

# Age of Alcohol Initiation Matters: Examining Gender Differences in the Recency and Frequency of Alcohol Use Across Adolescence Using a Sample of Impoverished Minority Adolescents

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## Abstract

While previous research has shown alcohol use to increase developmentally throughout adolescence, the age of alcohol initiation has rarely been incorporated into developmental trajectories. Simultaneous estimation of the effects of early alcohol initiation was made in relation to the recency and frequency of alcohol use utilizing a sample of 1,209 low-income, minority adolescents initiating alcohol between 12 and 18. Significant effects of both age of alcohol initiation and gender were found. Initial alcohol use was higher the later the adolescent initiated alcohol use. Following initiation, trajectories of the recency and frequency of alcohol use for female adolescents increased more rapidly the earlier they initiate alcohol use, while trajectories for male adolescents increased independent of their year

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of initiation. Modeling age of initiation using piecewise growth models provided more informative results regarding early alcohol initiation effects as compared to traditional longitudinal model.

### **Keywords**

alcohol use, gender, adolescent development, longitudinal models, piecewise growth curve models

Previous studies have demonstrated that alcohol use tends to increase across adolescence (K. A. Bolland et al., 2016; Chung, Kim, Hipwell, & Stepp, 2013; Duncan, Gau, Duncan, & Strycker, 2011; Griffin, Bang, & Botvin, 2010; Gutman, Eccles, Peck, & Malanchuk, 2011; Johnston, O'Malley, Bachman, & Schulenberg, 2012; Kelly et al., 2011). Not all adolescents who drink alcohol exhibit the same trajectories of use, however. Using growth mixture modeling techniques, researchers have identified several trajectories of adolescent alcohol use (e.g., Komro, Tobler, Maldonado-Molina, & Perry, 2010), with factors such as age of participants making a difference in the characteristics of the identified trajectories. Four trajectories seem to be robust: chronic high, increasing, decreasing, and non/low (Sher, Jackson, & Steinley, 2011). Whether such aggregate trajectories reflect cohort effects or age effects, however, is unclear (Chung et al., 2013; Malone, Northrup, Masyn, Lamis, & Lamont, 2012). For example, an aggregate increasing trajectory may primarily reflect the same individuals drinking more with age, more individuals initiating alcohol use as they grow older, or a combination of both these possibilities.

Although several studies have taken into account the longitudinal nature of adolescent alcohol use, most have not incorporated the initiation of alcohol use into the modeling of the trajectories. Importantly, any analysis that does not distinguish between initiation cohorts is likely to exaggerate the developmental growth in drinking. That is, any aggregate change in alcohol use between observations reflects both (a) increases for those who initiated alcohol use at the current observation and (b) changes (positive or negative) for those who initiated alcohol use at previous observations. In this study, therefore, we examined the trajectory of alcohol use as a function of age of initiation for adolescents initiating alcohol between the ages of 12 and 18. A piecewise growth curve modeling approach was used in lieu of a more conventional growth model approach to estimate post-initiation growth rates in alcohol use simultaneously for each initiation cohort.

Because gender differences in adolescent alcohol use, correlates, and consequences have been demonstrated in previous studies (Brook et al., 2010;

Burk et al., 2011; Gunn & Smith, 2010; Johnston et al., 2012), gender is included as a covariate in the present study. Socioeconomic status and race-ethnicity have also been suggested as important moderators of adolescent alcohol use (Bachman, O'Malley, Johnston, Schulenberg, & Wallace, 2011; Schulenberg, Patrick, Maslowsky, & Maggs, 2014), although not all findings are consistent (Van Ryzin, Fosco, & Dishion, 2012). Rather than include these socioeconomic status and race-ethnicity as variables in the present study, we have controlled for these variables by focusing on a primarily Black American sample living in low-income neighborhoods.

## Literature Review

### *Consequences of Adolescent Alcohol Use*

Many studies have focused on the relation between adolescent alcohol use and both short-term and long-term psychosocial and health outcomes. In particular, early adolescent alcohol initiation (before age 14) has been associated with higher levels of alcohol use in adolescence (K. A. Bolland et al., 2016), accelerated increase in use during adolescence (Komro et al., 2010; Maldonado-Molina, Jennings, & Komro, 2010; Mason et al., 2010), and later alcohol use (Brook et al., 2010; Irons, Iacono, & McGue, 2015). Adolescent alcohol use has been demonstrated to be a predictor of continued problematic alcohol use, including heavy episodic alcohol use (King & Chassin, 2007; Pitkänen, Kokko, Lyyra, & Pulkkinen, 2008; Warner, White, & Johnson, 2007) and alcohol dependency (Hingson, Heeren, & Winter, 2006; Windle & Windle, 2012). Adolescent alcohol use has also been associated with a variety of negative psychosocial and behavioral outcomes, including depression (Griffin et al., 2010), delinquent, violent, and criminal behavior (Centers for Disease Control and Prevention, 2008; Donovan & Molina, 2011; Odgers et al., 2008), suicide attempts (Swahn, Bossarte, Ashby, & Meyers, 2010), school absenteeism and poor academic performance (Henry, 2010; Marti, Stice, & Springer, 2010; Peleg-Oren, Saint-Jean, Cardenas, Tammara, & Pierre, 2009), and occupational and legal difficulties in young adulthood (Griffin et al.). Greater clarity with respect to trajectories of alcohol use during adolescence can help inform interventions designed to prevent initiation, continuation, and increased rates of alcohol use, and thus to lessen the negative outcomes associated with alcohol use.

### *Age of Alcohol Initiation*

Traditional longitudinal growth modeling can distinguish between post-initiation patterns of alcohol use only by separately modeling the growth in alcohol use for

each initiation cohort (i.e., those who initiate at age 12, those who initiate at age 13, etc.). Some studies have focused on differences between groups defined by age of alcohol initiation or developmental period within which alcohol use is initiated, but typically the number of comparison groups has been limited to 2 or 3. For example, studies that compared groups initiating before and after age 12 or 13 with those who initiated later found early initiators to exhibit greater frequency or recency of alcohol use in later adolescence (K. A. Bolland et al., 2016) or to exhibit more problem behaviors (Peleg-Oren et al., 2009) than those who initiated later. In addition, with very few exceptions, studies have not examined year-to-year continuity in adolescent drinking (Chung et al., 2013; Malone et al., 2012). Chung and colleagues and Malone and colleagues found greater continuity in alcohol use for White American adolescents compared with Black American adolescents. The Chung study focused on female adolescents, whereas the Malone study included both male and female adolescents. These studies highlight the importance of examining both age of initiation of alcohol use and continuity of alcohol use, as well as the importance of considering both gender and race-ethnicity.

### *Gender Differences in Adolescent Alcohol Use*

Alcohol use among female adolescents has increased over time (Chen & Jacobson, 2012), and a growing body of evidence suggests that males and females may differ in age of initiation and in levels and trajectories of alcohol use. Consistent gender differences in the timing of alcohol initiation, however, have not been established. Some studies have identified higher rates of early initiation for males (Trim, Schuckit, & Smith, 2010) and others for females (Duncan, Duncan, & Strycker, 2006). Other studies, however, have identified no gender difference in age of initiation (Malone et al., 2012; Sartor et al., 2009). Gender differences in psychosocial factors, such as disinhibition (Burk et al., 2011), depressed mood (Crum, Storr, Ialongo, & Anthony, 2008), and importance of family and peer relationships (Chan, Kelly, & Toumbourou, 2013; Gunn & Smith, 2010; Kelly et al., 2011; Nargiso, Friend, & Florin, 2013) may explain some observed gender differences in adolescent drinking behavior. Other studies, however, have revealed few gender differences in the effects of conduct problems and depressive symptomatology on adolescent substance use trajectories (Maslowsky, Schulenberg, & Zucker, 2014).

Age and gender differences in levels and patterns of adolescent alcohol use have also been examined but without consistent conclusions. Some studies have shown no interaction effects on early alcohol initiation and gender (e.g., Kaestle, Halpern, Miller, & Ford, 2008; King & Chassin, 2007),

whereas others have shown the interaction to be a predictor of later risk behavior (e.g., K. A. Bolland et al., 2016; Cho, Hallfors, & Iritani, 2007; Stueve & O'Donnell, 2005). Some studies have found alcohol use rates to be similar for males and females in eighth grade but higher for males in twelfth grade (Johnston et al., 2012; Swendsen et al., 2012). Other studies have found greater alcohol use among young female adolescents than among their male counterparts (Biehl, Natsuaki, & Ge, 2007; Chen & Jacobson, 2012; Duncan et al., 2006; Johnston et al., 2012). Chen and Jacobson found, however, that after age 14, females drank less than males. Some of the observed gender differences in adolescent drinking levels may be a function of gender differences in drinking patterns. Growth mixture model analyses tend to find males more likely to be in high-risk drinking classes (N. Jackson, Denny, & Ameratunga, 2014), but females may be more likely to continue drinking during the year that they start drinking (Malone et al., 2012) and to escalate more rapidly in their drinking (K. M. Jackson, 2010). Associations among gender, age, psychosocial factors, and developmental outcomes, including alcohol use and consequences, are so complex as to warrant continued study.

### *Socioeconomic and Race-Ethnicity Differences in Adolescent Alcohol Use*

Few studies of adolescent alcohol use in the United States focus on socioeconomic status, perhaps because of the difficulty separating socioeconomic status from race-ethnicity, and conclusions have not been consistent. It has been observed that adolescents from lower socioeconomic backgrounds have higher rates of alcohol use than adolescents from higher socioeconomic backgrounds (Najman et al., 2010; Wang et al., 2014), although alcohol use rates across socioeconomic status tend to be similar by 12th grade (Johnston et al., 2012). Mason and colleagues (2011), however, found that 14- to 18-year-old adolescents from middle-income backgrounds reported greater alcohol use than those from low-income backgrounds.

The potential interaction of race-ethnicity and socioeconomic status on adolescent delinquency, which includes substance use, has received little research attention (Fagan, Wright, & Pinchevsky, 2013). Fagan and colleagues, however, found that neighborhood disadvantage increased the likelihood of substance use only for the Black American adolescents in their study. Earlier, Goodman and Huang (2002) found a positive association between adolescent alcohol use and family income, with no race-ethnicity effects. Bachman and colleagues (2011) have concluded that socioeconomic status may have a greater effect on alcohol use for White American adolescents than for Black American adolescents, with low socioeconomic status being a

greater risk factor for White American adolescents than for Black American adolescents. Although few studies have examined the interaction of race-ethnicity and socioeconomic status with respect to adolescent alcohol use, several studies have focused on racial-ethnic differences.

Racial-ethnic differences in adolescent alcohol initiation age, levels of use, and continuity of use have been observed (N. Jackson et al., 2014). Black American adolescents, for example, have been found to initiate alcohol use later than White American adolescents and to be more likely to report alcohol use in years after their initiation (Malone et al., 2012). Compared with Black American adolescents, White American adolescents tend to report higher levels of alcohol use (Cooper et al., 2008; Khan, Cleland, Scheidell, & Berger, 2014) and higher rates of use (K. M. Jackson, 2010; Johnston, O'Malley, Bachman, & Schulenberg, 2010).

Racial-ethnic differences may also interact with age and gender to account for some observed differences in adolescent alcohol use. Compared with White American females, for example, Black American females have been found to use alcohol less at age 11 and to have a slower rate of increase (Loeber, Stepp, Chung, Hipwell, & White, 2010). Black American adolescents in high school may be more likely to report recent alcohol use than their middle school counterparts, and males more likely than females (Vidourek & King, 2013). After initiation of alcohol use, White American adolescents may be more likely than Black American adolescents to continue drinking (Dauber, Paulson, & Leiferman, 2011; Malone et al., 2012), with the relationship holding especially for females (Dauber et al.). Relatively few studies consider race-ethnicity, socioeconomic status, age, *and* gender in their investigations of adolescent alcohol use. Findings from studies that have addressed race-ethnicity and/or socioeconomic status show that these factors may be important determinants of adolescent alcohol use, suggesting that additional work considering age and gender in conjunction with race-ethnicity and socioeconomic status could be instructive. Although universal prevention and intervention programs are efficient to implement, more targeted programs based on race-ethnicity, gender, age, and initiation status may be effective (Chan et al., 2013; Chartier, Hesselbrock, & Hesselbrock, 2011; N. Jackson et al., 2014; Shih, Miles, Tucker, Zhou, & D'Amico, 2010; Van Ryzin & Dishion, 2014). Further research that considers these important factors, by measuring them and isolating them in analyses, could help inform targeted interventions.

### *The Present Study*

Summarizing the extant literature, although it has been well established that alcohol use tends to increase across adolescence, the degree to which that

increase is a function of more adolescents initiating alcohol use with age, adolescents increasing in their rate and/or frequency of use once they initiate, or a combination of these possibilities is not clear. In addition, gender, socio-economic status, and race-ethnicity may interact with age to affect alcohol use across adolescence. Greater understanding of adolescent alcohol use trajectories can inform both prevention and intervention efforts. Using a primarily Black American data set from adolescents living in impoverished neighborhoods, we address the following research questions:

**Research Question 1:** How is initial alcohol use affected by the age at which the adolescent initiates alcohol use?

**Research Question 2:** How do trajectories of alcohol use change after the adolescent initiates alcohol use?

**Research Question 3:** How does gender affect trajectories of adolescent alcohol use after initiation?

Singer and Willett (2003) suggest a piecewise growth curve modeling approach to fitting models characterized by discontinuity during multiple time phases. In our study, the first phase is pre-initiation alcohol use, the second phase is alcohol use in the year of alcohol initiation, and the third phase is post-initiation alcohol use. The approach is equivalent to fitting splines around knots defined by the point of hypothesized discontinuity (see Cnaan, Laird, & Slasor, 1997; Naumova, Must, & Laird, 2001). This analysis is novel because it can simultaneously predict trajectories for all ages of alcohol initiation, rather than fitting them in separate models. A more complete picture of the growth in adolescent drinking through the use of piecewise growth curve modeling has potential to inform more appropriate prevention and intervention efforts.

## Method

### *Sample*

The adolescent sample used in this study comes from the Mobile Youth Survey (MYS), a longitudinal study of poverty and adolescent risk conducted between the years of 1998 and 2011 in 13 of the most impoverished neighborhoods in Mobile, Alabama and its surrounding communities. The full MYS data set was collected annually from more than 10,000 adolescents between the ages of 9 and 19; however, a number of exclusions were made when generating the final data set for the current study. First, data from the

year 2011 were not available for the current analysis, hence only the years 1998 to 2010 were analyzed. In addition, data points collected at the ages 9, 10, and 19 were excluded due to low overall prevalence of observations at these ages as compared with the ages 11 to 18. Finally, only adolescents who initiated alcohol use *during* their participation in the MYS and who reported using alcohol during at least one succeeding year were included. To further expand, adolescents were required to have a single data point where they indicated that they had never consumed alcohol, followed at some point by an indication that they had consumed alcohol. This distinction would indicate an initiation of alcohol use in the prior year. Therefore, the final sample was 1,209 adolescents who participated in the MYS and indicated that they had initiated alcohol use between the ages of 12 and 18 (ages 11-18 were included in the analysis to allow for initiation to be verified).

The sample was fairly evenly split between males (51%,  $n = 620$ ) and females (49%,  $n = 589$ ). Because the sample had little racial and ethnic diversity (95% [ $n = 1,149$ ] Black American youth, 4% [ $n = 54$ ] Hispanic youth, and even fewer White American youth [0.5%,  $n = 2$ ] and Mixed Race youth [0.5%,  $n = 4$ ]), race-ethnicity differences were not investigated. In each year of the study, between 87.3% and 93% of the participating adolescents reported receiving free or reduced-cost lunch. The mean household income was US\$6,276 (K. A. Bolland et al., 2016), and 73% of the residents in these neighborhoods lived below the poverty level.

## Procedure

Complete details of the sampling procedure, data collection method, and missing data for the MYS study have been previously reported (K. A. Bolland et al., 2016); therefore, only a brief description of the sampling and data collection procedures follows. The MYS was designed using multiple cohorts across 14 waves (years 1998-2011), with adolescents followed across 9 ages (ages 10-18). Within a targeted low-income neighborhood, all adolescents between the ages of 10 and 18 were identified, with adolescents within 3 months of their 10th or 18th birthday included (ages 9-19). Attempts were made to contact all adolescents and their caregivers identified between these ages. Information about the study and invitations to participate were given to all adolescents and caregivers contacted. Participation in the MYS required both parental consent and adolescent assent, both obtained prior to data collection, consistent with requirements of the university's Institutional Review Board.

Administration of the MYS self-report survey was done in group settings of between 20 and 30 adolescents. Each question was read aloud to the group. Adolescents marked responses in a survey booklet provided by the

researchers. If adolescents had difficulty completing the survey in the group setting, a one-on-one administration was conducted. Very few adolescents had difficulty completing the survey in the group setting. Adolescents were rewarded with US\$10 for their participation prior to 2005 and US\$15 in the years after (K. A. Bolland et al., 2016).

The directed sampling method generated a representative sample of observations from the targeted low-income neighborhoods of interest. The sample was deemed to be representative by comparing MYS responses to school system records: The sample of adolescents within the MYS does not differ demographically or functionally from the adolescents within the sampling frame (A. C. Bolland, 2012).

## Measures

*Alcohol use.* Alcohol use was measured by creating a 6-point Recency and Frequency of Alcohol Use scale from three MYS self-report alcohol use items (see K. A. Bolland et al., 2016 for details). The three items were as follows: (a) Have you ever used alcohol? (b) During the past month did you use alcohol? and (c) During the past week did you use alcohol? The first question was dichotomous, with adolescents responding either “no” or “yes.” The two remaining questions had three options: “no,” “yes, just once,” or “yes, more than once.” The Recency and Frequency scale was not a simple sum; rather, responses were aggregated to create a Recency and Frequency scale from 0 to 5. On this 5-point scale, a “0” indicates that the adolescent has never consumed alcohol, a “1” indicates that they have consumed alcohol but have not consumed any alcohol in the past 30 days, a “2” indicates that they have consumed alcohol one time in the past 30 days, a “3” indicates that they have consumed alcohol more than once in the past 30 days, a “4” indicates that they have consumed alcohol once in the past 7 days, and a “5” indicates that he or she consumed alcohol more than once in the past 7 days. Higher scores on this scale indicate both more frequent and more recent use of alcohol, indicating a higher likelihood of problematic alcohol consumption. This scale of alcohol use did not measure the amount of alcohol consumed on each occasion; rather, it measured the occurrence of alcohol use. Scale consistency was high, with Cronbach’s alpha of .78.

*Alcohol initiation.* Alcohol initiation was identified when adolescents reported at least 1 year in which they did not consume alcohol, followed by a year in which they did report alcohol use. This pattern would indicate that alcohol initiation occurred in the previous year. In this way, alcohol initiation in our sample must have occurred between the ages of 12 and 18, as the data ranged

from 11 to 18 years (age 11 was needed for verification of alcohol initiation). Alcohol initiation for each adolescent was coded 0 for the years prior to initiating alcohol use and 1 at the year of initiation and in each subsequent year.

*Age of alcohol initiation.* The age of alcohol initiation was reported as the age in which the adolescent initially reports consuming alcohol, determined by the alcohol initiation variable. Age of alcohol initiation ranged between the ages of 12 and 18. The variable was centered at 11 for ease of interpretation and to be on the same scale as our centered age variable. While no alcohol use was indicated by adolescents at age 11, centering occurred at that age as it is typical to center at the first available data point.

*Age and gender.* Age of the adolescent was reported as biological age in years, which was then centered at age 11 for ease of interpretability. Gender is dichotomous, with males coded 0 and females coded 1.

### Analysis Plan

In longitudinal growth modeling, an unconditional growth model is estimated, from which a full model is then built by adding additional parameters. The piecewise growth curve modeling approach used in this study adds additional parameters that allows for the simultaneous estimation of all ages of alcohol initiation. In all of the subsequent models, the dependent variable was alcohol use measured by the recency and frequency of alcohol use.

The unconditional growth model, using the Singer and Willett (2003) notation, is given as

$$\text{Level 1: } Y_{ij} = \pi_{0i} + \pi_{1i} \times \text{age} + \varepsilon_{ij}$$

$$\text{Level 2: } \pi_{0i} = \gamma_{00}$$

$$\pi_{1i} = \gamma_{10} + \zeta_{1i}$$

One difference between the traditional unconditional growth model and the model shown above for this study was that we did not allow for a random intercept. All adolescents in our study data set reported no alcohol use at age 11. Because the intercept attempts to estimate this value, the random intercept was not needed. That is not to say that the estimate of the intercept will be exactly 0, but rather the model estimate of the intercept should be close to 0, indicating no alcohol use at age 11.

Second, quadratic growth was estimated in this model by adding age as a quadratic term to our unconditional growth model. Quadratic growth has been found to be significant in previous studies (e.g., K. A. Bolland et al.,

2016), and hence provides a good baseline for comparison with the piecewise growth model.

Finally, the full piecewise growth model was estimated, incorporating differential growth before and after alcohol initiation, with differing intercepts and growth after alcohol was initiated, allowing for differential effects based on age at which alcohol was initiated, while also including gender effects. Of note, the unconditional growth models are not nested within this parameterization, as the variance parameters differ between the two models.

In building the full piecewise growth curve model, three additional factors were added: alcohol initiation, age of alcohol initiation, and gender. The first effect added was alcohol initiation, which was added to the Level 1 portion of the model as a time-varying covariate. The values of the alcohol initiation variable are 0 prior to alcohol initiation and 1 at the age alcohol is first initiated and each subsequent year. This parameter was added both as a main effect to estimate the intercept (or jump) at the time of initiation and as an interaction term with age to estimate the differential slope after alcohol is initiated. Age of alcohol initiation was added to the Level 2 portion of the model, allowing for differential estimates for all effects in the Level 1 portion of the model based on age of alcohol initiation. These effects should not be significant for the intercept and age, the trajectories prior to alcohol initiation, but are more informative with respect to the alcohol initiation and the alcohol initiation by age effects, the trajectories after alcohol initiation. The full model parameterization was as follows:

$$\begin{aligned} \text{Level 1: } Y_{ij} = & \pi_{0i} + \pi_{1i} \times \text{age} + \pi_{2i} \times \text{alcohol initiation} \\ & + \pi_{3i} \times \text{alcohol initiation} \times \text{age} + \varepsilon_{ij} \end{aligned}$$

$$\begin{aligned} \text{Level 2: } \pi_{0i} = & \gamma_{00} + \gamma_{01} \times \text{age of initiation} + \gamma_{02} \times \text{gender} \\ \pi_{1i} = & \gamma_{10} + \gamma_{11} \times \text{age of initiation} + \gamma_{12} \times \text{gender} \\ \pi_{2i} = & \gamma_{20} + \gamma_{21} \times \text{age of initiation} + \gamma_{22} \times \text{gender} + \zeta_{2i} \\ \pi_{3i} = & \gamma_{30} + \gamma_{31} \times \text{age of initiation} + \gamma_{32} \times \text{gender} + \zeta_{3i} \end{aligned}$$

The random effects in this model were included only for the alcohol initiation and alcohol initiation by age effects, as they were not needed for the intercept and age effects (both these estimates should be 0 for all adolescents, because the intercept is the average amount of alcohol the individual consumes prior to initiating alcohol and the age effect is the change in the amount of alcohol consumed prior to initiating alcohol). The alcohol initiation effect and the alcohol initiation by age effect both require random effects, however, as they model the intercept and the slope of the alcohol use trajectories after alcohol use is initiated. The Bayesian Information Criterion (BIC) was used to compare model fit

**Table 1.** Distribution of Alcohol Initiation Age by Gender.

Gender	Age of alcohol initiation							
	12	13	14	15	16	17	18	
Males	69 (55%)	93 (48%)	92 (48%)	101 (49%)	98 (58%)	96 (61%)	71 (43%)	620 (51%)
Females	57 (45%)	99 (52%)	100 (52%)	105 (51%)	72 (42%)	61 (39%)	95 (57%)	589 (49%)
Total	126	192	192	206	170	157	166	<i>n</i> = 1,209
<i>z</i>	1.51	-0.61	-0.82	-0.394	2.82*	3.95*	-2.63*	

\**p* < .05.

between these two models, with lower BIC values indicating a better-fitting model. All analyses were conducted using proc mixed in SAS software Version 9.3 (SAS Institute Inc., Cary, North Carolina) using full-information maximum likelihood. Unstructured variance-covariance matrices were estimated.

## Results

### *Preliminary Analysis*

Prior to the longitudinal analysis, a contingency table of gender by the age of alcohol initiation was constructed (Table 1) to check for gender differences. Although a statistically significant difference in males' and females' age of initiation was discovered,  $\chi^2(6) = 16.2, p = .013$ , there was no clear pattern to the dependency. Proportions were compared between the two genders using post hoc *z*-tests (see Table 1). No statistically significant differences were found in the number of males versus females who initiated alcohol use between the ages of 12 and 15, though slightly more females than males initiated alcohol use between the ages of 13 and 15 and slightly more males initiated at age 12. At ages 16 and 17, significantly more males than females initiated alcohol use, yet at age 18 significantly more females than males initiated alcohol use. Results indicate that greater proportions of males were initiating at later ages (16 and 17) as compared with females.

### *Unconditional Growth Model*

The unconditional growth model was estimated to determine the overall trajectory of alcohol use between the ages of 11 and 18. Parameter estimates for the model are shown in Table 2. Because the study data set includes only adolescents who initiated alcohol use after age 11, the average recency and frequency of alcohol use at age 11 was not significantly

**Table 2.** Linear Growth Model of Recency and Frequency of Alcohol Use Based on Age of Initiation.

Parameter	Linear growth		Quadratic growth		Piecewise growth	
	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	-0.056	0.037	0.022	0.044	0	0.020
Initiation point					1.707*	0.115
Age	0.405*	0.012	0.291*	0.035	0	0.007
Age × Age			0.018*	0.005		
Age × Initiation point					0.186*	0.026
Age × Initiation point × Age of initiation × Gender					-0.014*	0.003
Variance (age)	0.037*	0.003	0.285*	0.034		
Variance (Age × Age)			0.006*	0.001		
Variance (initiation point)					6.380*	0.606
Variance (Age × Initiation point)					0.272*	0.272
Error variance	1.513*	0.040	1.285*	0.040	0.353*	0.011
BIC	13,906.9		13,809.2		10,224.7	

Note. BIC = Bayesian Information Criterion.

\* $p < .05$ .

different from 0,  $\gamma = -.06$ ,  $t(2,805) = -1.59$ ,  $p = .112$ . The recency and frequency of alcohol use significantly increased as the adolescent aged,  $\gamma = .41$ ,  $t(1,190) = 34.52$ ,  $p < .001$ . Results from this model indicate that, as expected, the recency and frequency of alcohol use significantly increased between the ages of 11 and 18.

A nonlinear growth model was also estimated by adding a quadratic term, which was found to be significant. Parameter estimates can be found in Table 2. Again, by definition, the average recency and frequency of alcohol use at age 11 did not differ from 0 in this model,  $\gamma = .02$ ,  $t(1,808) = 0.50$ ,  $p = .615$ , and the recency and frequency of alcohol use significantly increased between the ages of 11 and 18,  $\gamma = .29$ ,  $t(1,190) = 8.25$ ,  $p < .001$ . The positive quadratic term was also statistically significant,  $\gamma = .02$ ,  $t(996) = 3.56$ ,  $p < .001$ , indicating that the curve remains low and then increases more rapidly at older ages. This pattern in the data can be better captured by the piecewise modeling, with the slopes of alcohol use after the point of alcohol initiation uninfluenced by the slope from no use to initiation.

## Impact of Age of Initiation

The full longitudinal model was estimated to include all of the effects of age, alcohol initiation, age of alcohol initiation, and gender. Only significant parameters were retained in the final model, with estimates shown in Table 2. The smaller BIC for the final model indicates that it was a better-fitting model than either the unconditional linear or quadratic growth model.

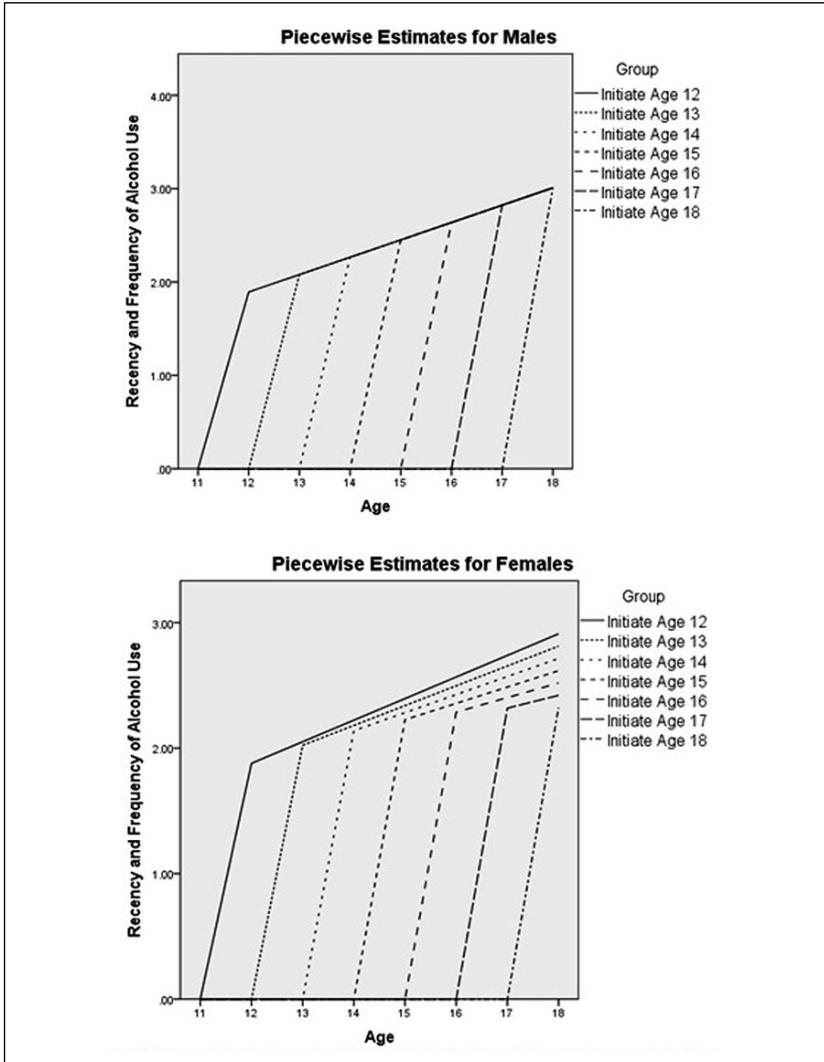
Because the data set includes only adolescents who initiated alcohol use after age 11, the average recency and frequency of alcohol use at age 11 did not differ significantly from 0,  $\gamma = .00$ ,  $t(2,406) = 0.00$ ,  $p = 1.00$ . The increase in the recency and frequency of alcohol use at the point of initiation is statistically significant,  $\gamma = 1.71$ ,  $t(1,121) = 14.88$ ,  $p < .001$ . This indicates that those who initiated alcohol use at older ages had greater recency and frequency of alcohol use at initiation than did those who initiated at younger ages. No gender differences were found for this effect.

After initiation of alcohol use, trajectories of the recency and frequency of alcohol use significantly increased over time,  $\gamma = .19$ ,  $t(465) = 7.07$ ,  $p < .001$ . These trajectories were identical for all males independent of the age at which alcohol is initiated. However, female adolescents were significantly affected by the age at which they initiate alcohol use,  $\gamma = -.01$ ,  $t(2,406) = -4.18$ ,  $p < .001$ . Female adolescents exhibited significantly larger increases in the recency and frequency of alcohol use over time the earlier alcohol was initiated.

Interpretation of the full model can be facilitated by examining the predicted trajectories of alcohol use, which are plotted in Figure 1. Two graphs were estimated based on the age at which the adolescent initiates alcohol use, with separate plots for males and females. Visually, the predicted trajectory plots appear different for the two genders. Both male and female adolescent trajectories exhibit increases in slope as the age of alcohol initiation increases, although with differing results with regard to age of initiation. Males, overall, have similar levels of alcohol recency and frequency, independent of when alcohol was initiated. Females who initiate alcohol use at younger ages, however, exhibit greater recency and frequency of alcohol use than those who initiate later.

## Discussion

The purpose of the current study was threefold. Using piecewise growth modeling, we examined (a) how initial recency and frequency of alcohol use was affected by the age at which the adolescent initiated alcohol use, (b) how trajectories of the recency and frequency of alcohol use change after the adolescent initiated alcohol use, and (c) if there were any gender differences in



**Figure 1.** Trajectories of the recency and frequency of alcohol use after initiation based on gender and age of initiation.

the trajectories of the recency and frequency of alcohol use after the adolescent initiated alcohol use. Our sample consisted of a highly understudied population of minority adolescents living in impoverished neighborhoods.

First, the initial levels of recency and frequency of alcohol use were significantly affected by the age of alcohol initiation. While both genders exhibited higher initial levels of recency and frequency of alcohol use the later in adolescence they initiated, increases were significantly greater for males. Second, there was an increase in the recency and frequency of alcohol use after the initiation of alcohol use; however, only females experienced a difference in slopes after initiation depending upon the age at which they initiated alcohol use. Females initiating alcohol use at a younger age had greater increases in the recency and frequency of alcohol use across adolescence. Both these findings taken together indicate that, third, there were significant gender differences in the overall trajectories of recency and frequency of alcohol use across adolescence.

In the male trajectories, the levels of recency and frequency of alcohol use were identical at the age of 18; however, the path to that point differed based on the age of alcohol initiation. Males who initiated later would, in a sense, “catch up” to those who initiated early by having higher levels of recency and frequency of alcohol use in their year of initiation as compared with their early initiating counterparts. This higher initial level, however, did not cause males to increase their alcohol use at a rate faster than the early initiators. In our sample, males may be experiencing high levels of peer pressure to drink as often as their peers who initiated prior. Church et al. (2012) found that adolescents from the same population experienced higher levels of peer influence to engage in delinquent behaviors if the adolescent was engaging in less delinquency. Adolescent males have been shown to be highly influenced by peer relationships (Fagan, Van Horn, Hawkins, & Jaki, 2013; Patrick & Schulenberg, 2014), and peer influence, in turn, has been shown to be highly related to substance use (e.g., Santor, Messervey, & Kusumaker, 2000).

In the female trajectories, more variability was visible in the recency and frequency of alcohol use at the age of 18. Those females who initiated earlier had significantly higher levels of recency and frequency of alcohol use at age 18. Similar to the male sample, females who initiated later in adolescence did exhibit higher initial levels of recency and frequency of alcohol use. Unlike the male sample, however, the females did not “catch up” with females initiating early due to the higher growth rates exhibited across adolescence for females initiating earlier. Early alcohol initiation in females followed by increased growth in the recency and frequency of use may be a result of less parental monitoring of females at a younger age. Church et al. (2015) found that females in this population experienced less parental monitoring when they were younger, resulting in higher levels of delinquency at a younger age. Previous research has shown females to be influenced by family relationships (Fagan et al., 2013; Patrick & Schulenberg, 2014), and the lower levels of

parental monitoring may be contributing to higher levels of alcohol use for early initiators.

In our sample, 42% ( $n = 510$ ) initiated alcohol use prior to the age of 15, with an equal proportion of both males and females initiating early. Our findings indicate an agreement with the previous literature that there were no gender differences in the rate of early initiation between the two genders (Malone et al., 2012; Sartor et al., 2009); however, in our sample, early alcohol use appears to be more problematic for females when looking at their overall trajectories of alcohol use. K. A. Bolland et al. (2016) found similar findings in this population when looking only at adolescents initiating prior to the age of 12. Recency and frequency of alcohol use was significantly higher at age 18 for females who initiated alcohol earlier in adolescence. Early initiation of alcohol use has been linked to many negative psychosocial and behavioral problems (e.g., Donovan & Molina, 2011; Griffin et al., 2010). For example, Tomek et al. (2015) found higher prevalence of suicidal ideations and attempts in this population when alcohol use was significantly higher.

In truth, the gender differences in trajectories may be related to other gender-related differences. For example, young female adolescents were found to be more likely to engage in alcohol use while at home or during the weekends (Goncy & Mrug, 2013), whereas young male adolescents found social drinking to be more acceptable for them out of the home, resulting in greater openness in their drinking behavior. Thus, those young females who do initiate early may have to make a greater effort to do so, which could be associated with their escalating use.

### ***Benefits of Piecewise Analysis***

The present study adds to the literature base in several important ways. A longitudinal growth modeling perspective is common in recent research about the problem of alcohol use in adolescence (e.g., Prins, Donovan, & Molina, 2011; Sher et al., 2011). The first analysis we conducted is not atypical: an unconditional growth model to estimate the change in alcohol use between the ages of 11 and 18. A significant increase was found in the level of alcohol use as the adolescents' age. This result is consistent with numerous other studies (e.g., K. A. Bolland et al., 2016; Chung et al., 2013; Duncan et al., 2011; Griffin et al., 2010; Gutman et al., 2011; Johnston et al., 2012; Kelly et al., 2011). The increase in the alcohol use across adolescence, however, appears to be an artifact of the differences in the differences at the point of initiation (intercept), rather than a function of a large increase in alcohol use of the individual across adolescence (slope).

The piecewise analysis revealed significant increases in alcohol use in the year of alcohol initiation. That is, alcohol use increased significantly from no use during the first year of alcohol use. From that point, there is growth for both males and females, although there were differential growth rates for the two groups. In the unconditional growth model, it appears that growth jumps around 0.41 points each year. However, a majority of that growth is encompassed by the large jump that occurs at the point of initiation, as growth after initiation was much smaller in the piecewise model (e.g., 0.19 points each year for males).

Adding the quadratic term in the unconditional growth model allowed for better fit of the data. A significant increase in fit was found in the nonlinear model compared with the unconditional growth model ( $\Delta\text{BIC} = 97.7$ ). Unlike the linear growth model, the quadratic growth model was better able to capture the shape of alcohol use that occurs; namely no alcohol use prior to initiation, the jump in the year of initiation, and growth afterward. However, the parameterization of the piecewise growth model provides an even more precise shape. Piecewise longitudinal analysis is able to better capture the trajectories of the individual alcohol user across time because the analysis accounts for both initial change and continuing trajectories of alcohol use. The improvement of fit for the nonlinear model was small compared with that gained by using the piecewise growth model ( $\Delta\text{BIC} = 3,682.2$ ). Overall, using piecewise growth models to estimate alcohol use resulted in a better fit to the data for the current sample.

## Limitations and Future Directions

This current study was limited to those adolescents who initiated alcohol use between the ages of 12 and 18. Adolescents who initiated prior to age 12 were not included, nor were adolescents who may have initiated but did not provide MYS data prior to initiation (e.g., the first data point was collected at age 15, yet they initiated alcohol at age 14, therefore initiation could not be identified).

The sample for this study was not diverse; therefore, the results may not be generalizable beyond this subpopulation. All adolescents reside in low-income neighborhoods in Alabama. In addition, 96% of the participants were Black Americans, further limiting the generalizability to adolescents of other races/ethnicities. The homogeneity of the sample does, however, support the internal validity of the results. Similar research with other racial and ethnic populations and more diverse socioeconomic populations would add to the knowledge base regarding trajectories of adolescent alcohol use.

Our measure of alcohol use, the recency and frequency of alcohol use, does not measure the amount of alcohol consumed. This is a limitation, as

those adolescents who had one drink on a single day in the last week received the same score as an adolescent who had five drinks on a single day in the last week. Additional research using piecewise longitudinal models should be directed toward the amount of alcohol consumed in addition to the recency and frequency of that consumption.

Finally, although this study illuminates gender differences in the recency and frequency of alcohol use for individuals who initiate alcohol use at different ages, it does not address the many psychosocial and biological correlates of alcohol use that have been suggested, nor the many negative consequences of adolescent alcohol use, some of which may differ by gender and age of initiation. Further research along those lines is warranted.

## **Conclusion**

Our findings that the recency and frequency of alcohol use increases throughout adolescence are consistent with previous research. We have demonstrated, however, that the increase is largely a function of more adolescents initiating alcohol use at each increasing age. The increase in recency and frequency of use, after the initial jump from no use to some use, is not as severe as it was assumed to be based on the unconditional growth model. Importantly, the age of alcohol initiation had an effect on female's alcohol use growth over time, with those who initiated at younger ages having greater recency and frequency of alcohol use at age 18 compared with those who initiated when they were older. Levels of alcohol use for males, however, were similar independent of the age at which they initiated alcohol use. By incorporating age of alcohol initiation into the longitudinal growth model, we could simultaneously compare all ages of alcohol initiation, resulting in greater statistical power. Our robust finding that early initiation of alcohol use is especially detrimental for young adolescent females supports the development and implementation of targeted prevention strategies as well as more universal prevention and intervention efforts.

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## References

- Bachman, J. G., O'Malley, P. M., Johnston, L. D., Schulenberg, J. E., & Wallace, J. M., Jr. (2011). Racial/ethnic differences in the relationship between parental education and substance use among U.S. 8th-, 10th-, and 12th-grade students: Findings from the monitoring the future project. *Journal of Studies on Alcohol and Drugs, 72*, 279-285.
- Biehl, M. C., Natsuaki, M. N., & Ge, X. (2007). The influence of pubertal timing on alcohol use and heavy drinking trajectories. *Journal of Youth and Adolescence, 36*, 153-167.
- Bolland, A. C. (2012). *Representativeness two ways: An assessment of representativeness and missing data mechanisms in a study of an at-risk population* (Unpublished doctoral dissertation). The University of Alabama, Tuscaloosa.
- Bolland, K. A., Bolland, J. M., Tomek, S., Devereaux, R. S., Mrug, S., & Wimberly, J. C. (2016). Trajectories of adolescent alcohol use by gender and early initiation status. *Youth & Society, 48*, 3-32.
- Brook, J. S., Balka, E. B., Crossman, A. M., Dermatis, H., Galanter, M., & Brook, D. W. (2010). The relationship between parental alcohol use, early and late adolescent alcohol use, and young adult psychological symptoms: A longitudinal study. *The American Journal on Addictions, 19*, 534-542.
- Burk, L. R., Armstrong, J. M., Goldsmith, H. H., Klein, M. H., Strauman, T. J., Costanzo, P., & Essex, J. J. (2011). Sex, temperament, and family context: How the interaction of early factors differentially predict adolescent alcohol use and are mediated by proximal adolescent factors. *Psychology of Addictive Behaviors, 25*, 1-15.
- Centers for Disease Control and Prevention. (2008, June 6). Youth risk behavior surveillance—United States, 2007. Surveillance summaries. *Morbidity and Mortality Weekly Report, 57*(SS-4), 1-131.
- Chan, G. K., Kelly, A. B., & Toumbourou, J. W. (2013). Accounting for the association of family conflict and heavy alcohol use among adolescent girls: The role of depressed mood. *Journal of Studies on Alcohol and Drugs, 74*, 396-405.
- Chartier, K. G., Hesselbrock, M. N., & Hesselbrock, V. M. (2011). Alcohol problems in young adults transitioning from adolescence to adulthood: The association with race and gender. *Addictive Behaviors, 36*, 167-174.
- Chen, P., & Jacobson, K. C. (2012). Developmental trajectories of substance use from early adolescence to young adulthood: Gender and racial/ethnic differences. *Journal of Adolescent Health, 50*, 154-163.
- Cho, H., Hallfors, D. D., & Iritani, B. J. (2007). Early initiation of substance use and subsequent risk factors related to suicide among urban high school students. *Addictive Behaviors, 32*, 1628-1639.
- Chung, T., Kim, K. H., Hipwell, A. E., & Stepp, S. D. (2013). White and Black adolescent females differ in profiles and longitudinal patterns of alcohol, cigarette, and marijuana use. *Psychology of Addictive Behaviors, 27*, 1110-1121.
- Church, W. T., Jagers, J., Tomek, S., Bolland, A. C., Bolland, K. A., Hooper, L. M., & Bolland, J. M. (2015). Does permissive parenting encourage delinquency?

- An examination of family management practices. *Journal of Juvenile Justice*, 4, 95-110.
- Church, W. T., Tomek, S., Bolland, K. A., Hooper, L. M., Jagers, J., & Bolland, J. M. (2012). A longitudinal examination of predictors of delinquency: An analysis of data from the Mobile Youth Survey. *Children and Youth Services Review*, 34, 2400-2408.
- Cnaan, A., Laird, N. M., & Slasor, P. (1997). Using the general linear mixed model to analyse unbalanced repeated measures and longitudinal data. *Statistics in Medicine*, 16, 2349-2380.
- Cooper, M. L., Krull, J. L., Agocha, V. B., Flanagan, M. E., Orcutt, H. K., Grabe, S., & Jackson, M. (2008). Motivational pathways to alcohol use and abuse among Black and White adolescents. *Journal of Abnormal Psychology*, 117, 485-501.
- Crum, R. M., Storr, C. L., Jalongo, N., & Anthony, J. C. (2008). Is depressed mood in childhood associated with an increased risk for initiation of alcohol use during early adolescence? *Addictive Behaviors*, 33, 24-40.
- Dauber, S. E., Paulson, J. F., & Leiferman, J. A. (2011). Race-specific transition patterns among alcohol use classes in adolescent girls. *Journal of Adolescence*, 34, 407-420.
- Donovan, J. E., & Molina, B. S. G. (2011). Childhood risk factors for early-onset drinking. *Journal of Studies on Alcohol and Drugs*, 72, 741-751.
- Duncan, S. C., Duncan, T. E., & Strycker, L. A. (2006). Alcohol use from ages 9-16: A cohort-sequential latent growth model. *Drug and Alcohol Dependence*, 81, 71-81.
- Duncan, S. C., Gau, J. M., Duncan, T. E., & Strycker, L. A. (2011). Development and correlates of alcohol use from ages 13-20. *Journal of Drug Education*, 41, 235-252.
- Fagan, A. A., Van Horn, M. L., Hawkins, J. D., & Jaki, T. (2013). Differential effects of parental controls on adolescent substance use: For whom is the family most important? *Journal of Quantitative Criminology*, 29, 347-368.
- Fagan, A. A., Wright, E. M., & Pinchevsky, G. M. (2013). Racial/ethnic differences in the relationship between neighborhood disadvantage and adolescent substance use. *Journal of Drug Issues*, 43, 69-84.
- Goncy, E. A., & Mrug, S. (2013). Where and when adolescents use tobacco, alcohol, and marijuana: Comparisons by age, gender, and race. *Journal of Studies on Alcohol and Drugs*, 74, 288-300.
- Goodman, E., & Huang, B. (2002). Socioeconomic status, depressive symptoms, and adolescent substance use. *Archives of Pediatric Adolescent Medicine*, 156, 448-453.
- Griffin, K. W., Bang, H., & Botvin, G. J. (2010). Age of alcohol and marijuana use onset predicts weekly substance use and related psychosocial problems during young adulthood. *Journal of Substance Use*, 15, 174-183.
- Gunn, R. L., & Smith, G. T. (2010). Risk factors for elementary school drinking: Pubertal status, personality, and alcohol expectancies concurrently predict fifth grade alcohol consumption. *Psychology of Addictive Behaviors*, 24, 617-627.

- Gutman, L. M., Eccles, J. S., Peck, S., & Malanchuk, O. (2011). The influence of family relations on trajectories of cigarette and alcohol use from early to late adolescence. *Journal of Adolescence, 34*, 119-128.
- Henry, K. L. (2010). Academic achievement and adolescent drug use: An examination of reciprocal effects and correlated trajectories. *Journal of School Health, 80*, 38-43.
- Hingson, R. W., Heeren, T., & Winter, M. R. (2006). Age at drinking onset and alcohol dependence: Age at onset, duration, and severity. *Archives of Pediatric and Adolescent Medicine, 160*, 739-746.
- Irons, D. E., Iacono, W. G., & McGue, M. (2015). Tests of the effects of adolescent early alcohol exposures on adult outcomes. *Addiction, 110*, 269-278.
- Jackson, K. M. (2010). Progression through early drinking milestones in an adolescent treatment sample. *Addiction, 105*, 438-449.
- Jackson, N., Denny, S., & Ameratunga, S. (2014). Social and socio-demographic neighborhood effects on adolescent alcohol use: A systematic review of multi-level studies. *Social Science & Medicine, 115*, 10-20.
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2010). *Monitoring the Future: National survey results on drug use, 1975-2009. Volume I: Secondary school students* (NIH Publication No. 10-7584). Bethesda, MD: National Institute on Drug Abuse.
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2012). *Monitoring the Future national results on adolescent drug use: Overview of key findings, 2011*. Ann Arbor: Institute for Social Research, The University of Michigan.
- Kaestle, C. E., Halpern, C. T., Miller, W. C., & Ford, C. A. (2008). Young age at first sexual intercourse and sexually transmitted infections in adolescents and young adults. *American Journal of Epidemiology, 161*, 774-780.
- Kelly, A. B., O'Flaherty, M., Toumbourou, J. W., Connor, J. P., Hemphill, S. A., & Catalano, R. F. (2011). Gender differences in the impact of families on alcohol use: A lagged longitudinal study of early adolescents. *Addiction, 106*, 1427-1436.
- Khan, M. R., Cleland, C. M., Scheidell, J. D., & Berger, A. T. (2014). Gender and racial/ethnic differences in patterns of adolescent alcohol use and associations with adolescent and adult illicit drug use. *The American Journal of Drug and Alcohol Abuse, 40*, 213-224.
- King, K. M., & Chassin, L. (2007). A prospective study of the effects of age of initiation of alcohol and drug use on young adult substance dependence. *Journal of Studies on Alcohol and Drugs, 68*, 256-265.
- Komro, K. A., Tobler, A. L., Maldonado-Molina, M. M., & Perry, C. L. (2010). Effects of alcohol use initiation patterns on high-risk behaviors among urban, low-income, young adolescents. *Prevention Science, 11*, 14-23.
- Loeber, R., Stepp, S. D., Chung, T., Hipwell, A. E., & White, H. R. (2010). Time-varying associations between conduct problems and alcohol use in adolescent girls: The moderating role of race. *Journal of Studies on Alcohol and Drugs, 71*, 544-553.

- Maldonado-Molina, M. M., Jennings, W. G., & Komro, K. A. (2010). Effects of alcohol on trajectories of physical aggression among urban youth: An application of latent trajectory modeling. *Journal of Youth and Adolescence*, 39, 1012-1026.
- Malone, P. S., Northrup, T. F., Masyn, K. E., Lamis, D. A., & Lamont, A. E. (2012). Initiation and persistence of alcohol use in United States Black, Hispanic, and White male and female youth. *Addictive Behaviors*, 37, 299-305.
- Marti, C. N., Stice, E., & Springer, D. W. (2010). Substance use and abuse trajectories across adolescence: A latent trajectory analysis of a community-recruited sample of girls. *Journal of Adolescence*, 33, 449-461.
- Maslowsky, J., Schulenberg, J. E., & Zucker, R. A. (2014). Influence of conduct problems and depressive symptomatology on adolescent substance use: Developmentally proximal versus distal effects. *Developmental Psychology*, 50, 1179-1189.
- Mason, W. A., Hitch, J. E., Kosterman, R., McCarthey, C. A., Herrenkohl, T. I., & Hawkins, J. D. (2010). Growth in adolescent delinquency and alcohol use in relation to young adult crime, alcohol use disorders, and risky sex: A comparison of youth from low- versus middle-income backgrounds. *Journal of Child Psychiatry*, 51, 1377-1385.
- Mason, W. A., Toumbourou, J. W., Herrenkohl, T. I., Hemphill, S. A., Catalano, R. F., & Patton, G. C. (2011). Early age alcohol use and later alcohol problems in adolescents: Individual and peer mediators in a bi-national study. *Psychology of Addictive Behaviors*, 25, 625-633.
- Najman, J. M., Clavarino, A., McGee, T. R., Bor, W., Williams, G. M., & Hayatbakhsh, M. R. (2010). Timing and chronicity of family poverty and development of unhealthy behaviors in children: A longitudinal study. *Journal of Adolescent Health*, 46, 538-544.
- Nargiso, J. E., Friend, K., & Florin, P. (2013). An examination of peer, family, and community context risk factors for alcohol use and alcohol use intentions in early adolescents. *The Journal of Early Adolescence*, 33, 973-993.
- Naumova, E. N., Must, A., & Laird, N. M. (2001). Tutorial in biostatistics: Evaluating the impact of critical periods' in longitudinal studies of growth using piecewise mixed effects models. *International Journal of Epidemiology*, 30, 1332-1341.
- Oggers, C. L., Caspi, A., Nagin, D. S., Piquero, A. R., Slutske, W. S., Milne, B. J., . . . Moffitt, T. E. (2008). Is it important to prevent early exposure to drugs and alcohol among adolescents? *Psychological Science*, 19, 1037-1044.
- Patrick, M. E., & Schulenberg, J. E. (2014). Prevalence and predictors of adolescent alcohol use and binge drinking in the United States. *Alcohol Research: Current Reviews*, 35, 193-200.
- Peleg-Oren, N., Saint-Jean, G., Cardenas, G. A., Tammara, H., & Pierre, C. (2009). Drinking alcohol before age 13 and negative outcomes in late adolescence. *Alcoholism: Clinical & Experimental Research*, 33, 1966-1972.
- Pitkänen, T., Kokko, K., Lyyra, A. L., & Pulkkinen, L. (2008). A developmental approach to alcohol drinking behaviour in adulthood: A follow-up study from age 8 to age 42. *Addiction*, 103, 48-68.

- Prins, J. C., Donovan, J. E., & Molina, B. S. G. (2011). Parent-child divergence in the development of alcohol use norms from middle childhood into middle adolescence. *Journal of Studies on Alcohol and Drugs, 72*, 438-443.
- Santor, D. A., Messervey, D., & Kusumaker, V. (2000). Peer pressure, popularity, and conformity in adolescent boys and girls: Predicting school performance, sexual attitudes, and substance use. *Journal of Youth and Adolescence, 29*, 163-182.
- Sartor, C. E., Agrawal, A., Lynskey, M. T., Bucholz, K. K., Madden, P. A. F., & Heath, A. C. (2009). Common genetic influences on the timing of first use for alcohol, cigarettes, and cannabis in young African-American women. *Drug and Alcohol Dependence, 102*, 49-55.
- Schulenberg, J., Patrick, M. E., Maslowsky, J., & Maggs, J. L. (2014). The epidemiology and etiology of adolescent substance use in developmental perspective. In M. Lewis & K. D. Randolph (Eds.), *Handbook of developmental psychopathology* (pp. 601-620). New York, NY: Springer.
- Sher, K., Jackson, K. M., & Steinley, D. (2011). Alcohol use trajectories and the ubiquitous cat's cradle: Cause for concern? *Journal of Abnormal Psychology, 120*, 322-335.
- Shih, R. A., Miles, J. N., Tucker, J. S., Zhou, A. J., & D'Amico, E. J. (2010). Racial/ethnic differences in adolescent substance use: Mediation by individual, family, and school factors. *Journal of Studies on Alcohol and Drugs, 71*, 640-651.
- Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence*. New York, NY: Oxford University Press.
- Stueve, A., & O'Donnell, L. N. (2005). Early alcohol initiation and subsequent sexual and alcohol risk behaviors among urban youths. *American Journal of Public Health, 95*, 887-893.
- Swahn, M. H., Bossarte, R. M., Ashby, J. S., & Meyers, J. (2010). Pre-teen alcohol use initiation and suicide attempts among middle and high school students: Findings from the 2006 Georgia Student Health Survey. *Addictive Behaviors, 35*, 452-458.
- Swendsen, J., Burstein, M., Case, B., Conway, K. P., Dierker, L., He, J., & Merikangas, K. R. (2012). Use and abuse of alcohol and illicit drugs in US adolescents: Results of the National Comorbidity Survey-Adolescent Supplement. *Archives of General Psychiatry, 69*, 390-398.
- Tomek, S., Hooper, L. M., Church, W. T., Bolland, K. A., Bolland, J. M., & Wilcox, K. (2015). Relations among suicidality, recent/frequent alcohol use, and gender in a Black American adolescent sample: A longitudinal investigation. *Journal of Clinical Psychology, 71*, 544-560.
- Trim, R. S., Schuckit, M. A., & Smith, T. L. (2010). Predicting drinking onset with discrete-time survival analysis in offspring from the San Diego prospective study. *Drug and Alcohol Dependence, 107*, 215-220.
- Van Ryzin, M. J., & Dishion, T. J. (2014). Adolescent deviant peer clustering as an amplifying mechanism underlying the progression from early substance use to late adolescent dependence. *Journal of Child Psychology and Psychiatry, 55*, 1153-1161.

- Van Ryzin, M. J., Fosco, G. M., & Dishion, T. J. (2012). Family and peer predictors of substance use from early adolescence to early adulthood: An 11-year prospective analysis. *Addictive Behaviors, 37*, 1314-1324.
- Vidourek, R. A., & King, K. A. (2013). Attitudinal correlates associated with recent alcohol use and episodic heavy drinking among African American youth. *The Social Science Journal, 50*, 530-539.
- Wang, B., Deveaux, L., Li, X., Marshall, S., Chen, X., & Stanton, B. (2014). The impact of youth, family, peer and neighborhood risk factors on developmental trajectories of risk involvement from early through middle adolescence. *Social Science & Medicine, 106*, 43-52.
- Warner, L. A., White, H. R., & Johnson, V. (2007). Alcohol initiation experiences and family history of alcoholism as predictors of problem-drinking trajectories. *Journal of Studies on Alcohol and Drugs, 68*, 56-65.
- Windle, M., & Windle, R. C. (2012). Early onset problem behaviors and alcohol, tobacco, and other substance use disorders in young adulthood. *Drug and Alcohol Dependence, 121*, 152-158.

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