

Solitary Alcohol Use in Teens Is Associated With Drinking in Response to Negative Affect and Predicts Alcohol Problems in Young Adulthood

Clinical Psychological Science
2014, Vol. 2(5) 602–610
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DOI: 10.1177/2167702613512795
cpx.sagepub.com


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Abstract

Adolescent solitary drinking may represent an informative divergence from normative behavior, with important implications for understanding risk for alcohol-use disorders later in life. Within a self-medication framework, we hypothesized that solitary alcohol use would be associated with drinking in response to negative affect and that such a pattern of drinking would predict alcohol problems in young adulthood. We tested these predictions in a longitudinal study in which we examined whether solitary drinking in adolescence (ages 12–18) predicted alcohol-use disorders in young adulthood (age 25) in 466 alcohol-using teens recruited from clinical programs and 243 alcohol-using teens recruited from the community. Findings showed that solitary drinking was associated with drinking in response to negative affect during adolescence and predicted alcohol problems in young adulthood. Results indicate that drinking alone is an important type of alcohol-use behavior that increases risk for the escalation of alcohol use and the development of alcohol problems.

Keywords

drug/substance abuse, longitudinal methods, adolescent development

Received 8/13/13; Revision accepted 10/18/13

Drinking alone can be considered a rather distinct form of teen and young-adult alcohol use, given that most young drinkers do not engage in this behavior. The vast majority of adolescents and young adults who drink alcohol do so in the company of others (Johnston, O'Malley, Bachman, & Schulenberg, 2006), with three fourths of adolescents and young adults citing "to have a good time with friends" as the primary motive for alcohol use (O'Malley, Johnston, & Bachman, 1998, p. 91). However, approximately 12% to 15% of college undergraduates reported engaging in solitary drinking in the past year (Christiansen, Vik, & Jarchow, 2002; O'Hare, 1990), and in a large school-based sample, 17% of eighth-grade adolescents admitted to having consumed alcohol at least once while alone (Tucker, Ellickson, Collins, & Klein, 2006). Thus, although most adolescents and young people drink alcohol only in social settings, a substantial minority consume alcohol while alone.

Solitary drinking may represent a rather distinct type of alcohol-use behavior and an informative divergence from normative behavior, with important implications for understanding pathways of risk for heavy drinking and alcohol-use disorders (AUDs) later in life. Prior research on undergraduate college students has shown that solitary drinking is associated with heavier alcohol consumption and more alcohol-related problems (Christiansen et al., 2002; Gonzalez, Collins, & Bradizza, 2009; Gonzalez & Skewes, 2013). The cross-sectional nature of these studies, however, prohibits drawing conclusions about the temporal relationship between variables. Furthermore, these studies have tended to assess

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counts of solitary-drinking occurrences, which is problematic given that greater frequency of drinking is likely associated with both social- and solitary-drinking contexts. Thus, it is not known whether solitary drinking precedes increased alcohol consumption and alcohol-related problems or, alternatively, whether solitary drinking can be largely explained by greater alcohol involvement. Longitudinal designs, and analyses that account for both solitary- and social-drinking frequency, are needed to determine whether solitary drinking is a risk factor for subsequent alcohol problems beyond other established risk factors, such as greater frequency of drinking and previous problems with alcohol.

Only one longitudinal study on solitary drinking has been conducted to date. Tucker et al. (2006) compared eighth-grade adolescents who endorsed ever having consumed alcohol when alone ($n = 577$) with those who drank only in social settings ($n = 1,426$)—in answer to the yes-or-no question, “Do you ever drink alcohol when you’re by yourself?”—on a range of adolescent and young-adult outcomes. During eighth grade, solitary drinkers held more positive alcohol-reinforcement expectancies, earned poorer grades, and engaged in more deviant behavior than did students who drank only in social settings. Furthermore, eighth-grade solitary drinkers, compared with social-only drinkers, were more likely to endorse a single item assessing alcohol problems at age 23 (i.e., alcohol use that negatively affected finances, home life, work life, relationships, or legal status) even after accounting for eighth-grade quantity and frequency of alcohol use. However, in this school sample, adolescents reported very little alcohol use (on average, one to two drinks on three occasions in the past year) and very few individuals (approximately 6%) reported alcohol problems at age 23. It is surprising that no studies have been conducted to examine solitary drinking in a sample of adolescents and young adults with substantial alcohol involvement. To determine whether solitary drinking in adolescence has implications for understanding risk for heavy drinking and AUDs later in life, researchers must include in their studies participants who report sufficient amounts of adolescent solitary drinking and young-adult AUD symptoms.

Because solitary drinking may be a rather distinct type of alcohol use behavior, it is important to understand whether it is associated with reports of drinking in response to negative or positive affect. Tomlinson and Brown (2012) found that drinking alone was associated with depression symptoms among eighth graders, but they did not measure drinking in response to negative affect. Gonzalez et al. (2009) and Tucker et al. (2006) found that young-adult and teen solitary drinking was associated with expectancies related to negative reinforcing effects of alcohol (e.g., beliefs that alcohol decreases

negative affect), but they did not directly measure the affective context of drinking situations. In the research reported here, we examined the association of adolescent solitary drinking with reports of drinking in response to both positive and negative affect. We hypothesized that solitary drinking would be associated with negative-affect situations and not with positive-affect situations. This finding would be consistent with the idea that solitary drinkers often self-medicate with alcohol to alleviate or cope with negative affect (Sher & Trull, 1994).

The current longitudinal study characterized solitary drinking in 466 alcohol-using teens recruited from clinical programs that included or focused on addictions treatment and in 243 alcohol-using teens recruited from the community, all of whom were followed into young adulthood. This procedure allowed us to study drinking alone among adolescents with a wide range of alcohol involvement and to examine predictive associations with young-adult alcohol problems. We also examined whether solitary drinking was associated with reports of drinking in the context of positive and negative affect. We hypothesized that (a) compared with other teen drinkers, adolescents who drink alone would report a higher frequency of use and a greater quantity of alcohol consumed per occasion, more AUD symptoms, and a younger age at which they first experienced alcohol intoxication; (b) adolescent solitary drinking would be positively associated with drinking in response to negative affect and would not be associated with drinking in response to pleasant emotions; and (c) solitary drinking in adolescence would predict alcohol problems in young adulthood even when accounting for teen alcohol-use patterns and problems.

Method

Participants

The sample comprised 709 adolescents, first seen between the ages of 12 and 18 years (mean age = 16.3 years, $SD = 1.5$), participating in a longitudinal study at the Pittsburgh Adolescent Alcohol Research Center. All participants reported alcohol use in the past year. Participants were recruited from both clinical (66%) and community (34%) sources to allow us to study adolescents with a wide range of alcohol involvement. A total of 466 clinical participants (195 females, 271 males) were recruited from psychiatric and addictions-treatment settings and juvenile justice programs. In addition, 243 community participants (136 females, 107 males) were recruited through a telephone-sampling-frame method and advertisements. Clinical and community samples were similar in demographic characteristics. Community participants were not excluded if they reported AUD

symptoms at recruitment. The sample was 82.5% Caucasian, 16.9% African American, and less than 1% other ethnic backgrounds. Participants were given follow-up assessments at 1 year, 3 years, 5 years, and at age 25. We used all assessments conducted during adolescence, both baseline and follow-ups, to characterize teen solitary drinking. Data from the assessment at age 25 were used as the young-adulthood assessment point. The assessment at age 25 included 528 (75%) of the initial 709 participants. Details about recruitment procedures and attrition analyses have been published in prior publications (e.g., Clark, Lynch, Donovan, & Block, 2001; Clark, Thatcher, & Martin, 2010). Participants who missed the young-adult assessment, compared with those who completed the visit, were more likely to be male, were older at baseline, were more likely to be African American, had a lower socioeconomic status (SES), were less likely to have been recruited from the community, and were more likely to have adolescent AUDs.

Procedure

At the initial assessment, adolescents completed daylong assessment protocols that characterized lifetime alcohol and drug use, substance-use disorders, other mental disorders, health status, and other variables. Similar protocols were used for subsequent assessments, which covered the interval since the last completed assessment. Participants were paid in gift certificates (prior to reaching age 18) or money (at age 18 and older) for completing each assessment. The study was approved by the University of Pittsburgh Human Subjects Institutional Review Board. Written informed consent was obtained from a parent for the adolescent's participation, and the adolescent provided assent. Informed consent was obtained from those aged 18 and older.

Measures

Demographics. Adolescent demographic characteristics, collected at the initial assessment, included gender, ethnicity, and SES as indicated by the Hollingshead (1975) Two-Factor Index.

Adolescent alcohol use and solitary drinking. Adolescent alcohol consumption and solitary versus social-only drinking were measured at each assessment by a version of the Lifetime Drinking History method (Skinner & Sheu, 1982), which was adapted for use with adolescents (Clark, Pollock, Mezzich, Cornelius, & Martin, 2001). This adapted version has been shown to be a reliable and valid measure for use with adolescents (see Clark, Pollock, et al., 2001). Participants reported alcohol-use frequency, average quantity of alcohol consumed per

occasion (in standard drinks), and percentage of time that their drinking occurred while alone versus with others (on a 0%–100% scale). These measures were collected at the baseline assessment for each year since the start of regular drinking (i.e., drinking at least once per month for at least 6 months) and again for each year since the last assessment at 1-, 3-, and 5-year follow-up interviews.¹

Drinking situations. The circumstances of adolescent alcohol consumption were assessed by the Inventory of Drinking Situations (IDS). The IDS is a 100-item self-report questionnaire that assesses the antecedents to drinking (Annis, Graham, & Davis, 1987). Adolescents were asked to rate the extent that they “drank heavily” in a wide range of situations or events in the past year; responses were made using a scale from 0 (*never*) to 3 (*almost always*). The IDS is a reliable and valid measure for use with adolescents (Parra, Martin, & Clark, 2005). On the basis of our study hypotheses, we analyzed three of the eight subscales of the IDS: the 20-item Unpleasant Emotions subscale (example item: “When I felt lonely”; $\alpha = .97$), the 20-item Conflict With Others subscale (example item: “When I had an argument with a friend”; $\alpha = .96$), and the 10-item Pleasant Emotions subscale (example item: “When something good happened and I felt like celebrating”; $\alpha = .94$).

Adolescent and young-adult AUDs. Information about adolescent and young-adult AUD symptoms and diagnoses were collected with a modified version of the Structured Clinical Interview for *DSM-IV* (First, Spitzer, Gibbon, & Williams, 2002; Martin, Kaczkynski, Maisto, Bukstein, & Moss, 1995; Martin, Pollock, Bukstein, & Lynch, 2000). Ages of onset and offset for symptoms and diagnoses were coded and used to generate past-year diagnosis and symptom-count data. Interviewers had a master-level education in a mental-health-related field, were trained to obtain more than 90% agreement with an experienced interviewer, and achieved excellent interrater reliabilities for AUD diagnoses ($\kappa = .94$; Martin et al., 2000).

Data analyses

The distributions of many alcohol-use variables were positively skewed (e.g., drinks per day, drinking days per month), so these variables were transformed by using a natural logarithm or inverse square root to meet the assumptions of regression analyses. The skewness and kurtosis values of the transformed variables were all between -1.0 and 1.0 . Untransformed values are presented in the tables for descriptive purposes.²

Preliminary analyses at each age across ages 12 through 18 years indicated that more than two thirds of

the sample remained stable in their endorsement of solitary drinking across ages (i.e., either consistently endorsing or consistently not endorsing solitary drinking), and less than one third of the sample showed a pattern of no solitary drinking at younger ages followed by solitary drinking at older ages. Of those participants who reported any solitary drinking through age 18, the mean percentage of time spent drinking in solitary situations was relatively stable across the adolescent period (see Table 1). Because most youth showed stability or an increase in proportion of solitary-drinking episodes, we used three summary variables to measure the predictor variable of solitary drinking in adolescence: mean percentage of time drinking alone ($Alone_{Mean}$), maximum percentage of time drinking alone ($Alone_{Max}$), and a binary variable of ever having drunk alone ($Alone_{Ever}$). The mean value captures the stable pattern of solitary drinking for participants with no significant increase or decrease over time, whereas use of the maximum value captures the peak for participants who showed an increasing pattern. Because many youth did not report any solitary drinking, the binary variable captures the distinction between any versus no solitary drinking during adolescence. These summary variables were correlated with one another ($Alone_{Mean}$ and $Alone_{Ever}$, $r = .58, p < .001$; $Alone_{Ever}$ and $Alone_{Max}$, $r = .65, p < .001$; $Alone_{Mean}$ and $Alone_{Max}$, $r = .88, p < .001$) but not so highly as to preclude their separate examination.

Hierarchical linear regression analyses were used to predict AUD-symptom counts in young adulthood from $Alone_{Mean}$, $Alone_{Max}$, and $Alone_{Ever}$ during ages 12 through 18 years. For these analyses, young-adult AUD-symptom count was regressed hierarchically on three sets of independent variables, which were entered in the following order: Step 1, gender, ethnicity, SES, and recruitment source; Step 2, alcohol-consumption quantity and frequency at age 18, adolescent AUD symptoms (yes/no);

and Step 3, solitary drinking in adolescence. A separate hierarchical regression was performed for each measure of solitary drinking ($Alone_{Mean}$, $Alone_{Max}$, $Alone_{Ever}$). Hierarchical logistic regression analyses were used in a similar way to predict young-adult alcohol dependence (yes/no) from the three solitary-drinking measures according to the classification in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994). We used *DSM-IV* dependence to examine whether drinking alone predicted more severe levels of young-adult alcohol problems; this diagnosis is more severe than is the AUD diagnosis in *DSM-5* (American Psychiatric Association, 2013; Martin, Steinley, Verges, & Sher, 2011).

We used linear multiple regression to determine whether adolescent solitary drinking was related to IDS subscale scores at the initial assessment. We controlled for age, gender, ethnicity, SES, recruitment source, and quantity/frequency of alcohol use in the prediction of the IDS Unpleasant Emotions, Conflict With Others, and Pleasant Emotions subscales. This procedure allowed us to test our hypothesis that solitary drinking would be associated with drinking in response to negative affect and would not be associated with drinking in response to positive emotion.

Results

Solitary drinkers versus social-only drinkers in adolescence

Of the 709 total participants, 275 (38.8%) reported adolescent solitary drinking and 434 (61.2%) reported never having drunk alone (i.e., reported use only in social settings). Table 1 shows mean and maximum percentage of time spent engaged in solitary drinking, as well as the

Table 1. Mean and Maximum Percentage of Time Spent Engaged in Solitary Drinking for Each Age Across the Adolescent Period

Measure	Age (years)						
	12	13	14	15	16	17	18
<i>n</i>	82	196	325	423	474	499	556
Solitary-drinking episodes							
Mean % (<i>SD</i>)	7.51 (16.9)	8.63 (19.7)	5.52 (14.5)	6.02 (15.46)	6.07 (14.9)	5.54 (14.2)	6.01 (16.13)
Minimum-maximum %	0–80	0–100	0–100	0–100	0–95	0–100	0–100
Adolescents reporting any solitary drinking (%)	26.8	24.5	23.7	26.2	27.2	23.8	23.0
Solitary-drinking episodes for solitary drinkers only, mean % (<i>SD</i>) ^a	28.0 (22.5)	35.2 (25.6)	23.3 (21.9)	22.9 (21.9)	22.3 (21.5)	23.2 (21.1)	26.1 (24.6)

Note: Adolescents, on average, provided data for 3.4 years ($SD = 1.8$) of the adolescent time period (ages 12–18). Sample size at each age represents the number of youth who reported regular drinking at that age on the Lifetime Drinking History measure. Data at each age include initial session and follow-up data within the adolescent time period.

^a $n = 275$.

percentage of adolescents who reported any solitary drinking, for each age across the adolescent period. From 24% to 28% of adolescents endorsed solitary drinking across different ages during adolescence and showed no significant increase or decrease over time. Among those teens who did report solitary drinking, this behavior occurred during an average of 22% to 35% of drinking occasions.

Table 2 shows descriptive characteristics of adolescents who reported any solitary drinking (Alone_{Ever}) compared with those who drank only in social situations (Social only). Solitary drinking was reported by 52.2% of the clinical sample compared with only 13.2% of the community sample. Overall, solitary drinkers were more likely to be male, had heavier and more frequent alcohol use, met criteria for more AUD symptoms, and were younger the first time they experienced alcohol intoxication. There were no differences in the ethnic distribution of adolescents who did and did not engage in solitary drinking.

Proportion of solitary drinkers in adolescents with and without AUD symptoms

Figure 1 shows the proportions of adolescents who reported any solitary drinking (Alone_{Ever}) compared with social-only drinkers across the adolescent period for participants with and without past-year AUD symptoms at each age. Two-way contingency-table analyses were

conducted at each age to evaluate whether adolescents with one or more AUD symptoms, compared with adolescents without AUD symptoms, were more likely to drink alone. As predicted, the proportion of solitary drinkers was higher among adolescents with at least one AUD symptom. For example, at age 15, 31.2% of adolescents with AUD symptoms reported solitary drinking compared with 14.3% of those without AUD symptoms, $\chi^2(1, N = 421) = 13.07, p < .001, \phi = .176$. Results were similar at all age points (at age 12–13, $p < .05$; at all other ages, $ps < .001$; ϕ -value range = .170–.402).

Adolescent solitary drinking and drinking in response to negative affect

Adolescent solitary drinking was positively and significantly related to unpleasant emotions, $\beta = 0.15, t(476) = 3.68, p < .001$, and to conflict with others, $\beta = 0.14, t(476) = 3.22, p < .001$, after we controlled for recruitment source, age, gender, ethnicity, SES, and quantity/frequency of alcohol use.³ The sample multiple correlation coefficients were .45 and .44, which indicated that approximately 19% to 20% of the variance in both the Unpleasant Emotions and the Conflict With Others subscales of the IDS can be accounted for by solitary drinking and the covariates. To determine that solitary drinkers did not endorse higher responses on IDS subscales generally, we used adolescent solitary drinking, controlling for covariates, to predict IDS scores on the Pleasant Emotions

Table 2. Demographic Characteristics and Alcohol-Related Variables of Adolescents Who Did and Did Not Engage in Solitary Drinking

Characteristic and variable	Alone _{Ever}	Social only	χ^2	<i>F</i>	<i>p</i>	Effect size	
						ϕ	η_p^2
Gender							
Male	166 (60.4)	212 (48.8)	8.97		.003	.112	
Female	109 (39.6)	222 (51.2)					
Race/Ethnicity ^a							
Caucasian	225 (81.8)	360 (82.9)	0.430		.512	.030	
African American	50 (18.2)	70 (16.1)					
SES, mean (<i>SD</i>)	37.3 (12.3)	38.9 (13.1)		2.72	.100		.004
Clinical (vs. community) subgroup	243 (52.2)	223 (47.8)	102.2		< .001	.380	
Age at first intoxication, mean (<i>SD</i>)	12.8 (1.8)	13.7 (2.0)		29.8	< .001		.048
Number of drinks per drinking day, mean (<i>SD</i>) ^b	7.3 (3.6)	5.7 (3.5)		33.9	< .001		.046
Drinking days per month, mean (<i>SD</i>) ^b	7.4 (4.5)	4.6 (4.0)		70.9	< .001		.091
AUD symptoms (past year), mean (<i>SD</i>) ^b	2.2 (1.5)	0.87 (1.1)		170.9	< .001		.195

Note: Data are *n* (%) unless otherwise noted. Alone_{Ever} = adolescents who reported any solitary drinking; Social only = adolescents who reported drinking in social situations only; SES = socioeconomic status; AUD = alcohol-use disorder.

^aLess than 1% of the sample identified their race/ethnicity as "other" ($n = 4$), and data from these individuals were not included in the table.

^bValues represent averages across ages 12 through 18 years. Separate tests were also run for each age group, and the significant results presented in the table remained highly significant at all ages. Results did not change when gender was entered as a covariate in these analyses.

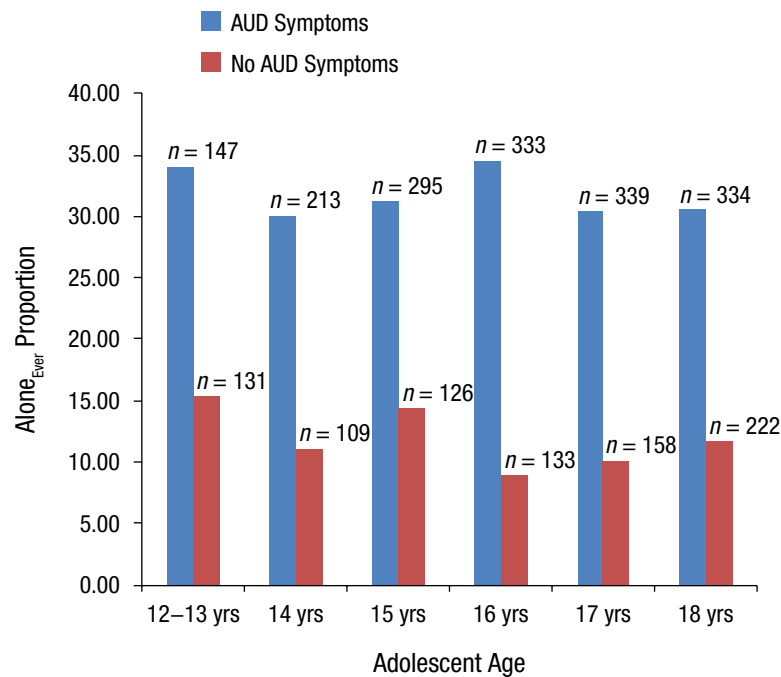


Fig. 1. Proportion of participants who reported any solitary drinking ($Alone_{Ever}$) across adolescence for individuals who have at least one versus no alcohol-use disorder (AUD) symptoms. Ages 12 and 13 were combined as a result of small sample sizes. Data at each age include initial session and follow-up data within the adolescent time period. yrs = years.

subscale. Solitary drinking was not related to pleasant emotions, $\beta = 0.05$, $t(476) = 1.26$, $p = .21$. Results indicated that adolescent solitary drinking was associated with drinking in circumstances associated with negative emotions but not with positive emotions.

Solitary drinking in adolescence and young-adult alcohol problems

In total, 50% of young adults ($n = 282$; 55% of clinical recruits and 36% of community recruits) had at least one past-year AUD symptom at age 25 ($M = 2.87$, $SD = 2.00$, range = 1–9). Overall, young adults reported a mean of 1.42 ($SD = 2.01$) AUD symptoms. Table 3 shows the hierarchical regression results predicting AUD symptoms at age 25 from three sets of predictors. We used our three indices of solitary drinking ($Alone_{Mean}$, $Alone_{Max}$, and $Alone_{Ever}$) to predict young-adult AUD symptoms and young-adult *DSM-IV* alcohol dependence. In the first step, we entered demographic covariates and observed a statistically significant relationship between AUD symptoms at age 25 and both male gender and African American ethnicity. In the second step, we entered adolescent quantity and frequency of alcohol use and found that frequency of alcohol use was significantly related to AUD symptoms at age 25. In the third step, the $Alone_{Mean}$

measure accounted for a unique proportion of the remaining variance in AUD symptoms at age 25. Furthermore, solitary drinking ($Alone_{Mean}$) continued to account for a unique proportion of the remaining variance in AUD symptoms at age 25 after we controlled for recruitment source in Step 1 and teen AUD symptoms (yes/no) in Step 2—Step 3 $R^2 = .14$, adjusted $R^2 = .13$, $\Delta R^2 = .01$, $\Delta F(1, 519) = 5.2$, $p < .05$. Results were very similar when we used $Alone_{Max}$ and $Alone_{Ever}$ as the solitary-drinking predictors.

Similarly, after we controlled for demographic variables in Step 1 and quantity/frequency of alcohol use at age 18 in Step 2 of a logistic regression analysis, solitary drinking ($Alone_{Mean}$) significantly predicted alcohol-dependence diagnoses at age 25, $\beta = 0.34$, $SE = 0.17$, Wald's $\chi^2(1, N = 530) = 3.9$, $p < .05$, $e\beta$ (odds ratio) = 1.4. Results failed to reach significance after we controlled for adolescent AUD symptoms in Step 2 of the model, $\beta = 0.14$, $SE = 0.18$, Wald's $\chi^2(1, N = 530) = 0.57$, $p = .45$, $e\beta = 1.15$.⁴ Results were very similar when we used $Alone_{Max}$ and $Alone_{Ever}$ as the solitary-drinking predictors.

Discussion

Drinking alone can be considered a rather distinct form of adolescent alcohol use, given that most teen drinkers

Table 3. Hierarchical Regression Analysis Predicting Alcohol-Use-Disorder Symptoms at Age 25

Variable	β	pr	t
Step 1			
Gender	0.23	.23	5.50***
Ethnicity	0.15	.15	3.52***
Socioeconomic status	0.01	.01	0.36
Step 2 ^a			
Alcohol quantity at age 18	0.07	.05	1.14
Alcohol frequency at age 18	0.11	.08	1.96*
Step 3 ^b			
Alone _{Mean}	0.13	.13	2.99**

Note: Betas reported are those from the step at which the variable was entered into the equation. Step 1 $R^2 = .07$, adjusted $R^2 = .07$, $\Delta F(3, 524) = 13.7$, $p < .001$; Step 2 $R^2 = .10$, adjusted $R^2 = .09$, $\Delta R^2 = .03$, $\Delta F(2, 522) = 7.3$, $p < .001$; Step 3 Alone_{Mean} $R^2 = .11$, adjusted $R^2 = .10$, $\Delta R^2 = .02$, $\Delta F(1, 521) = 8.9$, $p < .01$. Alone_{Mean} = mean percentage of time drinking alone.

^aAge 18 quantity and frequency of alcohol use were used because a majority of participants had data at this time point. Results were unchanged, however, when we used other age points.

^bSeparate regression analyses performed with the other two measures of solitary drinking—Alone_{Max} (maximum percentage of time drinking alone) and Alone_{Ever} (binary variable of ever having drunk alone)—entered at Step 3 produced similar results.

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

do not engage in this behavior. Prior studies have shown that approximately 12% to 17% of adolescents and young adults recruited from community and school sources engage in solitary drinking. Our results indicate that the prevalence of this behavior is twice as common in adolescents from clinical settings. Specifically, solitary-drinking estimates ranged from 30% to nearly 35% for adolescents with AUD symptoms and from 9% to 15% for adolescents without AUD symptoms. Our results also replicate observations that adolescents who engage in solitary drinking have greater alcohol involvement than do social-only drinkers (Tucker et al., 2006). We found that compared with other teen drinkers, adolescent solitary drinkers reported higher frequency of alcohol use and a greater quantity consumed per occasion, had more AUD symptoms, and were younger when they first experienced alcohol intoxication. A particular strength of our study lies in our measurement of solitary drinking. We defined *solitary drinking* solely as drinking “while alone” rather than also including situations in which “no one else was drinking” (Christiansen et al., 2002; Gonzalez, 2012) because the latter captures drinking in a social setting. In addition, we assessed solitary drinking as a percentage of total drinking episodes rather than as a count of solitary-drinking occurrences, which allowed us to avoid the confound of greater frequency of drinking being associated with both social-drinking and solitary-drinking contexts.

After we controlled for quantity/frequency of alcohol use, results showed that solitary drinking was associated with circumstances that elicit negative emotions but not positive emotions. This finding suggests that solitary drinking may be associated with the motive of drinking to cope with negative affect. Our results, along with prior research that has linked solitary drinking to depressive symptoms and negative affect (Christiansen et al., 2002; Mohr et al., 2001; Tomlinson & Brown, 2012), are consistent with the idea that solitary drinkers use alcohol to self-medicate as a way to cope with negative affect.

Our findings regarding the association of adolescent solitary drinking with young-adult alcohol problems were robust. Significant results occurred for both AUD-symptom counts and alcohol dependence and for all three measures of solitary drinking (the mean and maximum percentage of time spent in solitary drinking and a binary variable of ever having drunk alone). It is important that solitary drinking in adolescence predicted alcohol problems in young adulthood even when we controlled for adolescent alcohol use and AUD symptoms. These results suggest that it is not simply the case that early severe drinking predicts later severe drinking.

This study is the first to determine whether solitary drinking in adolescence predicts AUD symptoms and dependence in young adulthood, but it has limitations. We used the Lifetime Drinking History method, which required some participants to recall alcohol-use patterns over several years ($M = 3.4$ years, $SD = 1.6$). Although we achieved a similar pattern of results when we restricted our analyses to past-year alcohol-use data, some results failed to reach significance, perhaps as a result of a smaller sample size. It would be interesting to replicate our findings using past-year alcohol-use assessments in a larger sample. In addition, although the IDS has been shown to be strongly related to drinking motives (Cooper, 1994), future studies should evaluate motives for drinking using additional measures. A possible bias exists as a result of attrition over follow-up, given that those individuals who were less likely to complete the assessment at age 25 had an AUD at the initial assessment.

Future research should attempt to identify and test mechanisms that longitudinally predict the emergence of solitary drinking among teens. For instance, it would be important to know whether relevant behavioral and health outcomes (e.g., conduct disorder, stress reactivity), interpersonal and temperament factors (e.g., relationship problems, neuroticism), contextual factors (e.g., access to alcohol, friend alcohol use), and a variety of alcohol-related expectancies are associated with solitary drinking. Longitudinal designs that begin before the start of drinking would permit more sophisticated analyses to determine temporal relationships between measures of individual differences, solitary drinking, and

other alcohol use and to specify how patterns in these relationships might change with time. Ecological momentary assessment techniques could be incorporated to elucidate antecedents to adolescent solitary drinking by, for example, testing whether stressors/negative affect experienced during the day predicts solitary drinking that evening.

Laboratory studies would be useful to determine more proximal mechanisms of solitary drinking and to identify potential individual differences in the propensity to engage in this behavior. For instance, laboratory research that manipulates negative affect or interpersonal stress and assesses preference for solitary compared with social drinking would help to clarify causal relationships between variables and to identify which young people may be more vulnerable to this affect-regulating coping strategy. Given that prior research has identified dopamine-related genetic predictors of reward from social drinking (Creswell et al., 2012), it would be useful to examine possible genetic underpinnings of the tendency to engage in solitary drinking. Ultimately, such research would shed light on a minority of adolescents who appear to be especially vulnerable to heavy drinking and the development of alcohol problems.

Author Contributions

K. G. Creswell developed the study concept. All authors contributed to the study design. D. B. Clark and C. S. Martin performed the testing and collected the data. K. G. Creswell analyzed and interpreted the data. K. G. Creswell drafted the manuscript, and T. Chung, C. S. Martin, and D. B. Clark critically revised the manuscript. All authors approved the final version of the manuscript for submission.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Funding

This study was supported by National Institute on Alcohol Abuse and Alcoholism Grants 2R01AA13397, K24AA020840, and K02AA018195 and by Grant T32MH018269 from the National Institute of Mental Health.

Notes

1. We were concerned about the psychometric properties of an assessment of alcohol consumption/patterns over a period longer than 12 months (Grant, Harford, Dawson, Chou, & Pickering, 1995; Hasin & Carpenter, 1998). Therefore, although we had significantly less power to do so, we also examined key hypotheses using data from the past year only.
2. The same pattern of results emerged when we used untransformed values in analyses.
3. As noted previously, only adolescents who reported engaging in regular drinking at the initial assessment were included in this analysis.

4. The same overall pattern of results emerged when we used only past-year alcohol-use data in these linear and logistic hierarchical regression analyses. However, because of reduced power, some tests relating our predictor variables (i.e., Alone_{Mean}, Alone_{Ever}, Alone_{Max}) to AUD-symptom counts and alcohol dependence at age 25 failed to reach significance— $n = 289$; p -value range = .01–.15; adjusted R^2 range = .08–.12; $e\beta$ range = 0.90–1.3.

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