Trajectories of Adolescent Alcohol Use in the Year Following a Brief Alcohol Intervention

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ABSTRACT. Objective: Brief interventions have become increasingly popular for youth who engage in problematic drinking behavior. The purpose of this study was to examine the alcohol use trajectories of adolescents over a 12-month period following the receipt of a brief intervention. **Method:** The current sample came from two independent studies and consisted of 206 adolescents (ages 13–19; 52% male) recruited through an emergency department or community institution (e.g., courts, schools). Timeline followback methods were used at four points over 1 year to obtain daily estimates of alcohol use behaviors, with daily data then aggregated at the monthly level to examine trajectories of total drinks consumed and maximum drinks on one occasion. Using latent growth curve analysis, we expected a general pattern of increasing use over time, with lower use during the month immediately

following completion of the intervention. **Results:** Models with random intercepts, random linear slopes, and fixed quadratic trends provided good fit to the data for both total drinks and maximum drinks. For each outcome, there was an immediate decrease and then a gradual increase up to the 3- and 6-month assessments, with decreases seen in the months following assessments. Older age, White race, non-Hispanic ethnicity, and greater prior substance use were associated with greater initial levels of use and growth over time. **Conclusions:** Interindividual differences were observed in alcohol use trajectories over time for high-risk adolescents following an alcohol use intervention. Subsequent research may demonstrate more uniform and permanent modification of trajectories by incorporating intervention-related materials into follow-up contacts. (*J. Stud. Alcohol Drugs*, 76, 710–720, 2015)

ADOLESCENCE IS A DEVELOPMENTAL PERIOD marked by the onset and escalation of alcohol use. Nationally representative data of adolescents in the United States indicate that approximately 29.5% of adolescents in the 8th grade have experimented with alcohol and that these rates increase to 69.4% by the time adolescents reach the 12th grade (Johnston et al., 2013). Data on levels of problematic drinking—from being drunk to engaging in heavy episodic drinking—also demonstrate important age-related patterns. For example, 12.8% of eighth-grade adolescents report ever being drunk, and 5.1% report engaging in heavy episodic drinking (defined as five or more drinks on one occasion) in the past 2 weeks. By the time these adolescents reach the 12th grade, their rates of ever being drunk increase to 54.2%, and their rates of engaging in heavy episodic drinking in the prior 2 weeks increase to 23.7% (Johnston et al., 2013).

Because of these drinking behaviors, adolescents are often referred to interventions that may motivate them to change their behaviors and that may provide them with the skills required to do so. Brief interventions, usually ranging from one to five sessions and using motivational interview-

ing (MI) approaches, have become increasingly popular with adolescents and young adults. Most published research examining the efficacy of brief interventions has focused on emerging adult and adult populations. A recent review of 18 studies concluded that brief interventions for college students were effective in reducing alcohol consumption and alcohol problems (Fachini et al., 2012). Several trials dedicated to adolescent populations demonstrate that when compared with control conditions, including psychoeducation and assessment-only conditions, brief interventions lead to improved outcomes across various alcohol-related variables (e.g., Bernstein et al., 2010; Conrod et al., 2011; Goti et al., 2010; Marlatt et al., 1998; Masterman & Kelly, 2003; Monti et al., 1999; Ögel & Coskun, 2011; Spirito et al., 2004; Walton et al., 2010; Winters et al., 2012, 2014).

Several systematic reviews and meta-analyses have also demonstrated support for the use of brief interventions with alcohol-misusing adolescents (Erickson et al., 2005; Grenard et al., 2006; Jensen et al., 2011; Macgowan & Engle, 2010; Tait & Hulse, 2003; Tanner-Smith et al., 2013; Wachtel & Staniford, 2010). Overall, these studies demonstrate reductions in adolescents' drinking or drinking-related consequences by aggregating data collected during short-term follow-ups, with most studies reporting on 3-month, 6-month, and sometimes 12-month and 24-month follow-up time points (Wachtel & Staniford, 2010), although short-term improvements (3 months) followed by a return to baseline use by 12 months were also observed. Although this approach has generated support for the use of brief interventions with adolescents, there is still little that is known

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regarding short-term patterns of adolescents' alcohol use trajectories and intervention-related change following a brief intervention.

Trajectory-based approaches to post-intervention data with shorter time points offer several potential benefits. First, they provide greater insight into whether brief interventions have the potential to change the normative developmental drinking patterns often seen in non-treatment-seeking adolescent samples. For example, even when interventions appear to have no effect, they may in fact be influencing adolescents' drinking trajectories by decreasing risk for increased normative use. Second, they provide us with greater understanding about the rate and nature of intervention-related change (Miller, 1996; Stout, 2000) as well as the impact and duration of such intervention-related effects (Chung et al., 2004). Third, such approaches allow us to examine the potential impact that follow-up assessments may have on adolescents' drinking behavior.

Most research on drinking trajectories to date has focused on understanding the developmental trajectories of alcohol use from early adolescence to young adulthood among non-treatment-seeking samples. Less is known about the drinking trajectories of adolescents immediately following the receipt of alcohol interventions, and even less is known about adolescents receiving brief interventions. In fact, to date, only one study has examined the drinking trajectories of adolescents after they received a brief, evidence-based intervention (Becker et al., 2012), and only two have examined the trajectories of adolescents on a month-by-month basis over the course of 1 year following alcohol or other drug treatment (Chung et al., 2004, 2005). In the Becker et al. (2012) study, data from 3-, 6-, and 12-month follow-up interviews were examined, and three classes of response were identified: moderate users who decreased use over time, heavy users who decreased use, and heavy users who sustained use following a brief intervention in an emergency department. Further, Hispanic ethnicity and high levels of parental monitoring were associated with decreased likelihood of belonging to either of the two heavy use classes.

Given limitations in the literature on adolescents' post-intervention drinking patterns and the potential benefits of using trajectory-based approaches, the purpose of this study was to examine the alcohol use trajectories of adolescents over a 12-month period following the receipt of a brief intervention. Rigorous Timeline Followback (TLFB) methods were used to obtain daily estimates of alcohol use behaviors, which were then aggregated at the monthly level to examine trajectories. Monthly data, gathered using TLFB methods, provide for a much more granular and thorough examination than previous longitudinal work (e.g., Becker et al., 2012). This granularity provides for the identification of potential targets of intervention in future work. Using latent growth curve analysis, we expected to observe a general pattern of increasing use over time, with lowest alcohol use rates

during the months immediately following completion of the brief intervention. Further, given research suggesting the potential effect of assessments on participants' behaviors (Clifford et al., 2000), we also expected to find significant decreases in alcohol use in the month immediately after each follow-up assessment.

Method

Participants

To enhance the generalizability of the current study and statistical power of the analyses, participants were drawn from two independent studies with adolescents recruited to receive a brief motivational intervention as a result of their alcohol use.

Study 1. Between 2003 and 2008, adolescents (13–17 years old), treated in an emergency department (ED) in the Northeast, were enrolled in a brief intervention study (Spirito et al., 2011) if they (a) had a positive blood alcohol concentration (BAC) as tested by blood, breath, or saliva, or (b) self-reported alcohol consumption in the 6 hours before the ED visit. Alcohol-positive patients who were suicidal ($n = 17$), did not speak English or Spanish ($n = 4$), or had suffered serious traumatic injury ($n = 21$) were not approached to participate. Of 239 alcohol-positive eligible patients and families, 110 agreed to participate (46%). We also approached 25 adolescents in the ED who self-reported alcohol use (15 agreed to participate; 60%) and 10 adolescents who were in the ED for marijuana use who reported alcohol use (6 agreed to participate; 60%). The most common reasons for refusing to participate were discharge from the ED before completion of recruitment, lack of interest, being too tired, or being in too much pain. We also had 35 referrals from the community (29 who qualified for the study; 83%), resulting in a total sample of 160 participants (77 male, 83 female). The average age of participants was 15.61 years ($SD = 1.17$).

Interventionists with master's degrees in counseling and psychology conducted all aspects of the baseline contact, including obtaining written informed consent from parents and assent from the adolescents, administering the assessment, and conducting the intervention. The consent/assent procedure included assurances that parents would not be informed of any of the teen's responses. Patients were then randomly assigned to either an individual one-session motivational interview (IMI; $n = 81$) or the individual session plus a two-session (observational assessment session followed by a separate parental feedback session) parent-based motivational intervention (Family Check-Up; FCU; $n = 79$). Adolescents were not approached until their BAC was below 0.1%, and they had to pass a mental status exam and be able to describe the essential elements of the study in order to assent to participation. All procedures were approved by

TABLE 1. Characteristics of the study conditions

Variable	Study 1	Study 2
Recruitment site(s)	Emergency department	Schools, truancy court, family court, mental health agencies, self-referred from the community
Type of intervention	IMI or IMI plus FCU-1	e-CHUG + FCU-2 or e-CHUG + PP
Number of sessions	IMI (one session); IMI plus FCU-1 (three sessions)	e-CHUG (one session); FCU-2 (two sessions); PP (two sessions)

Notes: IMI = Individual motivational interview; FCU-2 = family check-up (two sessions—observational assessment session followed by a separate parental feedback session); e-CHUG = e-Check-up to Go (one session); PP = parental psychoeducation session.

both the university and hospital Institutional Review Boards, and a Certificate of Confidentiality was obtained from the National Institutes of Health. Because of high BACs and time of night in the ED, most participants in both conditions were scheduled to return to the hospital within a few days to complete their interventions.

The IMI, identical in both groups, was completed in 45–60 minutes before randomization. Participants in the IMI/FCU condition then returned with their parents for a 1-hour video assessment session, followed by a second 1-hour session at which parents received feedback. Parents in both conditions were given follow-up information on substance use treatment services and received five monthly booster brochures on parenting before the 6-month follow-up.

Study 2. Participants in Study 2 were recruited from a metropolitan area in the Northeast to take part in a randomized intervention trial conducted from 2008 to 2013. A sample of 92 adolescents (53 male, 39 female) were referred to the study due to concerns about alcohol use, with an age range of 13–19 years ($M = 15.93$, $SD = 1.28$; 8 participants ≥ 18 years). Youth were referred to the study from schools, truancy court, family court, and mental health agencies, as well as self-referred from the community, and were eligible if the participants and their parents both reported that the youth had used alcohol and/or marijuana in the 3 months before enrollment. Because the study was also examining the effects of the intervention on nonreferred siblings, participants also had to have a sibling within 5 years of the teen's age and within the ages of 12–21 years old. However, participants' siblings were not included in the current study's analysis. Both the index youth and sibling had to live at home with the identified primary caregiver. Parental consent and both teen and sibling assent were obtained before baseline assessments. The overseeing University's Institutional Review Board approved all study-related procedures, and a Certificate of Confidentiality was obtained from the National Institutes of Health.

After completing a baseline assessment, youth were randomized into either a one-session, computerized MI program, e-Check-up to Go (e-CHUG; www.e-chug.com/hs) plus the FCU ($n = 44$), or e-CHUG plus a parental psychoeducation session ($n = 48$). The e-CHUG program

was similar in content and length of time to the individual MI delivered in Study 1. The FCU session was the same as the session delivered in Study 1, with the exception that the video assessment (which included a parent and the teen) was conducted in conjunction with the baseline assessment so that parents only needed to return for a second visit to receive the feedback portion of the intervention. Adolescents in the psychoeducation condition received e-CHUG and completed the video assessment with their parent. Parents returned for a second visit to receive a psychoeducation session with a counselor. Parents in both conditions were given follow-up information on substance use treatment services and received five monthly booster brochures on parenting before the 6-month follow-up.

Table 1 presents a brief summary of the similarities and differences across studies with regard to the brief intervention conditions.

Current sample. The final sample used in this study included only those participants from Studies 1 and 2 with follow-up data. This resulted in a sample of 206 adolescents ($n_{\text{Study 1}} = 124$; $n_{\text{Study 2}} = 82$).

Baseline assessment

In both studies, adolescents completed a variety of measures examining parenting, peer influences on substance use, and parental substance use. For purposes of the current study, only baseline substance use measures are described here.

Adolescent Drinking Questionnaire. The Adolescent Drinking Questionnaire (Jessor et al., 1989) is scored on an 8-point scale and assesses drinking frequency (days per month), quantity (drinks per occasion), frequency of high-volume drinking (five or more drinks per occasion), and frequency of intoxication (feeling "drunk" or "very, very high") in the prior 3 months. For the purpose of this study, we reported only the frequency of drinking variable from the Adolescent Drinking Questionnaire (1 = *did not drink*, 2 = *<1 time/month*, 3 = *1 time/month*, 4 = *<1 time/week but >1 time/month*, 5 = *1 time/week*, 6 = *2–3 times/week*, 7 = *4–6 times/week*, 8 = *every day*). We also presented youth self-reports of the maximum daily drinks in the prior 3 months.

Cigarette use. Cigarette use was indexed by the single item, “Did you smoke cigarettes in the past 90 days?”

Marijuana use. Marijuana use was indexed by the single item, “Did you smoke marijuana in the past 90 days?”

Follow-up assessment

In both studies, in-person follow-up interviews were conducted at 3, 6, and 12 months by research assistants blind to treatment group assignment. These interviews were approximately 45 minutes in length, and only the TLFB (Sobell et al., 1996) data from these interviews are reported here. Before conducting the interview, research assistants read articles on the TLFB, role-played the interviews with trained interviewers, observed the TLFB being administered by a trained staff member, and then were observed conducting the interview.

Timeline Followback. The TLFB (Sobell & Sobell, 1996) is a calendar-assisted daily drinking and other drug use estimation method that has been used to measure substance use in randomized clinical trials with youth (Waldron et al., 2001). Only alcohol data are reported in the current study. Specifically, this investigation calculated the total number of drinks consumed per month and the peak number of drinks consumed on a single occasion using these TLFB data. Total number of drinks was chosen to represent a cumulative estimate of consumption per month, whereas peak number of drinks was chosen as a way to represent high-risk consumption per month. Frequency of heavy episodic drinking was not examined due to a low base rate with limited interindividual variability.

Plan of analysis

Analyses were performed using Mplus 6.0 (Muthén & Muthén, 1998–2010) with a full information maximum likelihood estimator to account for missing data over time. A structural equation modeling framework (Duncan et al., 2006) was used to examine latent growth curves of monthly alcohol use behaviors. Unconditional models were first estimated to demonstrate the overall trajectories of total alcoholic drinks and maximum daily drinks per month for 1 year following baseline assessment. Fixed chronometric factor loadings were used to represent the intercept (e.g., loadings fixed to 1 for each time point), linear slope (i.e., 0, 1, 2, and . . . 12), and quadratic trend (i.e., 0, 1, 4, and . . . 144). Model fit was evaluated using chi-square, comparative fit index (CFI; Bentler, 1990), and root mean square error of approximation (RMSEA; Steiger & Lind, 1980). Better model fit was indicated by smaller chi-square and RMSEA values and greater CFI values (CFI > .95 indicates good model fit). Because the model chi-square is often inflated to significance in situations where there are strong correlations among variables (e.g., alcohol use in Month 1 and alcohol

use in Month 2), alternative indices like the CFI and RMSEA are important for evaluating the quality of model fit.

We then performed conditional latent growth curve analyses using participant demographics and prior substance use behaviors as predictors of growth parameters (e.g., intercepts, linear slopes) while controlling for intervention condition. Associations between predictors and growth outcomes are presented using standardized beta weights (β).

Results

Comparing study samples

Although one of the primary reasons that data from the two studies were combined was to enhance the generalizability of the study by increasing the ranges of age and preexisting substance use, preliminary analyses were conducted to describe potential differences across samples. There were no differences found between the study samples by sex, $\chi^2(1) = 3.76$, $p = \text{n.s.}$, or age, $t(204) = 1.75$, $p = \text{n.s.}$

On the substance use variables, there was no difference between studies on reported cigarette use, 34.7% versus 35.4%, $\chi^2(1) = 0.01$, n.s. Marijuana use was more common in Study 2 (67.1%) compared with Study 1 (41.9%), $\chi^2(1) = 12.50$, $p < .001$. Frequency of alcohol use in the past 3 months did not differ by study, $t(204) = 1.58$, $p = \text{n.s.}$

Descriptive analysis

Table 2 presents the demographic characteristics of the current sample. The average participant age was almost 16 years, with a range of 13–19. There was a relatively even split with regard to participant sex, just over two thirds of the sample self-identified as racially White, and approximately one quarter reported Hispanic/Latino ethnicity. Alcohol use in the 3 months before baseline was reported by 190 participants (92.2%), whereas the remaining 16 participants reported use more than 3 months before baseline. The average frequency of drinking in the past 3 months was between one

TABLE 2. Demographic characteristics, frequencies/percentages, and means/standard deviations on substance use at baseline ($N = 206$)

Variable	Frequencies	Percentages	<i>M</i>	<i>SD</i>
Age			15.73	1.22
Sex (male)	106	52%		
Race (White)	138	67%		
Ethnicity (Hispanic)	49	24%		
Frequency of drinking in past 3 months			3.28	1.64
Maximum daily drinks in past 3 months			7.66	6.87
Past 3 mo. cigarette use (yes/no)	72	35%		
Past 3 mo. marijuana use (yes/no)	107	52%		

TABLE 3. Monthly alcohol use behaviors means and standard deviations

Variable	Total alcohol drinks consumed		Maximum daily drinks consumed	
	Raw values	Log transformed	Raw values	Log transformed
Month 1 (<i>n</i> = 199)	6.69 (17.00)	0.75 (1.34)	1.95 (4.00)	0.54 (0.91)
Month 2 (<i>n</i> = 199)	7.84 (19.92)	0.91 (1.37)	2.24 (4.21)	0.65 (0.93)
Month 3 (<i>n</i> = 199)	9.57 (22.27)	1.08 (1.44)	2.97 (5.40)	0.80 (1.00)
Month 4 (<i>n</i> = 178)	7.41 (18.44)	0.89 (1.36)	2.23 (3.72)	0.66 (0.94)
Month 5 (<i>n</i> = 178)	9.42 (21.71)	1.06 (1.45)	2.71 (4.91)	0.76 (0.98)
Month 6 (<i>n</i> = 178)	10.57 (22.20)	1.15 (1.51)	3.00 (5.01)	0.81 (1.02)
Month 7 (<i>n</i> = 152)	7.73 (19.15)	0.96 (1.37)	2.65 (4.82)	0.73 (0.98)
Month 8 (<i>n</i> = 152)	11.07 (30.38)	1.03 (1.51)	2.96 (6.02)	0.74 (1.03)
Month 9 (<i>n</i> = 152)	10.95 (37.16)	1.10 (1.48)	2.93 (4.93)	0.80 (1.02)
Month 10 (<i>n</i> = 152)	9.59 (34.37)	0.95 (1.41)	2.32 (4.09)	0.68 (0.95)
Month 11 (<i>n</i> = 152)	8.15 (16.79)	1.10 (1.39)	2.82 (4.46)	0.82 (0.99)
Month 12 (<i>n</i> = 152)	7.88 (17.31)	1.04 (1.38)	2.82 (4.62)	0.79 (0.99)

and three drinking occasions per month, and the maximum daily drinks consumed averaged more than seven drinks. Both cigarette (35.0%) and marijuana (51.9%) use were common.

The retention rate for the study was good, with 178 participants (86%) present at 6 months and 152 participants (74%) present at 9 and 12 months. There were no differences in alcohol use behaviors between those individuals retained and those lost to follow-up ($ps > .05$). Table 3 and Figures 1 and 2 present the monthly means of total alcoholic drinks consumed and maximum daily drinks. In general, both total and maximum drinks were shown to peak around Months

6–9, slightly decreasing afterward. This peak and decline is largely attributable to a single individual who drank heavily during Months 6–9 and then greatly reduced consumption. Analyses were performed with and without this individual, and results were nearly identical, so these data were retained in the final models. There also seemed to be consistent, short-term declines subsequent to each follow-up assessment. Given the considerable positive skew in the alcohol use behaviors, monthly values were log transformed to better facilitate subsequent model convergence. Because the log of zero is undefined, we followed standard procedures by adding 1 to all values before transforming. The ratios of means

FIGURE 1. Mean total number of drinks consumed per month across the 12 months after baseline

FIGURE 2. Mean maximum number of drinks consumed in 1 day across 12 months after baseline

to standard deviations were much more appropriate for the log-transformed variables.

Unconditional latent growth curve analyses

A latent growth model including a linear slope and quadratic trend provided acceptable fit to the total monthly drinks data, $\chi^2(71) = 140.68$, $p < .001$; CFI = .94; RMSEA < .07 (Figure 3). Three covariances between adjoining error terms were modeled to improve overall model fit by accounting for residual associations between these monthly values (i.e., Times 4 & 5, Times 5 & 6, and Times 8 & 9). Two sets of adjoining residual error terms were held constant because of their close estimates in order to increase model degrees of freedom. Significant means and variances were observed for the intercept and linear slope, whereas only the mean of the quadratic trend was significant. As such, the quadratic trend was held constant (i.e., $\sigma^2 = 0$). Because the quadratic factor had a variance of zero, correlations between the quadratic and intercept and linear slope were also fixed at zero. There was a significant linear increase over time, with a significant quadratic trend accounting for the elevated values in the middle months of the study.

A model including a linear slope and quadratic trend provided good fit to the maximum daily drinks data, $\chi^2(71) = 107.90$, $p = .003$; CFI = .95; RMSEA = .05 (Figure 4). As with the previous model, three covariances between adjoining error terms were modeled to improve overall model fit

(i.e., Times 4 & 5, Times 5 & 6, and Times 8 & 9), and two sets of adjoining residual error terms were held constant due to their close estimates in order to increase model degrees of freedom. Once again, significant means and variances were observed for the intercept and linear slope, and only the mean of the quadratic trend was significant (i.e., σ^2 quadratic was again fixed at zero). There was a significant linear increase in maximum daily drinks over time, with a significant quadratic trend again accounting for the elevated values in the middle months of the study.

Demographic and prior substance use predictors of growth

Predictors of intercepts and slope were examined sequentially. Results indicated that each predictor was associated with intercepts for total monthly drinks and maximum daily drinks, with the exception of participant sex. Membership in Study 2 (over Study 1) and age were associated with a greater intercept for each behavior (Table 4). White participants exhibited greater initial levels of total and daily maximum drinks than non-White participants, and Hispanic participants reported lower initial levels than non-Hispanic participants. Greater levels of prior alcohol use, as well as prior marijuana and cigarette use, were associated with greater initial levels of total monthly drinks and maximum daily drinks.

A single predictor was associated with each linear slope factor. The total number of drinks consumed monthly in-

FIGURE 3. Latent growth curve analysis of total drinks per month. Variables were log + 1 transformed. Residual error variances at (a) Months 7 and 8 and (b) Months 9 and 10 were held constant. Because the variance of the quadratic trend was fixed at 0, any potential factor covariances with this parameter were also fixed at 0. Model fit: $\chi^2(71) = 140.68, p < .001$; comparative fit index = .94; root mean square error of approximation < .07.

** $p < .01$; *** $p < .001$.

creased at a greater rate for non-White participants than for White participants. The maximum number of daily drinks consumed increased at a greater rate for older participants than for younger participants.

Additional analyses were performed examining differences across the four intervention conditions (experimental and control in Studies 1 and 2). Results indicated that the only significant differences observed were between the two

FIGURE 4. Latent growth curve analysis of maximum daily drinks per month. Variables were log + 1 transformed. Residual error variances at (a) Months 5 and 6 and (b) Months 7 and 8 were held constant. Because the variance of the quadratic trend was fixed at 0, any potential factor covariances with this parameter were also fixed at 0. Model fit: $\chi^2(71) = 107.90, p = .003$; comparative fit index = .95; root mean square error of approximation = .05. Max. drinks = maximum number of drinks.

* $p < .05$; ** $p < .01$; *** $p < .001$.

TABLE 4. Covariate standardized beta coefficients predicting growth parameters

Variable	Total drinks per month		Maximum daily drinks per month	
	Intercept	Linear slope	Intercept	Linear slope
Study	0.22**	-0.09	0.22**	-0.09
Age	0.20**	0.14	0.21**	0.19*
Race	0.15*	-0.19*	0.16*	-0.15
Ethnicity	-0.17**	0.01	-0.19**	0.02
Sex-0.06	-0.10	-0.02	-0.15	
Prior alcohol use (Frequency $\times$ Quantity)	-0.30**	0.08	-0.30**	0.09
Prior marijuana use (yes/no)	0.27***	-0.01	0.27***	-0.01
Prior cigarette use (yes/no)	0.24**	0.03	0.26**	0.01

* $p < .05$; ** $p < .01$; *** $p < .001$.

conditions in Study 1 and the two conditions in Study 2 on model intercept values.

Discussion

The purpose of this study was to examine the alcohol use trajectories of adolescents over 12 months following brief interventions. Each participant in the sample received some form of a brief alcohol intervention, with type (in-person or online; with or without parental sessions) based on random assignment. Rigorous TLFB methods were used to obtain daily estimates of alcohol use behaviors, which were then aggregated at the monthly level to examine trajectories. Results indicated that there was a general trend toward increased use during this developmental period, with marked declines following each assessment period. Demographic and prior substance use characteristics were also shown to affect initial level and change in alcohol use over time.

In general, the pattern of increased use across the length of the study corresponds to the literature showing adolescence to be a time of escalation in alcohol use (Schulenberg & Maggs, 2002; White et al., 2006). The sample used in this study, however, was not normative of the adolescent population, instead consisting of higher risk youth already engaging in alcohol use behaviors. As such, the initial rates of use observed in the current study were higher than in the general adolescent population. These greater baseline levels coupled with rates of increased use comparable to or greater than their same-age peers put this sample of adolescents at increased risk for alcohol-related negative consequences, making it an appropriate group for an intervention. Despite all participants being enrolled in an alcohol use trial, the general upward trajectory in use after the initial decrease from baseline was observable. It should be noted that participants in Study 2 had greater alcohol use than did those in Study 1. This could be related to the higher marijuana use in the Study 2 sample, which was another predictor of greater use, or the fact that a significant portion of the Study 2

sample were referred by parents rather than the courts. Adolescents may feel less motivated to reduce alcohol use when not compelled to do so by the courts. Nonetheless, given the previous alcohol use behaviors of this high-risk sample, it remains possible that the increasing trajectory would have been much steeper in the absence of any intervention. The current sample comes from two comparative effectiveness trials, and, as such, an untreated control condition was not available to compare the findings against.

The immediate declines in use after the follow-up assessment interviews highlight both the limitations and opportunities inherent in brief alcohol interventions. Brief interventions, particularly among participants defined by the transtheoretical model of change as in the precontemplation stage (Prochaska et al., 1988), can be susceptible to decay of effects over time (O'Donnell et al., 2014). Adolescents referred to alcohol intervention studies for current problematic alcohol use will vary in their readiness to change. The current study highlights, however, the potential for minimal continued contact to maintain and increase the power of intervention effects. Specifically, the relatively steep declines observed following each data collection suggest that, perhaps, simple brief contacts via phone calls of similar length to the follow-up assessments might be sufficient to cue adolescents back to intervention materials presented to them previously. It is also possible that similar maintenance of effects could be observed through the use of text messages, emails, or social media interactions. The enthusiasm regarding the impact of repeated contacts is tempered, somewhat, by the increases in use seen following these temporary decreases, implying the need for more frequent or substantial intervention efforts during these follow-up contact periods. Existing preventive intervention programs have shown the utility of these types of booster sessions (Doumas et al., 2013; Fleming et al., 2002), delivering novel program modules or reiterating prior modules. Researchers and practitioners might benefit from capitalizing on the preponderance of technology (e.g., cell phones, tablet

computers) and social media platforms (e.g., Facebook, Twitter) to periodically present intervention materials to at-risk adolescent participants.

The observed immediate declines in alcohol use immediately after the follow-up assessments may also suggest the potential effect of assessments on adolescents' drinking behaviors. Previous studies have found that participants exposed to regularly scheduled follow-up interviews report a significantly greater percentage of abstinent days as well as lower consumption of daily drinks and heavy drinking days (Clifford et al., 2000). Therefore, consideration of assessment reactivity effects is warranted.

The associations between covariates and latent growth parameters closely corresponded with prior research indicating that older adolescents drink more than younger adolescents (Johnston et al., 2012), White youth drink more than non-White youth (Duncan et al., 2012; Fuller-Thomson et al., 2013), and Hispanic youth drink less than non-Hispanic White youth (Johnston et al., 2011; Swaim et al., 2004). In addition, supporting Problem Behavior Theory (Jessor & Jessor, 1977), use of other substances like marijuana or tobacco was associated with increased levels of alcohol use. It is interesting to note that, with the exception of age on maximum daily drinks and race on monthly drinks, there were no significant predictors of linear increase (or decrease) in use over time. Given the significant variability observed in change over time in the current study, the mild to moderate demographic and prior use effects suggest that there remains room for interventions with periodic follow-ups focusing on modifiable characteristics to influence alcohol use trajectories in high-risk youth. Furthermore, the limited observed effects on change over time (i.e., linear slope) also suggest that theoretically informed booster sessions might demonstrate relatively universal effects on drinking over time.

Limitations

There are several limitations to the current study. First, by its nature, TLFB research design involves retrospective recall of alcohol use behaviors. The current study required participants, at each assessment, to report on daily use over a 90-day period. Although these methods are rigorous and have been found valid in numerous studies (Carey et al., 2001; Sobell & Sobell, 1996; Sobell et al., 1996), it is possible that monthly estimates were downwardly biased by participants seeking to appear more compliant to the intervention program. Future studies might benefit from the use of prospective time series methods with high-risk youth to obtain more accurate daily (and therefore monthly) estimates of alcohol use. Second, the sample consisted of participants from two independent studies with differing intervention protocols. Additional research replicating the current findings in a single, large sample of youth would eliminate the effects of differential interventions. Last, although ethnora-

cially diverse, the sample for this study came from a single metropolitan area in the Northeast United States. Future research with a more geographical representative sample of at-risk youth would enhance the external validity of the study findings.

Conclusions

The current study demonstrated interindividual differences that exist in alcohol use trajectories over time for high-risk adolescents following an alcohol use intervention. In general, there is a trend of increasing use over time, although follow-up contact with research staff seems to temporarily impede this trajectory. It is possible that the rate, although increasing, may have been dampened by the interventions. Subsequent research may demonstrate more permanent modification of alcohol use trajectories by incorporating intervention-related materials into these follow-up contacts with at-risk youth. The utility of these materials could be enhanced through tailoring the content to adolescents' needs and delivering the content through channels most likely to influence adolescents (e.g., text messaging or social media).

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