Antecedents, concurrent correlates, and potential consequences of young adult solitary alcohol use

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Abstract

Objective: Research on young adults has found solitary alcohol use to be positively associated with negative emotions, coping motives for drinking, and negative alcohol-related consequences, but most research has been cross-sectional and based on samples of college students. We examined associations across multiple time points within a sample that was diverse with respect to educational status and age.

Methods: A community sample (N = 754, ages 18–26; 56% female) completed surveys at baseline, monthly for 2 years, and at 30 months post-baseline. Multilevel and single-level regression models assessed longitudinal and concurrent associations between solitary drinking and potential correlates, adjusting for frequency of alcohol use.

Results: Moderate depressive symptoms at baseline was associated with greater likelihood of solitary drinking in drinking months in the subsequent two years (adjusted odds ratio [*AOR*] = 2.22, 95% CI [1.54–3.20]). During those two years, both depressive symptoms and coping motives were positively concurrently associated with solitary drinking at the between- and within-person level. Although solitary drinking in a particular month had a small and nonsignificant association with negative alcohol-related consequences, proportion of drinking months that involved solitary drinking was positively associated with negative alcohol-related consequences across months. More solitary drinking during monthly data collection was associated with greater likelihoods of hazardous drinking and moderate depressive symptoms at 30-month follow-up, but these associations were not statistically significant after adjusting for earlier measures of drinking and depressive symptoms.

Conclusions: The findings point to the importance of considering drinking context when screening and providing treatment for alcohol misuse.

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Keywords

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Frequent and heavy alcohol use is has numerous adverse physical, social, and mental health consequences among young adults (White & Hingson, 2013; Windle & Windle, 2005). Most research on young adult drinking has not distinguished between drinking with friends, family members, or other individuals and drinking alone. Among adolescents and young adults, solitary alcohol use (i.e., drinking alone) is less common than social drinking (i.e., drinking with others; Bourglault & Demers, 1997; McCabe, West, Veliz, Frank, & Boyd, 2014) and may have unique etiology and consequences.

Based on a review of research on solitary substance use among adolescents, we previously proposed a conceptual framework, derived from Cooper's motivational model of alcohol use (Cooper, Frone, Russell, & Mudar, 1995), of risk factors for and consequences of adolescent solitary versus social substance use (Mason, Stevens, & Fleming, 2019). Although developed to summarize the adolescent solitary substance use literature, this framework may also be relevant for young adults and is consonant with findings from a review and meta-analysis of studies on solitary drinking in both adolescents and young adults (Skrzynski & Creswell, 2020). Cooper suggested that drinking in different contexts is rooted in different motives and found evidence in an adolescent sample that solitary drinking was associated with drinking to cope with negative emotions (Cooper, 1994). Thus, our framework hypothesizes that constructs reflecting negative emotions, such as depression, positively predict solitary drinking. Because drinking to cope with or avoid distress can be negatively reinforcing, these patterns of drinking may escalate over time; in turn, solitary drinking is hypothesized to have more deleterious alcohol-related consequences than social drinking. Indeed, compared to adolescents who engaged in social-only drinking, Creswell et al. (2014) found that adolescents who drank alone were more likely to meet criteria for substance use dependence at age 25, even when adjusting for amount and frequency of alcohol use at age 18. In addition, laboratory studies indicate the effects of alcohol depend on the context in which it is consumed, with social drinking more likely to produce feelings of euphoria and solitary drinking more likely to exacerbate negative emotions (del Porto & Masur, 1984; Doty & de Wit, 1995), which could contribute to the development of depression and other internalizing disorders.

Skryzynski and Creswell's (2020) review found evidence linking solitary drinking to greater negative emotions, drinking coping motives, and negative alcohol-related consequences in young adult samples. These associations were demonstrated across a wide range of study methodologies. For instance, a range of measures were used to assess each construct. Negative emotions were assessed with measures of depression, anxiety, negative affect, and stress. Measures of alcohol consequences included indices of consequences, such as the Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Kahler, Strong, & Colder, 2006), as well as broader measures of drinking problems, such as the Alcohol Use Disorder Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). Studies also used a variety of statistical models (e.g., regarding inclusion of covariates

and testing for indirect effects) and sampling procedures (e.g., regarding screening for prior history of alcohol consumption and using college or noncollege samples). Although research consistently points to solitary drinking being rooted in negative emotions and leading to further negative emotions and alcohol-related consequence, the existing literature has limitations and gaps.

First, most studies on young adults have been cross-sectional, and it is unclear from these studies whether solitary drinking precedes and contributes to the development of psychopathology, or is a symptom of distress. Bilevicius et al. (2018) provide one exception, finding that negative affect, indicated by measures of depression and anxiety assessed at the beginning of college freshmen's first semester, predicted frequency of solitary drinking at the end of that semester, controlling for frequency of solitary drinking at the first time point. More longitudinal designs are needed to examine the temporal order of solitary drinking relative to depression and related distress. In addition, longitudinal repeated measures data allow for distentangling between- and within-person associations. Between-person associations may capture relationships between longer-term patterns of solitary drinking across multiple time points and average levels of other psychosocial variables across those same time points; within-person associations would point to how psychosocial correlates may vary with changes in solitary drinking within an individual over time.

A second limitation is that many prior studies have not adjusted for amount of alcohol use. A clear finding from Skrzynski and Creswell's (2020) review is that young adult solitary drinkers drink more than social-only drinkers with respect to frequency of any drinking and frequency of heavy drinking. Thus, alcohol consumption may be a third variable that contributes to the observed associations between solitary drinking and depression, drinking coping motives, and alcohol-related consequences. For example, in a sample ranging in age from early to late adulthood, Bourglault and Demers (1997) found the association between frequency of solitary drinking and negative alcohol-related consequences became small and nonsignificant after adjusting for amount of alcohol use; solitary drinking was only a marker of risk when it involved heavy drinking of 5 or more drinks on an occasion. In a study of young adults, however, Skrzynski et al. (2018) found a positive association between solitary drinking and drinking to cope with anxiety and depression after adjusting for both quantity and frequency of alcohol consumption. Also, Corbin et al. (2020) found solitary drinking was positively associated with YAACQ scores after adjusting for drinks consumed per day. Additional work such as this is needed to differentiate the lack of drinking companions from the amount of alcohol consumption, with controls that include frequency of heavy alcohol use, which may be strongly related to negative alcohol-related consequences such as accidents and physical illness.

A third limitation is that most prior studies of solitary drinking among young adults have focused on 4-year college students, with most samples predominantly composed of individuals under age 22. Nationwide, only a minority of young adults attend 4-year colleges (Ryan & Bauman, 2016), a setting with unique considerations for alcohol use. Although 4-year college students report drinking more than young adults not in that context (Schulenberg et al., 2019), college drinking is most often linked to social enhancement motives, peer influences, and social events (Del Boca, Darkes, Greenbaum, & Goldman,

2004; Neighbors, Lee, Lewis, Fossos, & Larimer, 2007), and 4-year college students tend to live in dormitories or other group-living situations. Therefore, it is likely that solitary drinking is less common than social-only drinking in college students compared to their non-4-year-college counterparts. It is also clear that the prevalence of solitary drinking increases with age from adolescence into young adulthood (Skrzynski & Creswell, 2020), and also from early into later adulthood (Bourglault & Demers, 1997). Although a number of prior studies on young adults control for age, the associations between solitary drinking and negative emotions, coping motives, and alcohol-related consequences may differ by the overlapping variables of educational status and age. For instance, because solitary drinking is less common among 4-year college students and younger adults, it may be viewed more negatively relative to social drinking; therefore, when solitary drinking does occur among 4-year college students and younger adults, it represents a deviation from normative behavior that may be more strongly rooted in psychological distress than it is for non-college young adults and those who are older. Exploring who is at risk for solitary drinking and its associated consequences is important for prevention and treatment, potentially helping service providers use information on drinking context to identify and help individuals caught in a maladaptive pattern of using substances to cope with distress.

In the current study, we examined solitary drinking in a community sample of young adults ranging in age from 18 to 26 years and representing a variety of educational statuses. Data included a baseline survey, monthly assessments for two years, and a follow-up survey at 30 months post baseline. We first evaluated depressive symptoms at baseline as a prospective antecedent of solitary drinking in drinking months during monthly assessments in the subsequent two years. Second, using concurrent monthly assessment of depressive symptoms and coping motives, we examined both between- and within-person associations between these variables and solitary drinking. Specifically, between-person associations show how average levels of depressive symptoms and coping motives across months are associated with likelihood of solitary drinking, whereas within-person associations show how elevations in these variables, adjusting for what is typical for a given person, are related to concurrent likelihood of solitary drinking in a particular month. Third, we used monthly assessments to also assess between- and within-person associations between solitary drinking and negative alcohol-related consequences. Finally, we examined the proportion of drinking months that involved solitary drinking as a potential predictor of subsequent hazardous drinking and depressive symptoms at 30 month follow-up. Each of these associations with potential predictors, correlates, and consequences of solitary drinking were assessed adjusting for frequency of any and heavy episodic drinking.

Based on our conceptual framework and research reviewed above, we hypothesized that solitary drinking would be preceded by higher prior levels of depressive symptoms, and be concurrently positively associated with depressive symptoms, drinking coping motives, and negative alcohol-related consequences at both the between- and within-person levels. We also hypothesized that individuals with more solitary drinking would subsequently report more severe depressive symptoms and hazardous drinking. In addition, we explored whether these associations varied by age and educational status.

Method

Participants and Procedures

The analysis sample included 754 young adults who were part of a longitudinal study on alcohol use and young adult social role transitions (Patrick et al., 2018). Eligibility criteria included being 18 to 23 years of age at screening, having consumed alcohol in the prior year, living within 60 miles of the study office in Seattle, Washington, and being able to come to the study office for consent and completion of a baseline assessment. Between January 2015 and January 2016, we recruited participants through a variety of methods (e.g., print and online advertisements, outreach at community colleges, and friend referral). Individuals completed an online eligibility survey and then came to the study offices where identity and age were verified, study procedures explained, and informed consent obtained. Participants completed a baseline assessment online while in the study office, for which they received a $40 gift card.

Participants were invited to complete 24 consecutive months of online surveys beginning the month after the baseline assessment. The monthly survey periods spanned 7–10 days at the beginning of each calendar month, and most questions referred to the prior calendar month. Participants received gift card codes as compensation (up to $680 total). At 30 months after enrollment, at which point participants ranged in age from 20 to 26 years, another online survey was administered, with compensation of a $50 gift card. The study procedures received approval from the University of Washington's Institutional Review Board.

Of 778 participants enrolled in the project who started monthly data collection, 24 were excluded because they did not complete any monthly surveys ($n = 5$) or did not report alcohol use in any of the monthly surveys ($n = 19$). The mean age for the analysis sample ($n = 754$) was 21.11 years ($SD = 1.70$) at baseline, and 56% reported sex at birth as female. The sample was 59% White, 18% Asian, 5%, Black, and 18% other (Native American, Pacific Islander, or multiracial); 9% of participants identified as Hispanic/Latino. At the beginning of the study, 75% were in school and 61% were employed. Only 10 were married and 8 were parents.

Measures

Solitary drinking.—Items concerning drinking context were derived from the Monitoring the Future study (Schulenberg et al., 2019). In the month 1–24 surveys, participants who reported any alcohol use in the prior month were asked, "When you used alcohol in the past month, how often did you use it in each of the following situations?" Different contexts were offered, with each context offering the following response options: 0 = Not at all, 1 = A few times, 2 = Some of the times, 3 = Most of the times, and 4 = Every time. One of the contexts was "When you were alone"; other contexts referred to places (e.g., at home, in a bar), activities (e.g., at a party, while playing a game such as quarters or beer pong), time of day (e.g., during the daytime), and drinking companions (e.g., with friends, family, romantic/dating partner, or co-workers). For this study, solitary drinking was based solely on answers to the "When you were alone" option, since all other contexts referred to drinking partners or were ambiguous with respect to whether other individuals were present.

For analyses examining depression as an antecedent of solitary drinking and its concurrent associations with depressive symptoms, coping motives and alcohol-related consequences, only data from months in which any alcohol use was reported were used and a dichotomous measure of solitary drinking in drinking months was created based on whether respondents reported any drinking when they were alone. For models examining monthly alcohol-related consequences and 30-month follow-up outcomes, a measure of solitary drinking across the 24 monthly surveys was created based on the proportion of drinking months in which solitary drinking was reported.

Moderate depressive symptoms.—The Patient Health Questionnaire 9 (PHQ-9; Kroenke, Spitzer, & Williams, 2001) was administered at baseline and at the 30-month follow-up. The PHQ-9 score is based on the sum of 9 depressive symptoms items, each with a past 30 day time frame and response options ranging from 0 = "Not at all" to 3 = "Nearly every day." We dichotomized at the cutoff for moderate depressive symptoms, which is a score of 10 or above. This cutoff score has been shown to yield high criterion validity for depressive disorder as assessed by clinical interview (Kroenke et al., 2001).

Amount of alcohol use.—At baseline and in the monthly surveys, we assessed two measures of alcohol use in the prior month: frequency of any alcohol use and frequency of heavy episodic drinking (HED; threshold of 4+/5+ for females/males in a two hour period, depending on sex at birth; National Institute of Alcohol Abuse and Alcoholism). Response options for frequency of any alcohol use and HED ranged from 0 = never to 7 = every day. The two measures of alcohol use were correlated r=.58 at baseline and r=.58 across all person drinking months in months 1–24. Person-average scores for the two measures, used in models predicting 30 month outcomes were correlated r=.68.

Monthly measure of depressive symptoms.—For the monthly surveys, depressive symptoms were measured with the PHQ-2 (Kroenke, Spitzer, & Williams, 2003), which asked how often, in the past month, respondents felt bothered by (1) "Little interest or pleasure in doing things" and (2) "Feeling down, depressed, or hopeless." A depressive symptom score was based on the sum of the two item scores. The monthly measure of depressive symptoms was standardized before being entered as a predictor of solitary drinking in order to aid in the interpretation of the estimated associations. For models assessing concurrent between- and within-person associations, the between-person measure of depressive symptoms was based on the average of monthly standardized scores across months.

Monthly coping motives for drinking.—Drinking motives were assessed with the 28-item Modified Drinking Motives Questionnaire-Revised (Modified DMQ-R; Grant, Stewart, O'Connor, Blackwell, & Conrod, 2007). The measure was adapted to ask about motives for drinking in the previous month with the lead-in question, "How often would you say that you drank in the past month for each of the following reasons?" Response options for individual items ranged from 1 = almost never/never to 5 = almost always/always. Thirteen items from the depression and anxiety coping subscales were averaged to form a scale of drinking coping motives (range for alpha across months = .90–.93; example items: "To cheer

me up when I'm in a bad mood," "To reduce my anxiety"). As with monthly measures of depressive symptoms, monthly scores on the coping motives measure were standardized and a between-person measure was based on the average of those monthly standardized scores.

Monthly Alcohol-related consequences.—In the month 1–24 surveys, participants who had consumed any alcohol were asked to indicate *yes* (1) or *no* (0) if they had experienced 24 negative consequences in the past month using the Brief YAACQ (Read et al., 2006). The negative consequences include physical symptoms (e.g., nausea, hangovers), risk-taking and dysregulated behavior, and interference with day-to-day tasks. Affirmative responses to the consequences were summed, creating a count variable of alcohol-related consequences.

Hazardous drinking.—Alcohol use disorder symptoms were assessed at the 30-month follow-up with the AUDIT (Babor et al., 2001), a 10-item self-report measure used to assess alcohol consumption and alcohol-related problems, with total scores ranging from 0 to 40. Some AUDIT items asked about current drinking patterns and some used a prior 6 months time frame. Using a standard cutpoint of 8 or above to indicate risk (Babor et al., 2001), we created a dichotomous measure of hazardous alcohol use. This assessment of hazardous drinking has shown good criterion validity for diagnosis of alcohol use disorder (Allen, Litten, Fertig, & Babor, 1997).

Educational status and age.—At baseline and each monthly assessment, and at 30-month follow-up, individuals reported their current educational status. When participants were on summer, winter, or spring break from college, they were instructed to report that they were college students. As would be expected, age and educational status strongly overlapped. For example, most four-year college students were under age 23 and most participants with post-secondary degrees were 23 or over. For this reason, we collapsed age and educational status into three categories: (1) currently attending a 4-year college, (2) not attending a four-year college and under age 23, and (3) not attending a 4-year college and age 23 or above. These categories broadly capture variation in these variables and allowed us to contrast 4-year college students, who have been the basis of most prior research on young adult solitary drinking, with young adults in other educational and developmental age contexts. It should be noted, however, that each of the categories contained variability with respect to education and age. For instance, of those categorized as non-4-year college and under age 23 category at baseline, 46% were in a 2-year college, 24% were not in school and had not graduated from a post-secondary educational program, and 30% were not in school and had graduated from a post-secondary program. In the non-4-year college and age 23 or older category, 21% were in a 2-year program, 9% had no post-secondary degree, and 71% had a post-secondary degree. Of those categorized as 4-year college students, 81% were under age 23 at that time point. Of course, the sample's age and educational status shifted during the study. At baseline, 48% were 4-year college students, 38% were not in 4-year college and under age 23, and 14% were not in 4-year college and age 23+. As the sample aged, an increasing proportion transitioned into the category of being out of 4-year college and age 23+ (56% at 30-month follow-up; Table 1).

Covariates.—Biological sex (0 = male, 1 = female), which determined the sex-specific cutoff for HED, was included as a covariate in our analysis models. We also included race/ethnicity, with four categories: Non-Hispanic White, Asian, Non-Hispanic Other (including Black, Native American, and mixed race/ethnicity), and Hispanic. Race/ethnicity was dummy-coded with Non-Hispanic White serving as the reference group.

Data Analysis

Before addressing our primary research questions, we examined the prevalence of solitary drinking during the 24 months of monthly data collection. We also conducted bivariate analyses to describe the overall associations between solitary drinking and both sex and age/educational status. We then ran a series of regression models. For each set of models, we first ran a main-effects model and then added interaction terms between the covariate of interest and age/educational status. Models in which the outcomes were measured with monthly data during the two years of monthly data collection were specified as multilevel, with monthly time points nested within individuals and intercepts allowed to vary across individuals. These models contrast drinking months in which solitary drinking occurred versus drinking months in which solitary drinking did not occur. All multilevel models were run with a maximum likelihood estimator, and unit-specific (i.e., conditional on random effects) estimates for fixed effects are provided for logistic and negative binomial models.

Our first question, whether depressive symptoms were associated with subsequent solitary drinking, was addressed with multilevel logistic regression models examining moderate depression at baseline as a time-fixed person-level predictor of solitary drinking at monthly time points. Essentially, these models assess the extent to which depression at baseline was associated with the proportion of drinking months that involved solitary drinking during the subsequent two years. These models included sex, race/ethnicity, and frequency and quantity of alcohol use at baseline as person-level covariates and age/educational status at the given month of data collection as a time-varying covariate.

Our second question, whether depressive symptoms and coping motives were associated concurrently with solitary drinking at the between- and within-person levels, was addressed with multilevel logistic regression models again predicting solitary drinking in drinking months. In these models, depressive symptoms and depression coping motives were treated both as time-varying predictors (i.e., the scores in a particular month) and between-person predictors (i.e., average scores across months). Monthly measures of frequency of any alcohol use and HED and age/educational status were time-varying predictors.

Our third question concerned potential concurrent consequences of solitary drinking. For this question, we estimated multilevel models with alcohol-related consequences as the outcome. Because this outcome was a discrete non-negative integer showing positive skew as well as evidence of over-dispersion, we specified a negative binomial distribution (Atkins, Baldwin, Zheng, Gallop, & Neighbors, 2013). Solitary drinking was included as a both a between-person predictor (i.e., proportion of drinking months in which solitary drinking occurred) and a within-person predictor (i.e., whether solitary drinking occurred in a particular month). Again, frequency of any drinking and HED and age/educational status were included as time-varying predictors. The associations between predictors and the

count outcome are expressed as rate ratios (RRs), which can be interpreted in terms of the proportional change in the number of consequences associated with a one unit increase in the given predictor (e.g., a month involving or not involving solitary drinking).

We addressed our fourth question, concerning solitary drinking as an antecedent of later hazardous drinking and depression outcomes at 30-month follow-up, with single-level multiple logistic regression models. These models used the proportion of drinking months in which solitary drinking occurred as the primary covariate of interest. For these models, age/educational status was measured at the time of the 30-month follow-up and frequency of any alcohol use and HED were measured as the averages across months 1–24, based on all available months, including months with no alcohol use. For models with depressive symptoms as an outcome, we ran main effects models both omitting and including a covariate for depression during the two years of monthly data collection based on average depressive symptoms scores across that time period.

In primary analyses we dichotomized PHQ-9 and AUDIT scores and, in multilevel models of monthly data, we dichotomized solitary alcohol use into solitary versus social-only drinking. We ran supplemental analyses without dichotomization. For the PHQ-9 and AUDIT, this involved using symptom counts; for monthly solitary drinking, we used scores based on the ordinal response options to the "When you were alone" context item. Negative binomial models were used for models in which PHQ-9 and AUDIT scores were the outcomes, and an ordinal logistic regression model was used when modeling frequency of solitary drinking as an outcome. Results of the supplementary analyses were similar in terms of the direction and statistical significance levels of all effect estimates compared to models using dichotomization (see Tables A–D in the online supplement).

Missing data.—Participants in the analysis sample completed an average of 20.14 monthly surveys ($SD = 5.90$), with 77% completing at least 18 and 47% completing all 24 months. Both number of completed monthly surveys and the proportion of monthly surveys in which alcohol use was reported were associated with some demographic and baseline variables (e.g., males and those reporting more hazardous drinking at baseline completing fewer monthly surveys and baseline measures of drinking associated with the proportion of monthly surveys in which alcohol use was reported; Tables E and F in the online supplement). In analyses of repeated measures of monthly data (e.g. depressive symptoms associated with monthly solitary drinking), the multilevel models, using maximum likelihood estimation, should yield unbiased estimates under the assumption that data are missing at random (MAR; i.e., missingness is only associated with measured covariates and not related to unmeasured variables; Graham, 2012). Complete data was required on all model covariates in the multilevel models. This resulted in the loss of 2% of individuals and 1% of person-months in models of baseline depressive symptoms predicting subsequent solitary drinking and the loss of 1 individual and less than 2% of person-months in models examining concurrent associations.

For single-level models with 30-month follow-up outcomes, 662 participants (88%) completed the 30-month follow-up survey and had a non-missing score on the assessment of hazardous drinking or depressive symptoms. Completion of the 30-month follow-up was

also associated with some baseline characteristics and behaviors (e.g., individuals who met the cutoff for moderate depressive symptoms were less likely to complete the 30-month follow-up; Tables E–G). Given the number of cases that would be lost with listwise deletion under the assumption of data being missing completely at random, we imputed missing 30-month data using multiple imputation by chained equations (MICE) approach, which should yield unbiased results under the MAR assumption (Azur, Stuart, Frangakis, & Leaf, 2011). In addition to all covariates and outcomes in the 30-month outcome models, the imputation model included auxiliary variables of baseline PHQ-9 and AUDIT scores and the last educational status reported in the month 1–24 data collection period. Forty imputed datasets were created. We estimated regression models within each dataset, averaged parameter estimates across those analyses, and calculated standard errors according to Rubin's rules (Azur et al., 2011). We ran imputation models and both multilevel and single level regression models with Stata 14.2 (StataCorp, 2016).

Results

Descriptive information on study variables is shown in Table 1. A substantial portion of the sample met criteria for moderate depressive symptoms (29%) at baseline. This percentage dropped to 19% at the 30-month follow-up, while 22% met the cutoff for hazardous drinking at the follow-up time point. Solitary drinking was reported in 30% of months in which any alcohol use was reported. Of the months in which solitary drinking was endorsed, a majority (60%) of the responses were "A few times." A majority of the sample (70%) reported solitary drinking in at least one month of the two years of monthly data collection. Males reported solitary drinking in a higher proportion of drinking months than females ($M = .29$, $SD = .32$ vs $M = .21$, $SD = .27$), $t(752) = 3.72$, $p < .001$, and 44% of males versus 30% of females reported solitary drinking in at least 25% of months, $\chi^2(1) = 13.83$, $p < .001$. Based on all person months, prevalence of past-month alcohol use was 79% for 4-year college students, 74% for those not in 4-year college and age <23, and 84% for those not in 4-year college and age 23+. Prevalence of solitary drinking, however, was lower among individuals in the 4-year college status. This was true when looking at all person-months (18% for 4-year college, 24% for non-4-year college age < 23, and 31% for non-4-year college age 23+) and for alcohol-use months (23% for 4-year college, 33% for non-4-year college age < 23, and 37% for non-4-year college age 23+).

Depressive symptoms as an antecedent of solitary drinking

As shown in Table 2, depressive symptoms at baseline was positively associated with the likelihood of solitary drinking in months 1–24, even after adjusting for frequency and quantity of alcohol use at baseline. Those who met the criterion for moderate or more severe depressive symptoms had odds of solitary drinking over twice as high as those who did not meet that criterion. Frequency of any alcohol use at baseline was associated with greater likelihood of solitary drinking, and HED frequency was negatively associated with solitary drinking, adjusting for other variables in the model. Similar to the results of bivariate analyses reported above, other main effects of note were for sex (females being less likely to report solitary drinking) and age/educational status. Odds of solitary drinking were 24% higher for the younger non-4-year college status compared to 4-year-college students

and 55% higher for the older non-4-year-college status. There was also evidence that the association between depressive symptoms at baseline and likelihood of solitary drinking differed by age/educational status, with the association being stronger among 4-year college students than in the other two statuses. The model-predicted prevalence of solitary drinking at the average values of other model covariates shows a relatively large difference between non-depressed and depressed 4-year college students (24% [95% CI=21–27%] vs 37% [95% CI=32–42%]) compared to the differences between non-depressed and depressed individuals in the other two age/education status categories (non-4-year college age <23: 28% [95% CI=25–31] vs 36% [95% CI=31–40]; non-4-year college age 23+: 30% [95% CI=27–34] vs 39% [95% CI=33–44]).

Concurrent associations with depressive symptoms and coping motives

Depressive symptoms and drinking coping motives in a given month were positively associated with greater likelihood of solitary drinking, adjusting for frequency and quantity of alcohol use (Table 3). Unique associations were present at both the between- and within-person level. Individuals who reported more depressive symptoms and coping motives on average were more likely to report solitary drinking; also, depressive symptoms and coping motives were associated with a greater likelihood of solitary drinking in a particular month, adjusting for person-level covariates. A standard deviation unit within-person increase in depressive symptoms was associated with a 21% increase in the odds of solitary drinking. The within-person association with coping motives was stronger, with a standard deviation within-person increase in coping motives associated with 66% greater odds of solitary drinking. As with baseline measures of alcohol use, concurrent measures showed a positive unique association between frequency of any alcohol use and solitary drinking and a negative unique association between frequency of HED and solitary drinking. Interactions between age/educational status and both depressive symptoms and coping motives were small and nonsignificant.

Concurrent associations with negative alcohol consequences

Table 4 shows models predicting number of alcohol-related consequences. The main effects model indicated that the proportion of drinking months in which solitary drinking was reported was positively associated with negative alcohol consequences. To illustrate, model predicted marginal estimates of average number of alcohol-related consequences for individuals who reported solitary drinking in 10% and 50% of drinking months were 1.90 (95% CI=1.71–2.10) and 2.54 (95% CI=2.26–2.81), respectively. Within-person monthly variation in solitary drinking were not strongly associated with drinking consequences: solitary drinking in a particular month was associated with a small (3%) and nonsignificant increase in alcohol-related consequences. Individuals in the younger and older non-4-year college statuses reported fewer alcohol-related consequences compared to 4-year college students, but odds ratios for interactions with solitary drinking were close to 1 and not statistically significant. Adjusting for other model variables, being female and both measures of alcohol consumption had positive unique associations with the number of alcohol-related consequences.

Solitary drinking as an antecedent of hazardous drinking and moderate depressive symptoms

As shown in Table 5, the unique association between the proportion of drinking occasions during months 1–24 that were solitary and whether individuals met the cutoff for hazardous drinking at 30-month follow-up was positive but not statistically significant. Greater frequency of both any alcohol use and HED showed independent positive associations with greater likelihood of hazardous drinking, with frequency of HED being the stronger predictor. The first main effect model predicting depressive symptoms at 30-month follow-up showed a strong positive association between proportion of drinking that was solitary and the likelihood of meeting the cutoff for moderate depressive symptoms. This association was still positive, but attenuated and not statistically significant after adjusting for mean level of depression symptoms across the 24 months of monthly data collection. Females showed greater than twice the odds of depressive symptoms compared to males. Neither measure of alcohol consumption averaged across the 24 months were uniquely and significantly associated with meeting the subsequent depression threshold. For neither hazardous drinking nor depressive symptoms at 30-month follow-up were the solitary drinking by age/educational status interaction effects statistically significant.

Discussion

Our findings support a conceptualization of solitary drinking among young adults as distinct from social drinking in its antecedents and correlates, but reveal mixed evidence for unique consequences of solitary drinking. The risk factors identified are consistent with Cooper's motivational model (Cooper et al., 1995; see also Mason et al., 2019), with solitary drinking motivated by a desire to mitigate negative emotions, such as depression and anxiety. Solitary drinking may have harmful alcohol-related consequences not accounted for by the amount of alcohol consumed. We found that individuals who reported solitary drinking in a large proportion of drinking months reported more alcohol-related consequences on average, but that solitary drinking in a particular month was not strongly associated with alcohol-related consequences in that same month. Our results also did not show strong support for solitary drinking predicting later hazardous drinking over and above the amount of alcohol consumption in the earlier time period. Solitary drinking did signal risk for moderate or more severe depressive symptoms assessed at the later time point, although this was at least partially accounted for by depressive symptoms concurrent with the period of solitary drinking. Our findings add to prior studies on solitary alcohol use in young adults by assessing longitudinal associations, adjusting for two dimensions of alcohol consumption, and using data from a young adult sample that was diverse with respect to educational status and age.

The associations found between solitary drinking and both depressive symptoms and coping motives in this young adult sample are similar to findings in prior cross-sectional studies (Skrzynski & Creswell, 2020). In our study, we controlled for two measures of alcohol consumption. Frequency of any alcohol use, as opposed to HED, had a positive association with of likelihood of solitary drinking, perhaps pointing to the salience of the number of opportunities for solitary drinking. The findings regarding depressive symptoms and

coping motives are consistent with a self-medication explanation of alcohol use (Bolton, Robinson, & Sareen, 2009; Crum et al., 2013), which tends to receive only mixed support in examinations of subclinical variation in alcohol use (Kuntsche, Knibbe, Gmel, & Engels, 2005). The self-medication model may be useful for explaining not only disordered drinking, but the related phenomenon of drinking defined by its context. Drinking with others is often associated with social and enhancement motives (Cooper, 1994), consistent with a model wherein alcohol is a catalyst, or is perceived to be a catalyst, for social interactions (Schulenberg & Maggs, 2002). Solitary drinking appears to be associated with coping motives, with the goal of managing negative emotions.

Another factor in the relationship between depressive symptoms and solitary drinking, however, is that depression frequently involves social isolation (Chou et al., 2011; Hawthorne, 2008; Matthews et al., 2016). Depressed individuals may simply spend more time alone, and their alcohol use, therefore, is more likely to occur in this context (Callinan et al., 2020). However, in a cross-sectional study of a college sample, Gonzalez (2013) found little evidence that solitary drinkers had smaller social networks or fewer friends with whom to drink. Still, more research is needed on this issue using longitudinal data and validated measures of social isolation.

We found that solitary drinking and negative alcohol-related consequences were associated with one another across two years of data collection, with individuals reporting more months of solitary drinking also reporting more negative consequences of alcohol use. This is similar to results from other studies (e.g., Corbin et al. 2020) that found unique associations between solitary drinking and alcohol consequences. We also expected to see associations at the within-person level, with solitary drinking in a particular month tied to increased negative consequences in that same month, but the estimate of this association was small and not significant. It may be that proportion of months that involve solitary drinking is an indicator of a personality characteristic or pattern of behavior that makes individuals prone to alcohol misuse and negative consequences from drinking rather than solitary drinking being a proximal and independent cause of those types of consequences at the monthly level.

Solitary drinking during the two years of monthly data collection was positively associated with hazardous drinking and depressive symptoms at the 30-month follow-up, although these associations were not statistically significant after including controls in our models. The fact that depressive symptoms preceded, followed, and were concurrently associated with solitary drinking points to a potential reciprocal relationship (Skrzynski & Creswell, 2020). Solitary alcohol use may increase negative emotions (del Porto & Masur, 1984; Doty & de Wit, 1995) or it might reinforce social isolation that, in turn, exacerbates internalizing problems. Our findings, however, provide only modest support for the hypothesis that the solitary drinking leads to substance use and mental health disorders. We controlled for amount of alcohol consumption, including frequency of HED, which was a strong predictor of alcohol-related consequences and hazardous drinking. In the case of prediction of moderate depressive symptoms, we also controlled for prior depressive symptoms. Adding these controls resulted in associations between solitary drinking and alcohol-related consequences and later hazardous drinking and depressive symptoms that were positive but not statistically significant. These findings differ from those from longitudinal studies of

adolescents that have found solitary drinking uniquely predicts later problems even after adjusting for prior alcohol use (Tucker et al., 2006; Creswell et al., 2014). Because solitary drinking is less common among adolescents than young adults (Skrzynski & Creswell, 2020), it may represent a stronger marker of psychosocial problems in teenagers that lead to negative outcomes. This would be consistent with findings from Bourgault (1997) indicating that solitary drinking becomes more common with age and that the association between frequency of solitary drinking and alcohol-related problems is weak in adulthood. With respect to hazardous drinking at the 30-month follow-up, it should be noted that the AUDIT combines information on both the frequency and consequences of alcohol use, and was strongly predicted by frequency of HED in months 1–24. It may be that a measure that is more specifically designed to assess social, physical, and mental health consequences of drinking would show evidence of a longitudinal, predictive relationship even after adjusting for amount of alcohol consumed.

Our sample included individuals not attending four-year colleges and ranging in age from 18 to 26 years. As expected, we found that solitary drinking was more prevalent among individuals who were not in college, with the highest prevalence solitary drinking among those who were age 23 and older. That solitary drinking was most prevalent among the older age group who were out of college further corroborates Bourglaut and colleagues' (1997) finding that prevalence of solitary drinking increases with age. We also found evidence that depressive symptoms were a stronger risk factor for subsequent solitary drinking for individuals in a 4-year college context. This may be attributable to solitary drinking being rare and considered less acceptable in the college context and, thus, a stronger marker of psychological distress. Concurrent associations between both depressive symptoms and depression coping motives and solitary drinking did not, however, vary substantially across age/educational status, nor did the associations between solitary drinking and alcohol consequences or later hazardous drinking or depressive symptoms. An important limitation of our investigation of this issue is that the age/educational status categories contained considerable heterogeneity with respect to life circumstances. Moreover, these categories also capture educational status at a particular time point and are an imperfect reflection of longer-term educational paths (e.g., whether young adults are on a path leading to graduating from college) that may be important with respect to understanding alcohol use patterns (Fleming, White, Haggerty, Abbott, & Catalano, 2012).

The sample was recruited in and around Seattle, Washington, and most of the participants attended a 4-year college or had graduated from a 4-year program. This level of educational attainment is not typical of the young adult population nationwide (Ryan & Bauman, 2016; Schulenberg et al., 2019), and future research on solitary alcohol use should attempt to recruit community samples with a larger proportion of young adults who are not on the 4-year college path. Issues of generalizability are also raised by the fact there was some evidence of differential attrition.

As noted by Skrzynski and Creswell (2020), there is a need for future studies to use carefully designed measures of drinking context and longitudinal data with closely spaced time points (e.g., via ecological momentary assessment studies) to better disentangle what are likely reciprocal causal relationships between solitary alcohol use and negative emotions.

Our measure of solitary drinking, based on one item with response options that capture a mix of proportion and frequency, was less than ideal. Measures that assess actual number of drinking occasions in different contexts or the percentage of drinking occasions that are in different contexts (see Skrzynski et al. 2018 for an example) are needed. In our study, we were able to address whether solitary drinking was an antecedent of hazardous drinking and depressive symptoms, adjusting for prior measures of drinking and depression. Those models thus capture within-person change. In examining depressive symptoms as an antecedent of subsequent solitary drinking, we controlled for alcohol consumption at the earlier time point, but lacked a baseline measure of drinking context and were not able to test whether depression predicted a change in the likelihood of solitary drinking. Although our monthly data allowed us to disentangle some between- and within-person associations and seem to offer an opportunity to assess month-to-month change in solitary drinking, negative emotions, coping motives, and drinking consequences, the spacing of time points is not ideal for disentangling the interplay among these variables, as the causal relationships likely play out over much shorter-term intervals.

Our findings have implications for prevention and clinical practice, pointing to the importance of considering alcohol use context in addition to simply the amount of alcohol consumed. For example, alcohol misuse prevention programs might directly address negative affect and incorporate additional skills training components that teach prosocial coping strategies as alternatives to drinking. In addition to the use of validated assessment tools for routine screening of depression and alcohol use, clinicians should assess the context of drinking, including solitary versus social drinking and motivations for alcohol use. Such a screening tool could be used to identify individuals who are using alcohol when alone to cope with negative emotions such as depression and anxiety. Brief or longer-term interventions could be tailored to address this cycle. For instance, an important intervention approach may be behavioral activation strategies of engagement in reward-based, substance-free activities (Jacobson, Martell, & Dimidjian, 2001; Martínez-Vispo, Martínez, López-Durán, Fernández del Río, & Becoña, 2018). The complementary goals of this approach would be to reduce alcohol misuse, depression, and social isolation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Public health significance statement:

In young adults, moderate depressive symptoms were associated with subsequent solitary drinking and, in turn, solitary drinking was associated with concurrent depressive symptoms and drinking to cope with depression and anxiety. Across two years, individuals who drank alone in more months reported more negative alcohol-related consequences on average. Drinking context may be important to consider in efforts to understand, prevent, and treat alcohol misuse.

Table 1

Summary statistics for study variables

Variable	n (%)	M (SD)
Fixed characteristics (n = 754)		
Female	425 (56)	
Race/ethnicity		
Non-Hispanic White	415 (55)	
Non-Hispanic Asian	132 (18)	
Non-Hispanic Other	139 (18)	
Hispanic	68 (9)	
Baseline measures used in test of depression as a predictor of solitary drinking (n = 741)		
Moderate depressive symptoms (10+ on PHQ9)	215 (29)	
Any alcohol use frequency		2.66 (1.61)
HED frequency		0.97 (1.27)
Monthly measures (n = 11,966 [a] person-months in which alcohol consumed)		
Frequency of solitary drinking (i.e, "When you were alone")		
Not at all	8,347 (70)	
A few times	2,181 (18)	
Some of the times	860 (7)	
Most of the times	417 (3)	
Every time	161 (1)	
Depressive symptoms (PHQ2)		1.35 (1.42)
Coping motives		1.45 (0.60)
Alcohol related consequences		2.65 (3.78)
Any alcohol use frequency		3.10 (1.43)
HED frequency		1.20 (1.39)
Age/educational status		
4-year college	4,593 (38)	
Not in 4-year college and age < 23	3,262 (27)	
Not in 4-year college and age 23+	4,111 (34)	
Measures averaged across months 1–24 used in prediction of age 30 outcomes (n = 754)		
Proportion of drinking months drank alone in months 1–24		.28 (.31)
Any alcohol use frequency		2.48 (1.40)
HED frequency		0.99 (1.02)
Depressive symptoms (PHQ-2)		1.45 (1.07)
30-month follow-up (n = 662)		
Hazardous drinking (8+ on AUDIT)	139 (22)	
Moderate depressive symptoms (10+ on PHQ9)	123 (19)	
Age/educational status		
4-year college	189 (29)	
Not in 4-year college and age < 23	100 (15)	
Not in 4-year college and age 23+	372 (56)	

Note. HED = heavy episodic drinking, PHQ = Patient Health Questionnaire, AUDIT = Alcohol Use Disorder Identification Test. Descriptive data are based on the available data for the analysis sample of 754 individuals and 11,966 person-months in which alcohol was consumed and frequency of solitary drinking was assessed. Additional person-months provided data that was used in calculating covariates used in models predicting 30-month follow-up outcomes.

Table 2

Multilevel logistic regression models predicting solitary versus social-only drinking in months 1–24 by prior depression

	Main effects		Interactions model	
Predictor	*AOR*	**95% CI**	*AOR*	**95% CI**
Between person				
Intercept	**0.06**	**(0.04–0.10)**	**0.06**	**(0.04–0.09)**
Female	**0.49**	**(0.35–0.68)**	**0.49**	**(0.35–0.68)**
Race/ethnicity (ref. = Non-Hispanic White)				
Non-Hispanic Asian	**0.53**	**(0.33–0.83)**	**0.52**	**(0.33–0.83)**
Non-Hispanic Other	0.89	(0.57–1.38)	0.90	(0.57–1.40)
Hispanic	0.63	(0.35–1.15)	0.65	(0.36–1.17)
Baseline alcohol use				
Any alcohol use frequency	**1.81**	**(1.59–2.06)**	**1.81**	**(1.59–2.06)**
HED frequency	**0.78**	**(0.66–0.91)**	**0.78**	**(0.66–0.91)**
Baseline moderate or more severe depression (10+ on PHQ9)	**2.22**	**(1.54–3.20)**	**3.01**	**(1.92–4.73)**
Within person (time varying)				
Monthly age/educational status (ref. = 4-year college)				
Not in 4-year college and age < 23	**1.24**	**(1.02–1.52)**	**1.41**	**(1.11–1.79)**
Not in 4-year college and age 23+	**1.55**	**(1.24–1.94)**	**1.77**	**(1.36–2.31)**
Baseline moderate depression by				
Not in 4-year college and age < 23			**0.63**	**(0.40–0.98)**
Not in 4-year college and age 23+			**0.63**	**(0.39–1.01)**

Note. AOR = adjusted odd ratio, CI = confidence interval, ref. = reference group, PHQ = Patient Health Questionnaire. Bold typeface indicates *p* < .05. n = 11,802 person-months among 741 individuals who had complete data on all model covariates.

Table 3

Multilevel logistic regression models predicting solitary drinking in drinking months during months 1–24 by depressive symptoms and coping motives

Predictor	Predictor: Depressive symptoms (PHQ2)				Predictor: Coping motives			
	Main effects		Interactions model		Main effects		Interactions model	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Between person								
Intercept	**0.04**	**(0.03–0.05)**	**0.04**	**(0.03–0.05)**	**0.04**	**(0.03–0.05)**	**0.04**	**(0.03–0.05)**
Female	**0.47**	**(0.35–0.65)**	**0.47**	**(0.35–0.65)**	**0.56**	**(0.41–0.76)**	**0.56**	**(0.41–0.76)**
Race/ethnicity (ref. = Non-Hispanic White)								
Non-Hispanic Asian	**0.64**	**(0.41–0.99)**	**0.64**	**(0.41–0.99)**	**0.56**	**(0.36–0.87)**	**0.56**	**(0.36–0.87)**
Non-Hispanic Other	0.85	(0.56–1.29)	0.85	(0.56–1.29)	0.84	(0.55–1.28)	0.84	(0.55–1.28)
Hispanic	0.64	(0.36–1.12)	0.64	(0.36–1.13)	0.61	(0.34–1.07)	0.60	(0.34–1.07)
Average depressive symptoms in months 1–24	**1.61**	**(1.27–2.04)**	**1.61**	**(1.27–2.04)**				
Average coping motives in months 1–24					**1.51**	**(1.21–1.87)**	**1.51**	**(1.22–1.88)**
Within person (time varying)								
Monthly measure of alcohol use								
Any alcohol use frequency	**2.01**	**(1.89–2.14)**	**2.01**	**(1.89–2.14)**	**1.95**	**(1.83–2.08)**	**1.95**	**(1.83–2.08)**
HED frequency	**0.92**	**(0.87–0.98)**	**0.92**	**(0.87–0.98)**	**0.87**	**(0.82–0.93)**	**0.87**	**(0.82–0.93)**
Monthly age/educational status (ref. = 4-year college)								
Not in 4-year college and age < 23	**1.33**	**(1.08–1.64)**	1.33	(1.08–1.64)	**1.41**	**(1.14–1.74)**	**1.40**	**(1.13–1.73)**
Not in 4-year college and age 23+	**1.78**	**(1.42–2.23)**	1.78	(1.42–2.23)	**1.86**	**(1.48–2.34)**	**1.85**	**(1.47–2.33)**
Depressive symptoms (PHQ-2; z-score)	**1.21**	**(1.12–1.31)**	1.25	(1.10–1.42)				
Coping motives (z-score)					**1.66**	**(1.53–1.81)**	**1.62**	**(1.44–1.84)**
Depressive symptoms by								
Not in 4-year college and age < 23			0.96	(0.81–1.13)				
Not in 4-year college and age 23+			0.93	(0.79–1.10)				
Coping motives by								
Not in 4-year college and age < 23							1.02	(0.87–1.19)
Not in 4-year college and age 23+							1.07	(0.89–1.28)

Note. AOR = adjusted odd ratio, CI = confidence interval, ref = reference group, PHQ = Patient Health Questionnaire. Bold typeface indicates *p* < .05. Sample sizes based on individuals and time points with complete covariate data in the given model; n = 11,366 person-months for depressive symptoms models, and n = 11,435 person-months for coping motives models, both among 750 individuals.

Table 4

Multilevel negative binomial regression models predicting alcohol consequences in months 1–24

Predictor	Main effects		Interactions model	
	ARR	95% CI	*ARR*	95% CI
Between person				
Constant	**0.48**	**(0.40–0.58)**	**0.48**	**(0.41–0.58)**
Female	**1.21**	**(1.03–1.41)**	**1.21**	**(1.03–1.41)**
Race/ethnicity (ref. = Non-Hispanic White)				
Non-Hispanic Asian	0.89	(0.72–1.11)	0.90	(0.72–1.11)
Non-Hispanic Other	1.07	(0.87–1.31)	1.07	(0.87–1.31)
Hispanic	1.01	(0.77–1.32)	1.01	(0.77–1.32)
Proportion of drinking months drank alone in months 1–24	**2.05**	**(1.59–2.66)**	**2.05**	**(1.58–2.65)**
Within person (time varying)				
Monthly measures of alcohol use				
Any alcohol use frequency	**1.17**	**(1.15–1.20)**	**1.17**	**(1.15–1.20)**
HED frequency	**1.31**	**(1.29–1.34)**	**1.31**	**(1.29–1.34)**
Monthly age/educational status (ref. = 4-year college)				
Not in 4-year college and age < 23	**0.84**	**(0.79–0.90)**	**0.85**	**(0.78–0.92)**
Not in 4-year college and age 23+	**0.80**	**(0.74–0.87)**	**0.79**	**(0.72–0.86)**
Solitary drinking	1.03	(0.97–1.08)	1.01	(0.94–1.09)
Solitary drinking by				
Not in 4-year college and age < 23			1.00	(0.89–1.11)
Not in 4-year college and age 23+			1.05	(0.94–1.17)

Note. ARR = adjusted rate ratio, CI = confidence interval, ref. = reference group. Bold typeface indicates $p < .05$. $n = 11,435$ person-months among 750 individuals with complete data on all model covariates.

Table 5

Logistic regression models predicting hazardous drinking and moderate or more severe depression at 30-month follow-up

Predictor	Hazardous drinking				Moderate or more severe depressive symptoms					
	Main effects		Interactions model		Main effects (1)		Main effects (2)		Interactions model	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Intercept	**0.02**	**(0.01–0.05)**	**0.01**	**(0.00–0.04)**	**0.11**	**(0.06–0.21)**	**0.01**	**(0.00–0.03)**	**0.01**	**(0.00–0.03)**
Female	0.72	(0.45–1.17)	0.71	(0.44–1.15)	**2.55**	**(1.64–3.96)**	**2.47**	**(1.49–4.12)**	**2.50**	**(1.50–4.16)**
Race/ethnicity (ref. = Non-Hispanic White)										
Non-Hispanic Asian	1.03	(0.46–2.26)	1.00	(0.45–2.22)	0.93	(0.52–1.68)	0.96	(0.48–1.90)	0.97	(0.49–1.94)
Non-Hispanic Other	0.99	(0.51–1.93)	0.94	(0.47–1.85)	1.21	(0.72–2.05)	1.30	(0.70–2.41)	1.36	(0.73–2.54)
Hispanic	0.71	(0.28–1.83)	0.69	(0.27–1.77)	1.64	(0.82–3.26)	1.97	(0.87–4.46)	2.03	(0.89–4.60)
Age/educational status at 30-month follow-up (ref. = 4-year college)										
Not in 4-year college and age < 23	1.00	(0.46–2.18)	1.09	(0.32–3.65)	0.83	(0.44–1.55)	0.65	(0.31–1.35)	0.88	(0.30–2.56)
Not in 4-year college and age 23+	0.64	(0.35–1.18)	1.07	(0.47–2.45)	0.86	(0.53–1.41)	0.75	(0.43–1.31)	0.64	(0.31–1.36)
Proportion of drinking months drank alone in months 1–24	1.96	(0.77–4.98)	**6.80**	**(1.12–41.38)**	**3.97**	**(1.90–8.31)**	1.72	(0.71–4.17)	1.41	(0.22–9.08)
Alcohol use in months 1–24										
Any alcohol use frequency	**1.53**	**(1.14–2.05)**	**1.56**	**(1.15–2.10)**	0.87	(0.69–1.09)	1.15	(0.88–1.52)	1.16	(0.88–1.53)
HED frequency	**3.80**	**(2.72–5.29)**	**3.91**	**(2.79–5.47)**	1.22	(0.92–1.61)	1.02	(0.74–1.40)	1.01	(0.73–1.39)
Average depressive symptoms (PHQ2) in months 1–24							**3.32**	**(2.58–4.26)**	**3.36**	**(2.61–4.32)**
Solitary drinking proportion in months 1–24 by										
Not in 4-year college and age < 23			0.47	(0.03–6.93)					0.41	(0.02–7.96)
Not in 4-year college and age 23+			0.17	(0.02–1.33)					1.62	(0.21–12.47)

Note. AOR = adjusted odd ratio, *CI* = confidence interval, ref. = =reference group, HED = heavy episodic drinking, PHQ = Patient Health Questionnaire, AUDIT = Alcohol Use Disorder Identification Test. Bold typeface indicates $p < .05$. Models averaged across analyses performed on 40 imputed data sets, each containing data on 754 individuals.