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Adolescent Alcohol Use Before and After the High School Transition

Jasmina Burdzovic Andreas, PhD and
Norwegian Institute for Alcohol and Drug Research (SIRUS)

Kristina M. Jackson, PhD
Brown University

Abstract

Background—An important question is whether the high-school entry is a critical developmental event associated with escalation of alcohol use. The present study examined trajectories of adolescent alcohol use as a function of a normative developmental event, the high-school entry. In addition, given that at-risk youth may be particularly vulnerable to the stress associated with **this** transition, we examined how these alcohol use trajectories may be shaped by a measure of early behavioral risk, early adolescent delinquency.

Methods—Participants included 891 12-year olds from the prospective National Longitudinal Survey of Youth-1997 (NLSY97) for whom relevant longitudinal school data were available (51.2% boys; 61.4% White).

Results—Alcohol use after high-school entry increased at a significantly greater rate than did use during the middle-school years, even after accounting for students' age at transition. In addition, early delinquency emerged as a risk factor such that differences in alcohol use existed prior to the transition. That is, children with early delinquency characteristics displayed more rapid progression in alcohol use, but this effect was evident only during middle school.

Conclusions—High-school entry appears to be a critical developmental event associated with increased social risk for greater alcohol use that goes beyond the simple maturational (i.e., ageing) factors. Youth with behavioral problems appear to be at greater risk in middle school, in contrast to lower risk youth for whom high school entry may be a more critical event, in part because high school is a less restrictive environment and/or because alcohol use becomes more normative at that time. Adolescent substance use may be described as a series of distinct developmental stages that closely correspond to school transitions, and suggest a critical period for targeted intervention that may differ as a function of pre-existing risk.

Keywords

alcohol; adolescent; trajectory; high-school; transition

Correspondence concerning this article should be addressed to Kristina M. Jackson, Center for Alcohol and Addiction Studies, Brown University, Box G-S121-4, Providence, RI 02912. Telephone: (401) 863-6616. kristina_jackson@brown.edu.

Introduction

Rates of alcohol involvement tend to increase during the adolescent years, with young adulthood comprising the period of peak prevalence for alcohol use (Johnston et al., 2010). Adolescence is arguably the time of greatest change: it includes key biological processes and major environmental transitions (Windle et al., 2008) which can contribute to early substance use (Abadi et al., 2011). Indeed, developmental science has recognized adolescence as a critical period of vulnerability during which alcohol and other substance use tends to escalate (Brown et al., 2008). Although both epidemiological and developmental literature support age-related increases in drinking, such changes may in fact be non-linear and discontinuous, with periods of stasis interspersed with periods of growth and decline.

The secondary school environment has been recognized as important social context of early alcohol use (Ennett et al., 2008) and a primary platform for substance use prevention efforts (Brown et al., 2005, Ellickson et al., 2003). However, less attention has been paid to normative developmental changes and shifts associated with school transitions – or how such transitions may shape risky behaviors such as alcohol use. An important developmental transition, or "turning point" (Elder, 1998), that may lead to escalation in alcohol use is the transition from lower to higher educational level, which is generally a time of movement from a more controlled to less restrictive school environment. Although the increase in alcohol involvement that occurs during the transition from high school to college is well-documented (Baer et al., 1995, Johnston et al., 2010), less is known about the patterns of alcohol use during the transition from middle school to high school; i.e., after high-school entry.

A handful of studies have examined changes in alcohol use across the middle school and high school ages. Duan et al. (2009) showed a relatively constant increase in drinking frequency from grades 6 through 12, but did not note a discrete shift in drinking during the transition from middle school to high school. A study by Guo et al. (2000) revealed increases in heavy drinking in the transition from the middle school years (ages 13 and 14) to the high-school years (ages 15, 16, and 17); however, this study did not explicitly capture the high school transition. Guilamo-Ramos and colleagues failed to detect grade effects in progression from light experimentation to heavy drinking after one year among 7–11th graders (Guilamo-Ramos et al., 2004), but again, this study did not focus specifically on the transition between middle school and high school. Finally, Simons-Morton (2004) showed that drinking prevalence more than doubled from fall to spring of sixth grade (5.5% vs. 12.6%) but alcohol use was not examined beyond 6th grade in this study. Several studies examining change in alcohol use from adolescence to early adulthood have modeled growth separately for the middle school and high school years (Brown et al., 2005, Capaldi et al., 2009, Crawford et al., 2003, Li et al., 2001). These studies recommend use of piecewise models of growth across these two developmental periods (although there is no empirical evidence cited in support of this recommendation); these piecewise models tend to show a discontinuity in growth rate, suggesting that there is in fact a shift in drinking at the point of the high school transition. Thus, an important research question is whether the high school transition is a critical period for escalation in adolescent alcohol use.

In addition, the transition from middle school to high school has been described as a period of increased vulnerability when negative outcomes may be especially apparent among youth who are already at risk (Sullivan and Farrell, 1999). Difficult temperament and early antisocial tendencies (i.e., aggression and delinquent behaviors) are noted independent risk factors for adolescent substance use (Tan et al., 2012). Numerous reports document the strong and unique association between early adolescent delinquency/conduct problems and problematic substance use (Prince and Maisto, 2012, Mason et al., 2010). The association between early conduct problems and substance use often persists even after early substance use is accounted for (Rossow and Kuntsche, 2013), and it frequently demonstrates a class- or dose-response pattern where more specific and more severe antisocial problems are associated with greater substance use problems (Eklund and af Klinteberg, 2009). Roeser and colleagues noted in several reports that it is during the adolescent years and not later that some individuals' life paths turn in the direction of antisocial activity, academic failure, and other risk behavior such as drug use and abuse; that is, some youth are already on a pathway toward negative outcomes in later adolescence (Roeser et al., 1999). Thus, it is reasonable to expect that some children are particularly vulnerable to the stress associated with the high school transition (Reyes and Hedeker, 1993). In support of this idea, Li and colleagues found that deviant behavior prior to 9th grade predicted growth in drinking during high school (Li et al., 2001), although this was shown to be true only among those with low (but not high) alcohol use in middle school.

Overview of the present study

The present study draws on a national sample of youth to describe and examine the changes in adolescent alcohol use before and during high-school years. As putative continuities, discontinuities, and complex patterns in alcohol use may not always be fully described with simple linear age models, we examined these behaviors among adolescents by treating time flexibly. Specifically, we utilized an "event"-based approach, in which we examined the expected non-linear changes in adolescent alcohol use as a function of a specific event (i.e., transition to high-school in this case) which is age-related but does not occur at the exact same age for all participants.

We drew on a national prospective study that permitted decoupling of high-school attendance from chronological age: that is, the confounding between school transition and age could be pulled apart in this sample by capitalizing on data on school district regulations regarding the grade of high school entry, as well as on individual student differences in grade promotion and retention. We examined underage alcohol use in relation to timing of a specific event, the high school transition, expecting that alcohol use would increase as adolescents get older, but in a non-linear fashion.

Specifically, we were interested in detecting whether the specific 'event' of high-school transition would shape adolescent alcohol use. We modeled trajectories of adolescent alcohol use using a linear spline model, explicitly comparing alcohol use before and after the high-school transition. In doing so, we implicitly examined alcohol use trajectories as a function of adolescents' 'social' age (i.e., whether or not the youth has transitioned into high-school) instead of their simple 'chronological' age. Finally, we were interested in

whether a measure of early behavioral risk would alter trajectories of adolescent alcohol use. Specifically, we examined whether children with early adolescent delinquency tended to have greater drinking rates, as well as more rapidly increasing drinking trajectories over time, again using our approach of delineating time into pre- and post- high-school periods. Method

Participants and Procedure

Data used in this report were drawn from the publicly available National Longitudinal Survey of Youth 1997 (NLSY97) data set, which was designed to describe the transition from school to the labor market and into adulthood using a nationally representative youth sample (Bureau of Labor Statistics, 2012). The NLSY97 utilized a complex sampling strategy and an accelerated longitudinal design, where approximately 9,000 youth born between 1980 and 1984 were assessed for the first time in 1997 and then tracked over time through annual follow-up surveys. The NLSY97 currently consists of 14 annual waves or "rounds" (R) of surveys; at each round, youth completed an in-person or telephone-administered questionnaire. The present longitudinal study only utilized data from the initial six rounds of NLSY because the high school transition did not occur beyond the sixth assessment. Retention rates in NLSY97 were very high; for example, 88% of the initial sample completed the first six assessments utilized in this report.

For the present study, we utilized data from the youngest cohort 12, i.e., from the participants who were 12 years old at R1 (baseline assessment). There were two primary reasons for this sub-sample selection. First, because our primary question concerned the effects of high-school transition on youth alcohol use, the participants needed to have sufficient number of observations for both the middle school and for the high-school period. This was most likely among the youngest NLSY97 participants, i.e., among Cohort 12 members. Second, we were interested in the potential moderating effects of other early problem behaviors (i.e., delinquency) on adolescent alcohol use, and baseline assessment of delinquency at older cohorts would most likely have a different developmental meaning than the baseline assessment of early delinquency at the age of 12. For these reasons, we only retained those participants from Cohort 12 who had the meaningful and complete data available: i.e., data points for both middle school and high school, as well as the complete demographic and personality variables at R1. These inclusion criteria resulted in the analysis sample of 891 12-year olds at R1. Approximately half of the analysis sample (51.2%) were boys, and almost 2/3 (61.4%) were White. The majority reported being either 13 (R2) or 14 (R3) years old at the first high-school assessment. Characteristics of the selected analytic sample are shown in Table 1.

Measures

Demographics—Basic demographics were assessed in Round 1, and were re-coded into dichotomous variables of sex ("1" = boy) and race ("1" = White, including Hispanic Whites).

Early adolescent delinquency (R1, age 12)—Participants' delinquent behaviors was a count of ten criminal/delinquent activities such as purposely destroying property, running

away from home, and selling drugs. This was an overall low-delinquency sample, with an average of 0.9 (1.13) delinquent acts at baseline.

Alcohol use—At each round, participants reported the number of days they drank alcohol during the past 30-day period (Frequency), as well as the average number of drinks per day during the same period (Quantity); see Table 1. These two drinking indicators were used to compute the alcohol use outcome – alcohol average volume – as a product of Quantity and Frequency (QxF) items. Because of the skew, this QxF variable was first re-coded (by adding a value of 1 to each variable to: a) avoid deleting youth who reported non-drinking on only one of the items and b) to enable logarithmic recode) and then log-transformed.

Analytic procedures

Our central question concerned the changes in adolescent alcohol use over time, which we modeled as a non-linear pattern marked by a critical developmental point. Thus, we treated time somewhat flexibly (Singer and Willett, 2003) and examined alcohol use in relation to the timing of a developmentally meaningful event: high-school (HS) entry which occurred at different chronological ages for the participants.

To model hypothesized developmental discontinuity (Hernández-Lloreda et al., 2004) and non-linearity of growth (Singer and Willett, 2003), we utilized a simple linear spline model: a piece-wise linear regression model in which schooling time for each participant was divided into two developmentally meaningful and distinct segments (i.e., before and after HS). This simple linear spline model (or the “broken-stick” model) is easily extended to longitudinal growth models of behavioral development (Hernández-Lloreda et al., 2004), and it allows flexibility in modeling of an otherwise non-linear pattern by dividing it into a series of separate and easily comparable linear slopes. In our case, the pre- and post-HS segments were modeled as two independent linear slopes and joined at a single “knot” representing the timing of critical event (Chou et al., 2004). Non-equivalence of these slopes would demonstrate different rates of alcohol use growth during these distinct periods, supporting hypothesized non-linearity in adolescent drinking patterns. In addition, growth in alcohol use during these two time periods could be differentially affected by (possibly different) predictors, which can also be empirically tested.

Creation of pre- and post-high school time periods—At each annual assessment round, participants were asked to provide information about each school they attended that round. Based on these reports, we were able to code for the round at which participants reported HS attendance for the first time. Because the exact timing of this transition cannot be ascertained based on the available NLSY data, the HS transition was estimated to have taken place between the two known times: 1) the round of the first reported HS attendance, and 2) the previous round (i.e., the last report of middle school attendance). The follow-up interviews were generally carried out mid-school year (the majority of participants were assessed in January or the immediately preceding/following month); thus, we defined the HS transition as the mid-point between the first report of HS attendance and the previous assessment (although there were students for whom this transition took place slightly earlier or slightly later). Consequently, the metric of time was re-cast to reflect neither the simple

chronological age not the current reported grade, but the estimated HS entry for each student and corresponding 'before' and 'after' periods.

All models were estimated as mixed longitudinal models with random intercept and slopes and exchangeable covariance structure using the STATA statistical software. Before and after-HS periods were created using the STATA *mkspline* command, which automatically segmented and coded 'time in relation to HS transition' into 'before' and 'after' HS periods based on time '0' as the selected single knot. The utilized procedure and the general hierarchical linear approach permit use of all available data under the Missing-at-Random (MAR) assumption and the restricted maximum likelihood (REML) estimation method. Fit indices including Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC), and Log Restricted Likelihoods were also reported to inform model evaluation.

Results

We fit a set of three nested mixed models predicting adolescent alcohol use. The base model (Model 1) addressed whether and how adolescent alcohol use changed over time.[1] Putative effects of early delinquency on alcohol use were examined using Model 2 and Model 3. Specifically, Model 2 built upon Model 1 and examined whether early delinquency elevated the risk for alcohol use while controlling for basic demographics (i.e., sex and race); and Model 3 examined possible moderating effects of early delinquency by testing the hypothesis that children who exhibited early delinquency problems followed different alcohol use trajectories.

Complex, non-linear growth of adolescent alcohol use

The simple effects of the HS transition (Table 2) are shown in the results for Model 1. Significant increases in alcohol use were observed for both the period before HS ($\beta_{\text{Pre-HS}} = 0.10$, $p = .004$) and after HS entry ($\beta_{\text{Post-HS}} = 0.26$, $p < .001$). However, even though the both periods were marked by a statistically significant growth, alcohol use after HS entry increased more rapidly and at a significantly greater rate than did drinking during the middle-school years ($\beta_{\text{Pre-HS}} = 0.10$ vs. $\beta_{\text{Post-HS}} = 0.26$; *parameter estimate* = −.15, $p < .001$).

The effects of early delinquency: Level of adolescent alcohol use

Model 2 tested whether children with greater early delinquency also tended to drink more and more often, after accounting for basic demographics. The results revealed a significant main effect of early delinquency on alcohol use, such that with each additional delinquent act, alcohol QxF scores increased by approximately one-third of a point ($\beta_{\text{Delinquency}} = 0.27$, $p < .001$).

Note that the models were relatively unaffected, as the slopes of alcohol use before and after HS remained stable across Model 1 and Model 2; significantly different both from zero

[1]Note that Model 1 is also the unconditional means model, examining only the effects of time and whether there is a sufficient heterogeneity in adolescent alcohol use trajectories to warrant further study. Variance components were significantly different from zero, thus supporting further investigation of these temporal trends.

($\beta_{Pre\text{-}HS}$ = 0.13, p < .001 vs. $\beta_{Post\text{-}HS}$ = 0.28, p < .001) and from each other (*parameter estimate* = −.14, p < .001). In other words, even after controlling for basic demographics and early delinquency, delineation of alcohol use marked my HS transition remained stable.

The effects of early delinquency: Changes over time in adolescent alcohol use

Finally, Model 3 tested the hypothesis that children with early delinquency problems would also exhibit differential and possibly the greatest increase in alcohol use over time. Inclusion of an interaction term (Delinquency × Time) was used to test this proposition. We observed significant interactions between early delinquency and time, as measured through the timing of HS transition. Specifically, there was a significant interaction between delinquency and time before HS transition ($\beta_{Delinquency \times Pre\text{-}HS}$ = 0.14, p < .001), such that alcohol use before HS transition increased at a greater rate for those children who had greater early delinquency problems. Furthermore, we observed no significant interactions between delinquency and time after HS transition ($\beta_{Delinquency \times Post\text{-}HS}$ = 0.002, *ns*), indicating that during the high-school years alcohol use increased at the same – perhaps more normative – rate for all adolescents, yet the initial levels of alcohol use at the beginning of high-school were very different and shaped by adolescents' early delinquency tendencies. Finally, after accounting for the possible interactions of time and delinquency, the growth of alcohol use before HS was reduced to non-significance ($\beta_{Pre\text{-}HS}$ = 0.03, p = .46, *ns*) while it remained significant during HS years ($\beta_{Post\text{-}HS}$ = 0.28, p < .001). These overall slopes also significantly differed from one another (*parameter estimate* = −.24, p < .001).

Following recommendations for probing interaction terms in growth models (Bauer and Curran, 2005, Singer and Willett, 2003), we plotted alcohol use trajectories for those with average delinquency problems (dotted line), for those who scored at the top 10th percentile (i.e., "high" delinquency group) and for those who scored at the bottom 10th percentile (i.e., "low" delinquency group), with remaining covariates (gender, race) set at sample averages. Figure 1 summarizes the results from Model 3, showing the fitted trajectories for adolescent alcohol use as a function of time before- and after- high-school transition and delinquency tendencies. Nonlinearity of alcohol use trajectories is demonstrated by the evident sharp 'break' in the regression lines at the estimated time of HS transition, after which all adolescents appear to increase their alcohol use at a significant, yet uniform rate. This was indicated by the significant main effect of post-HS time ($\beta_{Post\text{-}HS}$ = 0.28, p < .001), but non-significant interaction effect of post-HS time and delinquency ($\beta_{Delinquency \times Post\text{-}HS}$ = 0.002, p = .80, *ns*), which resulted in parallel slopes of alcohol use for all adolescents during HS years (see Figure 1). In contrast, overall rates of alcohol use before HS entry were relatively low and flat, save for children with high delinquency problems. This was indicated by the non-significant main effect of pre-HS time ($\beta_{Pre\text{-}HS}$ = 0.03, p = .46), but significant interaction effect of pre-HS time and delinquency ($\beta_{Delinquency \times Pre\text{-}HS}$ = 0.14, p < .001), and the resulting differential slopes of alcohol use for three delinquency groups during middle school years (see Figure 1).

Finally, an identical set of models was estimated with the addition of the chronological age at transition as a covariate, in order to control for the possible age effects. Save for the anticipated significant main effects of age – where a dose-response effect was observed,

such that alcohol use magnified with each additional year of age – the addition of this covariate did not substantially change hereby reported results. For example, the model of most substantive interest (Model 3) was unaffected by the addition of chronological age, as evidenced by identical parameter estimates for the substantive predictors as in the original model reported above: $\beta_{Delinquency}$ (s.e.) = .25 (.02), $p < .001$; $\beta_{Delinquency \times Before\ HS}$ (s.e.) = .14 (.03), $p < .001$; $\beta_{Delinquency \times After\ HS}$ (s.e.) = −.0007 (.01), *ns*.

Discussion

The goal of this study was to examine trajectories of alcohol use during adolescence and across a normative developmental event; the high-school entry. We found that adolescent alcohol use increased over time, but in a complex fashion dependent on 'social age' marked by HS transition. Further, increases in alcohol use were dependent both on the critical developmental event (i.e., the HS entry) and on the children's own early behavioral profiles. Specifically, our results suggest the importance of critical yet "normative" ecological transitions (Seidman and French, 2004) -- i.e., high-school entry and the associated transitions and changes -- and their effect on the progression of alcohol use among adolescents. Our analytical approach may tentatively be understood as an implicit test of the person-environment interaction in its focus on individual-level delinquency in conjunction with two different and unique environments corresponding to middle-school and high-school. The results underscore the importance of "social age" resulting not only from maturation but also from the shifts in children's social environments, as well as the interaction of children's own delinquent tendencies with those unique environments.

There may be several explanations for why youth engage in increasingly risky behavior, including substance use, upon high-school entry. This is arguably a potentially disruptive time during which adolescents face increased social and academic stress (Benner, 2011), including several specific factors that may elevate their risk for alcohol involvement. High school is a less controlled environment than junior high school, usually with a larger and more diverse student body, lessened adult monitoring, and greater personal freedoms and opportunities (Gillock and Reyes, 1996). This also is a time when adolescents are redefining themselves in terms of their roles (Roeser et al., 1999) and they may feel social pressure to establish new peer groups – not only are preexisting peer groups disrupted, but youth can lose status as they go from being the oldest in middle school to the youngest in high school. The literature consistently shows that peers are one of the greatest influences on youth drinking (Maxwell, 2002) and the importance of peers relative to family is heightened during adolescent years (Zhang et al., 1997).

Further, extant literature demonstrates that norms and expectations regarding alcohol use change over time, with high-school potentially being an important junction. For example, with each additional grade, middle school students increased their perceptions of what is normative substance use among their peers (Pedersen et al., 2013), and by high-school, students tend to overestimate prevalence of peer substance use (Page et al., 2002), leading to an increased tendency to drink more themselves (D'Amico and McCarthy, 2006). A study examining alcohol use over the college transition showed that high school students who held the belief that heavy drinking is typical in college were more likely to drink in college

(Stappenbeck et al., 2010); a similar phenomenon may occur in the transition from middle school to high-school. Finally, alcohol access increases in high-school (Storvoll et al., 2008), and greater availability of alcohol is associated with alcohol use and problems (Komro et al., 2007). A study comparing sources of alcohol among 6th, 9th, and 12th graders found that whereas 6th graders predominantly obtained alcohol from parents and other family members, friends and parties were much more frequently endorsed for 9th and 12th graders (Harrison et al., 2000).

We hypothesized that children with early delinquency problems would show more rapidly increasing drinking trajectories over time, with the expectation that youth who enter high school with already elevated risk will be more sensitive to a range of changes generally associated with high-school entry. However, the present study findings appear more complex. There were indeed important differences in alcohol use as a function of the transition to a new environment and pre-existing risk (early delinquency), but the elevated risk associated with early delinquency was evident only in middle school. That is, alcohol use trajectories during the high-school years were parallel, but youth with high delinquency entered the transition with significantly greater alcohol use than their low-delinquency peers, and consequently remained at elevated use trajectory. In a more restrictive environment such as that experienced by middle schoolers, at a time when alcohol may be more difficult to obtain and its use may be less normative, it was only those children with pre-existing behavioral problems who displayed rapid progression in alcohol use. One might speculate that these youth are seeking out environments that support alcohol consumption (deviant peers, identifying sources of alcoholic beverages). Following the high school transition, however, all adolescents increased their alcohol use; this may reflect the social reality of high-school environment, when alcohol use becomes more accessible, acceptable, and perhaps even implicitly expected of all students. Although our study cannot speak to these mechanisms, each of these possibilities is consistent with our findings and with the literature showing high-school to be both a substantively distinct environment and a unique developmental period. Future research using datasets that include measures such as alcohol availability and alcohol-norms at the school level is necessary to make more concrete inferences as to the processes underlying this phenomenon.

Implications for Substance Use Prevention

The present study pinpointed the timing of a critical period characterized by discontinuity in development, and it implied specific person-environment interactions based on the risk of early delinquency. Further, these findings characterize alcohol use trajectories for both high-delinquency and for more “normative” adolescent behavioral profiles over this sensitive developmental period, possibly suggesting differential prevention strategies – both in terms of timing and targeted groups. The literature on universal interventions emphasizes the importance of timing program implementation to occur during the developmental window when adolescents are just beginning to initiate substance use (Spoth et al., 2009). Despite a lack of clear empirical evidence showing a jump in substance use during the transition from middle school, many prevention programs are initiated in the middle school years, including Project CHOICE (D'Amico and Edelen, 2007), Project ALERT (Ellickson et al., 2003), the Family Check-Up (Van Ryzin et al., 2012) and the Iowa Strengthening Families Program

and Preparing for the Drug Free Years Program (Spoth et al., 2009).Clearly, underage substance use interventions are well-informed by considering the role of development upon behavior (D'Amico et al., 2005, Weinstein et al., 1998).

The present study provides empirical support for a critical period of risk for targeted interventions, supporting the idea that adolescent substance use is characterized as distinct developmental stages of use that correspond to school transitions, rather than as one continuous developmental trajectory (Crawford et al., 2003). Interventions tailored to stage of alcohol acquisition have shown success (Werch et al., 1996) although clearly the value of using this targeted approach lies in the ability to identify risk factors that predict movement among stages (Weinstein et al., 1998). In addition, it is critical to evaluate the impact of prevention programs among at-risk adolescents making a developmental transition because they are more liable than others to progress to regular use of alcohol. As expected, early delinquency emerged as a general risk factor for substance use (Hayatbakhsh et al., 2008, King et al., 2004): our results point yet again to children with externalizing behavioral problems as being the most likely to progress into alcohol use both more rapidly and more severely. Most importantly, perhaps, is that this elevated risk was manifested well in advance of the normative trends in alcohol use that are characteristic of late adolescence. Clearly these youth are the strongest candidates for targeted early interventions (van Lier et al., 2009, Castellanos-Ryan et al., 2013), and programs that aim to reduce delinquency may result in delayed drinking onset or reduced rates of risky drinking.

Strengths and Limitations

The present study drew on a large general population sample of adolescents and young adults that permitted coding of school transition timing, and de-coupling of chronological age and school attendance timing. This enabled us to conduct more precise examination of the hypothesized transition effects by using linear spline models that explicitly compared the growth in drinking before and after the high-school transition. Nevertheless, our analyses were somewhat constrained by the NLSY study timing and design, including the somewhat dated data (i.e., majority of the NLSY97 sample entered high-school during 1998–1999) and annual spacing of assessments which did not permit a fine-grained consideration of transition effects (e.g., temporarily elevated drinking resulting from the stress of the transition). Similarly, one would ideally examine these alcohol use trajectories for different ages and delinquency profiles; however, that would require multiple time-varying covariates and multiple higher-order interactions with time (i.e., age X delinquency X time, for both school-delineated segments). There is also no information on characteristics of the transition itself (e.g., school size and quality, stability of friends/peers across the transition). Further, as noted above, although the high school transition is likely associated with changes in peer status, unfortunately the NLSY did not obtain information on peer alcohol use beyond the first wave of the survey; this hindered our ability to examine whether the uniform increase in alcohol-related behaviors observed after high-school entry is due to contemporaneous beliefs and expectations of peer alcohol use as normative during high-school years. We hope that these findings will stimulate future research that considers this important turning point not only for identifying youth at greatest risk but also for identifying potentially modifiable stage-specific mechanisms underlying various risk profiles. Future research on the critical

high school transition is necessary to further our understanding of the processes and risk factors underlying patterns of underage alcohol use.

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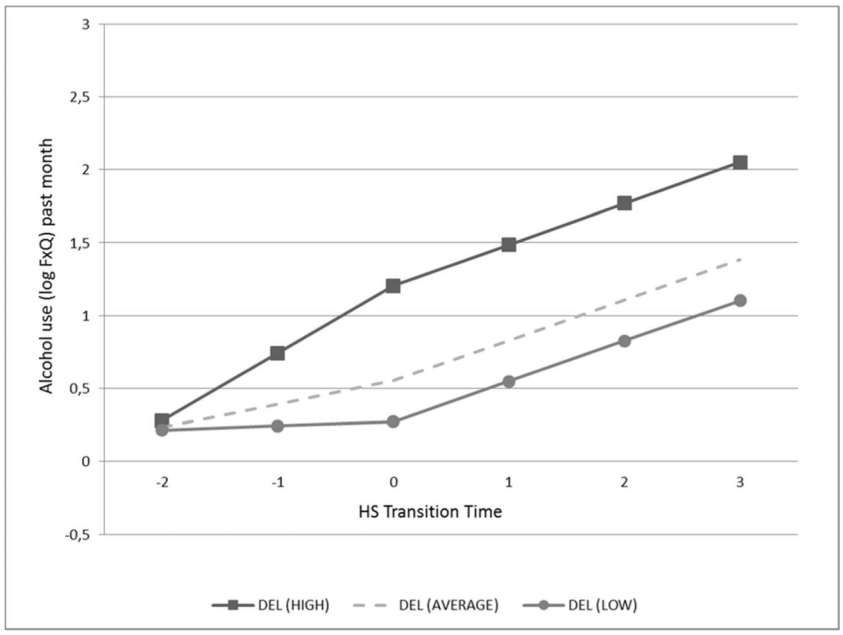

Figure 1.
Changes in adolescent alcohol use as a function of high-school transition and early delinquency.

Table 1

Sample demographics.

Variable	*N*	% or *M* (*SD*)
Gender (% male)	891	51.2%
White [a]	891	61.4%
Delinquency at age 12 (R1)	891	.90 (1.32)
Age (round) at first high-school report [b]		
13 (R2)	415	46.6%
14 (R3)	372	41.8%
15 (R4)	78	8.8%
16 (R5)	13	1.5%
17 (R6)	13	1.5%
Number of drinking days past month [c]		
R1	890	.18 (1.54)
R2	887	.62 (2.03)
R3	877	1.08 (3.13)
R4	874	1.32 (3.28)
R5	851	1.67 (3.39)
R6	854	2.51 (4.55)
Number of drinks per day past month [c]		
R1	890	.19 (2.77)
R2	886	.66 (3.55)
R3	875	.93 (3.07)
R4	873	1.62 (5.04)
R5	851	1.83 (3.84)
R6	850	2.29 (4.59)

[a] About 1/3 (188/547) of the above defined “Whites” were ethnically Hispanic. The remaining sample was African American (24%), Asian (10%), and mixed race/other (4%).

[b] Age (Round) at which participants from the selected cohort first reported attending high-school as part of the NLSY annual assessments.

[c] Drinking indicators are hereby reported as distributed in the original NLSY data set -- across assessment waves (rounds), as opposed to across chronological ages or school years (as examined in this report).

Table 2

Changes over time in adolescent alcohol use using event-based approach, as a function of demographic and personality characteristics.

	Estimate (s.e.)	Estimate (s.e.)	Estimate (s.e.)
	Model 1	**Model 2**	**Model 3**
Intercept	.27*** (.02)	−.06 (.05)	−.02 (.04)
Time before HS	.10*** (.04) ↑	.13*** (.04) ↑	.03 (.04)
Time after HS	.26*** (.01) ↑	.28*** (.01) ↑	.28*** (.01) ↑
Sex (boy)		.04 (.04)	.04 (.04)
White		.19*** (.04)	.18*** (.04)
Delinquency		.27*** (.01)	.24*** (.02)
Delinquency × Before HS			.14*** (.03) ↑
Delinquency × After HS			.002 (.01)
Fit statistics			
AIC/BIC LL	16,733/16,773 −8,360	16,416/16,475 −8,199	16,398/16,470 −8,188

Note:

$N = 891$.

* $p \leq .05$;

** $p \leq .01$,

*** $p \leq .001$.

Arrows in all models indicate terms associated with statistically significant changes in adolescent alcohol use over time (a log-transformed Frequency × Quantity measure of past month alcohol use). Smaller AIC/BIC fit indices suggest a better model fit.

In the estimated spline models, parameter estimates for “Before HS” and “After HS” represent individual slopes for pre- and post-HS intervals (default coding by STATA *mkspline* command, without invoking the ‘*marginal*’ option), and the associated *p*-values show whether these individual slopes significantly differ from zero, or whether there is a significant growth in alcohol use over those distinct time periods. Additional probing of these effects was conducted, indicating a significant difference between these slopes for every ‘event-based’ model as well: parameter estimate β (s.e.) = −.16 (.04), $p < .001$ for Model 1; parameter estimate β (s.e.) = −.14 (.04), $p < .001$ for Model 2, and parameter estimate β (s.e.) = −.24 (.05), $p < .001$ for Model 3.