Exploring the Effects of Age of Alcohol Use Initiation and Psychosocial Risk Factors on Subsequent Alcohol Misuse*

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ABSTRACT. *Objective:* This study examines whether the age of initiation of alcohol use mediates the effects of other variables that predict alcohol misuse among adolescents and also whether the age of initiation of alcohol use accounts for known gender differences in the severity of alcohol misuse. *Method:* Data were taken from an ethnically diverse sample of 808 (412 male) students who were recruited in grade 5 at age 10-11 and followed prospectively on an annual basis for the next 7 years to age 17-18. State-of-the-art missing data methodology was used to address nonresponse due to noninitiation of alcohol use. Structural equation modeling was used to examine hypotheses for the prediction of alcohol misuse. *Results:* A younger age of alcohol initiation was strongly related to a higher level of alcohol misuse at age 17-18 and fully mediated the effects of parent drinking, proactive parenting, school bonding, peer alcohol initiation and ethnicity, all measured at age 10-11, and perceived harmfulness of alcohol use, measured at age 10-11 and age 11-12. However, age of alcohol initiation did not fully account for gender differences in the level of alcohol misuse at age 17-18. To further examine the role of gender, interactions between gender and school bonding, and gender and friend's alcohol initiation, were evaluated. However, neither of the interaction terms had direct effects on either age of initiation or level of alcohol-related problems. *Conclusions:* Most measured risk factors for alcohol misuse were mediated through age of alcohol initiation. Only gender differences in alcohol misuse at age 17-18 were not mediated by age of alcohol initiation. Variables associated with these differences require further study. The results of this study indicate the importance of prevention strategies to delay the age of initiation of alcohol use. (*J. Stud. Alcohol* **58:** 280-290, 1997)

RECENT REVIEWS of predictors of alcohol and other drug misuse by adolescents have indicated that an early age of initiation is an important precursor to later misuse (e.g., Hawkins et al., 1992, 1995; Kandel et al., 1986; Robins, 1992). Other predictors of later misuse include parents' drinking, friends' drinking, poor family management practices and favorable attitudes towards drug use. Other work has shown that more males than females drink heavily (Johnston et al., 1992; Robins, 1992). Many of the predictors of later alcohol misuse are also predictors of an earlier age of initiation of alcohol use (Hawkins et al., 1992, 1995). However, the existing literature has not addressed several important questions about the relationship of predictors such as family management practices and age of alcohol use initiation to subsequent alcohol misuse. One unanswered question is whether predictors of alcohol misuse such as poor family management practices or parents' drinking directly predict later alcohol misuse or predict only indirectly through their effect on age of initiation. The answer to this question would help to determine the importance of delaying alcohol use initiation as a goal for preventive interventions. If the effects of such psychosocial risk factors are mediated by age of initiation, then delaying initiation of alcohol use would appear to be an important goal for preventive efforts. However, if the effects of psychosocial risk factors are not mediated by age of initiation, then attention need not focus on delaying the initiation of alcohol use among adolescents. A related question is whether males' higher levels of alcohol misuse in adolescence when compared with females simply reflect an earlier age of alcohol use initiation among males, or reflect other factors distinct from age of initiation in males and females. To the extent that age of initiation does not fully mediate the effects of gender on alcohol misuse, efforts to understand the different rates of alcohol misuse in males and females should focus on more proximate risk factors that appear later in development after alcohol use initiation.

Predictors of alcohol misuse

Males use alcohol more frequently and more heavily than females (Johnston et al., 1992; Robins, 1992). Johnston et al. (1992) found that among high school seniors, 5.3% of males versus 1.6% of females reported drinking daily over the past 30 days and 37.8% of males versus 21.2% of females reported

heavy drinking (five or more drinks in a row in the past 2 weeks). Furthermore, Newcomb and Bentler (1988) reported that males experienced significantly more problems with alcohol than females as young adults.

Ethnic differences in frequent and heavy alcohol use have also been reported (e.g., Johnston et al., 1992; Robins, 1992). Johnston et al. (1992) found that among high school seniors white students reported nearly double the rate of heavy drinking as black students. Hispanic students were found to be intermediate to white and black students.

In addition to gender and ethnic differences, studies have identified several important psychosocial predictors of the misuse of alcohol by adolescents. In the family domain, family process factors have been identified as particularly salient. Poor family management practices (failure to set clear expectations for behavior, lax monitoring of children and excessively severe and inconsistent discipline) predict later alcohol misuse (Peterson et al., 1994; Reilly, 1975; Robins, 1992). A high level of family conflict also predicts increased alcohol misuse (Robins, 1992). The absence of closeness between parents and children (i.e., the absence of bonding to family) also has been found to predict alcohol misuse (e.g., Brook et al., 1990; Jessor and Jessor, 1977; Kim, 1979). Another important family factor related to later alcohol misuse is perceived permissiveness of parents towards alcohol or drug use by their children (e.g., Hansen et al., 1987; McDermott, 1984). Parental drinking has also been found to be related to later adolescent misuse of alcohol (e.g., Brook et al., 1990; Jessor et al., 1980; Kandel et al., 1978; Peterson et al., 1994).

As children mature, they enter networks of friends and peers and form social connections with institutions outside the family, such as schools. Studies have consistently found a positive relationship between peer drinking patterns and alcohol misuse by youth (e.g., Barnes and Welte, 1986; Harford, 1985; Newcomb and Bentler, 1986) and have also shown that students manifesting a lower commitment to school report higher levels of drug use (e.g., Friedman, 1983; Johnston et al., 1985; Kelly and Balch, 1971).

In studies of drug use, an earlier age at which drug use was initiated is consistently related to a greater level of later drug-related problems (e.g., Kandel, 1982; Robins and Przybeck, 1985). Only one study has examined the effect of early initiation specifically for alcohol (Rachal et al., 1982), and it found that an early age of initiation was predictive of later alcohol misuse.

In summary, a higher level of alcohol misuse problems during adolescence is related to being male or of white ethnic background. Variables measuring poor family functioning (poor family management, conflict, and bonding to family), a higher frequency of parent drinking behavior, the use of alcohol by peers and a low commitment to school are also related to later alcohol misuse by adolescents. In addition, a younger age at which alcohol use was initiated is predictive of later alcohol misuse.

Predictors of age of initiation

A number of the variables identified as predictors of later misuse have also been identified as predictors of the age of initiation of alcohol use. A consistent finding is that males begin to use alcohol at an earlier age than females (Okwumabua and Duryea, 1987; Okwumabua et al., 1989; Robins, 1992). Also, white children typically initiate alcohol use at an earlier age than black children (Robins, 1992).

Among family domain variables, both poor family management practices and low bonding to family have been found consistently to be related to an earlier age of initiation (e.g., Baumrind, 1983; Brook et al., 1990; Kandel and Andrews, 1987; Kandel et al., 1978; Penning and Barnes, 1982). Drinking by parents has also been linked to an earlier age of initiation (e.g., Goodwin, 1985; Johnson et al., 1984; Kandel et al., 1978; McDermott, 1984).

The presence of attitudes favorable to alcohol use has been found to precede the initiation of alcohol use (e.g., Kandel et al., 1978; Krosnick and Judd, 1982; Smith and Fogg, 1978). Although it is likely that such attitudes result from the child's family and social environment, this relationship has not been studied in seeking to predict alcohol initiation.

The role of age of initiation

The literature on predictors of alcohol misuse and the age of initiation shows that a number of variables that are associated with age of initiation are also associated with later alcohol misuse. What, then, is the role of age initiation with respect to the predictors of later misuse? As Robins (1992) notes, one possibility is that age of initiation is simply a correlate of other factors that are the true causes of later misuse. The second possibility is that age of initiation is important in the etiology of later misuse and that variables such as family management are associated with later misuse only through their effects on age of initiation. An important question with implications for prevention is whether the bivariate relationships between variables such as family management and later alcohol misuse are mediated by age of alcohol initiation.

The literature on predictors of alcohol misuse also raises concerns about the effect of gender on age of initiation and level of problems due to alcohol use. Studies consistently affirm that males both initiate alcohol use earlier and subsequently experience a higher level of problems with alcohol misuse. However, it is not clear to what extent psychosocial risk factors are mediated by age of initiation of alcohol use for both males and females. One possibility is that gender exerts direct effects on either age of initiation or level of alcohol misuse problems; that is, males simply have more alcohol-related problems. The second possibility is that gender interacts with other variables in predicting age of initiation or level of alcohol misuse. It is possible that certain variables (e.g., peer alcohol initiation, or bonding to school) are stronger predictors for males or females.

Resolution of these questions is central to designing prevention programs. It is important to focus prevention strategies on the factors that are part of the causal chain leading to alcohol misuse. If the mediation model holds, prevention programs should focus directly on delaying the age of alcohol initiation. However, if the mediation model fails, then delaying alcohol use initiation would not appear to be a viable goal for prevention initiatives.

Present study

The present study examines two questions. The first question is whether age of initiation mediates the effects of variables that have also been found to be associated with alcohol misuse. The second set of questions asks whether the mediation model helps explain gender differences in problems associated with alcohol misuse: Are gender differences in alcohol misuse primarily a result of differences in age of initiation? Does gender interact with other variables in predicting age of initiation or alcohol misuse? Does gender have a unique effect on alcohol misuse?

In the present study, data on a multiethnic sample of males and females who were followed prospectively from 1985, when participants were in the first semester of the fifth grade, to 1993 were used to address these questions. Data on alcohol initiation were collected at each assessment and the presence of problems due to alcohol use were collected at the 1993 assessment when participants were 17 or 18 years of age. Data on parenting, peers' use and school bonding were collected in 1985 and 1986 when students were in the fifth and sixth grades, respectively.

Figure 1, which also shows the results, depicts the model to be tested. Age of initiation is modeled as a mediator between all other hypothesized predictors and alcohol misuse at age 17-18. Our work and theory indicate that conventional norms (in this case perceived harm from alcohol use) mediate the link between family and social environment and alcohol initiation. Family management practices, parental drinking, bonding to school and best friends' drinking are expected to affect beliefs about harm associated with alcohol use. In turn, beliefs about the perceived harm associated with alcohol use are hypothesized to directly affect the initiation of alcohol use. The mediation model described by Baron and Kinney (1986) has been shown to be mathematically equivalent to covariance structure models such as the one tested in this study (MacKinnon and Dwyer, 1993; MacKinnon et al., 1991).

Method

Participants

The participants in this study are the 808 students and their caretakers (83% of whom were the students' mother or mother-surrogate at the initial assessment) who participated in the Seattle Social Development Project (SSDP) (Hawkins et al., 1987, 1988, 1991; Peterson et al., 1994). These partic-

ipants were recruited in the fall of 1985 from the population of fifth-grade students attending 18 Seattle elementary schools whose students were from predominantly high-crime neighborhoods ($N = 1,053$). From this population of 1,053 fifth-grade students, 808 (77%) consented to take part in a longitudinal study. This rate is comparable to those reported by other studies of preadolescents and adolescents (e.g., Ellickson and Bell, 1990; Thornberry et al., 1991). Of the 808 students, 412 (51%) were male; 372 (46%) were white, 195 (24.1%) were black, 170 (21%) were Asian American, 45 (2.1%) were Native American and the remaining 26 (6.8%) students were of other ethnic backgrounds. Also, 40.6% of students were from low income families at their recruitment as measured by eligibility for the free school lunch program.

Assessments

Students and their caretakers (most often the mother) were assessed at recruitment in the fall of fifth grade (age 10-11), in the spring of the fifth-grade year (1986), and annually thereafter in the spring of the year through 1991. Students but not their caretakers were assessed in the spring of 1993. Annual participation rates for students were consistently high; 94% of the sample (757 participants) completed the age 17-18 assessment in 1993.

The students' female caretaker was asked first to complete the assessment. However, if the female caretaker was unavailable or unwilling, the male caretaker was approached. At the initial fifth-grade assessment, 83% of the responding caretakers were the students' mother or mother-surrogate.

The student assessments elicited detailed information on the participants' alcohol involvement, including age of onset, frequency of use, any problems resulting from alcohol use, perceived norms and expectations regarding alcohol use and relationships with parents, peers, teachers and their schools. The students' caretakers also completed self-report assessments of their own use of alcohol, in addition to other topics.

Constructs

Alcohol misuse. The dependent construct, alcohol misuse, was developed from three scales measuring related aspects of heavy alcohol consumption by age 17-18. The Drink and Drive scale consisted of two items measuring the frequency of drinking and driving in the past year and whether the respondent had driven unsafely after drinking. The Heavy Drinking scale used items measuring the frequency of drinking five or more drinks in a row during the past month, the frequency of drinking in the past month and the frequency of drunkenness in past year. The Alcohol Problems scale consisted of eight items measuring different problems that might arise as a result of heavy or sustained alcohol or drug use (e.g., Hurt your performance in school or on job; Hurt your relationship with parents). All item indicators in this con-

struct were taken from the 1993 assessment at age 17-18. A higher score indicated greater alcohol misuse.

At age 17-18, 43.6% of the sample had drunk alcohol in the past month; 23.6% had drunk five or more drinks in a row in the past month; 47.6% had been drunk in the past year; 17% had driven after drinking during the past year; 30.7% reported the presence of two or more problems attributed to alcohol use; 19.5% reported the presence of three or more such problems. In summary, alcohol use and associated problems were prevalent in this sample.

Gender. This construct was a single item indicator of the respondent's gender. Males were coded 0 and females were coded 1.

Ethnicity. This construct was a single item indicator of the respondent's ethnicity. Preliminary analyses showed that pairwise comparisons with the white group were highly similar across ethnic groups. Because of this similarity, the complexity of the models to be examined and the small sample sizes in some ethnic groups, we created an ethnicity variable including only two groups: whites were coded 0, and all other students were coded 1.

Parents' drinking. This construct was measured by two items assessing the frequency of the caretakers' own drinking and their partners' drinking as reported by the responding caretaker. Both items were taken from the initial assessment at grade five. A higher score indicated more frequent drinking.

Proactive parenting. This construct was developed from three scales of four items each from the students' initial assessment at grade five. The items were chosen from a factor analysis of items tapping involvement of the student with caretakers in activities, caretakers' supervision and discipline practices, family conflict, and communication style (e.g., The rules in my family are clear; Our family members get along well with each other; When you have misbehaved, did your parents discuss what you did?; My parents notice when I am doing a good job and let me know about it). Each of the 12 items loaded in excess of .40 on one factor. For purposes of indicator construction for later analyses, the items were rank-ordered by magnitude of their loadings and then divided into groups of three items with similar loadings. Items in each group were then randomly assigned to one of three indices and averaged to form the score for that indicator. A higher score indicated more proactive parenting.

School bonding. This construct was measured by items that assessed students' attachment and commitment to school at the initial assessment. Six items (Likes teacher this year; Likes school; Likes class this year; Looks forward to going to school; Keeps working on assignments until finished; Does extra work in school) were divided into three indicators as described for the proactive parenting construct. A higher score indicated greater bonding to school.

Friends' alcohol initiation. This construct was measured by four items asking whether each of the students' four best friends had ever tried alcohol as of the initial assessment. A higher score indicated that a larger proportion of friends had initiated alcohol use. At the initial assessment 8.2% of the best friends had initiated use (9.6% of the males' vs 6.8% of the females' best friends, and 9.4% of the whites vs 7.2% of the nonwhites' best friends).

Perceived alcohol harm. This construct was measured at the initial assessment (age 10-11) and again in the following school year's assessment (age 11-12). The same two items were used for each measurement. The items asked about the perceived harm of trying one or two drinks and the harm of drinking one or two drinks daily. A higher score indicated more perceived harm associated with drinking.

Age of drinking initiation. The latent construct was based on three measures of the age at which the student began drinking. The first was a prospective measure of the grade at which the participant first drank alcohol and was constructed from the students' responses to the item "Have you ever drunk alcohol?" that was asked of the participant at each assessment. The other two measures were retrospective items that were asked at the age 17-18 assessment only: "At what age did you first have more than a sip or two of alcohol?" and "How old were you when you first began drinking regularly, that is, at least once or twice a month?" For the two retrospective items, the *age* of initiation was coded. If the person indicated he or she had never begun using (or not regularly), the variable was set to missing (to be handled later by the missing-data procedure). A latent construct based on both prospective and retrospective measures was used to overcome the limitations of each and to allow optimal estimation of the intended construct, actual age of initiation. The prospective measure of age of initiation suffers from left censoring in that some students will already have initiated use at the start of the study. The retrospective measures help to compensate for this problem, since they do not suffer from left censoring. The common variance between these three measures provides an optimal estimation of actual age of initiation.

The prospective grade of initiation measure was created in the following manner. For participants with complete data on the "ever drunk alcohol" item up until the first report of alcohol use, the grade of initiation was coded as the earliest grade at which the participant first reporting using alcohol. Participants who had not reported having used alcohol as of the final assessment (grade 12) were coded as initiating alcohol use in the following year. This procedure is preferable to dropping these participants from the analysis. For participants who had missing data at one or more assessments and reported using alcohol at a later assessment, grade of initiation was coded as the mean of the grade of initiation for those participants with the same pattern of "no" and "yes" answers and who did have data for the intermediate grades.

At the initial assessment 24.4% reported that they had initiated alcohol use (27.1% of the males vs 21.5% of the females, and 32.8% of the whites vs 17.3% of the nonwhites). By the final assessment 74.1% reported that they had initiated

alcohol use (75.9% of the males vs 72.3% of the females, and 82.3% of the whites vs 67.1% of the nonwhites).

Missing data analysis strategy

In the present study, there were 25,048 data points (808 participants and 31 measured variables). Of these, 3,872 (about 15%) were missing. These missing values were distributed across 753 of the 808 participants. The annual participation rates were quite high and compared very favorably to those recorded in other prevention studies (see Hansen et al., 1990). Of the 808 participants who provided longitudinal consent at fifth grade (age 10-11), 69% (because of a district-mandated change in consent procedures) provided data at age 11-12, and 94% provided data at age 17-18. Ages 10-11, 11-12 and 17-18 were the three ages included in this study. Nonparticipation at either the age 11-12 or 17-18 assessment was not associated with gender, ethnicity or ever having used alcohol at age 10-11.

New missing-data procedures have emerged in recent years (e.g., Graham et al., 1994; Little and Rubin, 1987; Rubin, 1987; Schafer, in press), and we have drawn on these to deal with missing data in the present study. Through these procedures researchers are able to make use of all the data available by including important variables and cases with only a few missing values that would have to be omitted from the analysis if listwise deletion procedures were used. Further, using these procedures researchers are able to correct for most of the biases relating to the missing data and to do hypothesis testing by obtaining reasonable estimates of standard errors for all key model parameters. We present these procedures in some detail here as a methodological example.

The procedures, recently described by Graham et al. (1996) are: (1) EM (expectation-maximization) algorithm (Dempster et al., 1977; Little and Rubin, 1987), estimating standard errors with bootstrap procedures (Efron, 1981, 1994); (2) multiple-group structural equation modeling (Allison, 1987; Bentler, 1989; Donaldson et al., 1994; Graham et al., 1994; Jöreskog and Sörbom, 1989; Muthen et al., 1987); (3) multiple imputation (Rubin, 1987; Schafer, in press); and (4) raw maximum-likelihood structural equation modeling (Arbuckle, 1995; Neale, 1991).

In the present study, we used the Amos program (Arbuckle, 1995). The Amos program uses a raw maximum-likelihood feature to solve missing-data problems. This Windows-based structural equation modeling program allows the analyst to solve most missing data problems and obtain reasonable standard errors in a single analysis. For results involving manifest variable models with missing data, Amos parameter estimates are identical to those obtained using the EM algorithm (see Graham et al., 1996). For models involving latent variables, both the Amos and EM procedures yield unbiased parameter estimates, but the estimates based on the Amos program are very slightly more efficient (smaller standard errors; Graham et al., 1994, 1996).

Causes of missingness. There are three potential causes of missingness on a variable Y: (1) the cause is a variable that is uncorrelated with the missing variable Y (we will refer to this as missing completely at random); (2) the cause is a variable that is correlated with Y, but is measured for everyone and is included in the analysis model (as in Graham and Donaldson, 1993, we refer to this as an "accessible" missing-data mechanism); and (3) the cause of missingness *is* the missing variable Y, itself (as in Graham and Donaldson, 1993, we refer to this as an "inaccessible" missing-data mechanism).

If the data are missing completely at random, or if the missing-data mechanism is accessible, then parameter estimates based on the Amos or the EM algorithm are unbiased and efficient. However, it is important to note that even if the missing-data mechanism is inaccessible, parameter estimates based on Amos or the EM algorithm are never worse than, and are often better than, those based on other methods (e.g., listwise or pairwise deletion; Bentler, 1989; Graham et al., 1994, 1996). Hence the Amos procedure was used to account for missing data in estimating model parameters.

Structural equation modeling strategy

Gender differences in model tests. Our initial plan was to test the model in Figure 1 separately for males and females. However, preliminary analyses revealed few substantive differences between the structural models for males and females. Therefore, rather than testing separate models for males and females (or performing a formal multiple groups analysis), we performed a single analysis for males and females combined. Gender-specific relationships that had been found during the preliminary analyses were modeled with interaction terms (see below). A gender main effect term was also added to account for differences in means between males and females.

Measurement model. The model estimation and missing data analyses were performed in a single step using the Amos program (Version 3.10; Arbuckle, 1995). All analyses were done in a covariance metric.[1] The measurement model was straightforward, with two or more manifest variables as indicators of every factor except Gender and Ethnicity. Four manifest indicators for the interaction factor (Gender × Friends' Alcohol Initiation) were constructed by multiplying gender with each of the Four Friends' Alcohol Initiation items (Newcomb and Felix-Ortiz, 1992). In order to minimize the correlation with the main effect terms, all items were standardized prior to multiplying. Three manifest indicators of the interaction factor (Gender × School Bonding) were constructed in the same fashion. In order to help identify the model, equality constraints were placed on the factor loadings for the two-item factors of Parents' Drinking, Perceived Alcohol Harm 10-11 and Perceived Alcohol Harm 11-12.

Minimizing retrospective reporting bias. It is known that retrospective reports (e.g., recalling the age of initiation of alcohol use) can be biased (e.g., Collins et al., 1985). It has also

been shown that this bias can be isolated in structural equation models and rendered harmless, provided certain assumptions are met (Graham and Unger, 1993). If the response bias affects some, but not all, of the indicators of a latent variable, then the effects of the response bias are at least partially controlled (i.e., the bias has reduced effect on other factor relationships in the model) if the residual covariance is estimated between the bias-prone indices (see Graham and Collins, 1992; Kenny and Kashy, 1992). Thus, to control for any possible response bias in the retrospective reports, we estimated the covariance of the errors of the two retrospective reports of age of alcohol initiation.

Goodness of fit. Indicators of goodness of fit are based on the difference between the predicted and actual covariance matrix. In the case of the Amos raw maximum-likelihood estimation, however, the sample covariance matrix is not estimated directly, and goodness of fit indices are not calculated. In order to get an idea about the goodness of fit in the models presented here, we estimated the covariance matrix using the EM algorithm (EMCOV.EXE), (Graham and Hofer, 1993). The parameter estimates for the final model based on the two approaches were very similar, providing confidence in the parameter estimates shown in Figure 1.

Another consideration in estimating goodness of fit in the missing-data case is figuring the sample size. Because some data are missing, it is not clear what sample size should be used. In the present case, we used the mean of the 66 pairwise sample sizes corresponding to the 66 covariances between the 12 indices used in our model. That mean sample size was 680. This value is somewhat arbitrary, but, for the purpose of testing goodness of fit, this sample size is conservative. The estimation of standard errors (see below) did not depend upon this arbitrary sample size.

Results

The fit of the overall model was judged to be acceptable. Although the chi square ($\chi^2 = 834.66$, 374 df) was significant, the rather large sample size ($N = 680$) virtually guarantees a significant chi square for a model with this number of indicators (31). In addition, various indicators of practical fit suggested an acceptable level of fit: The Goodness of Fit Index (GFI) (Jöreskog and Sörbom, 1989) was .93; the Adjusted Goodness of Fit Index (AGFI) (Jöreskog and Sörbom, 1989) was .90; and RHO (Bentler and Bonett, 1980; Tucker and Lewis, 1973) was .91.

Measurement model. Results indicated that the measurement model was very strong: factor loadings for all factors were substantial and significant. The factor loadings for the measurement model are available from the first author upon request.

Structural model. All factors were specified to predict Alcohol Misuse at age 17-18. Further, all factors except Alcohol Misuse were specified to predict the Age of Initiation of Alcohol Use factor. Finally, gender, ethnicity and all age 10-11 factors, including interaction factors, were specified to

predict Perceived Alcohol Harm at age 11-12. All factor relationships not specified as factor regressions were specified as factor correlations. That is, gender, ethnicity and all age 10-11 factors were specified to be correlated.

Unstandardized factor regression coefficients and (standardized) factor correlations are presented in Table 1. The results of significant paths are summarized in Figure 1 as standardized estimates. As shown in Figure 1, the only significant unique predictors of Perceived Alcohol Harm at age 11-12 (besides Perceived Harm at age 10-11) were Parents' Drinking ($\beta = -.17$, $p < .05$) and Proactive Parenting ($\beta = .20$, $p < .01$). For Parents' Drinking, greater parental alcohol use was associated with lower adolescent belief in the harmful effects of alcohol use. For Proactive Parenting (e.g., discussing issues with children) greater proactive parenting was associated with greater adolescent belief in the harmful effects of alcohol use.

Perceived harmfulness of alcohol use at age 11-12 (Perceived Alcohol Harm 11-12) was, in turn, a significant predictor of Age of Initiation of Alcohol Use ($\beta = .23$, $p < .001$). Greater perceived alcohol harm was associated with later initiation. Other direct predictors of Age of Initiation were ethnicity ($\beta = .21, p < .001$; white students began
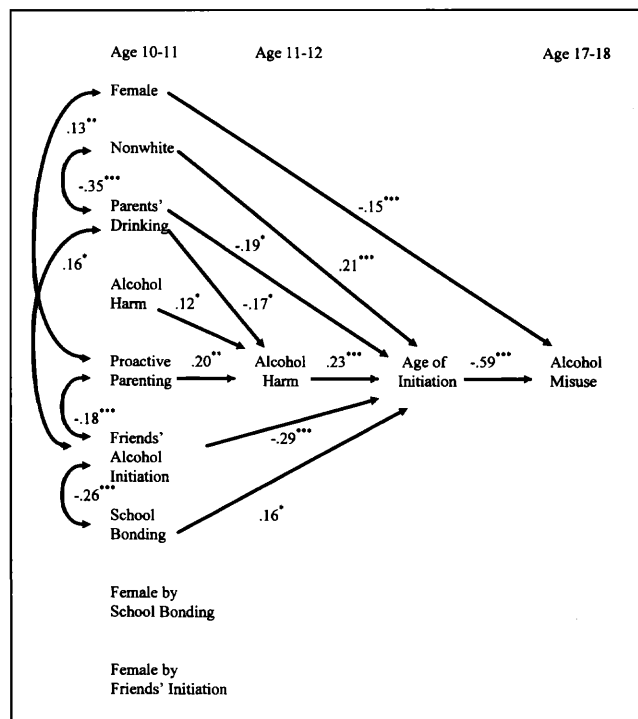

FIGURE 1. Predicting alcohol misuse at age 17-18. Nonsignificant regression paths are not shown for the sake of clarity. Factor correlations and standardized regression coefficients are shown. Only exogenous correlations involved in the significant mediated effects are shown. All exogenous variables were allowed to covary and each endogenous variable was allowed to be predicted by all variables to the left of that variable. Model $\chi^2 = 834.66$, 374 df, based on $N = 680$, which was the average pairwise N; GFI = .927; AGFI = .903; RHO = .914. $*p < .05$. $**p < .01$. $***p < .001$.

TABLE 1. Factor regressions and correlations

	UNSTANDARDIZED FACTOR REGRESSIONS		
	Outcome		
Predictor	Perceived alcohol harm 11-12	Age of alcohol initiation	Alcohol misuse
Gender	.01	.03	−.110‡
Ethnicity	−.03	.278§	.08
Parent's Drinking	−.165*	−.163*	−.01
Proactive Parenting	.189†	−.06	.01
Perceived Alcohol Harm 10-11	.113*	.02	−.03
Friends' Alcohol Initiation	−.07	−.273§	.09
School Bonding	−.04	.151*	.05
Gender × Friends' Initiation	−.05	−.07	−.03
Gender × School Bonding	.04	−.02	.00
Perceived Alcohol Harm 11-12		.203‡	.05
Age of Alcohol Initiation		0	−.645§
Alcohol Misuse		0	0

Note: Single digit elements were fixed at values shown. $*p < .05$. $†p < .01$. $‡p < .001$. $§p < .0001$.

	FACTOR CORRELATIONS AMONG PREDICTOR VARIABLES								
	1	2	3	4	5	6	7	8	9
1. Gender	1.00								
2. Ethnicity	−.01	1.00							
3. Parents' Drink	−.07	−.35‡	1.00						
4. Proactive Parenting	.13†	−.05	.10	1.00					
5. Perceived Harm 10-11	.14†	−.00	−.08	.09	1.00				
6. Friends' Initiation	−.05	−.08	.16*	−.18‡	−.12*	1.00			
7. School Bonding	.10*	.19‡	−.16†	.48‡	.10*	−.26‡	1.00		
8. Gender × Friends' Init.	.03	.11*	−.04	−.05	−.06	−.12*	−.00	1.00	
9. Gender × Bonding	.00	.02	.01	.01	.02	−.01	−.03	−.25‡	1.00

$*p < .05$. $†p < .01$. $‡p < .001$.

drinking younger), Parents' Drinking ($\beta = −.19$, $p < .05$; children of drinking parents began drinking younger), School Bonding ($\beta = .16$, $p < .05$; students more bonded to school initiated alcohol use later) and Friends' Alcohol Initiation ($\beta = −.29$, $p < .001$; students with drinking friends began drinking younger). Age of initiation was, in turn, a strong predictor of Alcohol Misuse at age 17-18 ($\beta = −.59$, $p < .001$; students who began drinking early misused alcohol more at age 17-18). Finally, gender was a direct predictor of Alcohol Misuse at age 17-18 ($\beta = −.15$, $p < .001$; males misused alcohol more than females).

Significant mediated effects

As depicted in Figure 1, there are several significant mediated effects. The strongest causal statements can be made about mediated effects when there are significant links between variables at different points in time. The temporal priority of the hypothesized cause helps rule out alternative causal interpretations. The first group of mediated effects falls into this category. Among these effects, both Parents' Drinking and Proactive Parenting had significant effects on alcohol misuse at age 17-18, mediated by perceptions of the harmfulness of drinking and age of initiation. Also, both ethnicity and Friends' Alcohol Initiation (at grade 5) had a sig-

nificant effect on alcohol misuse at age 17-18, mediated by age of initiation.

There may be other mediated effects; however, the case for these other effects is weaker, in that the first link in the causal chain is represented by a simultaneous correlation rather than by a regression of variables over time, and causal directionality cannot be established definitively in these data. Although clear temporal priority is missing from these effects, it may still be possible to posit causal mediation provided two assumptions are met. First, the hypothesized effect in the causal chain must be a significant predictor of perceptions of the harmfulness of drinking, or age of initiation. Parental Drinking, Proactive Parenting, Friends' Alcohol Initiation and School Bonding meet this requirement. Second, one must be able to mount a plausible logical argument for the hypothesized first causal link in the chain (the link based on a significant simultaneous correlation). For example, it is more likely that Gender causes Proactive Parenting than vice versa.

There were five significant effects that met both of these criteria. First, Gender predicted Age 17-18 Alcohol Misuse mediated by Proactive Parenting. Second, Ethnicity had a further effect on Age 17-18 Alcohol Misuse mediated by Parental Drinking. Third, Parental Drinking had a further effect on Age 17-18 Alcohol Misuse mediated by Friends' Al-

cohol Initiation at age 10-11. Fourth, Proactive Parenting had a further effect on Age 17-18 Alcohol Misuse mediated by Friends' Alcohol Initiation. Fifth, School Bonding had an effect on Age 17-18 Alcohol Misuse mediated by Friends' Alcohol Initiation at age 10-11.

Discussion

Strengths and limitations

This study used state-of-the-art methodology to address important questions relating to alcohol misuse at age 17-18. An important strength of the study is that it included a good measure of alcohol misuse. This was not simply a quantity-frequency measure of alcohol consumption. Rather, a latent variable was used that was made up of frequency of heavy drinking, drunk driving and other problems relating to alcohol use. The missing data analyses used in this study allowed a much stronger model test than could have been conducted without these procedures. The longitudinal nature of the data strengthens the plausibility of causal interpretations, although, clearly, these results require replication.

Two limitations of this study should be acknowledged. First, the prospective measure of age of initiation suffered from left censoring in that some students had already initiated use at the start of the study. The retrospective measures should have compensated for this problem, in that they did not suffer from left censoring, but the compensation may not have been complete. In order to take this left censoring into account, we estimated the model with the grade of initiation variable set to missing if the participant initiated alcohol use at grade 6 (age 11-12) or earlier. Using this approach, the interpretation of regression weights involving age of initiation, especially the path from beliefs about alcohol harm (age 11-12) to age of initiation, was more clear cut. All regression weights that were significant in the original model were also significant in this test, with the exception of school bonding predicting age of initiation.

Second, all measures of age of initiation suffered from right censoring since 26% of the sample reported no use of alcohol by age 17-18. However, the retrospective reports were considered to be missing if the students had not yet begun to use by age 17-18, thus the missing data procedure used in this study gave these people less weight in the analyses. This helped to mitigate the problem of right censoring.

Conclusions

The present study investigated two questions concerning the role of age of initiation in the development of alcohol misuse. These questions were examined using data from an ethnically diverse sample of students followed for 7.5 years beginning in the fifth grade at age 10-11.

The first question concerned whether age of initiation mediated the effects of family, school, peer and individual risk factors for alcohol misuse among adolescents. The results showed that the younger individuals are when they begin drinking alcohol, the greater their level of problems associated with alcohol misuse. Further, the results showed that age of initiation of alcohol use was an important mediator of the effects of ethnicity, parents' drinking, proactive parenting, school bonding, friends' alcohol initiation and perceived harmfulness of alcohol on alcohol misuse at age 17-18. That is, parents' drinking, proactive parenting, peer influences and perceptions of the harm of drinking, all measured in late childhood, affect the age of alcohol initiation, which, in turn, affects alcohol misuse in late adolescence. In fact, with the exception of gender, there was not a single significant effect on age 17-18 alcohol misuse that was not mediated by age of initiation.

The results confirm that peers' alcohol use is a strong predictor of adolescent use and misuse of alcohol. Again, the effect of peers' alcohol use in late childhood on alcohol misuse at age 17-18 is mediated through the age of initiation of alcohol use. Children with alcohol-using peers at age 10-11 are more likely to initiate alcohol use early and to misuse alcohol later in adolescence.

The results also suggest that parental behavior plays a central role in adolescent use and misuse of alcohol. Parental drinking affected adolescent alcohol misuse in several ways. The children of drinking parents were less likely to see drinking as harmful and more likely to start drinking earlier. Both these attitudes and behaviors, in turn, predicted greater alcohol misuse at age 17-18. Parental drinking may also be mediated by friends' alcohol use in predicting alcohol misuse in adolescence. Children of drinking parents may feel less inhibited from forming friendships with other children who have tried alcohol at age 10-11, reflecting a selection effect (Hansen et al., 1987).

Positive parenting methods also appear to inhibit adolescent alcohol misuse. Children of parents who communicated and were involved with their children at age 10-11, who set clear expectations for children's behavior, who practiced good supervision and consistent discipline, and who minimized conflict in the family, were more likely to see alcohol use as harmful at age 11-12, less likely to initiate alcohol use early, and, in turn, were less likely to misuse alcohol at age 17-18.

The effect of ethnicity on later alcohol misuse was also found to be mediated by age of initiation. White children generally began using alcohol earlier than did children of other ethnic backgrounds, and were, in turn, more at risk for later alcohol misuse. This effect may also be mediated by parental drinking. The fact that white parents drank more than nonwhite parents could also have mediated the effect of ethnicity on later alcohol misuse.

The second question concerned whether the mediation model would help us understand known gender differences in the severity of alcohol misuse. The strongest result in the present study was a significant direct relationship between gender and age 17-18 alcohol misuse (males misused more than females). That is, over and above the mediated effects

already described, which apply to both males and females, there was a significant residual effect of gender on alcohol misuse that was not explained by variation in the age of initiation between males and females. However, another gender effect that was potentially mediated by age of initiation was the effect on proactive parenting. Parents in the present sample were more likely to employ proactive parenting with their female children.

Further research is needed to identify the source of the significant direct effect of gender on alcohol misuse at age 17-18 observed here. The fact that no main effect of gender on age of initiation was found indicates that the differences in levels of alcohol misuse between males and females at age 17-18 result from factors arising after alcohol use has been initiated. Norms regarding the acceptability of alcohol misuse in mid to late adolescence may differ for males and females.

Implications for prevention

These results have important implications for prevention programs seeking to reduce alcohol misuse. First, they indicate that efforts to delay the initiation of alcohol use as a prevention strategy are well conceived. The importance of age initiation found here indicates that delaying the age of initiation should be a goal of programs seeking to prevent alcohol misuse. Although further work is needed to identify how males and females reach different levels of alcohol-related problems, the strong association between age of initiation and later alcohol problems indicates that delaying the age of onset of alcohol use should reduce alcohol misuse for both males and females.

Further, the results suggest the promise of prevention programs that strengthen proactive parenting. These data suggest that programs should teach parents to set clear expectations for their children's behavior; to monitor and reinforce their children's behavior consistently and appropriately; to educate their children about the potential risks of alcohol use, even if the parents drink; to encourage their children to delay alcohol initiation; to help their children avoid or resist the influence of alcohol-using peers; to communicate and be involved with their children; and to manage family conflict effectively. These proactive parenting practices help delay alcohol initiation and, thereby, help prevent later alcohol misuse.

Interventions seeking to prevent alcohol misuse also should target elementary and middle school children directly. These results indicate that increasing the perceived harmfulness of alcohol use among children at ages 11-12 should delay the initiation of alcohol use, which, in turn, should reduce alcohol misuse at age 17-18.

Acknowledgments

Note

1. Because large differences in variances across items create problems in estimation, variables were rescaled (standardized) prior to input to AMOS. The covariance matrix on which the analyses are based is available from the first author.

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