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Reassessing the Effects of Early Adolescent Alcohol Use on Later Antisocial Behavior: A Longitudinal Study of Students in Victoria, Australia and Washington State, United States

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Abstract

The effect of early adolescent alcohol use on antisocial behavior was examined at one- and two-year follow-up in Washington, United States and Victoria, Australia. Each state used the same methods to survey statewide representative samples of students (N = 1,858, 52% female) in 2002 (Grade 7 [G7]), 2003 (Grade 8 [G8]), and 2004 (Grade 9 [G9]). Rates of lifetime, current, frequent, and heavy episodic alcohol use were higher in Victoria than Washington State, whereas rates of five antisocial behaviors were generally comparable across states. After controlling for established risk factors, few associations between alcohol use and antisocial behavior remained, except that G7 current use predicted G8 police arrests and stealing and G9 carrying a weapon and stealing; G7 heavy episodic use predicted G8 and G9 police arrests; and G7 lifetime use predicted G9 carrying a weapon. Hence, risk factors other than alcohol were stronger predictors of antisocial behaviors.

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Keywords

adolescence; alcohol use; longitudinal; cross-national; antisocial behavior

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Adolescent alcohol use has long been associated with engagement in non-violent and violent antisocial behaviors (Clark et al., 1997; Raskin White, Tice, Loeber, & Stouthamer-Loeber, 2002; Waldman & Slutske, 2000). Adolescent antisocial behavior, defined as any behavior that violates societal rules and conventions or personal rights (Kazdin, 1987), includes behaviors such as violence, stealing, and weapon carrying. Antisocial behavior is prevalent in Western societies such as Australia and the United States (US) ranging from 5% to 17% depending on the criteria used (Costello, Mustillo, Erklanli, Keeler, & Angold, 2003; Sawyer et al., 2001). Using a similar measure of antisocial behavior to that reported in this paper, Hemphill et al (2006) found rates of around 18% for Grade 7 and 9 boys and around 11% for girls in Victoria and Washington State, with no state differences in these rates. Further, antisocial behavior rises in prevalence through adolescence, with peak incidence in mid-to-late adolescence (Baker, 1998; Bond, Thomas, Toumbourou, Patton, & Catalano, 2000; Rutter & Giller, 1983). Such behavior is costly to the community, impacting individuals through physical damage to people and property, as well as society at large through increased costs of interventions and the criminal justice system (Hemphill, 1996).

Associations between adolescent alcohol use and later antisocial behavior

Associations between alcohol use and later antisocial behavior have been found in large prospective studies following mid-late adolescents into early adulthood to investigate multiple outcomes (e.g. Bates & Labouvie, 1997; Hill, White, Chung, Hawkins, & Catalano, 2000; Rhode, Lewinsohn, Kahler, Seeley, & Brown, 2001), with antisocial behavior included in some of these studies as one component of a composite risk score (Bates & Labouvie, 1997). Adolescent alcohol use is also associated with antisocial behaviors (particularly physical fighting) in young adulthood, in retrospective self-report studies (Hingson, Edwards, Heeren, & Rosenbloom, 2009; Hingson, Heeren, & Zakocs, 2001).

However, not all studies have detected relationships between adolescent alcohol use and later antisocial behaviors. For instance, Hill and colleagues (2000) reported that both early-onset adolescent heavy episodic drinking and late-onset adolescent heavy episodic drinking did not predict engagement in crime (e.g. assault, stealing, threatening behaviors) in young adulthood, in analyses adjusted for multiple covariates (including demographics, childhood and substance use measures). Young and colleagues (2008) also found no longitudinal association between alcohol use and antisocial behavior from ages 11 to 15; however, they did find modest cross-sectional relationships. Further prospective research on early adolescent alcohol use and later antisocial behaviors that accounts for relevant covariates is warranted. The current paper seeks to address these issues.

Potential explanations for links between alcohol use and later antisocial behavior

Alcohol use appears to be a potential trigger for adolescent antisocial behavior, although it is unclear why. There are a number of possible explanations, however the end results tend to be similar – in that behavioral inhibitions are compromised (Young, et al., 2008). For example, one possibility is that alcohol use reduces inhibitions that would otherwise keep an adolescent from engaging in problem behaviors (Bushman & Cooper, 1990). Another possibility is that chronic alcohol use or misuse damages areas of the brain that are responsible for memory, learning and executive functions (Howard, 2006; Tapert, Caldwell, & Burke, 2005). As a result, cognitive control and inhibitory functions are impaired, leading to an inability to control inappropriate and impulsive aggressive behavior (Giancola, 2000). Further, chronic excessive alcohol use may negatively impact an individual's ability to carry on successful relationships with parents and peers, education and employment problems, and affiliation with deviant peers (Brook, Cohen, & Brook, 1998), which may in turn be associated with later antisocial behavior. There is some evidence that individuals who engage in antisocial behavior, use alcohol more excessively than do others (Young, et al., 2008), suggesting that antisocial behavior may precede, not follow from, the use of alcohol. This relationship could arise through shared genetic factors for antisocial behavior and alcohol use (Clark, Vanyukov, & Cornelius, 2002; Stallings et al., 2005), or through shared risk factors such as association with antisocial, substance using peers (Barnow, Schuckit, & Lucht, 2002).

Risk factors for antisocial behavior

Risk factors for adolescent problem behaviors have been organized into the socialization domains of family, peer group, school and community, as well as individual risk factors (Catalano, Haggerty, Hawkins, & Elgin, 2011). *Risk factors* are factors which increase the probability of adverse health and behavioral outcomes (Catalano, et al., 2011; National Crime Prevention, 1999; Pollard, Hawkins, & Arthur, 1999). Amongst the common individual risk factors for antisocial behavior are student attitudes that are favorable to antisocial behavior and rebelliousness (Hawkins et al., 2000; Herrenkohl et al., 2000). Another well-established risk factor is interaction with antisocial peers (Hawkins, et al., 2000; Hemphill et al., 2009; Herrenkohl, et al., 2000). Adolescents who interact with other peers who engage in antisocial behavior are more likely to engage in antisocial behavior themselves (e.g. Hemphill, et al., 2009). This association is consistent with peer deviancy training whereby a group of adolescents already engaging in antisocial behavior who interact together can develop a culture that reinforces antisocial behavior by group members (Dishion & Piehler, 2007; Dodge, Dishion, & Lansford, 2006). Family risk factors for antisocial behavior include family history of antisocial behavior, poor family management practices, and family conflict (Hawkins, et al., 2000; Herrenkohl, et al., 2000). Living in a neighborhood where there is crime and abandoned buildings increases the likelihood of adolescents engaging in antisocial behavior (Hawkins, et al., 2000; Herrenkohl, et al., 2000). In the current paper, the links between early alcohol use and mid-adolescent antisocial

behavior will be examined after controlling for these established risk factors for antisocial behavior.

The current paper

Given inconsistent findings in the literature, further research on the longitudinal relationships between early adolescent drinking and later adolescent antisocial behavior is needed (Hingson, et al., 2009; Hingson, et al., 2001; Loeber, Burke, & Pardini, 2009; Maughan, Pickles, Rowe, Costello, & Angold, 2000). In the current paper, the longitudinal effects of adolescent alcohol use on antisocial behavior will be examined using a cross-national sample of students living in the state of Victoria in Australia and Washington State in the United States. Cross-national studies of this type can make an important contribution to the understanding of the effects of adolescent alcohol use. Specifically, they can highlight differences in alcohol use trends and predictors, and can investigate differences between the country's policy approaches. Comparison between the US and Australia is of interest given the differences in the policies addressing alcohol and substance use in these countries (Toumbourou, Hemphill, McMorris, Catalano, & Patton, 2009). While the US adopts a use-reduction and abstinence-based approach with zero tolerance, Australian policies reflect a harm-reduction approach focused on remediation rather than ostracization (Toumbourou, et al., 2009).

Consistent with the differences in substance use policies, there are also differences in the ways that antisocial behavior is managed. For example, in Victorian government schools the emphasis is on ensuring that disciplinary actions do not negatively impact on students' studies and suspension from school is not usually implemented unless other disciplinary measures have been unsuccessful (Directorate of School Education, 1994). The emphasis is on discipline rather than punishment. Strategies used include the withdrawal of privileges as a logical consequence of problem behavior, temporary removal from the classroom ('timeout'), detention during recess breaks or after school, and discipline meetings of school staff and parents to define the issues, set goals, and agree on tasks and responsibilities (Directorate of School Education, 1994). In contrast, a zero tolerance approach (e.g., school suspension or expulsion) toward preventing school violence characterizes Washington State (consistent with other areas of the US) (Casella, 2003). For example, although the Gun-Free Schools Act originally mandated that students bringing a gun to school would be expelled for at least one year, amendments to the legislation have extended the Act to cover a broader range of weapons (Casella, 2003). Given these differences, it might be expected that links between alcohol use and antisocial behavior would not be as strong in Victoria where alcohol use is more tolerated, whereas stronger links between these "deviant" behaviors might be expected in Washington State.

Thus, cross-national studies of the kind reported here may provide information on the impact of these varied policy approaches on alcohol and substance use, and related factors such as antisocial behaviors. Previous research on the risk and protective factors (excluding substance use) predictive of antisocial behavior at 12-month follow-up has shown that the predictors are similar in the two states (Hemphill, et al., 2006). This paper draws on data from the International Youth Development Study (IYDS) to examine the prospective effects

of early adolescent (Grade 7) alcohol use on Grade 8 and 9 antisocial behavior and police arrests, after taking into account established risk factors for antisocial behavior. In this study, it is hypothesized first that current and frequent drinking in Grade 7 will be associated with antisocial behaviors and police arrests in Grade 8 and Grade 9. Second, consistent with the majority of research studies to date, the associations between Grade 7 current and frequent alcohol use and later antisocial behaviors and arrests will remain after controlling for established risk factors and demographic factors including state. It is expected that even though the rates of alcohol use differ, in line with the findings of Hemphill and colleagues (2006), the associations between early alcohol use and later antisocial behavior will be similar in Victoria and Washington State.

Method

Ethics approval

Ethics approval for this study was obtained from The University of Washington Human Subjects Review Committee in the US and the Royal Children's Hospital Ethics in Human Research Committee in Victoria. In Washington State, relevant school districts provided permission to conduct the study in schools. Permission to conduct the study in Victoria was provided by the Department of Education and Training for government schools, and the Catholic Education Office for some private schools. In both states, permission to conduct the study in each school was provided by the school principal.

Participants

Participants in this study were seventh grade students enrolled in the IYDS and resurveyed in Grade 8 and 9. The IYDS utilizes standardized methodologies in Washington State, US and Victoria, Australia. The study employed a two-stage cluster sampling approach in Grade 7 in 2002. A probability proportionate to grade-level size sampling procedure (Kish, 1965) was used to randomly select public and private schools containing students in fifth, seventh and ninth grades across both states. At the second stage, a target classroom within each school was randomly selected.

Parents provided written consent for all participating students prior to the first survey in Grade 7, and students provided their assent to participate on the day of the survey. For Grade 7 students, classes in Washington State yielded a total of 1,226 eligible students, of whom 961 (78.4%) consented to and participated in the survey. In Victoria, 1,301 Grade 7 students were eligible for consent and survey administration, of whom 984 (75.6%) consented and participated. Further details on student recruitment procedures and participation rates have been published previously (McMorris, Hemphill, Toumbourou, Catalano, & Patton, 2007). In both Grade 8 and 9, retention rates were 98% or above in both states.

In each state, the Grade 7 cohort was composed almost entirely of 12- and 13-year-olds (Victoria $M = 12.9$, $SD = 0.4$; Washington $M = 13.1$, $SD = 0.4$). Males and females are equally represented in each cohort. In terms of ethnicity, 65% of students in Washington State described themselves as White, 16% as Hispanic, 6% as Asian/Pacific Islander, 6% as

Native American, 4% as African American, and 3% reported belonging to other ethnic groups. In Victoria, the majority of students described themselves as Australian (91%), 6% as Asian/Pacific Islander, 1% as Aboriginal or Torres Strait Islander, less than 1% each as African or Spanish, and 1% reported belonging to other ethnic groups.

Procedure

Surveys were first administered in Grade 7 and repeated in Grade 8 and Grade 9. Each year survey administration occurred over the period from February to June in Washington State and May to November in Victoria to ensure seasonal equivalence. A single survey administration protocol was used by trained survey staff across both states. Surveys were administered to students within the classroom setting and took approximately 50–60 minutes to complete. If students were absent on the day of the survey, trained school personnel administered and supervised the survey at a later date. Surveys were administered over the telephone by survey staff in a small percentage of cases where the students no longer attended the school (less than 3% in Grade 7, less than 4% in Grade 8, and 2% in Grade 9). After return of their consent forms in 2002, students in Victoria received a small pocket calculator. Victorian students received a stress ball and a highlighter following survey completion in Grade 8 and Grade 9 respectively. Washington State students received $10 at the completion of each survey.

Instruments

Risk factors, alcohol use and antisocial behavior measures for the current study were drawn from The Communities That Care (CTC) self-report youth survey (Arthur, Hawkins, Pollard, Catalano, & Baglioni, 2002; Glaser, Lee Van Horn, Arthur, Hawkins, & Catalano, 2005; Pollard, et al., 1999). The survey has been successfully adapted for use in Victorian schools (Bond, Toumbourou, Thomas, Catalano, & Patton, 2005), and has demonstrated adequate reliability and cross-sectional validity with large samples of US students in Grades 6–12 (Arthur, et al., 2002; Glaser, et al., 2005; Pollard, et al., 1999) as well as reliability and longitudinal validity in the IYDS sample (Hemphill et al., 2011). Table 1 presents the summary statistics and alpha coefficients for the alcohol use, antisocial behaviors, and risk factors utilized in the analyses for this study.

Alcohol use in Grade 7—Participant level of alcohol consumption was measured using four items. Lifetime alcohol use was measured by asking participants "In your lifetime on how many occasions (if any) have you: Had alcoholic beverages (like beer, wine or liquor/ spirits) to drink – more than just a few sips?". The item "In the past 30 days on how many occasions (if any) have you: Had more than just a few sips of an alcoholic beverage (like beer, wine or liquor/spirits)?" was used to measure current alcohol use. Participants responded to these items using an 8-point rating scale ranging from *Not at all* to *40 or more times*. Due to the skewed distributions on these variables, scores were recoded to form a dichotomous measure, *never or no use* (0) and *responses other than never or none* (1).

Heavy episodic drinking was assessed using the item "Think back over the last 2 weeks, how many times have you had five or more drinks in a row?" on a 6-point rating scale ranging from *None* to *10 or more times*. Given the skewed distribution for heavy episodic

drinking, scores were dichotomised to *no heavy episodic drinking* (0) and *any heavy episodic drinking* (1). To construct a measure for frequent alcohol use using the measure for current alcohol use, scores were recoded to form a dichotomous measure, *no or less than 3 drinks* (0) and *3 or more drinks* (1) in the past month.

Antisocial behavior in Grade 8 and 9—There were five different measures of antisocial outcomes each of which related to behavior in the past 12 months; these behaviors included carrying a weapon, threatening someone with a weapon, having been arrested, and stealing something worth more than $US5/$AUS10. Two items were used to examine violent behavior; beating up someone so badly that they probably needed to see a doctor or nurse, and attacking someone with the idea of seriously hurting someone ($r = 0.31$). All antisocial behavior items were rated on an 8-point scale, ranging from *never* (1) to *40 or more times* (8). Due to the skewed distribution of data on these variables, scores were recoded to form dichotomous measures, *never engaged in antisocial behavior* (0) and *engaged in antisocial behavior once or more* (1).

Risk factors in Grade 7—In this paper, the risk factors measured in Grade 7 for inclusion in the adjusted analyses were those within peer/individual, family, and community domains. Three scales examined peer/individual factors. Interaction with antisocial peers was measured using eight items such as, "In the past year how many of your best friends have been suspended from school?", each rated on a five-point rating scale ranging from *None of my friends* (0) to *4 of my friends* (4). Five items measured favorable attitudes toward antisocial behavior (e.g., "How wrong do you think it is for someone your age to pick a fight with someone?"). Items were rated on a 4-point scale of *Very wrong* (1) to *Not wrong at all* (4). Rebelliousness was assessed using three items including "I do the opposite of what people tell me, just to get them mad?" Items were rated on four-point scale ranging from *Definitely no* (1) to *Definitely yes* (4).

Family risk factors were measured using three scales. Poor family management was measured using nine items (e.g., "The rules in my family are clear", reverse coded). Family conflict was measured using three items (e.g., "People in my family have serious arguments?"). Items for both poor family management and family conflict were rated on a 4-point rating scale, *Definitely no* (1) to *Definitely yes* (4). Family history of substance use and antisocial behavior was measured using ten items rated on a five-point scale including "Have any of your brothers or sisters been suspended or expelled from school?" and "About how many adults (over 21) have you known personally in the past year who have sold or dealt drugs?".

Community risk factors were measured with one scale assessing community disorganization. This scale comprised five items scored on a 4-point scale ranging from *Definitely no* (1) to *Definitely yes* (4). Items were prefaced by the question "How much do each of the following statements describe your neighborhood" and "lots of empty or abandoned buildings" is an example item.

Student dishonesty—Three criteria were used to categorize students' responses to the survey as dishonest. First, students were asked "How honest were you in filling out this

survey?" with response options of *I was honest all of the time*, *I was honest most of the time*, *I was honest some of the time*, *I was honest once in a while*, and *I was not honest at all*. Students who selected the final option were coded as dishonest. Second, students were asked "In the past 30 days on how many occasions (if any) have you: Used [name of fictional drug]?" and "In your lifetime on how many occasions (if any) have you: Used [name of fictional drug]?" If students answered that they had used the fictional drug one or more times for either of these questions, they were coded as dishonest. Third, student responses were coded dishonest if they reported they had used illicit drugs on more than 120 occasions in the past 30 days. The number of students meeting the dishonesty criteria were low (a total of 17 in Grade 7, 35 in Grade 8, and 27 in Grade 9). All 'dishonest' cases were excluded from the data analyses.

Statistical analyses

Analyses included only participants with complete data on the variables examined in this paper. Data for 1,858 students in seventh grade at the first survey were analyzed in this study using the statistical software STATA IC for Windows (version 10) (StataCorp, 2009). The analyses consisted of seven stages. First, chi-square analyses and independent *t*-tests were conducted to compare frequencies/means of Grade 7 risk factors and alcohol use and Grade 7–9 antisocial behavior in each state. Second, correlation analyses were conducted to examine bivariate associations between Grade 7 measures of alcohol use, Grade 7 risk factors, and antisocial behavior at Grades 8 and 9. The magnitude of associations was examined for multicollinearity. All correlations were below 0.56, and therefore, well below levels suggestive of multicollinearity (Tabachnick & Fidell, 2007).

Third, to examine the bivariate relations between Grade 7 alcohol use and antisocial behavior in Grade 8 and 9, logistic regression analyses were performed with Grade 7 alcohol use predicting each outcome at Grade 8 and 9, controlling for the clustering of students in schools in the combined Victorian and Washington State sample (Unadjusted analyses in Table 2).

The effect of demographic factors was examined in the fourth set of logistic regression analyses. Partially adjusted logistic regression analyses (see Table 2) were conducted investigating Grade 7 alcohol use as a predictor of Grade 8 and 9 antisocial behavior, controlling for age, gender, state, the clustering of students in schools, and Grade 7 antisocial behavior. Next, the effect of risk factors was investigated in the fifth set of logistic regression analyses.

In the sixth step of these analyses, two sets of hierarchical regression analyses were performed in which Grade 7 risk factors were grouped by domain from the most to least proximal influence and hierarchically added into the model in the order of: 1) demographics (age, gender and state); 2) Grade 7 antisocial behavior and the relevant alcohol use measure (lifetime alcohol use, current alcohol use, frequent alcohol use or heavy episodic drinking); 3) peer/individual attitudes favorable to antisocial behavior and rebelliousness, 4) interaction with antisocial peers, 5) parental attitudes favorable to antisocial behavior, poor family management, and family conflict, and 6) community disorganization. Grade 7 demographics, antisocial behavior, risk factors and alcohol use predicted antisocial behavior

in Grade 8 and 9. Both sets of analyses controlled for the clustering of students in schools and were conducted for the combined Victorian and Washington State sample (Fully adjusted in Table 2).

Finally, to examine whether the effect of alcohol use in Grade 7 impacted on antisocial behavior in Grade 8 and 9 differently in each state, a series of logistic regression analyses testing state interactions were conducted. Each Grade 7 risk factor was standardized and multiplied by state (coded 0 and 1). The analyses described in step six were repeated using the standardized variable and state interaction term. Statistically significant interaction terms were retained and added as a final step in the hierarchical logistic regression analyses. The Pseudo R^2 for the models with and without interactions were compared. Across all models the inclusion of the interaction terms resulted in minimal change to the Pseudo R^2 (< 0.02) (Cohen, Cohen, West, & Aiken, 2003). Therefore, the fully adjusted models presented are those which demonstrate a more parsimonious model, that is, without interaction terms, and the results of analyses for the combined Washington State-Victorian sample are reported. A similar process was followed to test interactions between gender and each risk factor. However, as for the interactions between state and each risk factor, the more parsimonious models were the ones without interaction terms included and these are the models presented in this paper.

Results

Descriptive statistics for risk factors, alcohol use and antisocial behavior outcomes

Summary statistics for Grade 7 alcohol use and risk factors, and Grade 7, 8 and 9 antisocial behavior are presented in Table 1. Rates of lifetime, current and frequent alcohol use and heavy episodic drinking are higher in Victorian students relative to students in Washington State in Grade 7. Rates for Victorian boys are at least double those of Washington State boys. Similar results were found for Victorian relative to Washington State girls. For the combined sample, males generally report higher rates of each level of alcohol use. Percentages for antisocial behavior show Washington State students report higher levels of carrying a weapon and police arrests in Grade 7; however Victorian students report higher levels of violent behavior and threatening another person using a weapon in Grade 8 and 9 compared to their Washington State counterparts. Mean values for Grade 7 risk factors show Victorian students report having more favorable attitudes toward antisocial behavior and report higher levels of poor family management relative to students in Washington State. However, greater interaction with antisocial peers is reported by Washington State Grade 7 students. Mean levels of family history of antisocial behavior are greater for Washington State students, and these students perceive their community to be more disorganized than Victorian students.

Longitudinal associations between alcohol use and antisocial behavior

Unadjusted, partially adjusted, and fully adjusted logistic regression models testing longitudinal associations between Grade 7 alcohol use and antisocial behavior in Grade 8 and 9 are presented in Table 2 for the combined Victorian and Washington State sample. Each measure of Grade 7 alcohol use was associated with each of the antisocial behavior

outcomes one year later (Grade 8) in unadjusted and partially adjusted analyses; however only a few of these effects were maintained after controlling for Grade 7 risk factors in the fully adjusted analyses.

The changes in the odds ratio for the effect of Grade 7 alcohol use on Grade 8 antisocial behavior were examined at each step of hierarchically adding risk factor domains (individual, peer, family and community) into the fully adjusted model. This examination sought to identify the step at which the odds ratio became statistically non-significant. The inclusion of individual factors led to current and frequent alcohol use becoming statistically non-significant predictors for all antisocial behaviors, and heavy episodic drinking became a statistically non-significant predictor for carrying a weapon and threatening someone with a weapon. Similarly, the effects of lifetime and current alcohol use on stealing and violent behavior became statistically non-significant with the inclusion of family risk factors. This was also the case for the association between heavy episodic drinking and police arrests. Also, peer risk factors resulted in a statistically non-significant effect of current alcohol use on carrying a weapon, threatening someone with a weapon, and police arrests, and a statistically non-significant effect of heavy episodic drinking for stealing (for full details, contact first author).

After adjustment for all risk factors and demographic variables (Table 2, fully adjusted model), current alcohol use and heavy episodic drinking were associated with two antisocial behaviors. The odds of being arrested by the police were at least doubled for students who reported either current alcohol use or heavy episodic drinking. Further, for students who reported current alcohol consumption the odds of engaging in stealing were doubled.

Similar to the aforementioned analyses, each measure of Grade 7 alcohol use was associated with all antisocial behavior outcomes in Grade 9 in unadjusted analyses. In the partially adjusted analyses controlling for demographic variables, antisocial behavior was predicted by measures of Grade 7 current alcohol use and heavy episodic drinking. Adjustment for individual and peer risk factors in the fully adjusted model reduced associations between Grade 7 alcohol use and Grade 9 antisocial behavior.

The odds ratio change for the prediction of Grade 9 antisocial behavior was examined at each step of hierarchically adding risk factor domains into the fully adjusted model. The inclusion of individual factors resulted in statistically non-significant associations between Grade 7 heavy episodic drinking and Grade 9 antisocial behaviors, carrying a weapon, threatening with a weapon, stealing, and violent behaviors. Additionally, peer risk factors removed the predictive associations between lifetime alcohol use and two antisocial behaviors (police arrests and stealing), and between current alcohol use and threatening with a weapon (for more details, contact the first author).

Only the association between lifetime alcohol use and carrying a weapon maintained statistical significance in the fully adjusted model. Current alcohol use increased the odds of carrying a weapon by one and half times, and doubled the odds of stealing. Likewise the association between heavy episodic drinking and police arrests maintained statistical significance in the fully adjusted model, with the odds of police arrests doubling.

To examine the shared versus unique variance explained in antisocial behavior by prior alcohol use, Pseudo R^2 values for unadjusted analyses investigating associations between alcohol use and antisocial behavior are presented in Table 3. The same table also shows the variance explained in the fully adjusted models when all risk factors including alcohol were added to the models. In general, the unique variance in antisocial behavior explained by alcohol use was small, and considerably lower, than the shared variance estimates for the fully adjusted models.

Discussion

This paper is unique in examining whether early alcohol use predicts antisocial behavior one and two years later using standardized methods to collect and analyze data from two states, Washington State in the US and Victoria, Australia. The results of this study show that there are longitudinal associations between alcohol use measures including lifetime, current and frequent alcohol use as well as heavy episodic drinking, and a range of antisocial behaviors such as carrying a weapon, stealing, and being arrested by police. However, in contradiction of the hypotheses, when analyses controlled for demographics, earlier antisocial behavior, and established risk factors, only a few associations between alcohol use and antisocial behavior remained uniquely significant. Overall, the findings suggest that for the age groups studied in this paper, early adolescent alcohol use was an infrequent and weak unique predictor of many later antisocial behaviors. The risk factors included in these analyses appear to explain the relationship between alcohol use and antisocial behavior. A subsidiary finding of the current study is that although the rates of alcohol use are noticeably higher in Victorian students than in Washington State students, Washington State students had higher rates of some antisocial behaviors, and the longitudinal effect of alcohol on antisocial behavior appeared to be similar across the two states. This provides further support for the relatively less important predictive role of alcohol use in early adolescence for later adolescent antisocial behaviors.

The findings presented in this study differ from those of previous research examining associations between adolescent alcohol use and antisocial behaviors. For example, Hingson et al., (2001) reported early onset adolescent alcohol use was associated with increased odds of being involved in a physical fight whilst, or directly following, the consumption of alcohol. In a later study by the same authors similar results were reported (Hingson, et al., 2009). Both studies were cross-sectional in nature, and controlled for potential confounders, including demographics, individual behavior characteristics, tobacco and cannabis use, and years of alcohol consumption. The incongruity between the results of the current study, and those of Hingson and colleagues (2009; 2001), may relate to differences in both the study design, and adjustment of covariates. Unlike Hingson et al., (2001) the current study did not examine fighting behavior while drinking or soon after drinking. The present study is prospective which allows for inferences about the temporal ordering of the variables under investigation, namely adolescents' alcohol use and later antisocial behavior. Further, the current study adjusted for a range of potential confounders, including those within individual, family, and peer domains.

Another study by Rhode et al. (2001) showed a longitudinal relationship between early adolescent alcohol use disorder and mid-adolescent antisocial personality disorder. However, that study failed to control for a number of important confounds that could have accounted for this observed relationship. Thus, it may be that the adjustment for prior risk factors in the present study is associated with the incongruence in results with previous studies examining adolescent alcohol use as a predictor of later antisocial behavior.

Conversely, the results of the current study are consistent with the findings of Hill et al (2000) who reported that adolescent heavy episodic drinking was not a predictor of engagement in crime (e.g., assault, stealing, threatening behaviors) in young adults in multivariate adjusted models. Our findings replicate this finding for participants at a younger age. Similarly, consistent with the current study, Young et al. (2008) found no longitudinal relationship between alcohol use and later antisocial behavior between the ages of 11 and 15.

The pattern of results reported in the hierarchical logistic regression analyses showed that alcohol use was no longer a statistically significant predictor of antisocial behavior after risk factors from the peer and individual domains were entered into analyses of associations between Grade 7 and Grade 8 and Grade 7 and Grade 9, as well as the family domain for analyses between Grade 7 and Grade 9. These findings suggest that there are factors other than alcohol use in the individual, peer, and family domains that are strong predictors of antisocial behavior at the ages examined in this study. Indeed, the amount of unique variance in antisocial behavior explained by alcohol use was much smaller than the total amount of variance explained by the inclusion of all of the risk factors. Further detailed investigation of the specific risk factors (other than alcohol) that more strongly predict antisocial behavior in early-mid adolescence is needed to assist with planning of appropriate prevention strategies for this age group.

As reported previously, in the current study the rates of alcohol use in Victorian students were clearly higher than their counterparts in Washington State (Hemphill, et al., 2011; McMorris, et al., 2007; Toumbourou, et al., 2009). It has been shown that there are more accepting student, parent and community norms for alcohol and other drug use in Victoria relative to Washington State (Hemphill, et al., 2011). This may, in part, explain the higher rates of alcohol use in Victoria. However, in contrast to the higher prevalence of alcohol use in Victoria, Washington State was found to have a higher prevalence of antisocial behaviors. Further, no cross-national differences in the relationship between alcohol use and later antisocial behavior were found. These results further support the finding that the association between early adolescent alcohol use and mid adolescent antisocial behaviors appears to be accounted for by shared risk factors.

Study strengths and limitations

The present study investigating the longitudinal associations between alcohol use and antisocial behavior has several strengths. First, this study is one of the first to ensure that two cross-national sites have used the same recruitment, survey, and follow up procedures, as well as the same data management practices (McMorris, et al., 2007). The use of identical procedures ensures that any state differences cannot be attributed to the design and methods

of the study. Second, this study sample was a state-representative and achieved good response rates for participation, it includes approximately equal numbers of male and female students in each state, and it has achieved a good sized sample across students aged 12 – 15 years of age. Third, this study included separate measures of alcohol use and antisocial behavior across time to examine the influence of early alcohol use on later antisocial behavior.

Some potential limitations of the current study should be noted. First, the study uses student self-report data. However, the use of self-report measures in studies of pre-adolescents and adolescents is considered a reliable source of data for behavior problems such as substance use and antisocial behavior (Brener, Billy, & Grady, 2003; Huizinga & Elliott, 1986; Johnston, O'Malley, Bachman, & Schulenberg, 2007; Jolliffe et al., 2003; Rutter & Giller, 1983) that are not readily visible to adults. Second, the generalizability of the results in this study is limited to the states and grade level examined here, however, the sample is representative of these states and can therefore be applied with confidence to those groups (McMorris, et al., 2007). In addition, the results of the current study that suggest that alcohol use may not exert a strong, independent influence on subsequent antisocial behavior, relative to other predictors, in the age group studied here, need to be replicated in other studies. Further, future research is necessary to examine whether any of these "shared risk factors" are possible mediators for associations between alcohol use and later antisocial behavior. For example, alcohol use may lead to interaction with antisocial peers which may in turn lead to later engagement in antisocial behaviors.

Implications of study findings

A central message from the results of this study is that although alcohol use is one influential factor to consider when addressing problematic behavioral outcomes, there are also other risk factors in a young person's life that need to be targeted, and that these factors are seemingly more important, or may mediate the associations between alcohol use and antisocial behavior. It is crucial that multifaceted prevention approaches are implemented to address student characteristics, as well as peer, family, and community level factors linked with antisocial behavior in adolescents. These same risk factors have been shown to increase alcohol use (Hemphill, et al., 2011). It is likely that addressing the risk factors measured here will decrease both problems. Consistent risk factors for antisocial behavior and police arrests in this study were prior engagement in antisocial behavior, interaction with antisocial peers, and poor family management. A comprehensive approach is necessary for effective prevention of antisocial behavior in adolescents. Examples of evidence-based multifaceted prevention approaches include the Seattle Social Development Project (Hawkins et al., 1992), Olweus Bullying Prevention Program (Bauer, Lozano, & Rivara, 2007), Strengthening Families Program for Children and Youth (Molgaard, Spoth, & Redmond, 2000), and Communities That Care (Hawkins & Catalano, 2002; Hawkins, Catalano, & Arthur, 2002).

The current paper presents a novel study of longitudinal associations between alcohol use and antisocial behavior in early adolescence for students in Washington State and Victoria, Australia. Although there are associations between different forms of alcohol use (lifetime,

current, frequent and heavy episodic drinking) and antisocial behavior, these links no longer remain for most of the outcomes once analyses controlled for other established risk factors for problem behavior, suggesting that these associations can be explained or mediated by other related factors, rather than alcohol use itself. The study described in this paper is unique in the comprehensive measurement of risk factors and alcohol use variables and in the standardized methods used in the two cross-national sites. Further research that examines links between alcohol use and problem behavior in different countries around the world with varying policy contexts is crucial to enrich understanding of how alcohol consumption impacts on the behavior of adolescents.

Acknowledgments

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Table 1

Means, standard deviations and Cronbach's alphas for alcohol use and risk factors measured in Grade 7 and antisocial behavior outcomes measured in Grades 7, 8 and 9 for the Victorian (n = 938) and Washington State (n = 920) samples.

GRADE 7 RISK FACTORS

	Victoria [Mean(SD)]	Victoria (α)	Washington State [Mean(SD)]	Washington State (α)	Combined Sample [Mean(SD)]	Combined Sample (α)
Individual risk factors						
Favorable attitudes to antisocial behavior	1.45 (0.53)***	0.85	1.36 (0.47)	0.83	1.40 (0.51)	0.84
Rebelliousness	1.81 (0.65)	0.81	1.76 (0.62)	0.75	1.79 (0.64)	0.78
Peer risk factor						
Interaction with antisocial peers	0.19 (0.34)	0.71	0.28 (0.48)***	0.85	0.23 (0.42)	0.81
Family risk factors						
Family history of antisocial behavior	1.70 (0.70)	0.77	1.81 (0.87)**	0.82	1.75 (0.79)	0.79
Poor family management	1.61 (0.48)**	0.79	1.55 (0.51)	0.82	1.58 (0.50)	0.81
Family conflict	2.15 (0.79)	0.81	2.19 (0.82)	0.80	2.17 (0.81)	0.81
Community risk factor						
Community disorganization	1.44 (0.49)	0.76	1.53 (0.61)**	0.83	1.49 (0.55)	0.80

GRADE 7 ALCOHOL USE

	Victoria %		Washington State %		Combined Sample %	
	Males	Females	Males	Females	Males	Females
Lifetime alcohol use	64.11***	53.85***	37.53	39.37	51.00	46.65
Current alcohol use	35.67***	26.82***	10.34	13.00	23.17	19.94
Frequent alcohol use	11.16***	7.48***	2.47	2.52	6.87	5.01
Heavy episodic drinking	11.38***	8.73*	3.15	5.24	7.32	6.99

GRADE 7 ANTISOCIAL behavior

	Victoria %	Washington State %	Combined Sample %
Carrying a weapon	9.38	13.40**	11.38
Threaten with a weapon	3.75	2.93	3.35

GRADE 7 ANTISOCIAL behavior

	Victoria %	Washington State %	Combined Sample %
Police arrests	0.86	2.07*	1.46
Stealing	1.71	2.71	2.21
Violent behavior	7.07	8.04	7.55

GRADE 8 ANTISOCIAL BEHAVIOR

	Victoria %	Washington State %	Combined Sample %
Carrying a weapon	13.84	15.14	14.5
Threaten with a weapon	6.75***	2.94	4.86
Police arrests	3.42	3.80	3.61
Stealing	3.32	3.15	3.23
Violent behavior	13.06*	9.90	11.49

GRADE 9 ANTISOCIAL behavior

	Victoria %	Washington State %	Combined Sample %
Carrying a weapon	10.93	12.05	11.49
Threaten with a weapon	5.94***	2.85	4.39
Police arrests	3.42	3.80	3.61
Stealing	4.69	5.59	5.14
Violent behavior	13.10	10.73	11.92

Note. Significant state differences for dichotomous variables calculated using chi-square test. Significant state differences for continuous variables calculated using independent *t*-tests, indicated with asterisks attached to the significantly higher value.

*
 $p < .05$;

**
 $p < .01$;

***
 $p < .001$; α = Cronbach's alpha.

Table 2

Unadjusted, partially adjusted, and fully adjusted associations between alcohol use in Grade 7 and antisocial behavior in Grades 8 and 9.

Grade 8 antisocial behavior

Grade 8 antisocial behavior	Unadjusted OR (95% CI)	Partially adjusted OR (95% CI)	Fully adjusted OR (95% CI)	Unadjusted OR (95% CI)	Partially adjusted OR (95% CI)	Fully adjusted OR (95% CI)
	Grade 7 lifetime alcohol use[a]			**Grade 7 current alcohol use[b]**		
Carrying a weapon	2.01 (1.55, 2.62)***	2.07 (1.58, 2.70)***	0.90 (0.65, 1.24)	2.38 (1.76, 3.20)***	2.64 (1.89, 3.68)***	1.12 (0.73, 1.71)
Threaten with a weapon	4.16 (2.45, 7.06)***	2.67 (1.48, 4.82)**	1.58 (0.72, 3.52)	4.19 (2.63, 6.67)***	2.69 (1.55, 4.64)***	1.16 (0.64, 2.10)
Police arrests	2.37 (1.41, 3.98)**	2.33 (1.39, 3.92)**	1.25 (0.64, 2.44)	4.28 (2.57, 7.13)***	4.81 (2.96, 7.80)***	2.04 (1.07, 3.88)*
Stealing	3.95 (2.06, 7.58)***	3.92 (2.05, 7.49)***	1.45 (0.72, 2.93)	7.40 (4.28, 12.80)***	8.41 (4.57, 15.45)***	2.39 (1.30, 4.38)**
Violent behavior	2.86 (2.07, 3.97)***	2.26 (1.62, 3.16)***	1.41 (0.91, 2.18)	3.24 (2.43, 4.32)***	2.43 (1.76, 3.34)***	1.27 (0.84, 1.92)
	Grade 7 frequent alcohol use[c]			**Grade 7 heavy episodic drinking[d]**		
Carrying a weapon	2.40 (1.57, 3.66)***	2.32 (1.42, 3.81)**	0.81 (0.42, 1.58)	2.51 (1.61, 3.90)***	2.68 (1.71, 4.19)***	0.95 (0.56, 1.62)
Threaten with a weapon	4.97 (2.77, 8.91)***	2.68 (1.09, 6.60)*	1.11 (0.48, 2.57)	5.57 (3.44, 9.02)***	2.92 (1.55, 5.52)**	1.21 (0.54, 2.70)
Police arrests	4.66 (2.52, 8.62)***	4.37 (2.22, 8.60)***	1.37 (0.58, 3.20)	6.83 (3.91, 11.94)***	6.92 (3.85, 12.44)***	2.62 (1.07, 6.41)*
Stealing	6.58 (3.48, 12.44)***	6.40 (3.22, 12.73)***	1.57 (0.71, 3.46)	8.78 (4.79, 16.10)***	8.72 (4.55, 16.73)***	2.11 (0.85, 5.23)
Violent behavior	4.37 (2.82, 6.76)***	2.45 (1.56, 3.86)***	1.33 (0.79, 2.24)	3.73 (2.61, 5.32)***	2.33 (1.50, 3.61)***	1.01 (0.55, 1.84)

Grade 9 antisocial behavior

Grade 9 antisocial behavior	Unadjusted OR (95% CI)	Partially adjusted OR (95% CI)	Fully adjusted OR (95% CI)	Unadjusted OR (95% CI)	Partially adjusted OR (95% CI)	Fully adjusted OR (95% CI)
	Grade 7 lifetime alcohol use[e]			**Grade 7 current alcohol use[f]**		
Carrying a weapon	2.36 (1.78, 3.13)***	1.81 (1.34, 2.46)***	1.56 (1.11, 2.19)*	2.44 (1.75, 3.42)***	2.10 (1.43, 3.08)***	1.59 (1.02, 2.48)*
Threaten with a weapon	2.39 (1.32, 4.33)**	1.87 (0.98, 3.56)	1.13 (0.55, 2.29)	3.21 (2.04, 5.03)***	2.44 (1.41, 4.22)**	1.36 (0.76, 2.45)
Police arrests	1.86 (1.14, 3.02)*	1.94 (1.16, 3.25)*	1.00 (0.53, 1.88)	2.47 (1.59, 3.83)***	2.67 (1.65, 4.32)***	1.39 (0.80, 2.42)
Stealing	2.89 (1.83, 4.56)***	2.72 (1.66, 4.47)***	1.41 (0.78, 2.54)	4.83 (3.13, 7.44)***	5.15 (3.03, 8.74)***	2.67 (1.58, 4.52)***
Violent behavior	2.03 (1.48, 2.78)***	1.61 (1.15, 2.27)**	1.08 (0.73, 1.59)	2.58 (1.88, 3.54)***	2.03 (1.41, 2.93)***	1.26 (0.83, 1.91)
	Grade 7 frequent alcohol use[g]			**Grade 7 heavy episodic drinking[h]**		

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Grade 8 antisocial behavior	Grade 7 lifetime alcohol use[a]			Grade 7 current alcohol use[b]		
	Unadjusted OR (95% CI)	Partially adjusted OR (95% CI)	Fully adjusted OR (95% CI)	Unadjusted OR (95% CI)	Partially adjusted OR (95% CI)	Fully adjusted OR (95% CI)
Carrying a weapon	3.00 (1.96, 4.59)***	2.20 (1.26, 3.81)**	1.42 (0.78, 2.57)	2.92 (1.80, 4.74)***	2.43 (1.47, 4.01)**	1.60 (0.91, 2.83)
Threaten with a weapon	2.48 (1.31, 4.67)**	1.47 (0.61, 3.54)	0.76 (0.32, 1.77)	3.26 (1.69, 6.28)***	2.21 (1.02, 4.76)*	1.10 (0.49, 2.45)
Police arrests	2.46 (1.26, 4.82)**	2.29 (1.02, 5.15)*	0.99 (0.40, 2.40)	4.66 (2.61, 8.33)***	4.94 (2.62, 9.30)***	2.36 (1.06, 5.26)*
Stealing	3.39 (1.78, 6.47)***	2.90 (1.35, 6.25)**	1.25 (0.54, 2.90)	3.99 (2.30, 6.93)***	3.16 (1.65, 6.04)**	1.48 (0.71, 3.09)
Violent behavior	2.71 (1.71, 4.28)***	1.58 (0.91, 2.73)	0.92 (0.51, 1.68)	3.19 (2.10, 4.84)***	2.26 (1.41, 3.62)**	1.40 (0.82, 2.37)

Note. CI = confidence interval. N = 1,860 (lifetime alcohol use $n = 906$, current alcohol use $n = 400$, frequent alcohol use $n = 110$, heavy episodic drinking $n = 133$. Analyses compared alcohol users vs. non-users for each measure of alcohol use.

Across all of the fully adjusted analyses, the variables that generally remained statistically significant in the models were prior antisocial behavior, gender, and poor family management (full details available from first author on request).

*
$p < 0.05$,

**
$p < 0.01$,

***
$p < 0.001$.

[a] The association between Grade 7 lifetime alcohol use and Grade 8 antisocial behavior was no longer statistically significant at step 3 (peer/individual attitudes favorable to antisocial behavior and rebelliousness entered) for carrying a weapon, threatening with a weapon, police arrests, and non-violent antisocial behavior, and at step 5 (parental attitudes favorable to antisocial behavior, poor family management, and family conflict entered) for violent behavior.

[b] The association between Grade 7 current alcohol use and Grade 8 antisocial behavior was no longer statistically significant at step 4 (interaction with antisocial peers) for carrying a weapon, threatening with a weapon, police arrests, and at step 5 (parental attitudes favorable to antisocial behavior, poor family management, and family conflict entered) for violent behavior.

[c] The association between Grade 7 frequent alcohol use and Grade 8 antisocial behavior was no longer statistically significant at step 1 (prior behavior entered) for carrying a weapon, and at step 3 (peer/individual attitudes favorable to antisocial behavior and rebelliousness entered) for threatening with a weapon, police arrests, non-violent antisocial behavior, and violent behavior.

[d] The association between Grade 7 heavy episodic drinking and Grade 8 antisocial behavior was no longer statistically significant at step 3 (peer/individual attitudes favorable to antisocial behavior and rebelliousness entered) for carrying a weapon, threatening with a weapon, and violent behavior, at step 5 (parental attitudes favorable to antisocial behavior, poor family management, and family conflict entered) for police arrests, and at step 4 (interaction with antisocial peers) for non-violent antisocial behavior.

[e] The association between Grade 7 lifetime alcohol use and Grade 9 antisocial behavior was no longer statistically significant at step 2 (prior behavior entered) for threatening with a weapon, step 4 (interaction with antisocial peers) for police arrests and non-violent antisocial behavior, and at step 3 (peer/individual attitudes favorable to antisocial behavior and rebelliousness entered) for violent behavior.

[f] The association between Grade 7 current alcohol use and Grade 9 antisocial behavior was no longer statistically significant at step 5 (parental attitudes favorable to antisocial behavior, poor family management, and family conflict entered) for carrying a weapon, step 4 (interaction with antisocial peers) for threatening with a weapon, and at step 3 (peer/individual attitudes favorable to antisocial behavior and rebelliousness entered) for police arrests and violent behavior.

[g]The association between Grade 7 frequent alcohol use and Grade 9 antisocial behavior was no longer statistically significant at step 3 (peer/individual attitudes favorable to antisocial behavior and rebelliousness entered) for carrying a weapon, police arrests, and non-violent antisocial behavior, step 1 (demographics entered) for threatening with a weapon, and at step 2 (prior behavior entered) for violent behavior.

[h]The association between Grade 7 heavy episodic drinking and Grade 9 antisocial behavior was no longer statistically significant at step 3 (peer/individual attitudes favorable to antisocial behavior and rebelliousness entered) for carrying a weapon, threatening with a weapon, non-violent antisocial behavior and violent behavior.

Table 3

Unique and shared variance in associations between alcohol use in Grade 7 and antisocial behavior in Grades 8 and 9.

Grade 8 antisocial behavior	Unique Variance (%)	Shared Variance (%)	Unique Variance (%)	Shared Variance (%)
	Grade 7 lifetime alcohol use		Grade 7 current alcohol use	
Carrying a weapon	1.78	**26.07**	2.26	**26.06**
Threaten with a weapon	5.01	**31.50**	5.62	**31.26**
Police arrests	1.94	**21.45**	5.51	**22.22**
Stealing	4.31	**26.10**	10.31	**27.15**
Violent behavior	3.63	**19.43**	4.22	**19.29**
	Grade 7 frequent alcohol use		Grade 7 heavy episodic drinking	
Carrying a weapon	.87	**26.07**	1.15	**26.05**
Threaten with a weapon	3.54	**31.23**	4.85	**31.26**
Police arrests	3.11	**21.47**	6.33	**22.49**
Stealing	5.25	**26.14**	8.59	**26.63**
Violent behavior	1.15	**19.25**	2.62	**19.18**

Grade 9 antisocial behavior	Unique Variance	Shared Variance	Unique Variance	Shared Variance
	Grade 7 lifetime alcohol use		Grade 7 current alcohol use	
Carrying a weapon	2.49	**16.32**	2.35	**16.30**
Threaten with a weapon	2.07	**14.36**	3.55	**14.53**
Police arrests	1.07	**12.96**	2.05	**13.16**
Stealing	3.05	**15.18**	6.93	**16.78**
Violent behavior	1.73	**13.75**	2.68	**13.84**
	Grade 7 frequent alcohol use		Grade 7 heavy episodic drinking	
Carrying a weapon	1.45	**16.00**	1.62	**16.12**
Threaten with a weapon	.82	**14.41**	1.88	**14.35**
Police arrests	.82	**12.96**	3.64	**13.88**
Stealing	1.77	**15.01**	2.83	**15.14**
Violent behavior	1.15	**13.74**	1.95	**13.86**

Note. N = 1,860 (lifetime alcohol use *n* = 906, current alcohol use *n* = 400, frequent alcohol use *n* = 110, heavy episodic drinking *n* = 133). Analyses compared alcohol users vs. non-users for each measure of alcohol use.

Unique variance refers to Pseudo R^2 for the unadjusted model examining associations between alcohol use and later antisocial behavior.

Shared variance refers to Pseudo R^2 for the fully adjusted model examining associations between all risk factors including alcohol use and antisocial behavior.