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Risky Drinking in Adolescents and Emerging Adults: Differences Among Individuals Using Alcohol Only versus Polysubstance Use

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Abstract

Background: Factors related to risky drinking (e.g., motives, protective behavioral strategies [PBS]) may vary between youth who engage in polysubstance use compared to those who consume alcohol only. We examined differences in factors among youth who consume alcohol only compared to alcohol with other substances (i.e., polysubstance use), and correlates associated with risky drinking between the groups.

Methods: Participants (*N*=955; ages 16-24; 54.5% female) who reported recent risky drinking completed measures of alcohol/substance use, alcohol-related consequences, drinking motives, alcohol PBS, mental health symptoms, and emotion dysregulation. Participants were in the polysubstance group if they reported using at least one other substance (e.g., cannabis, stimulants) in addition to alcohol in the past three months. Chi-square and *t*-tests examined differences between the two groups and multiple regression analyses examined correlates of risky drinking.

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Trial Registration: Data reported here are from the baseline (pre-intervention) phase of a RCT.

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Disclosure Statement

The authors do not have any personal financial interests related to this manuscript, with two exceptions: MAW is a minor shareholder in Facebook and has a conflict-of-interest plan approved by the University of Michigan. SDY has received an unrestricted gift from Facebook, on file with the University of California, Irvine.

Results: —Most participants (70.4%, *n*=672) reported polysubstance use; these individuals engaged in riskier patterns of drinking, experienced more alcohol-related consequences, used fewer PBS, had stronger drinking motives (enhancement, social, coping), endorsed more mental health symptoms, and reported more emotion dysregulation. Regression models showed that emotion dysregulation significantly associated with risky drinking in the alcohol-only group; conformity and coping motives, alcohol PBS, and anxiety symptoms significantly associated with risky drinking in the polysubstance group.

Conclusions: Among risky drinking youth, results indicated youth engaging in polysubstance use have greater comorbidities and individual-level factors associated with risky drinking than youth who consume alcohol only. These findings may inform the tailoring of interventions for individuals who engage in risky drinking and polysubstance use.

Keywords

risky alcohol use; polysubstance use; adolescents; emerging adults

Introduction

Alcohol and other substance use among adolescents and emerging adults remains a serious public health concern, as early substance use increases the risk for developing an alcohol/substance use disorder and experiencing more negative outcomes (Andersson et al., 2021; Behrendt et al., 2009; Moss et al., 2014). It is estimated that 50% of substance use initiation occurs before the age of 20 (Blanco et al., 2018), signifying the importance of understanding alcohol/substance use in this population. Although a recent national survey indicated declines in alcohol use, possibly influenced by the COVID-19 pandemic, risky alcohol use behaviors (e.g., binge drinking, high-intensity drinking) remain prevalent among adolescents and emerging adults (Johnston et al., 2022; Schulenberg et al., 2021). Risky drinking refers to alcohol consumption that increases an individual's risk for health consequences (Patel & Balasanova, 2021). Individuals who drink in a risky manner, such as those who demonstrate elevated risk for alcohol misuse or alcohol use disorders on clinical screeners, may be at greater odds of using multiple substances (Hingson & Zha, 2018).

In addition to alcohol use, use of other substances is prevalent among adolescents and emerging adults. In 2020, 13.8% of adolescents (age 12-17) and 37.0% of emerging adults (age 18-25) reported past-year use of illicit drugs and cannabis (Substance Abuse and Mental Health Services Administration [SAMHSA], 2021). Prevalence rates indicated using more than one substance (e.g., alcohol and cannabis) is quite common (Halladay et al., 2020). For example, in a study of Canadian youth, 53% endorsed use of two or more substances within the past year (Zuckermann et al., 2020). Use of multiple substances during a defined time period is often referred to as polysubstance use, and may include the sequential use (i.e., the use of more than one substance on separate occasions) and simultaneous use (i.e., the use of more than one substance on the same occasion or use such that effects overlap; Crummy et al., 2020). Polysubstance use is associated with an increased likelihood of experiencing negative consequences, including poor academic/work performance, psychological distress, overdose, and engagement in other health-risk

behaviors (e.g., condomless sex; Bohnert et al., 2014; Peppin et al., 2020; Zuckermann et al., 2020).

Prior research showed that college students who use alcohol combined with other substances (e.g., cannabis, stimulants) reported more alcohol and other drug use-related problems compared to students who consumed alcohol only (Mallett et al., 2017; Shillington & Clapp, 2001, 2006). Similarly, youth aged 15–21 years who consumed alcohol and cannabis were significantly more likely to report alcohol-related and other behavioral problems (e.g., missed work or school and interpersonal problems due to drinking, damaged property) compared to those who consumed alcohol only (Shillington & Clapp, 2002). In community samples of young adults, simultaneous alcohol and cannabis use was associated with heavier alcohol use (Lee et al., 2020; Linden-Carmichael et al., 2019) and more positive and negative consequences related to alcohol use (Lee et al., 2020).

Many prior studies have focused on comparing consumption of alcohol only to alcohol and cannabis consumption, and include any alcohol use rather than a focus on risky alcohol use behaviors. Additionally, participants from these studies did not consist of youth who screened positive for risky alcohol use. The present study extends the existing literature by examining individual factors associated with polysubstance use in a sample of adolescents and emerging adults who engage in risky drinking only or risky drinking plus other substance use. In our study, we used the Alcohol Disorders Identification Test-Consumption (AUDIT-C) to determine risky drinking as individuals who screen positive are at risk for alcohol-related consequences. Identifying associations between individual factors and polysubstance use that includes alcohol and substances other than cannabis may inform intervention efforts in this area.

There are several potentially modifiable factors that are commonly addressed in effective alcohol/substance use interventions, such as protective behavioral strategies (e.g., limiting one's alcohol use), motives (e.g., drinking to cope), mental health symptoms (e.g., anxiety, depression), and emotion regulation strategies (e.g., strategies one employs to influence their emotional experience; McRae & Gross, 2020). Protective behavioral strategies, a common intervention target, are cognitive and behavioral strategies that people can use with the goal of reducing alcohol- and substance-related negative consequences (Martens et al., 2005; Pearson, 2013; Pedersen et al., 2016). Alcohol protective behavioral strategies that target manner of drinking (e.g., pregaming, drinking games) may enhance interventions as these strategies specifically focus on reducing alcohol use (Martens et al., 2005; O'Donnell et al., 2019). However, evidence suggests that harm reduction interventions that solely rely on increasing protective behavioral strategies may not be as effective as multicomponent interventions (LaBrie et al., 2015; O'Donnell et al., 2019; Peterson et al., 2021). Thus, it may be important to augment protective behavioral strategies interventions with other intervention components (e.g., skills training) and to address co-occurring risk factors (e.g., drinking motives, mental health symptoms).

Drinking motives, or reasons for drinking, are another individual-level factor related to patterns of alcohol use (Cooper, 1994; Cooper et al., 2016). Different individuals may have similar reasons for drinking alcohol that extend to the use of other substances or to the

co-use of alcohol and other substances (e.g., coping with negative affect, to enhance one's experience; Foster et al., 2016). Indeed, prior research shows concordance between motives for using alcohol and motives for using other substances (Cooper et al., 2016; Mahu et al., 2021). Additionally, extant research shows that motives can be changed through intervention (Blevins et al., 2016; Gilmore & Bountress, 2016); however; it is important to identify how drinking motives relate to polysubstance use among people who engage in risky drinking.

Alcohol and other substance use frequently co-occurs with mental health symptoms, including depression and anxiety (Arunogiri & Lubman, 2015; Dierker et al., 2018; Prior et al., 2017). Individuals who experience depression and anxiety may use alcohol or other substances to cope with these symptoms (e.g., coping motives), especially if they have limited emotion regulation skills (Berking & Wupperman, 2012). Prior research also demonstrated a link between difficulties with emotion regulation and substance use, such that difficulties regulating emotions and controlling behavioral impulses strongly associated with substance use (Garke et al., 2021). Whether an individual believes they can effectively use strategies to regulate their emotions is another aspect of emotion regulation (Gratz & Roemer, 2004). Increasing an individual's cognitions about their ability to use emotion regulation strategies may increase global emotion regulation skills thereby improving mental health and decreasing alcohol and other substance use.

Given the consequences associated with both risky drinking and polysubstance use, additional research is needed to advance the understanding regarding patterns of use as well as the unique risk factors associated with their occurrence in young people who drink in a risky manner who warrant clinical intervention. It is critical to understand how multiple modifiable factors may distinguish polysubstance use to identify avenues for enhancing existing interventions to reduce use of alcohol with other substances and mitigate negative consequences.

The present study

Understanding individual factors among adolescents and emerging adults who consume alcohol only vs. use of alcohol with other substances over a defined period (herein referred to as polysubstance use) can help identify potential risk factors as well as targets for intervention that can be tailored to the individual. Thus, the purpose of this paper is to examine differences between alcohol-only and polysubstance groups on individual-level factors related to risky patterns of alcohol use, alcohol-related consequences, mental health symptoms, emotion regulation, drinking motives, and use of protective behavioral strategies. We expected individuals in the polysubstance group to report riskier patterns of drinking, more alcohol-related consequences, greater difficulties with emotion regulation, higher endorsement of mental health symptoms, and use of fewer protective behavioral strategies compared to the alcohol-only group. We expected that the polysubstance group would have stronger enhancement, social, and coping motives; we did not expect any differences in conformity motives between the groups given prior evidence of low conformity endorsement among people who use non-alcohol substances (Mahu et al., 2021). Following these main analyses, we conducted sub-analyses to examine separate correlates of risky alcohol use for both the alcohol-only and polysubstance groups.

Method

Participants and procedure

Participants were 955 individuals between the ages of 16-24 residing in the U.S. who reported drinking in a risky manner. We recruited participants through social media (Instagram/Facebook) advertisements to participate in a research study. Interested individuals completed a screening survey to determine study eligibility for a randomized controlled trial (Bonar et al., 2020). Participants were eligible if they had a positive AUDIT-C screen (i.e., ages 16-17 years: >=3 women, >=4 men; 18-24 years: >=4 women, >=5 men; Chung et al., 2000; Liskola et al., 2018; Reinert & Allen, 2007), were a US resident between the ages of 16–24, had a Facebook account, and submitted a selfie that matched their Facebook profile for identification purposes. Participants who met eligibility criteria were invited to complete baseline measures, which are the focus of the current analyses. The university's Institutional Review Board approved all study procedures.

Measures

Demographic information—Participants provided sociodemographic information including age, sex assigned at birth, racial identity, and ethnicity using items adapted from prior research (Bachman et al., 2011; Bauermeister et al., 2012; Brener et al., 2002).

Patterns of risky drinking—We used a past 3-month version of the AUDIT-C (Bush et al., 1998), a 3-item measure that identifies individuals with risky patterns of drinking. We created a total score with higher scores indicating riskier drinking patterns. Additionally, participants completed an online self-administered version of the Timeline Follow Back (TLFB; Martin-Willett et al., 2019; Sobell & Sobell, 1992) that assessed quantity and frequency of drinking over the past 30 days. We calculated five variables using the TLFB: number of drinking days, number of binge drinking days (i.e., days with >=4 drinks consumed for women; >=5 drinks consumed for men), number of high-intensity drinking days (i.e., days with >=8 drinks consumed for women, >=10 drinks consumed for men), total number of drinks consumed over the past 30 days, and average number of drinks consumed per day.

Substance use—We used items from the Tobacco, Alcohol, Prescription Medications, and Other Substance tool Part 2 (TAPS; McNeely et al., 2016) to assess whether participants used other substances over the past three months. Specifically, participants reported whether they used, cannabis, illicit stimulants, heroin, ecstasy/molly, other illicit/recreational drugs (e.g., LSD, mushrooms, poppers) and if they misused prescription drugs (response options: yes/no). We used participants responses to these questions to determine whether they engaged in polysubstance use (see Data Analytic Plan below for additional detail).

Alcohol-related consequences—We used a slightly modified version of the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler et al., 2005) wherein we replaced two infrequently endorsed items with two items from the full-length measure (Read et al., 2006; for additional detail on items used see Bonar et al., 2022). We assessed frequency of each consequence in the past three months with response options ranging from

0 (*none*) to 4 (*more than 5 times*). The modified 24-item measure had excellent internal consistency (α = .92). We created a total score by summing the 24 items.

Protective behavioral strategies—We used 14 items from the Protective Behavioral Strategies Scale (PBSS; Martens et al., 2005; Treloar et al., 2015) to assess frequency of protective behavioral strategies used while drinking over the past three months. We added five additional items of interest (i.e., avoided shots [Manner of Drinking], found safe way home [Serious Harm reduction], ordered non-alcoholic drink that could pass as alcohol [Limiting/Stopping Drinking], kept track of drinks [Limiting/Stopping Drinking], avoided drinks from people did not know [Serious Harm Reduction]; Bonar et al., 2011; Rosenberg et al., 2011) resulting in a total of 19 items. We included the additional items in relevant subscales: Limiting/Stopping Drinking (e.g., "Set a limit on the number of drinks"), Manner of Drinking (e.g., "Avoided drinking games"), and Serious Harm Reduction (e.g., "Avoided combining alcohol with marijuana"). Response options ranged from 1 (*never*) to 5 (*always*). All subscales had acceptable internal consistency: Limiting/Stopping Drinking, α = .73, 6 items); Manner of Drinking, α = .76, 5 items; Serious Harm Reduction, α = .73, 8 items). We summed the items for each subscale to create the three total subscale scores used in analyses.

Drinking motives—Given the need for brevity in online assessments, we included five items from the Drinking Motives Questionnaire-Revised (Cooper, 1994) assessing drinking motives across four domains: Enhancement, Social, Conformity, and Coping (2 items). Participants responded to each item indicating how much their own drinking is motivated by each reason (e.g., "Because it makes social gatherings more fun") on a 5-point Likert scale with response options ranging from 1 (*almost never/never*) to 5 (*almost always/always*). We used the individual items in analyses apart from the Coping motives subscale where we averaged the two items to create a total Coping motives score.

Mental health symptoms—We used the 7-item Generalized Anxiety Disorder–7 (GAD-7; Spitzer et al., 2006) to assess symptoms of anxiety. Participants reported how often they were bothered by each item (e.g., "Worrying too much about different things") over the past two weeks, with response options ranging from 0 (*not at all*) to 3 (*nearly every day*). The GAD-7 had excellent internal consistency (α = .93).

We used the Patient Health Questionnaire–8 (PHQ-8; Kroenke et al., 2009) to assess depression symptoms. Participants responded to each item indicating how much they were bothered by different symptoms ("e.g., Feeling down, depressed, or hopeless") over the past two weeks, with response options ranging from 0 (*not at all*) to 3 (*nearly every day*). The PHQ-8 demonstrated excellent internal consistency (α = .91). We summed items to create total scores for the GAD-7 and PHQ-8, respectively.

Emotion regulation—We used three items from the Limited Access to Emotion Regulation Strategies subscale of the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) to evaluate beliefs about one's ability to effectively regulate negative emotions (e.g., "When I'm upset, it takes me a long time to feel better.") with response

options ranging from 1 (*almost never*) to 5 (*almost always*). The three items had excellent internal consistency (α = .91). We summed the three items to create a total score.

Data analytic plan

We conducted analyses using SPSS Statistics version 27.0. First, we created an indicator variable to distinguish individuals who used alcohol-only vs. polysubstance use. Participants who indicated using at least one substance other than alcohol on the TAPS in the prior three months were coded into the polysubstance group. We computed descriptive statistics by grouping and conducted bivariate analyses (e.g., *t*-tests, chi-square) to examine differences between the groups on continuous and categorical variables. Finally, we used two separate multiple regression analyses to examine correlates of risky alcohol use, controlling for age and sex, among the alcohol-only and polysubstance groups. We did not include depression symptoms (i.e., PHQ-8 variable) in regression models due to concerns of multicollinearity (Variance Inflation Factor (VIF) = 3.07, tolerance = .33 [alcohol-only]; VIF = 3.39, tolerance = .30 [polysubstance use] and overlap with other variables (e.g., emotion dysregulation, “When I’m upset, I believe that I will end up feeling very depressed”).

Results

Participant characteristics

Seventy percent of participants (n = 672) reported polysubstance use. In the polysubstance group, 56.4% of participants reported use of one other substance, 22.3% reported use of two other substances, and 21.3% reported use of three or more substances in addition to alcohol in the past three months. Prevalence of the other substances used among participants in the polysubstance group were as follows: 89.4% used cannabis, 19.5% reported use of other illegal or recreational drugs (e.g., LSD, mushrooms, poppers), 10.7% reported use of ecstasy/molly, 10.6% used illicit stimulants (i.e., cocaine, crack, methamphetamine), and 0.4% reported use of heroin. Regarding misuse of prescription medications, 19.5% misused prescription stimulants, 15.6% misused anxiety or sleep medications, and 13.8% misused prescription opioids.

Group differences in alcohol use and individual factors

Descriptive statistics for the entire sample and by alcohol-only/polysubstance group status as well as results of the independent samples *t*-tests and chi-square analyses are presented in Table 1. Participants in the polysubstance group were significantly younger, more likely to be male, and engaged in more risky drinking, including higher scores on the AUDIT-C, a greater number of total binge drinking days, high-intensity drinking days, and consumed more drinks over the past 30 days. There were statistically significant differences in the use of alcohol protective behavioral strategies, such that participants in the polysubstance use group used fewer alcohol protective behavioral strategies than participants in the alcohol-only group. Regarding motives, the polysubstance use group had significantly higher enhancement, social, and coping motives compared to the alcohol-only group, but no differences in conformity motives between the two groups were found. The polysubstance use group reported significantly more alcohol-related consequences, symptoms of anxiety and depression, and difficulties with emotion regulation. Correlations

between study variables for the alcohol-only and polysubstance groups are presented in Table 2.

Multiple regression analyses

Results of the regression analyses are displayed in Table 3 (alcohol-only) and Table 4 (polysubstance). The models predicting risky drinking in the alcohol only group, $F(11, 271) = 8.43$, $p < .001$, and polysubstance group, $F(11, 660) = 22.94$, $p < .001$, were significant. In both models, female sex was related to less drinking whereas older age was associated with greater drinking. When examining correlates of risky drinking in the alcohol-only group, difficulties with emotion regulation negatively related to risky drinking in the alcohol-only group ($\beta = -.16$, $p = .032$), after adjusting for age and sex. The other predictors did not significantly relate to risky drinking among the alcohol-only group after adjusting for age and sex.

When examining correlates of risky drinking in the polysubstance use group, conformity motives ($\beta = -.08$, $p = .024$) negatively related to risky drinking whereas coping motives ($\beta = .16$, $p < .001$) positively related to risky drinking. Enhancement and social motives did not significantly relate to risky drinking among the polysubstance group. Protective behavioral strategies focused on stopping/limiting drinking positively related to risky drinking ($\beta = .09$, $p = .026$) whereas manner of drinking ($\beta = -.27$, $p < .001$) and serious harm reduction ($\beta = -.09$, $p = .028$) protective behavioral strategies negatively related to risky drinking. Anxiety symptoms ($\beta = -.11$, $p = .020$) negatively related to risky drinking. Emotion regulation difficulties did not significantly relate to risky drinking in the polysubstance group.

Discussion

Our results suggest that adolescents and emerging adults who engage in the co-use of alcohol and other substances are at greater risk for drinking in a risky manner, as the polysubstance group reported higher AUDIT-C scores and engaged in more patterns of risky alcohol use than the alcohol-only group. Specifically, our findings indicated that youth in the polysubstance group reported more binge and high-intensity drinking days as well as a greater number of drinks consumed over a 3-month period relative to the alcohol-only group. Although these associations exist, we are unable to make inferences regarding directionality (e.g., Does risky drinking lead to polysubstance use? Does using other substances increase the chance of riskier patterns of drinking?). Future longitudinal studies examining the development of risky alcohol patterns and subsequent substance use, and elucidating the nuance of sequential and/or simultaneous use of alcohol with various different substances, are warranted.

A notable finding is that the polysubstance group experienced significantly more alcohol-related consequences, suggesting that consequences specific to alcohol use are heightened among individuals who use alcohol and other substances, indicating clinical severity. Relatedly, the polysubstance group used fewer alcohol-specific protective behavioral strategies, including those targeting serious harm reduction, which may relate to reports of more alcohol-related consequences among this group. In examining predictors of risky alcohol use for the polysubstance group, all three types of protective behavioral strategies

predicted risky alcohol use; however, an interesting finding was that strategies used to stop/limit drinking related to riskier patterns of alcohol use whereas strategies focused on manner of drinking and serious harm reduction were associated with less risky alcohol use. Strategies focused on changing the manner of drinking had the strongest effect on risky alcohol use, consistent with research findings that suggests interventions incorporating protective behavioral strategies emphasize those that directly target ways of consuming alcohol (O'Donnell et al., 2019). Although the polysubstance use group used fewer alcohol-specific protective behavioral strategies, they may have been engaging in other substance-specific protective behavioral strategies not assessed in this study (e.g., avoid mixing cannabis with other drugs, purchase less cannabis to reduce cannabis use; Pedersen et al., 2017). Overall, these findings underscore the importance of tailoring interventions to incorporate more effective behavioral strategies focused on manner of consumption, particularly among youth reporting co-use of alcohol and other substances.

While we found differences in drinking motives between the two groups, such that the polysubstance group had higher motives compared to the alcohol-only group, the average motive scores varied only slightly, making it difficult to assess to what extent this represents clinically meaningful differences between the groups. Drinking to cope was associated with risky alcohol use among the polysubstance group, suggesting that coping motives may extend to the use of other substances, a finding consistent with the existing literature (Cooper et al., 2016; Mahu et al., 2021). Although we only assessed drinking motives in the present study, there may be similar motives for using other substances among people who engage in the co-use of alcohol and other substances. For example, if coping is the goal and using substances to cope has been effective, then drinking alcohol or using other substances may meet that goal. Addressing drinking motives among adolescents and emerging adults who drink alcohol and use other substances could also be an important intervention target to reduce risky drinking and associated consequences (Gilmore & Bountress, 2016).

Regarding mental health, anxiety and depression symptoms were higher among the polysubstance group, perhaps indicating important mental health targets for interventions. Anxiety symptoms positively, although not statistically significant, related to risky alcohol use in the alcohol-only group, whereas anxiety symptoms negatively and significantly related to risky drinking in the polysubstance group. A possible explanation for the negative association in the polysubstance group is that individuals with greater anxiety symptoms may use other substances to cope with anxiety, thus reflecting the negative association with less risky alcohol use. The nuanced relationships between anxiety, alcohol consumption, risky drinking behaviors, and polysubstance use require finer-grained detail to understand these complexities, thus underscoring future studies using ecological momentary assessment techniques. Given the high rates of co-occurring alcohol/substance use and mental health symptoms, it is imperative to continue addressing the mental health needs of youth, including those focused on substance use (SAMHSA, 2021).

In examining emotion regulation difficulties, the polysubstance group had more difficulties with emotion regulation compared to the alcohol-only group. Specifically, we assessed participants' subjective beliefs about their ability to effectively employ emotion regulation strategies. Our findings indicate that believing one would have difficulties regulating their

emotions was associated with less risky drinking in the alcohol-only group and was not associated with risky drinking in the polysubstance group. The significant association found in the alcohol-only group may reflect the drinking to cope phenomenon; however, the effect is not significant in the polysubstance group due to the confounding effects of other drug use.

Emotion regulation has been conceptualized as consisting of different facets (e.g., awareness of emotional experiences, behaving consistently with one's goals even when having negative emotional experiences; Gratz & Roemer, 2004). In the present study, we included three items, all from the Limited Access to Emotion Regulation Strategies subscale, which limits our ability to fully assess emotion regulation difficulties. Although such difficulties have been associated with alcohol/substance use (Garke et al., 2021), a study using a large sample of college students found that difficulties with emotion regulation were associated with consequences related to alcohol use rather than the specific use of alcohol (Dvorak et al., 2014). This latter finding is consistent with our findings at the bivariate level, where emotion regulation difficulties positively associated with alcohol-related consequences.

Individuals with low self-efficacy related to their emotion regulation abilities may benefit from interventions that include skills training for emotion regulation while also increasing self-efficacy in their ability to use the learned strategies when experiencing intense emotions. Future research to determine the specific facets of emotion regulation that relate to risky alcohol use will inform interventions focusing on enhancing strategies for emotion regulation. Additionally, future studies may consider including assessment of difficulties regulating positive emotions, as positive emotions have also been linked to alcohol and other substance use (Paulus et al., 2021; Weiss et al., 2018).

Limitations

In addition to the limitations described above, the following limitations are important to consider when interpreting the findings of this study. Although we have data on participants' co-use of alcohol and other substances over a period of time, we did not assess whether this co-use was simultaneous vs. sequential. Importantly, some of our participants may have engaged in simultaneous polysubstance use, which has been shown to associate with higher quantities and more frequent alcohol and cannabis use as well as increased odds of drunk driving compared to sequential polysubstance use (Subbaraman & Kerr, 2015). Future studies could implement ecological momentary assessment to determine whether the use of multiple substances occurred at the same time and how this relates to other factors. Additionally, results of this study may not be generalizable or representative of all adolescents and emerging adults who engage in risky drinking. Relatedly, although we over-sampled Black and Hispanic/Latinx individuals and 30.4% of participants identified as Black or other racial identities and 20.2% identified their ethnicity as Hispanic/Latinx, most of our participants identified as non-Hispanic White which may limit the generalizability of our findings. The assessment of consequences and motives could be improved by including measurement of consequences related to alcohol as well as other substances and including full-length measures of motives, respectively. Finally, the present study focused on individual-level factors related to risky drinking and polysubstance use. Future studies

should consider examining social and environmental factors to enhance our understanding of factors related to alcohol/substance use among this population.

Conclusion

Risky patterns of alcohol use, alone and in conjunction with other substances, is of rising concern as both are associated with detrimental consequences. Understanding the relationship between individual-level factors and polysubstance use among adolescents and emerging adults who engage in risky drinking is necessary to enhance understanding of these patterns. Our findings suggest several differences in anxiety, motives, and protective behavioral strategies among individuals who engage in risky drinking only compared to risky drinking with other substance use. This information may aid in the tailoring of interventions to individuals' substance use behaviors, including risky alcohol use alone, and/or in combination with other substance use.

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Table 1.

Demographic information and characteristics for all participants and by alcohol-only/polysubstance use status.

Variable (sample range)	All Participants (*N* = 955) *M* (*SD*) or %	Alcohol use only (*n* = 283) *M* (*SD*) or %	Polysubstance use (*n* = 672) *M* (*SD*) or %	χ^2 or *t*	*p*	Cramer's V / Cohen's d
Age (16–24)		21.0 (2.5)	20.2 (2.6)	4.52	**<.001**	.312
Sex				4.50	**.034**	.069
Female	54.5%	59.7%	52.2%			
Male	45.5%	40.3%	47.8%			
Race				3.46	.177	.060
Black/African American	19.3%	17.0%	20.2%			
White/Caucasian	69.6%	73.9%	67.9%			
Other	11.1%	9.2%	11.9%			
Ethnicity				3.24	.072	.058
Hispanic or Latinx	20.2%	16.6%	21.7%			
Not Hispanic or Latinx	79.8%	83.4%	78.3%			
AUDIT-C (3–12)	6.6 (1.9)	6.1 (1.8)	6.8 (1.9)	−5.26	**<.001**	.360
Timeline Follow Back						
Total # of Drinking Days (0–30)	7.7 (7.0)	7.8 (7.0)	7.8 (7.0)	−0.01	.990	.001
Total # of Binge Drinking Days (0–30)	2.6 (3.8)	2.0 (2.9)	2.8 (4.1)	−3.62	**.002**	.224
Total # of High Intensity Drinking Days (0–29)	0.8 (2.1)	0.5 (1.0)	1.0 (2.4)	−4.60	**<.001**	.245
Total # of Drinks (0–409)	34.6 (38.0)	27.8 (28.0)	37.7 (41.5)	−3.83	**<.001**	.263
Average Alcohol Drinks per Day (0–20)	3.8 (2.6)	3.2 (2.0)	4.0 (2.8)	−4.53	**<.001**	.307
Alcohol-related Consequences (0–68)	13.2 (11.4)	10.4 (10.1)	14.4 (11.7)	−5.35	**<.001**	.356
Protective Behavioral Strategies						
Stopping/Limiting Drinking (6–30)	15.1 (4.9)	15.6 (4.9)	14.9 (4.9)	2.03	**.043**	.144
Manner of Drinking (5–25)	13.4 (4.8)	14.4 (5.0)	13.0 (4.6)	4.08	**<. 001**	.300
Serious Harm Reduction (8–40)	33.0 (5.3)	34.9 (5.2)	32.2 (5.2)	7.59	**< .001**	.538
Drinking Motives						
Enhancement (1–5)	3.7 (1.0)	3.5 (1.1)	3.8 (1.0)	−3.12	**.002**	.228
Social (1–5)	4.0 (1.0)	3.9 (1.0)	4.0 (0.9)	−2.04	**.042**	.145
Conformity (1–5)	2.3 (1.2)	2.2 (1.2)	2.3 (1.2)	−1.38	.168	.098
Coping (1–5)	2.6 (1.2)	2.4 (1.2)	2.6 (1.2)	−2.22	**.027**	.157
Anxiety (GAD-7 score; 0–21)	8.7 (6.4)	7.9 (6.2)	9.0 (6.4)	−2.44	**.015**	.173
Depression (PHQ-8 score; 0–24)	8.7 (6.5)	7.7 (6.0)	9.2 (6.7)	−3.35	**.001**	.228
Difficulties with Emotion Regulation (3–15)	7.1 (3.7)	6.5 (3.4)	7.4 (3.8)	−3.49	**.001**	.238

Note. For *t*-tests the alcohol-only group was coded 0 and polysubstance group coded 1. AUDIT-C = Alcohol Use Disorders Identification Test-Consumption; GAD-7 = Generalized Anxiety Disorder–7; PHQ-8 = Patient Health Questionnaire-8. Full possible range of continuous measures were AUDIT-C = 0–12; Timeline Follow Back = 0–30; Alcohol-related Consequences = 0–96; Stopping/Limiting Drinking = 6–30; Manner of Drinking = 5–25; Serious Harm Reduction = 8–40; Absolute ranges for Protective Behavioral Strategies subscales, Drinking Motives subscales, GAD-7, PHQ-8, and Difficulties with Emotion Regulation are the same as the sample range.

Table 2.

Correlations between study variables by alcohol-only/polysubstance use status.

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. AUDIT-C	–	.42**	.14**	.11*	−.04	.15**	−.16**	−.29**	−.22**	−.09*	−.04	−.05
2. Brief YAACQ	.43**	–	.23**	.17**	.19**	.44**	−.14**	−.22**	−.30**	.30**	.36**	.30**
3. Enhancement	.07	.26**	–	.31**	.07	.24**	−.18**	−.19**	−.08*	.08	.11*	.14**
4. Social	.17*	.26**	.44**	–	.33**	.14**	-.18**	-.26**	-.07	.03	.04	.06
5. Conformity	.09	.20*	.12*	.34**	–	.28**	-.02	-.11*	-.13*	.15**	.17**	.17**
6. Coping	.12*	.39**	.26**	.19*	.18*	–	-.06	-.10*	-.23**	.48**	.51**	.50**
7. Stopping/ Limiting Drinking	-.23**	-.14*	-.06	-.12	.001	-.11	–	.53**	.41**	.06	.16	.01
8. Manner of Drinking	-.24**	-.24**	-.16*	-.15*	-.15*	-.18*	.58**	–	.42**	.04	.02	.04
9. Serious Harm Reduction	-.18*	-.11	.02	-.04	-.11	-.16*	.44**	.39**	–	-.07	-.11*	-.12*
10. Anxiety (GAD-7)	.03	.27**	.11	.04	.10	.53**	-.04	-.05	-.14*	–	.80**	.71**
11. Depression (PHQ-8)	.02	.27**	.13*	.03	.11	.57**	-.14*	-.14	-.20*	.75**	–	.74**
12. DERS	-.06	.20*	.10	.09	.17*	.56**	-.12*	-.07	-.15*	.66**	.72**	–

Note: Below diagonal = alcohol-only, above diagonal = polysubstance use. AUDIT-C = Alcohol Use Disorders Identification Test–Consumption; YAACQ = Young Adult Alcohol Consequences Questionnaire; GAD–7 = Generalized Anxiety Disorder–7; PHQ–8 = Patient Health Questionnaire–8; DERS = Difficulties in Emotion Regulation Scale.

** $p < .001$;

* $p < .05$

Table 3.

Results of multiple regression for alcohol-only group.

Outcome: AUDIT-C score	R^2	β (*SE*)	*p*	95% CI [LL, UL]
Model: Alcohol-only	.26		**<.001**	
Age		.20 (.04)	**<.001**	[0.07, 0.23]
Female sex assigned at birth		−.35 (.21)	**<.001**	[−1.66, −0.85]
Enhancement		.04 (.10)	.522	[−0.14, 0.27]
Social		.11 (.11)	.078	[−0.02, 0.42]
Conformity		.03 (.09)	.655	[−0.13, 0.20]
Coping		.09 (.10)	.193	[−0.07, 0.33]
Stopping/Limiting Drinking		-.11 (.03)	.112	[−0.09, 0.01]
Manner of Drinking		-.07 (.03)	.291	[−0.08, 0.02]
Serious Harm Reduction		-.04 (.02)	.483	[−0.06, 0.03]
Anxiety (GAD-7)		.14 (.02)	.063	[−0.002, 0.08]
Difficulties with emotion regulation (DERS)		-.16 (.04)	**.032**	[−0.16, −0.01]

Note: AUDIT-C = Alcohol Use Disorders Identification Test–Consumption; CI = confidence interval; LL = lower limit; UL = upper limit; GAD-7: Generalized Anxiety Disorder-7; DERS: Difficulties in Emotion Regulation Scale.

Table 4.

Results of multiple regression for polysubstance group.

Outcome: AUDIT-C score	R^2	β (*SE*)	*p*	95% CI [LL, UL]
Model: Polysubstance use	.28		**<.001**	
Age		.31 (.03)	**<.001**	[0.18, 0.28]
Female sex assigned at birth		-.21 (.14)	**<.001**	[−1.07, −0.52]
Enhancement		.06 (.07)	.083	[−0.02, 0.26]
Social		.03 (.08)	.431	[−0.09, 0.21]
Conformity		-.08 (.06)	**.024**	[−0.25, −0.02]
Coping		.16 (.07)	**<.001**	[0.13, 0.39]
Stopping/Limiting Drinking		.09 (.02)	**.026**	[0.004, 0.07]
Manner of Drinking		-.27 (.02)	**<.001**	[−0.15, −0.08]
Serious Harm Reduction		-.09 (.02)	**.028**	[−0.06, −0.004]
Anxiety (GAD-7)		-.11 (.02)	**.020**	[−0.06, −0.01]
Difficulties with emotion regulation (DERS)		.01 (.03)	.828	[−0.04, 0.06]

Note: AUDIT-C = Alcohol Use Disorders Identification Test–Consumption; CI = confidence interval; LL = lower limit; UL = upper limit; GAD-7: Generalized Anxiety Disorder–7; DERS: Difficulties in Emotion Regulation Scale.