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Authors

D'Amico, Elizabeth J
Rodriguez, Anthony
Tucker, Joan S
et al.

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Disparities in functioning from alcohol and cannabis use among a racially/ethnically diverse sample of emerging adults

Elizabeth J. D'Amico[1], **Anthony Rodriguez**[2], **Joan S. Tucker**[1], **Michael S. Dunbar**[3], **Eric R. Pedersen**[4], **Rachana Seelam**[1]

[1]RAND Corporation; 1776 Main St., Santa Monica, CA 90401

[2]RAND Corporation, 20 Park Plaza #920, Boston, MA 02116

[3]RAND Corporation, 4570 Fifth Avenue, Suite 600, Pittsburgh, Pennsylvania 15213

[4]University of Southern California, Los Angeles, CA 90089, USA

Abstract

Background.—Trajectory studies have consistently shown that alcohol and cannabis (AC) use during emerging adulthood (EA) affect functioning; however, few studies examine whether racial/ethnic disparities may occur at similar levels of use.

Methods.—We conducted web-based surveys across five waves from mean age 18.3 through 22.6. The sample (N=2,945) is 55% female, 46% Hispanic, 23% Asian, 23% White, 6% multi-racial (MR)/other, and 2% Black.

Measurements.—Past month substance use was defined as number of days used. Outcomes at age 22.6 included negative consequences, delinquency, physical ailments and health, depression and anxiety, peer relationship functioning, life satisfaction, employment, and education.

Results.—Compared to White EAs, Hispanic, Asian, and MR/other EAs reported less initial alcohol use; Hispanic and Asian EAs reported less initial cannabis use, whereas Black EAs reported more cannabis use. Greater initial frequency and increased frequency of AC use were associated with poorer outcomes (e.g., worse mental health). In terms of disparities, compared to White EAs, Hispanic EAs reported poorer physical health at the same levels of AC use; Hispanic, Asian, and MR/other EAs reported greater alcohol consequences and delinquency; Black, Hispanic, Asian and MR/other EAs reported lower life satisfaction; and Hispanic and

Corresponding Author: Elizabeth J. D'Amico, RAND Corporation, 1776 Main St., Santa Monica, CA 90401, 310-393-0411 ×6487, damico@rand.org.

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MR/other EAs were less likely to pursue education beyond high school (although Asian EAs were more likely).

Conclusions.—Findings emphasize that trajectories of AC use during EA are associated with a range of functional outcomes. Disparities in functioning at similar levels of AC use highlight the importance of reaching racially/ethnically diverse EAs with prevention and intervention programming.

Keywords

alcohol; cannabis; marijuana; emerging adults; disparities

1. INTRODUCTION

Emerging adulthood (age 18–24) is an important developmental period bridging the end of adolescence and transitions to adult roles and responsibilities (Arnett, 2000). The functioning of young people during this critical period can influence how well they navigate transitions and affect later adult functioning (Rudolph & Zacher, 2017; Schulenberg & Schoon, 2012). For example, dropping out of school or unstable employment during this period can have long-term effects on financial security, depression and stress levels (Faas et al., 2018). In addition, having strong peer relationships can increase happiness and feelings of belonging, which affect overall well-being (Sandstrom & Dunn, 2014).

Trajectory studies have consistently shown that alcohol and cannabis (AC) use during late adolescence and emerging adulthood affect functioning during this period, for example, by increasing likelihood of school dropout (Benner et al., 2021; Epstein et al., 2015; Thompson et al., 2019) and problematic relationships (Carter et al., 2020). AC use is also associated with numerous problems, including greater use of illicit drugs and substance use problems (Boden et al., 2019; Brook et al., 2016; Lee et al., 2017; Thrul et al., 2021; Yuen et al., 2020) and poorer physical and mental health (Caldeira et al., 2012). Most studies, however, tend to focus on effects of AC use on one specific domain, such as mental health or substance use, which provides a limited picture of potential disruptions that use may cause on functioning during this important developmental period. Furthermore, previous longitudinal research in this area has tended to focus on either alcohol or cannabis use trajectories (Bechtold et al., 2015; Danielsson et al., 2010; Evans-Polce et al., 2015; Mulia et al., 2018; Williams et al., 2018), although there has been increased attention on examining co-use of both substances (Evans-Polce et al., 2015; Green et al., 2017; Keyes et al., 2015), particularly in light of expanded access to adult-use cannabis in many parts of the US. (National Conference of State Legislatures, 2021). It is important to capture effects of both alcohol and cannabis use across multiple dimensions during emerging adulthood in order to understand the heterogeneity of effects for both the substance and the domain of functioning.

Research has also tried to understand trajectories of AC use across different racial/ethnic groups. For example, studies have shown that Black and Hispanic youth are less likely to use alcohol or cannabis compared to White youth (Finlay et al., 2012; Lee et al., 2010; Park et al., 2018); however, some studies have shown greater risk of both cannabis and alcohol use for multi-racial youth (Finlay et al., 2012; Goings et al., 2016; Goings et al., 2020), and

a recent analysis of the Youth Risk Behavior Surveys from 1991–2017 indicated significant increases in the prevalence of cannabis use among Black (11.5%) and Hispanic (8.1%) adolescents compared to White adolescents (3.4%) (Dai, 2019). What is missing, however, is an examination of whether diverse groups may experience worse outcomes at similar levels of AC use over time.

Although some studies examine racial/ethnic differences in AC use over time, most do not address whether there may be disparities in functioning at similar levels of AC use during adolescence or emerging adulthood (Lopez-Vergara et al., 2021). In addition, few studies include Asian American youth (Phillips et al., 2021). Research with adults has consistently shown health disparities from AC use, with non-White individuals reporting worse health outcomes (Whitesell et al., 2014) and more interpersonal problems and other negative outcomes from substance use (Danielsson et al., 2010; Galvan & Caetano, 2003; Mulia et al., 2008; Vaeth et al., 2017; Wu et al., 2016) compared to White individuals, even with less substance use. Further research is needed during emerging adulthood to identify whether disparities may occur at similar levels of AC use during this development period, and in which domains, so that providers can address the effects of AC use for different racial/ethnic groups and understand when intervention is most needed.

We conducted one of the first studies examining AC trajectories and disparities in adolescence with youth from age 11 to 17, assessing outcomes across multiple domains, including academics, mental and physical health, social functioning, and delinquency. First, adolescents reporting cannabis use experienced more problems at age 17 than those reporting alcohol use, emphasizing the importance of addressing both substances during this developmental period (D'Amico, Tucker, et al., 2016). In addition, disparities in physical health and academics emerged at this early age, whereby Asian and multi-racial adolescents reported more problems with physical health than White adolescents when using AC at the same level; Asian, Black and Hispanic adolescents reported being less prepared academically, and Hispanic and multi-racial adolescents reported lower academic performance compared to White adolescents. The current study moves the field forward significantly by following this same cohort of youth during emerging adulthood from age 18 to 23 to: 1) assess differences in initial AC use frequency (intercept) and rate of change in AC use frequency (slope) by race/ethnicity, 2) examine whether the intercept and slope (average and change) of AC use from age 18 to 23 predict outcomes across several key domains of functioning at age 23 (consequences, delinquency, mental and physical health, peer relationship functioning, life satisfaction, employment, education), and c) compare outcomes for White, Black, Hispanic, Asian and multi-racial emerging adults to understand whether functioning differs for these groups after controlling for differences in level of AC use.

2. METHOD

2.1 Methods

Participants are from two student cohorts in 6th and 7th grade in 2008, who were recruited from 16 middle schools in Southern California to evaluate a substance use prevention program, CHOICE (D'Amico et al., 2012). Schools were selected to obtain a diverse

sample, have similar substance use rates at baseline, and were matched to their nearest neighbor school based on a squared Euclidean distance measure (D'Amico et al., 2012). Procedures were approved by the RAND IRB. Cohorts were followed annually across 12 waves through 2020; waves 1 through 5 were in physical education classes. Following wave 5, adolescents were re-consented to complete annual web-based surveys and paid $50 for each survey. Participants who did not complete a particular wave of data collection remained eligible to complete subsequent waves. Details for recruitment and retention for waves 1–7 are provided in detail elsewhere (D'Amico, Tucker, et al., 2016). The current study utilizes wave 8 (mean age 18.3; fielded in 2015–16) through wave 12 (mean age 22.6; fielded in 2019–20). Wave-to-wave retention rates ranged from 89%−92%. Based on multivariate logistic regression analyses, retention from wave 11 to wave 12 was not predicted by wave 11 past-month use of alcohol, cannabis, or cigarettes, similar to all previous waves (D'Amico, Tucker, et al., 2016; D'Amico, Rodriguez, et al., 2020); however, retention was slightly higher among females than males (93.41% vs. 90.53%, respectively); among Hispanic (93.28%) and Asian (92.93%) participants compared to White (90.87%), Black (82.76%), or other participants (90.11%); and among those who were younger versus older (mean age = 21.57 vs. 21.85 at wave 11, respectively). The sample of 2,945 participants includes those that completed a survey at any wave from waves 8 to 12; 78% completed 4 or more survey waves; 89% of the sample still lives in California.

2.2 Measures

Demographics and covariates.—Participants reported age, sex at birth, and race/ethnicity. They were classified into one of five racial/ethnic groups: non-Hispanic White (reference group), Hispanic/Latinx/o, Asian or Pacific Islander, non-Hispanic Black, and multi-racial (indicated more than race)/other (Native American, Native Hawaiian). Mother's education, a proxy for SES, was a binary measure of pursuing education beyond high school or not. Intervention status was a binary measure of either being in a school that received the substance use prevention program in 2008 or being in a control school.

Alcohol and cannabis use.—Separate items assessed number of days in the past month participants reported use of each substance.

Outcomes.—Negative consequences in the past year due to alcohol (e.g., passed out) and cannabis use (e.g., missed school, work, or other obligations) were assessed by summing 9 and 10 items, respectively (D'Amico, Parast, et al., 2016) (1= "never" to 7= "20 or more times"). Delinquency in the past year was assessed with five items (e.g., fighting, stealing) (Tucker et al., 2003), dichotomized (never vs 1+ times) and summed (range 0–5; α=.87). Physical health included one item on general health from the Short-Form Health Survey (Ware et al., 1996) (0="excellent" to 4= "poor") and two items from the PROMIS Pediatric Physical Function Scales (DeWitt et al., 2011) (0= "with no trouble" to 4= "not able to do"; e.g., physically able to do activities that one enjoys; α=0.79). Physical ailments were assessed with four items from the Physical Health Questionnaire-15 (Kroenke et al., 2002) on how bothered the respondent had been in the previous 4 weeks by stomach pain, headaches, feeling tired/low energy, and trouble sleeping (0= "not at all bothered" and 1= "bothered a little or a lot"; α=0.73). Depression in the last two weeks

was assessed using a sum from the 8-item Patient Health Questionnaire (PHQ-8) (Kroenke et al., 2009) (0="not at all" to 4="nearly every day"; α = 0.92). Anxiety in the last two weeks was assessed with the 8-item Generalized Anxiety Disorder scale (GAD-7) (Spitzer et al., 2006) (0="not at all" to 3="nearly every day"; e.g., feeling nervous, anxious, or on edge; α = 0.95). Stress was assessed with the 10-item Perceived Stress Scale (Cohen et al., 1983) (0="never" to 4="very often"; e.g., how often have you felt that you were on top of things; α=0.67). Peer relationship social functioning was assessed with eight items (0="never" to 4="always"; e.g., I was able to count on my friends; α=.96) from the PROMIS Peer Relationships Short Form item bank (DeWalt et al., 2013). Life satisfaction was assessed with the 5-item Satisfaction With Life Scale (Diener et al., 1985) (1="strongly disagree" to 7="strongly agree"; e.g., so far I have gotten the important things I want in life; α=.92). Employment was a binary indicatory of any employment (part- or full-time) versus no employment. Education was a binary measure of any education beyond high school versus not. Unless otherwise noted, items for each scale were summed, with higher scores indicating a greater level of the construct (e.g., more consequences, more delinquency, better health, more physical ailments, more depression, more anxiety, better social functioning, more life satisfaction).

2.3 Statistical Analysis

We used latent growth modeling to examine frequency of AC use over time within a structural equation modeling framework, using Mplus v8.1. (Muthén & Muthén, 2012–2017). This approach allows us to treat change as both an outcome (as in conventional growth models) and a predictor of distal outcomes. Separate models were estimated for alcohol and cannabis. The intercept represents the predicted value of the outcome when the predictor is equal to zero and thus reflects initial use frequency. The slope represents change in use as the individual ages. Models were estimated using robust maximum likelihood estimation or where necessary the WLSMV estimator (both can accommodate non-normality and a mixture of binary and continuous variables as well as missing data). Model fit was evaluated using the chi-square test, the comparative fit index (CFI: ≥ 0.95), root mean square error of approximation (RMSEA: ≤ 0.08), and standardized root mean residual (SRMR: ≤ 0.08). Note that although we report chi-square, this test can be overpowered, suggesting statistically significant misfit when discrepancies are trivial. For this reason, we report on the set of model fit indices.

After first establishing trajectories of use, we then examined race/ethnicity as a predictor of intercept and slope (dummy coded, with White as the reference, compared to categories of Black, Hispanic, Asian, multi-racial/other), controlling for age, sex at birth, mother's education, and whether the individual attended an intervention school. Separate models were estimated for alcohol and cannabis. We next examined whether the slope and intercept for use were associated with outcomes measured at wave 12. Finally, we estimated a single model to control for intercept and slope of both alcohol and cannabis use and estimated the direct effect from race/ethnicity to each outcome to examine race/ethnic differences.

3. RESULTS

Table 1 provides sample information. Participants were on average 18 years old at wave 8 and 23 years old at wave 12. Days of use increased over time, with participants reporting an average of 4 days of alcohol use and 3.6 days of cannabis use in the past month at age 23.

3.1 Unconditional latent growth models of use.

Alcohol. The overall model fit was: RMSEA=0.078, CFI=0.95, SRMR=0.04. There was a significant level of alcohol consumption at wave 8 (B=0.58, p<.001), and a significant increase in frequency of use over time (B=0.73, p<.001). Baseline frequency and change over time were associated such that those with higher initial frequency of use had a less steep increase in frequency over time (r= −0.12, p=0.004). Cannabis. The overall model fit was: RMSEA=0.08, CFI=0.97, SRMR=0.044. There was a significant level of cannabis use at wave 8 (B=0.466, p<.001), and a significant increase in frequency of use over time (B=0.222, p<.001). Baseline frequency and change over time were associated such that those with higher initial frequency of use had a less steep increase in frequency over time (r= −0.267, p<0.001).

3.2 Predictors of intercept and slope of use.

Coefficients are presented in Table 2. Alcohol. The overall model fit was: RMSEA=0.048, CFI=0.94, SRMR=0.028. Being older at wave 8 (p<.001) and higher maternal education (p=.002) were associated with greater initial frequency of alcohol use. Being older at wave 8 was also associated with a less steep increase in alcohol use over time (p=.002). Compared to White EAs, Hispanic (p<.001), Asian (p<.001), and multi-racial/other (p<.001) EAs reported less frequent initial alcohol use, and there was a less steep increase in alcohol use frequency for Black (p=.035), Hispanic (p=.044), and Asian (p=.008) participants. Cannabis. The overall model fit was: RMSEA = 0.045, CFI=0.97, SRMR=0.025. Being older at wave 8 (p=.035), being male (p<.001), and higher maternal education (p=.002) were associated with more frequent initial cannabis use, and being older was associated with a less steep increase in cannabis use over time (p=.006). Compared to White EAs, Hispanic (p=.002) and Asian (p<.001) EAs reported less frequent initial cannabis use, Black EAs reported more frequent initial cannabis use (p=0.009), and Hispanic EAs showed a steeper increase in cannabis use frequency (p=.046).

3.3 *Effects of use on wave 12 outcomes*.

Coefficients are presented in Table 3. Alcohol. The overall model fit was: RMSEA=0.029, CFI=0.98, SRMR=0.029. Greater initial frequency of alcohol use was associated with more physical ailments (p=.011), alcohol consequences (p<.001), and delinquent behavior (p<.001), as well as better peer relationship functioning (p=.037) at age 23. Further, increased alcohol use over time was associated more depressive symptoms (p=.001), physical ailments (p<.001), alcohol consequences (p<.001) and delinquent behavior (p=.003), and lower likelihood of unemployment (p=.046). Cannabis. The overall model fit was: RMSEA=0.035, CFI=0.98, SRMR=0.019. Higher initial frequency of cannabis use was associated with greater depressive symptoms (p=.051), greater anxiety (p=.017), perceived stress (p=.016), cannabis consequences (p<.001), delinquent behavior (p<.001),

and lower likelihood of pursuing education beyond high school (p<.001) at age 23. Increased cannabis use over time was associated with depressive symptoms (p<.0001), greater anxiety (p=.008), perceived stress (p=.001), cannabis consequences (p<.001), delinquent behavior (p=.020), as well as poorer physical health (p<.001), more physical ailments (p=.001), lower life satisfaction (p=.003) and lower likelihood of pursuing education beyond high school (p=.003).

3.4 Racial/ethnic differences for wave 12 outcomes controlling for both alcohol and cannabis use.

Coefficients are presented in Table 4. The model fit was: RMSEA=.05, CFI=.93, SRMR=.06. After controlling for initial AC use frequency and increases over time, there were several racial/ethnic differences in functioning. Compared to White EAs, Hispanic EAs reported poorer physical health (p=.022); Hispanic, Asian, and multi-racial/other EAs reported greater alcohol consequences (p's <.001) and delinquent behavior (p's ≤.013); Black, Hispanic, Asian and multi-racial/other EAs reported lower life satisfaction (p's ≤ .008); and Hispanic and multi-racial/other EAs were less likely (p's ≤ .03) to pursue education beyond high school (although Asian EAs were more likely; p=.007).

4. DISCUSSION

The current study moves the field forward in several ways. We first examined how trajectories of *AC use frequency* from ages 18 to 23 among a diverse sample of emerging adults differed for White EAs compared to those who identified as Hispanic/Latinx/o, Asian, Black, and multi-racial/other, and then how trajectories were associated with functioning for physical and mental health, academics and life satisfaction, employment, social functioning, and risk behaviors. Finally, we assessed racial/ethnic disparities in functioning between White EAs and those who identified as Hispanic, Asian, Black and multi-racial/other after controlling for levels of AC use. Overall, findings highlight racial/ethnic differences in use throughout emerging adulthood, how AC use affects numerous domains of functioning, and that similar levels of AC use affect diverse groups of EAs in different ways, with non-White EAs experiencing poorer functioning across many areas.

Similar to other work (Finlay et al., 2012; Goings et al., 2020), we found that White EAs continue to be at greater risk for alcohol use during this developmental period; however, Black and Hispanic EAs were at greater risk for cannabis use, similar to other work (Dai, 2019). Examination of effects of alcohol use on outcomes indicated that participants with greater initial frequency of alcohol use at age 18 reported more physical ailments, alcohol consequences, and delinquency at age 23. Those who increased frequency of alcohol use from age 18–23 reported more depressive symptoms, physical ailments, alcohol consequences, and delinquency, and a lower likelihood of unemployment at age 23. This is generally consistent with alcohol use patterns on outcomes we found during high school (D'Amico, Tucker, et al., 2016), and adds that those EAs who increased alcohol use over time were also more likely to employed. Other studies have similarly shown that greater alcohol use among this age group is associated with employment (Patrick et al., 2021). This may be related to increased stress in the work environment (Siegrist & Rödel, 2006) or

having more income to spend on alcohol and/or more opportunities for drinking because of work-related functions (e.g., happy hour after work) (Lee et al., 2018). Further, it is interesting to note that greater initial frequency of alcohol use at age 18 was associated with better social functioning at age 23, also similar to the pattern we found during adolescence (D'Amico, Tucker, et al., 2016). This likely occurred as some items for peer relationships and social functioning address acceptance (other people my age want to be with me) and popularity (other people want to be my friend), which are often associated with heavier drinking during EA (Montgomery et al., 2020).

Overall, EAs who reported higher initial frequency of cannabis use at age 18 also indicated greater depression, anxiety, stress, cannabis consequences, and delinquency, and a lower likelihood of pursuing education beyond high school at age 23. Escalation of cannabis use from ages 18–23 was associated with problems across even more domains at age 23, including greater stress, depression, anxiety, cannabis consequences, and delinquency, as well as more physical ailments, poorer physical health, lower life satisfaction, and a lower likelihood of pursuing education beyond high school.

Findings are similar to previous work with adolescents, which showed that *any use* of cannabis was associated with more problems than *any use* of alcohol in high school seniors (D'Amico, Tucker, et al., 2016), and that rates of Cannabis Use Disorder (CUD) were three times as high as rates of Alcohol Use Disorder among a sample of approximately 1500 teens attending a primary care appointment despite similar prevalence of use of both substances (D'Amico, Parast, et al., 2016). Thus, although adolescents and EAs view cannabis as less harmful than alcohol (Greene, 2018; Hanauer et al., 2021; Schulenberg et al., 2021), our work has shown that cannabis use is consistently associated with poorer functioning across a range of outcomes compared to alcohol use. Results emphasize the importance of continuing to educate EAs that cannabis use can adversely affect functioning across many domains (Burggren et al., 2019; Scheier & Griffin, 2021). This is particularly important as more than one-third of the US population lives in states that have passed laws allowing retail sales of cannabis for adults (aged 21+ years) for nonmedical purposes, and EAs aged 21 to 25 are twice as likely to meet criteria for CUD compared to other age groups (Hasin et al., 2015), yet they are the least likely to pursue treatment for CUD (Wu et al., 2017). Brief intervention may be one way to reach adolescents and EAs (D'Amico et al., 2018; D'Amico et al., 2019; Laporte et al., 2017; Stein et al., 2018).

In terms of disparities, our previous study of this cohort indicated differences due to AC use as early as high school, with non-White teens reporting more problems with academics and physical health than White teens at similar levels of AC use (D'Amico, Tucker, et al., 2016).

Current findings show that these disparities continue in emerging adulthood. Compared to White EAs at similar levels of AC use, Hispanic EAs reported poorer physical health, and Asian, Hispanic, and multi-racial/other EAs reported greater delinquency and alcohol consequences. This translates, for example, to these non-White youth reporting more blackouts, greater legal problems, and/or more relationship difficulties due to alcohol use, which could affect other aspects of day-to-day functioning. In addition, Black, Hispanic, Asian and multi-racial/other EAs all reported lower life satisfaction than White EAs at

similar levels of AC use, and Hispanic, Black and multi-racial/other EAs reported a lower likelihood of attending college. Of note, we did not find disparities for mental health or perceived stress in this sample, similar to results from analyses of this cohort during adolescence (D'Amico, Tucker, et al., 2016). However, poorer functioning in some domains, such as college attendance, could subsequently affect mental health during this important developmental period. For example, one longitudinal study using Add Health data found that youth who dropped out of college reported greater anxiety and depression (Faas et al., 2018).

More research is needed to understand health equity and disparities due to substance use (McCuistian et al., 2021). Several recent papers note that greater consequences and poorer functioning from substance use may occur due to unique and/or additive stressors experienced by non-White individuals that may compound the negative effects of substance use. These stressors include but are not limited to: greater overall experiences of discrimination (Saint-Fleur & Anglin, 2021), including disproportionately criminalizing substance use among racial and ethnic minority groups (Camplain et al., 2020); greater overall acculturative stress (Kim et al., 2021; McCabe et al., 2021), which incorporates culturally-based stressors such as discrimination, context of reception, and bicultural stress (Salas-Wright & Schwartz, 2019); and greater prevalence of traumatic event exposure (Shevorykin et al., 2021). More work is needed in this understudied area, especially with respect to understanding the factors that may contribute to these disparities during the critical developmental periods of adolescence and emerging adulthood.

One exception to the disparity patterns we found was the higher likelihood of college attendance among Asian EAs compared to White EAs; this is particularly notable given that Asian adolescents were found to be less academically prepared (although not necessarily lower performing) compared to Whites in high school at similar levels of AC use (D'Amico, Tucker, et al., 2016). Although Asian EAs tend to have higher college enrollment rates compared to other racial/ethnic groups (Hussar et al., 2020), additional research is needed to determine whether there may be disparities in academic performance during college (e.g., GPA, graduate rates) between Asian and White EAs at similar levels of AC use.

Limitations of the current study include reliance on self-reported substance use and generalizability as the sample mainly lived in California. However, our sample's use rates over time are similar to rates seen for national samples (Schulenberg et al., 2021). Another limitation is that we did not examine heterogeneity within the standard race/ethnicity categories we used (e.g., Asian subgroups) (Shih et al., 2015). We also had a small percentage of Black youth in the sample due to the composition of the middle schools we initially recruited from in 2008. Finally, it is important to note that other factors not included in our analyses could have potentially contributed to either AC use or poorer functioning, such as discrimination, family AC use, or neighborhood quality.

Overall, findings emphasize that greater frequency of AC use at age 18 and escalating AC use from age 18–23 are associated with a host of problems at age 23. In addition, participants reporting increases in cannabis use also reported poorer functioning across more domains compared to those reporting increases in alcohol use. Finally, disparities

in functioning continue during emerging adulthood at similar levels of AC use, with non-White EAs reporting poorer physical health, less life satisfaction, greater risk behaviors, and a lower likelihood of obtaining a college degree compared to White EAs. Results highlight the importance of reaching racially/ethnically diverse youth with prevention and intervention programming as they transition from late adolescence into emerging adulthood to help mitigate substance use-related disparities during this critical period of development. Several studies have shown that brief motivational interventions across diverse settings can successfully reach non-White adolescents and EAs and reduce or stabilize AC use (D'Amico et al., 2018; D'Amico, Dickerson, et al., 2020; Feldstein Ewing et al., 2021; Lee et al., 2021).

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Author agreement

All authors have seen and approved the final version of the manuscript being submitted. Please note that the current material has not been published in whole or in part elsewhere, the paper is not currently being considered for publication elsewhere and all authors (Rodriguez, Tucker, Dunbar, Pedersen, & Seelam) have been personally and actively involved in substantive work leading to the report and will hold themselves jointly and individually responsible for its content. There are no conflicts of interest and all relevant ethical safeguards have been met in relation to subject protection.

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Statement 2: D'Amico, Rodriguez, and Tucker designed the study. D'Amico conducted the literature review and wrote the first draft of the paper. Dr. Rodriguez conducted all statistical analyses. Seelam programmed the data and conducted analyses for tables. Dunbar and Pedersen provided conceptual input and edited the manuscript.

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HIGHLIGHTS

- Alcohol and cannabis trajectories in emerging adulthood predicted numerous problems
- Frequency of cannabis use was associated with more problems than alcohol use
- Non-White participants had more problems than White participants with similar use rates

Table 1.

Sample information

	N/mean	%/SD
Demographics		
Age at wave 8	18.33	0.78
Age at wave 12	22.56	0.82
Sex at birth		
Male	1139	44.98%
Female	1392	54.98%
Intersex/Other	1	0.04%
Race/ethnicity		
White	669	22.72%
African-American	59	2.00%
Hispanic	1365	46.35%
Asian	665	22.58%
Multi-racial/Other	187	6.35%
Mother's highest level of education		
High school or less	1065	36.18%
More than high school	1879	63.82%
Outcomes (Wave 12)		
Negative consequences due to alcohol use in past year	13.05	6.82
Negative consequences due to cannabis use in past year	12.69	6.66
Delinquency	0.26	0.76
Physical health	9.23	2.30
Physical ailments	1.98	1.40
PHQ-8	5.58	5.59
GAD-7	5.16	5.57
Peer relationship social functioning	50.00	10.00
Perceived stress	14.19	4.79
Life satisfaction	22.31	7.82
Employment		
Unemployed	658	26.06%
Employed	1867	73.94%
Education (Highest degree earned)		
High school or less	1038	41.04%
More than high school	1491	58.96%
Substance use – past month		
Alcohol Use – number of days used in past month		
Wave 8	1.79	4.10

	N/mean	**%/SD**
Wave 9	2.28	4.36
Wave 10	3.54	5.24
Wave 11	4.31	5.77
Wave 12	4.13	5.75
Cannabis Use – number of days used in past month	*N/mean*	*%/SD*
Wave 8	2.33	6.26
Wave 9	2.89	6.91
Wave 10	3.51	7.47
Wave 11	3.69	8.24
Wave 12	3.62	8.31

Table 2.

Parameter estimates predicting alcohol and cannabis intercept and slope

	Alcohol		Cannabis	
	Intercept	**Slope**	**Intercept**	**Slope**
Race/ethnicity				
White (reference category)				
Black	−0.360 (−.745, .025) *p*=.067	**−0.475 (−.908, −.042) *p*=.031**	**0.459 (.113, .805) *p*=.009**	0.094 (−.300, .488) *p*=.639
Hispanic	**−0.426 (−.568, −.285) *p*=.000**	**−0.166 (−.328, −.005) *p*=.044**	**−0.200 (−.329, −.071) *p*=.002**	**0.150 (.003, .297) *p*=.046**
Asian	**−0.584 (−.733, −.436) *p*=.000**	**−0.230 (−.400, −.059) *p*=.008**	**−0.339 (−.475, −.203) *p*=.000**	−0.064 (−.220, .092) *p*=.422
Multi-racial/other	**−0.515 (−.774, −.257) *p*=.000**	−0.229 (−.520, .063) *p*=.124	−0.041 (−.274, .192) *p*=.730	0.046 (−.218, .311) *p*=.731
Age	**0.108 (.056, .160) *p*=.000**	**−0.092 (−.150, −.033) *p*=.002**	**0.051 (.004, .098) *p*=.035**	**−0.075 (−.129, −.022) *p*=.006**
Female	−0.002 (−.106, .103) *p*=.977	−0.061 (−.178, .057) *p*=.315	**−0.248 (−.341, −.154) *p*=.000**	0.008 (−.100, .115) *p*=.890
Intervention	.006 (−0.098, 0.110) *p*=.915	.003 (−0.115, 0.120) *p*=.965	0.057 (−0.037, 0.151) *p*=.233	-0.014 (−0.121, 0.092) *p*=.791
Mother's Education	**0.185 (0.066, 0.304) *p*=.002**	0.116 (−0.018, 0.250) *p*=.090	**0.173 (0.066, 0.280) *p*=.002**	0.018 (−0.105, 0.140) *p*=.779

Table shows estimate (95% confidence interval) and corresponding p-value. Statistically significant effects are bolded.

Table 3.

Parameter estimates of alcohol and cannabis predicting outcomes at wave 12

	Alcohol		Cannabis	
	Intercept	**Slope**	**Intercept**	**Slope**
Depression	0.022 (−.032, .076) *p*=.419	**0.096 (.039,.153) *p*=.001**	0.050 (.000, .100) *p*=.051	**0.101 (.045, .156) *p*<.001**
Anxiety	0.055 (−.001, .110) *p*=.054	0.046 (−.013, .104) *p*=.128	**0.060 (.011, .110) *p*=.017**	**0.076 (.020, .131) *p*=.008**
Physical health	0.007 (−.044, .058) *p*=.782	−0.027 (−.087, .032) *p*=.369	−0.017 (−.066, .033) *p*=.505	**−0.105 (−.160, −.049) *p*<.001**
Physical ailments	**0.069 (.016, .122) *p*=.011**	**0.105 (.046, .163) *p*<.001**	0.035 (−.014, .084) *p*=.166	**0.096 (.042, .151) *p*=.001**
Perceived stress	−0.025 (−.085, .036) *p*=.423	0.044 (−.019, .108) *p*=.169	**0.061 (.012, .111) *p*=.016**	**0.093 (.038, .149) *p*=.001**
Social functioning	**0.052 (.003, .100) *p*=.037**	**0.083 (.020, .146) *p*=.009**	−0.014 (−.064, .036) *p*=.580	−0.025 (−.081, .031) *p*=.386
Alcohol consequences	**0.444 (.418, .471) *p*<.001**	**0.417 (.389, .445) *p*<.001**		
Cannabis consequences	-	-	**0.376 (.334, .417) *p*<.001**	**0.409 (.363, .455) *p*<.001**
Delinquent behavior	**0.249 (.217, .282) *p*<.001**	**0.063 (.021, .104) *p*=.003**	**0.184 (.136, .232) *p*<.001**	**0.066 (.010, .121) *p*=.020**
Life satisfaction	−0.002 (−.058, .054) *p*=.941	0.006 (−.056, .068) *p*=.844	−0.034 (−.083, .015) *p*=.179	**−0.082 (−.137, −.027) *p*=.003**
More than HS education	0.018 (−.047, .083) *p*=.591	0.031 (−.040, .102) *p*=.388	**−0.116 (−.181, −.051) *p*<.001**	**−0.116 (−.194, −.038) *p*=.003**
Unemployed	−0.065 (−.139, .008) *p*=.083	**−0.082 (−.162, −.002) *p*=.046**	−0.012 (−.086, .062) *p*=.750	−0.028 (−.118, .063) *p*=.549

Table shows estimate (95% confidence interval) and corresponding p-value. Statistically significant effects are bolded. Models controlled for age, sex at birth, mother's education, and whether the individual attended an intervention school

Table 4.

Parameter estimates for race/ethnicity predicting outcomes at wave 12, controlling for both alcohol and cannabis use

	Black	Hispanic	Asian	Multi-racial/other
Depression	−0.036 (−.350, .278) *p*=.823	0.027 (−.093, .146) *p*=.661	0.083 (−.045, .210) *p*=.203	0.084 (−.127, .294) *p*=.435
Anxiety	−0.057 (−.371, .257) *p*=.721	0.022 (−.097, .141) *p*=.713	0.024 (−.103, .151) *p*=.714	0.045 (−.166, .255) *p*=.677
Physical health	−0.121 (−.433, .191) *p*=.446	**−0.138 (−.256, −.020) *p*=.022**	−0.099 (−.225, .027) *p*=.124	−0.040 (−.250, .170) *p*=.709
Physical ailments	0.015 (−.292, .323) *p*=.922	0.054 (−.062, .171) *p*=.361	0.095 (−.029, .220) *p*=.134	0.006 (−.201, .213) *p*=.953
Perceived stress	0.119 (−.193, .432) *p*=.455	−0.051 (−.169, .068) *p*=.404	0.031 (−.096, .158) *p*=.636	0.084 (−.126, .294) *p*=.435
Social functioning	0.123 (−.189, .435) *p*=.441	0.041 (−.078, .159) *p*=.500	0.066 (−.061, .192) *p*=.307	0.018 (−.191, .228) *p*=.864
Alcohol consequences	−0.028 (−.301, .246) *p*=.843	**0.222 (.119, .325) *p*<.001**	**0.231 (.121, .342) *p*<.001**	**0.323 (.140, .505) *p*=.001**
Cannabis consequences	−0.196 (−.473, .081) *p*=.165	−0.052 (−.157, .053) *p*=.329	0.034 (−.078, .146) *p*=.552	−0.008 (−.193, .178) *p*=.935
Delinquent behavior	−0.112 (−.420, .196) *p*=.477	**0.217 (.100, .333) *p*=.000**	**0.158 (.034, .283) *p*=.013**	**0.268 (.062, .474) *p*=.011**
Life satisfaction	**−0.466 (−.775, −.158) *p*=.003**	**−0.184 (−.301, −.067) *p*=.002**	**−0.213 (−.338, −.088) *p*=.001**	**−0.279 (−.486, −.072) *p*=.008**
More than HS education	−0.288 (−.630, .054) *p*=.099	**−0.295 (−.438, −.153) *p*=.000**	**0.223 (.062, .385) *p*=.007**	**−0.266 (−.506, −.025) *p*=.030**
Unemployed	−0.213 (−.651, .225) *p*=.341	−0.107 (−.272, .059) *p*=.206	−0.015 (−.193, .162) *p*=.867	0.064 (−.214, .343) *p*=.650

Table shows standardized estimate (95% confidence interval) and corresponding p-values. Statistically significant effects are bolded. Models controlled for age, sex at birth, mother's education, and whether the individual attended an intervention school