Conclusions

These findings demonstrate once again how common it is for teens to begin drinking under the legal age. They also show a relationship between earlier initiation of underage drinking and a sustained higher level of drinking and alcohol misuse when compared to peers who do not drink at such a young age. The findings also demonstrate that those who start drinking younger are more likely to put themselves and others in danger by their risky driving behavior, some of which continues well into adulthood. The risks young drivers face behind the wheel are already high and these findings suggest that a longer history of alcohol use further increases those risks even when alcohol is not involved in the specific driving situation. The combination of underage drinking and teen driving occurring during this developmental period greatly increases risks to teens and has far-reaching negative effects. Injury prevention efforts for early drinkers need to be sustained from adolescence into young adulthood and should not be limited to alcohol risk-taking but include related behaviors such as risky driving.

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Fig. 1.
a–d percentage with risky driving offenses, alcohol offenses, crashes, and alcohol crashes by age period and drinking onset.

Table 1

Survey administration

HS Graduation Year	Spring Grade 5	Spring Grade 6	Spring Grade 7	Spring Grade 8	Fall Grade 10	Spring Grade 10	Spring Grade 12	Young Adult
1991		*	*	*	*	*	*	*
1992		*	*		*	*	*	*
Mean Age	11.0±.4	12.0±.4	13.1±.4	14.1±.4	15.7±.5	16.1±.5	17.9±.5	23.9±.8

* Survey administered.

Table 2

Distribution of demographic characteristics as of young adulthood by drinking onset group (N=1,738)

	Earliest Onset	Grade 10 Onset	Grade 12 Onset	School Non-Drinker	Non-Drinker
Sex *					
Male	513	156	61	35	50
Female	504	270	65	34	50
Race *					
White	904	352	101	55	48
Black	42	34	8	4	9
Hispanic	14	12	4	2	4
Other	47	25	12	8	37
Missing*	10	3	1	0	2
Education*					
Less than HS diploma	69	9	4	1	0
HS graduate	254	80	22	9	11
Post HS education	694	337	100	59	89
Marital status					
Married	254	95	27	12	36
Formerly married	33	8	5	1	3
Never married	728	322	94	56	61
Missing	2	1	0	0	0
Total	1017	426	126	69	100

* p<0.0001.

Table 3
Means (and Standard Deviations) of alcohol use and alcohol misuse by onset group

	Earliest Onset (n=1,017)	Grade 10 Onset (n=426)	Grade 12 Onset (n=126)	School Non-Drinker (n=69)	Non-Drinker (n=100)	ANOVA/ t-test (F/ t)
Grade 5/6						
Alcohol Use	1.4 (6.6)	na	na	na	na	—
Alcohol Misuse	1.3 (2.6)	na	na	na	na	—
Grade 6/7						
Alcohol Use	3.0 (13.6)	na	na	na	na	—
Alcohol Misuse	1.6 (2.8)	na	na	na	na	—
Grade 7/8						
Alcohol Use	6.3 (25.1)	na	na	na	na	—
Alcohol Misuse	2.8 (4.0)	na	na	na	na	—
Grade 10						
Alcohol Use	13.8 (36.6)	6.6 (22.6)	na	na	na	4.07 ^b
Alcohol Misuse	4.4 (4.9)	2.6 (3.7)	na	na	na	6.86 ^b
Grade 12						
Alcohol Use	20.0 (37.6)	11.6 (27.1)	10.7 (26.7)	na	na	6.91 ^c
Alcohol Misuse	5.6 (5.1)	4.2 (5.2)	3.4 (4.8)	na	na	12.53 ^b
Young Adult						
Alcohol Use ^a	15.7 (21.5)	10.7 (15.1)	11.4 (21.3)	6.7 (9.6)	na	10.28 ^b
Alcohol Misuse ^a	2.4 (2.4)	1.8 (2.1)	1.8 (2.1)	1.4 (2.4)	na	11.30 ^b

^aYoung adult alcohol use and alcohol misuse items differed from similar items on school surveys.

^bp<0.0001.

^cp<0.01.

na Had not used alcohol.