



Racial/ethnic discrimination and tobacco and cannabis use outcomes among US adults

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ABSTRACT

Introduction: Racial/ethnic discrimination (hereafter, discrimination) is associated with use of individual tobacco and cannabis products. However, we know little about how discrimination affects dual/polytobacco and cannabis use and associated use disorders.

Methods: We used cross-sectional data on adults (18+) from the 2012–2013 National Epidemiologic Survey on Alcohol and Related Conditions-III ($n = 35,744$). We defined past-year discrimination as a summary scale (range: 0–24) based on six scenarios. We created a mutually exclusive six-category use variable: noncurrent, individual tobacco and noncannabis, individual tobacco and cannabis, individual cannabis and nontobacco, dual/polytobacco and noncannabis, and dual/polytobacco and cannabis based on past 30-day tobacco use of four products (i.e., cigarettes, electronic nicotine delivery systems, other combustibles (cigars, pipe), smokeless tobacco) and cannabis use. We also examined past-year tobacco use disorder (TUD) and cannabis use disorder (CUD) as a four-level variable: no disorders, TUD only, CUD only, and TUD and CUD. We estimated associations between discrimination and each outcome using adjusted multinomial logistic regression and assessed effect modification by stratifying adjusted models by race/ethnicity (i.e., Hispanic, non-Hispanic (NH) White, NH Black, and another race/ethnicity).

Results: Experiencing more discrimination was associated with each outcome but was most strongly associated with dual/polytobacco and cannabis use (OR: 1.13, 95 % CI: 1.07–1.19) and joint TUD and CUD (OR: 1.16, 95 % CI: 1.12–1.20). Models stratified by race/ethnicity showed that discrimination was associated with dual/polytobacco and cannabis only among NH White adults, and with joint TUD and CUD only among NH Black and NH White adults.

Conclusions: Discrimination was associated with tobacco and cannabis use outcomes among multiple adult racial/ethnic populations, but associations were more profound for NH White and NH Black adults than adults from other racial/ethnic populations.

1. Introduction

As a leading cause of morbidity and mortality in the United States (US), tobacco use continues to be a public health problem (Cornelius et al., 2022; Gentzke et al., 2022). Among US adults, the prevalence of cigarette use is at an all-time low, but the rise in use of electronic nicotine delivery systems (ENDS) and the continued use of other tobacco products, such as cigars, remain at high levels (Cornelius et al., 2022;

Gentzke et al., 2022; Meza et al., 2020). As more products are introduced into the market, dual (two products) and polytobacco (three or more products) use increases (Fix et al., 2014; Hirschtick et al., 2021; Mattingly et al., 2021; Pacek et al., 2019). For example, polytobacco use without cigarettes increased among US adults from 2014 to 2019 (Mattingly et al., 2021). Dual/polytobacco use is associated with several deleterious health outcomes, including nicotine dependence (Rostron et al., 2016; Sung et al., 2018), higher frequency of use (Choi et al.,

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2019; Rostron et al., 2016), and higher mortality risk (Choi et al., 2019), making dual/polytobacco use an important public health issue to study.

Adult cannabis use is an additional public health concern, especially given the shifting legal landscape in the United States, conflicting perceptions of social norms and harms related to use, and the many forms through which cannabis can be consumed (Azofeifa et al., 2016; Carliner et al., 2017; Jeffers et al., 2021; Keyes et al., 2017; Mead, 2019; Palamar et al., 2021; Rabin & George, 2015; Yu et al., 2020). Cannabis use is intertwined with tobacco in many ways (Lemyre et al., 2019). Cannabis use is more common among people who use tobacco than people who do not use tobacco (Goodwin et al., 2018; Strong et al., 2018), and vice versa (Azagba et al., 2020; Weinberger et al., 2021). Concurrent use (hereafter, co-use) is another use modality that increases the risk for additive toxicant exposure, use disorders, and difficulty quitting both substances (Rabin & George, 2015; Smith et al., 2020). Since tobacco and cannabis share similar routes of administration (ROA) (Lemyre et al., 2019; Rabin & George, 2015), use of one substance might facilitate the other, which is an important consideration given that the health effects of nicotine and cannabis co-administration are not well understood (Braymiller et al., 2020; Rabin & George, 2015; Smith et al., 2020).

Using cannabis in tobacco products is most common among younger adults and certain racial/ethnic groups. For example, 80 % of young adults who use cannabis have done so at least once in a tobacco product, with cigars, hookah, and ENDS as the most used products (Seaman et al., 2020). Research has examined racial/ethnic disparities in cannabis use within tobacco products, such as blunting and vaping cannabis (Montgomery et al., 2018; Montgomery & Mantey, 2018; Uddin et al., 2020). Findings reveal that non-Hispanic (NH) African American young adults initiate and use more blunts than Hispanic or NH White young adults (Montgomery et al., 2018). Furthermore, Hispanic and NH Black adults are more likely to vape nicotine and cannabis than White adults (Uddin et al., 2020). These studies highlight the need for additional explanation and understanding of disparate use and co-use patterns across racial/ethnic groups. Common ROA and enhancing the experienced effects of each substance are cited as reasons that encourage co-use (Rabin & George, 2015; Smith et al., 2021; Walley et al., 2019). However, other factors, such as social determinants that might be driving disparities in tobacco and cannabis use by race/ethnicity, require further inquiry.

Exploring risk factors that determine variation in tobacco and cannabis use and co-use by race/ethnicity will shed light on ways to prevent use and promote health equity. One determinant of racial/ethnic disparities in health is racial/ethnic discrimination (hereafter, discrimination) (Krieger, 1990; Williams, 2018). Discrimination is a direct result of racism, associated with poorer mental and physical health outcomes, and a potential cause of racial/ethnic health inequities (Churchwell et al., 2020; Cobbinah & Lewis, 2018; Lee et al., 2019; Pascoe & Smart Richman, 2009; Spence et al., 2016; Williams, 2018; Williams et al., 2019). Discrimination is a psychological stressor that can elicit coping responses, such as substance use (Amaro et al., 2021; Lazarus & Folkman, 1984), and prior work demonstrates that discrimination is associated with tobacco and cannabis use in youth and adult populations (Assari et al., 2019; Mattingly, Fleischer, et al., 2020; Parker et al., 2017; Pro et al., 2018; Unger, 2018; Unger et al., 2016). However, the extent to which discrimination is associated with dual/polytobacco use with or without cannabis is not well known (Mattingly et al., 2022), and an important line of inquiry since use of tobacco products and cannabis vary by race/ethnicity (Hirschtick et al., 2021; Keyes et al., 2017; Meza et al., 2020; Palamar et al., 2021). Furthermore, studies investigating the relationship between discrimination and substance use disorders (Clark et al., 2015; Kcomt, Evans-Polce, Engstrom, West, Boyd, et al., 2021; Kcomt, Evans-Polce, Engstrom, West, & McCabe, 2021; Lee et al., 2016; McCabe et al., 2019) and discrimination and substance use outcomes stratified by race/ethnicity are limited. Discrimination affects racial/ethnic populations differently (Bleich et al., 2019; Findling, Bleich, et al., 2019; Findling, Casey, et al., 2019; Lee et al., 2019;

McMurtry et al., 2019; Williams et al., 2019), and additional insight into how these experiences shape substance use by race/ethnicity is needed.

This study examined associations between discrimination and tobacco and cannabis use outcomes. Specifically, we investigated whether past-year discrimination was associated with past 30-day patterns of tobacco and cannabis use as well as past-year tobacco and cannabis use disorders. Given that discrimination quantitatively varies across racial/ethnic groups in the United States (Lee et al., 2019), its relationship with tobacco and cannabis use may also depend on racial/ethnic identity. Thus, to examine these racial/ethnic differences, we additionally assessed effect modification through stratification by race/ethnicity.

2. Material and methods

2.1. Data

We used data from the 2012–2013 National Institute on Alcohol Abuse and Alcoholism (NIAAA) National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III). NESARC-III is a cross-sectional study that evaluated the mental health status among US adults and is nationally representative of the adult (18 years or older) non-institutionalized, civilian population. NESARC-III study investigators collected data via the Alcohol Use Disorder and Associated Disabilities Interview Schedule-5 (AUDADIS-5), a semi-structured, face-to-face diagnostic interview method that reliably captures mental health disorders according to the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5) (Grant et al., 2014; Hasin et al., 2015). They also oversampled Hispanic, Black, and young adults (aged 18–24). More details on NESARC-III methodology are reported elsewhere (Grant et al., 2014). We received approval from the University of Michigan Institutional Review Board to conduct this research.

2.2. Participants

NESARC-III included 36,309 adults. The survey asked respondents who identified as Hispanic ($n = 7037$) about ethnic discrimination and respondents who identified as NH and any race ($n = 29,272$) were asked about racial discrimination. We included respondents who had complete information on either racial/ethnic discrimination measure, each tobacco product and cannabis use measure, and each sociodemographic and geographic characteristic included in our analyses, resulting in an analytic sample size of 35,744. We display the selection of the analytic sample in a flow chart in Supplementary Fig. 1.

2.3. Measures

2.3.1. Racial/ethnic discrimination

NESARC-III included measures on experiences of discrimination (EOD) (Krieger, 1990). It asked respondents six questions on EOD in specified settings, once for discrimination that occurred prior to the past year, and once for discrimination that occurred in the past year. These six questions included, “(about) how often did you experience discrimination because you are Hispanic or Latino/because of your race or ethnicity in: 1) your ability to obtain health care or health insurance coverage, 2) how you were treated when you got care, 3) public, like on the street, in stores or in restaurants, 4) ANY other situation, like obtaining a job or on the job, getting admitted to a school or training program, in the courts or by the police,” and “(about) how often were you 5) called a racist name or 6) made fun of, picked on, pushed, shoved, hit, or threatened with harm.” Response options for each scenario included: 0) never, 1) almost never, 2) sometimes, 3) fairly often, and 4) very often. For past-year racial/ethnic discrimination (hereafter, discrimination), we summed the six experiences to create summary scales (range 0–24) according to prior research using these measures (Kcomt, Evans-Polce, Engstrom, West, Boyd, et al., 2021; Kcomt, Evans-

Polce, Engstrom, West, & McCabe, 2021; McCabe et al., 2019). The Cronbach's alpha for the discrimination summary scale was 0.81, demonstrating excellent internal reliability.

2.3.2. Individual tobacco product use

We used four classifications of tobacco products: cigarettes, ENDS (i.e., e-cigarettes and e-liquid), other combustible products (OC; cigars, pipe), and smokeless tobacco (SLT) (i.e., snuff, moist, dipping tobacco). We defined current tobacco use as any use in the past 30 days.

2.3.3. Cannabis use

NESARC-III respondents were asked about any cannabis use (i.e., weed, pot, dope, hashish, Mary Jane, joints, blunts). We defined current cannabis use as any use in the past 30 days.

2.3.4. Patterns of tobacco and cannabis use

This study defined co-use of both substances as the use of tobacco and cannabis within the past 30 days. We classified the four tobacco product use variables (i.e., cigarettes, ENDS, OC, SLT), into three use categories: never/former, individual (i.e., only one tobacco product), and dual/polytobacco (i.e., two or more products). We combined this variable with past 30-day cannabis use to create a six-category use variable: 1) never/former tobacco and cannabis, 2) individual tobacco and non-cannabis, 3) individual tobacco and cannabis, 4) individual cannabis and non-tobacco, 5) dual/polytobacco and non-cannabis, and 6) dual/polytobacco and cannabis.

2.3.5. Tobacco and cannabis use disorders

We also examined tobacco use disorder (TUD) and cannabis use disorder (CUD) outcome measures (see Supplementary Table 1), defined based on DSM-5 criteria using AUDADIS-5 (American Psychiatric Association, 2013). AUDADIS-5 operationalized TUD includes symptoms pertaining to all types of tobacco products, and operationalized CUD symptoms pertaining to all types of cannabis use (Grant et al., 2014; Hasin et al., 2015). We included two variables that indicated whether participants had a past-year DSM-5 TUD or a past-year DSM-5 CUD (both yes/no). With these two variables, we created a four-category variable indicating whether participants had 1) no TUD/CUD, 2) individual TUD, 3) individual CUD, or 4) joint TUD and CUD.

2.3.6. Sociodemographic and geographic characteristics

We included the following characteristics as covariates: age (continuous), sex (male, female), race/ethnicity (Hispanic, NH White, NH Black, another race/ethnicity), highest educational attainment (high school/GED or less, some college, college degree or more), annual household income (\$25,000/year, \$25,000 to \$59,999/year, and \$60,000/year or greater), urbanicity (rural, urban), and geographic region (Northeast, North Central/Midwest, South, West). The group that we classify as "another race/ethnicity" included respondents who identified as NH American Indian/Alaska Native (NH AI/AN), NH Asian/Native Hawaiian/other Pacific Islander (A/NH/OPI), and NH multiracial (two or more races).

2.4. Statistical analysis

We estimated the prevalence of participant characteristics (i.e., sociodemographic, geographic characteristics, discrimination, each outcome) in the analytic sample. We compared distributions of participant characteristics across both outcome variables using chi-square tests for independence and analysis of variance (ANOVA).

We fit two crude multinomial logistic regression models to estimate the associations between 1) discrimination and the six-category tobacco and cannabis use variable (referent: never/former use), and 2) discrimination and the four-category TUD and CUD variable (referent: no TUD/CUD). The study adjusted for mean-centered age, a quadratic term for age due to non-linearity of age and tobacco or cannabis use

(Azofeifa et al., 2016; Jeffers et al., 2021), sex, race/ethnicity, highest educational attainment, annual household income, urbanicity, and geographical region in additional models.

To investigate differences in these associations by race/ethnicity, we fit an adjusted model for each outcome with a two-way interaction term between discrimination and race/ethnicity. We performed Wald tests at an alpha level of 0.05 to determine whether the interactions were statistically significant. To examine effect modification, we stratified each adjusted model by race/ethnicity. All analyses accounted for the complex sample design of NESARC-III using Stata 16.1.

We also conducted several sensitivity analyses. One analysis included prior-to-past-year discrimination, rather than past-year discrimination, to estimate associations for each outcome, following the same analysis scheme above. We did this analysis to investigate whether timing of discriminatory experiences differentially impacted past 30-day substance use. The second analysis examined the means of each discrimination item by race/ethnicity to explore potential pairwise differences between each racial/ethnic minoritized group and NH White respondents. The third analysis disaggregated the "another race/ethnicity" group into NH AI/AN and NH A/NH/OPI to estimate stratified associations as sample size allowed. We conducted this analysis based on recommendations from prior research (Chaiyachati et al., 2022) and to be as inclusive as possible given the focus on racial/ethnic disparities. The fourth analysis explored other functional forms of the discrimination measure. We sought to examine whether dropping extreme cases (i.e., scores over 20) impacted the regression results. We also categorized discrimination (i.e., 0, 1–5, 6–10, 11–15, and 16+) to investigate whether a linear trend remained in regression models with this measure.

3. Results

3.1. Prevalence of participant characteristics

Table 1 shows the prevalence of participant characteristics among the analytic sample. The mean discrimination scale was 1.0 (SD: 2.3). Individual (17.9 %) and dual/poly (2.2 %) tobacco use groups without cannabis were more prevalent than the individual and dual/poly tobacco use groups with cannabis (3.3 % and 0.7 %, respectively); the prevalence of individual cannabis and non-tobacco use was 2.4 %. The prevalence of individual TUD, individual CUD, and joint TUD and CUD were 18.2 %, 0.9 %, and 1.6 %, respectively. Distributions of participant characteristics by patterns of tobacco and cannabis use and tobacco and cannabis use disorders are in Supplementary Tables 2–3.

3.2. Discrimination and patterns of tobacco and cannabis use

In the adjusted model, each unit increase in discrimination was associated with higher odds of each tobacco/cannabis use group compared to the never/former use group (Table 2). Specifically, respondents had 5 % higher odds (95 % CI: 1.04–1.07) of individual tobacco and non-cannabis use, 9 % higher odds (95 % CI: 1.07–1.12) of individual tobacco and cannabis use, 6 % higher odds (95 % CI: 1.03–1.09) of individual cannabis and non-tobacco use, 11 % higher odds (95 % CI: 1.07–1.15) of dual/polytobacco and non-cannabis use, and 13 % higher odds (95 % CI: 1.07–1.19) of dual/polytobacco and cannabis use.

3.3. Discrimination and tobacco and cannabis use disorders

In the adjusted model, each unit increase in discrimination was associated with 8 % higher odds (95 % CI: 1.07–1.10) of individual TUD and 8 % higher odds of individual CUD (95 % CI: 1.04–1.12), compared to no TUD/CUD (Table 3). The association for joint TUD and CUD, compared to no TUD/CUD, was stronger in magnitude, with each unit increase in discrimination associated with 16 % higher odds (95 % CI: 1.12–1.20) of joint TUD and CUD.

Table 1

Weighted prevalence of participant characteristics among the analytic sample, the National Epidemiologic Survey on Alcohol and Related Conditions-III, 2012–2013 ($n = 35,744$).

Participant characteristics	
Age (mean \pm SD)	46.6 \pm 17.8
Sex, n (%)	
Female	20,169 (52.0)
Male	15,575 (48.0)
Race/ethnicity, n (%)	
Hispanic	6928 (14.7)
NH White	18,930 (66.3)
NH Black	7611 (11.7)
Another race/ethnicity	2275 (7.3)
Highest educational attainment, n (%)	
High school graduate/GED or less	15,030 (38.7)
Some college	11,934 (33.1)
College graduate	8780 (28.1)
Annual household income, n (%)	
Less than \$25,000	12,570 (27.2)
\$25,000 to \$59,999	12,413 (33.2)
\$60,000 or more	10,761 (39.6)
Urbanicity, n (%)	
Urban	29,722 (78.7)
Rural	6022 (21.3)
Geographic region, n (%)	
Northeast	5125 (18.3)
Midwest	7465 (21.5)
South	14,233 (36.9)
West	8921 (23.3)
Past-year discrimination scale (mean \pm SD)	1.0 \pm 2.3
Past 30-day patterns of tobacco and cannabis use, n (%)	
Never/former use	25,869 (73.4)
Individual tobacco & non-cannabis	6627 (17.9)
Individual tobacco & cannabis	1292 (3.3)
Individual cannabis & non-tobacco	1010 (2.4)
Dual/polytobacco & non-cannabis	708 (2.2)
Dual/polytobacco & cannabis	238 (0.7)
Past-year DSM-5 tobacco and cannabis use disorders, n (%)	
No disorders	28,243 (79.3)
Individual tobacco use disorder only	6536 (18.2)
Individual cannabis use disorder only	377 (0.9)
Joint tobacco and cannabis use disorders	588 (1.6)

3.4. Effect modification by race/ethnicity

3.4.1. Patterns of tobacco and cannabis use

The two-way interaction between discrimination and race/ethnicity in the model estimating the association of discrimination on tobacco and cannabis use was statistically significant overall ($p < 0.001$). When examining the statistical significance of the interaction term with specific levels of the outcome, the terms were statistically significant for individual tobacco and non-cannabis ($p = 0.001$), individual tobacco and cannabis ($p = 0.002$), dual/polytobacco and non-cannabis ($p = 0.002$), and dual/polytobacco and cannabis ($p < 0.001$) (Table 4).

In race/ethnicity-stratified models, each unit increase in discrimination was associated with higher odds of individual tobacco and non-cannabis use among all racial/ethnic groups. For individual tobacco and cannabis use, associations were observed only for NH White (OR: 1.14, 95 % CI: 1.10–1.19), NH Black (OR: 1.09, 95 % CI: 1.05–1.13), and respondents who identified as another race/ethnicity (OR: 1.10, 95 % CI: 1.01–1.19), but not Hispanic respondents. For individual cannabis and non-tobacco use, associations were observed for Hispanic (OR: 1.05, 95 % CI: 1.01–1.09), NH White (OR: 1.09, 95 % CI: 1.02–1.17), and NH Black (OR: 1.06, 95 % CI: 1.02–1.10) respondents but not respondents who identified as another race/ethnicity. For dual/polytobacco and non-cannabis use, each unit increase in discrimination was associated with use among NH White (OR: 1.17, 95 % CI: 1.12–1.23) and NH Black (OR: 1.07, 95 % CI: 1.01–1.12) respondents but not Hispanic and respondents who identified as another race/ethnicity. Furthermore, each unit increase in discrimination was associated with dual/polytobacco

and cannabis use only among NH White respondents (OR: 1.24, 95 % CI: 1.16–1.32).

3.4.2. Tobacco and cannabis use disorders

The two-way interaction between discrimination and race/ethnicity in the model estimating the association of discrimination on the four-category TUD and CUD variable was statistically significant ($p < 0.001$). For each level of the outcome, the interaction terms were statistically significant for individual TUD ($p < 0.001$) and joint TUD and CUD ($p = 0.001$). Each unit increase in discrimination was associated with higher odds of individual TUD for each racial/ethnic group. For individual CUD, discrimination was associated with 10 % (95 % CI: 1.05–1.14), 12 % (95 % CI: 1.03–1.22), and 13 % (95 % CI: 1.03–1.24) higher odds among NH Black, NH White, and respondents who identify as another race/ethnicity, respectively, but not Hispanic respondents. For joint TUD and CUD, each unit increase in discrimination was associated with 13 % (95 % CI: 1.09–1.18) higher odds among NH Black respondents and 24 % (95 % CI: 1.17–1.31) higher odds among NH White respondents, but not Hispanic and respondents who identified as another race/ethnicity.

3.5. Sensitivity analyses

Overall and stratified results from the first sensitivity analyses (Supplementary Tables 4–6), which examined prior-to-past-year discrimination and tobacco and cannabis use outcomes, yielded similar estimates to the main analyses. However, one key difference in race/ethnicity-stratified models was that each unit increase in prior-to-past-year discrimination was associated with higher odds of dual/polytobacco and cannabis use among respondents who identified as another race/ethnicity (OR: 1.16, 95 % CI: 1.04–1.30). Another important difference was that prior-to-past-year discrimination was associated with higher odds of joint TUD and CUD among all racial/ethnic groups as opposed to only NH White and NH Black respondents for past-year discrimination. The second analysis revealed that NH White respondents had statistically lower mean discrimination for each item relative to other racial/ethnic minoritized groups (Supplementary Table 7). In the third analysis, where we further disaggregated “another race/ethnicity” in effect modification analyses, past-year discrimination was not associated with any use group among NH AI/AN respondents ($n = 499$) (Supplementary Table 8), and the model for NH Asian/NH/OPI respondents ($n = 1776$) did not converge. For TUD/CUD outcomes, discrimination was not associated with disorders among NH AI/AN respondents but was associated with TUD (OR: 1.09, 95 % CI: 1.03–1.17), CUD (OR: 1.24, 95 % CI: 1.09–1.42), and joint TUD and CUD (OR: 1.27, 95 % CI: 1.10–1.47) among NH Asian/NH/OPI respondents. The fourth analysis that examined various functional forms of the discrimination measure found that dropping extreme cases resulted in nearly identical regression estimates (data not shown). In addition, categorizing discrimination and refitting the regression models with this measure showed that the estimates remained approximately linear (data not shown).

4. Discussion

In a nationally representative study, adults who experienced more discrimination had higher odds of using tobacco and cannabis under two outcomes of interest: tobacco and cannabis use patterns and individual and joint TUD and CUD. Associations were stronger for dual/polytobacco use outcomes with and without cannabis than for individual tobacco use outcomes with and without cannabis, and for joint TUD and CUD than for individual TUD or CUD. These relationships varied by race/ethnicity, with associations for more severe outcomes such as dual/polytobacco and cannabis use and joint TUD and CUD being stronger for NH White and NH Black respondents compared to Hispanic and respondents who identified as another race/ethnicity.

Table 2

Adjusted associations between past-year discrimination and past 30-day patterns of tobacco and cannabis use (n = 35,744).

	Past 30-day patterns of tobacco and cannabis use ^a				
	Individual tobacco & non-cannabis	Individual tobacco & cannabis	Individual cannabis & non-tobacco	Dual/polytobacco & non-cannabis	Dual/polytobacco & cannabis
	OR (95 % CI) ^b	OR (95 % CI) ^b	OR (95 % CI) ^b	OR (95 % CI) ^b	OR (95 % CI) ^b
Past-year discrimination scale	1.05 (1.04–1.07)	1.09 (1.07–1.12)	1.06 (1.03–1.09)	1.11 (1.07–1.15)	1.13 (1.07–1.19)
Age (continuous) ^c	0.90 (0.88–0.92)	0.56 (0.52–0.59)	0.62 (0.58–0.66)	0.73 (0.68–0.78)	0.48 (0.41–0.55)
Age, quadratic (continuous) ^c	0.86 (0.85–0.87)	0.87 (0.84–0.91)	1.01 (0.98–1.04)	0.85 (0.81–0.89)	0.87 (0.81–0.94)
Sex (ref: female)					
Male	1.59 (1.48–1.71)	2.49 (2.12–2.94)	2.26 (1.91–2.67)	3.00 (2.45–3.68)	7.59 (4.76–12.10)
Race/ethnicity (ref: NH White)					
Hispanic	0.34 (0.30–0.38)	0.26 (0.21–0.32)	0.54 (0.43–0.68)	0.20 (0.14–0.28)	0.23 (0.13–0.39)
NH Black	0.56 (0.51–0.62)	0.74 (0.59–0.94)	1.32 (1.05–1.65)	0.25 (0.19–0.33)	0.78 (0.50–1.21)
Another race/ethnicity	0.61 (0.53–0.71)	0.54 (0.38–0.76)	0.48 (0.32–0.70)	0.48 (0.32–0.73)	0.23 (0.11–0.50)
Highest educational attainment (ref: high school graduate/GED or less)					
Some college	0.65 (0.60–0.71)	0.70 (0.59–0.82)	1.18 (0.96–1.45)	0.74 (0.59–0.93)	0.86 (0.62–1.21)
College graduate	0.27 (0.24–0.30)	0.25 (0.19–0.33)	0.80 (0.61–1.06)	0.24 (0.17–0.33)	0.26 (0.15–0.44)
Annual household income (ref: less than \$25,000)					
\$25,000 to \$59,999	0.76 (0.70–0.82)	0.50 (0.43–0.58)	0.65 (0.55–0.77)	0.85 (0.65–1.10)	0.44 (0.29–0.65)
\$60,000 or more	0.49 (0.44–0.55)	0.28 (0.22–0.36)	0.48 (0.39–0.60)	0.53 (0.38–0.73)	0.29 (0.19–0.46)
Urbanicity (ref: urban)					
Rural	1.14 (1.02–1.27)	0.78 (0.61–0.99)	0.85 (0.57–1.28)	1.55 (1.21–2.00)	1.58 (1.10–2.26)
Geographic region (Northeast)					
Midwest	1.26 (1.10–1.44)	0.76 (0.57–1.01)	0.61 (0.45–0.83)	1.76 (1.15–2.70)	0.68 (0.44–1.05)
South	1.21 (1.05–1.39)	0.61 (0.46–0.81)	0.54 (0.40–0.73)	1.86 (1.26–2.74)	0.85 (0.56–1.28)
West	0.88 (0.76–1.02)	0.87 (0.64–1.18)	1.45 (1.06–1.98)	1.69 (1.07–2.68)	0.93 (0.62–1.38)

Bolded text indicates statistical significance ($p < 0.05$).^a The outcome referent group: never/former use of both tobacco and cannabis.^b Adjusted odds ratios (OR) and 95 % confidence intervals (CI) adjusted for all variables in the table.^c Each one-unit increase in age is rescaled to represent 10 years.

Like other studies, we showed that discrimination is a risk factor for substance use (Assari et al., 2019; Mattingly, Fleischer, et al., 2020; Parker et al., 2017; Pro et al., 2018; Unger, 2018; Unger et al., 2016). Our findings shed light on how discriminatory experiences impact tobacco and cannabis use together, such as how associations were stronger for dual/polytobacco use groups with and without cannabis, relative to individual use groups. Our results are also consistent with prior work that has observed relationships between discrimination and substance use disorders (Clark et al., 2015; Kcomt, Evans-Polce, Engstrom, West, Boyd, et al., 2021; Kcomt, Evans-Polce, Engstrom, West, & McCabe, 2021; Lee et al., 2016; McCabe et al., 2019). A few studies using NESARC-III data reported associations between sexual orientation discrimination and TUD among sexual minoritized adults (Kcomt, Evans-Polce, Engstrom, West, Boyd, et al., 2021; Kcomt, Evans-Polce, Engstrom, West, & McCabe, 2021; McCabe et al., 2019). Another study found that sexual orientation discrimination was associated with CUD among sexual minoritized men (Lee et al., 2016). While our study differs in focusing primarily on racial/ethnic discrimination, as well as the intersection between TUD and CUD, minority stress experienced by sexual minoritized adults due to discrimination likely influences substance use in similar stress-coping mechanisms to race-related stress experienced by racial/ethnic minoritized groups (Meyer, 2003). Altogether, our findings provide further evidence that social vulnerabilities to tobacco and cannabis use and misuse may function through the stress-coping process for all population groups (Amaro et al., 2021; Griffin & Armstead, 2020; Lazarus & Folkman, 1984).

We observed substantial variation by race/ethnicity in associations between discrimination and tobacco and cannabis use outcomes, such as NH White respondents, compared to other racial/ethnic groups, having associations for discrimination with each tobacco and cannabis use outcome, including dual/polytobacco and cannabis use, a more severe outcome than individual use of either substance. These results show that NH White adults in the US feel discriminated against based on their racial identity, which may increase their risk to use substances. This

phenomenon may seem counterintuitive. While racial discrimination is harmful to everyone, the system of racism is defined by White supremacy in the United States directed at non-White populations (Williams et al., 2019). It is counterintuitive that White Americans experience “racial” discrimination as a result of White supremacy. However, the fact that some White Americans perceive to be discriminated based on their race is demonstrated in empirical research (Earle & Hodson, 2020; Lee et al., 2019). NH White Americans have also reported feeling discriminated against for reasons related to religious and political affiliations, resource entitlement, and relative social mobility (Earle & Hodson, 2020; Isom Scott, 2018; Lee et al., 2019; Mayrl & Saperstein, 2013; Wilkins & Kaiser, 2014). These factors are likely linked to feelings of anti-White discrimination and may intersect with beliefs that discrimination occurs primarily based on race. In other words, NH White Americans do not experience racial discrimination as a result of systemic racism. However, some members of this group do report feeling mistreated on the basis of their skin color. The measure of racial discrimination used in this study, like all other community surveys, relies on self-report via interview. Thus, that a proportion of NH White respondents report experiencing discrimination based on race is not surprising.

We also observed an association between experiencing more discrimination and dual/polytobacco and non-cannabis use among NH Black respondents, while these associations were null for Hispanic and respondents who identified as another race/ethnicity. Since racial/ethnic minoritized groups experience discrimination at greater rates than their NH White counterparts (Bleich et al., 2019; Findling, Bleich, et al., 2019; Findling, Casey, et al., 2019; Lee et al., 2019; McMurtry et al., 2019), the stress accompanied with such events may lead to poorer health outcomes (Cobbinah & Lewis, 2018; Pascoe & Smart Richman, 2009; Thoits, 2010). However, the stress accumulated from experiencing discrimination does not pattern equally across racial/ethnic groups, nor does the coping with racial discrimination lead to uniform patterns of substance use. Further understanding of the differential mechanisms by which racial discrimination leads to substance use

Table 3Adjusted associations between past-year discrimination and past-year DSM-5 tobacco and cannabis use disorders ($n = 35,744$).

	Past-year DSM-5 tobacco and cannabis use disorders ^a		
	Individual tobacco use disorder	Individual cannabis use disorder	Joint tobacco & cannabis use disorders
	OR (95 % CI) ^b	OR (95 % CI) ^b	OR (95 % CI) ^b
Past-year discrimination scale	1.08 (1.07–1.10)	1.08 (1.04–1.12)	1.16 (1.12–1.20)
Age (continuous) ^c	0.85 (0.82–0.87)	0.57 (0.52–0.62)	0.48 (0.43–0.53)
Age, quadratic (continuous) ^c	0.86 (0.84–0.87)	1.05 (1.00–1.11)	0.91 (0.87–0.96)
Sex (ref: female)			
Male	1.45 (1.36–1.56)	2.39 (1.83–3.12)	2.27 (1.78–2.89)
Race/ethnicity (ref: NH White)			
Hispanic	0.24 (0.21–0.28)	0.78 (0.54–1.13)	0.23 (0.17–0.30)
NH Black	0.46 (0.41–0.51)	1.45 (1.09–1.94)	0.74 (0.52–1.05)
Another race/ethnicity	0.55 (0.47–0.64)	0.49 (0.29–0.81)	0.56 (0.32–0.97)
Highest educational attainment (ref: high school graduate/GED or less)			
Some college	0.68 (0.62–0.74)	1.15 (0.85–1.54)	0.79 (0.62–0.99)
College graduate	0.26 (0.23–0.29)	1.01 (0.68–1.50)	0.21 (0.14–0.31)
Annual household income (ref: less than \$25,000)			
\$25,000 to \$59,999	0.74 (0.68–0.81)	0.75 (0.56–0.99)	0.57 (0.45–0.72)
\$60,000 or more	0.46 (0.41–0.52)	0.62 (0.43–0.90)	0.36 (0.26–0.48)
Urbanicity (ref: urban)			
Rural	1.14 (1.02–1.27)	0.79 (0.51–1.21)	0.90 (0.68–1.19)
Geographic region (Northeast)			
Midwest	1.09 (0.96–1.24)	0.51 (0.32–0.81)	0.96 (0.66–1.38)
South	1.05 (0.92–1.20)	0.69 (0.50–0.94)	0.78 (0.53–1.14)
West	0.88 (0.74–1.03)	1.34 (0.93–1.93)	0.98 (0.68–1.42)

Bolded text indicates statistical significance ($p < 0.05$).^a The outcome referent group: no past-year tobacco or cannabis use disorder.^b Adjusted odds ratios (OR) and 95 % confidence intervals (CI) adjusted for all variables in the table.^c Each one-unit increase in age is rescaled to represent 10 years.

for each racial/ethnic group will help reduce associated disparities in use.

Several of our sensitivity analyses require further inquiry. For the first analysis, timing of discrimination may matter in how it relates to tobacco and cannabis use. Prior-to-past-year discrimination was associated with dual/polytobacco and cannabis use among respondents who identified as another race/ethnicity but associations between past-year discrimination and this outcome were null. Discrimination occurs over the life course and it is important to understand how these exposures collectively impact adverse health behaviors. Our result might truly represent a phenomenon in which a population of adults, who had

recalled discrimination occurring prior to the year of data collection, had these instances relate more with problematic substance use than instances of discrimination that had occurred more recently. The second analysis showed that NH White respondents reported lower mean discrimination for each discrimination item compared to other racial/ethnic groups. These findings show that racial/ethnic minoritized groups experience more discrimination on average with probable health implications beyond that of tobacco and cannabis use and use disorders. However, the relationship between discrimination and tobacco and cannabis use is stronger among NH White respondents than racial/ethnic minoritized groups. Our third sensitivity analysis that explored

Table 4Adjusted associations between past-year discrimination and past 30-day patterns of tobacco and cannabis use and past-year tobacco and cannabis use disorders stratified by race/ethnicity ($n = 35,744$).

	Race/ethnicity ^a			
	Hispanic	NH White	NH Black	Another race/ethnicity
	OR (95 % CI) ^b	OR (95 % CI) ^b	OR (95 % CI) ^b	OR (95 % CI) ^b
Past 30-day patterns of tobacco and cannabis use ^{c, e}				
Individual tobacco & non-cannabis	1.03 (1.002–1.06)	1.09 (1.06–1.11)	1.03 (1.01–1.05)	1.07 (1.02–1.12)
Individual tobacco & cannabis	1.03 (0.98–1.09)	1.14 (1.10–1.19)	1.09 (1.05–1.13)	1.10 (1.01–1.19)
Individual cannabis & non-tobacco	1.05 (1.01–1.09)	1.09 (1.02–1.17)	1.06 (1.02–1.10)	1.04 (0.96–1.13)
Dual/polytobacco & non-cannabis	1.03 (0.96–1.11)	1.17 (1.12–1.23)	1.07 (1.01–1.12)	1.05 (0.93–1.18)
Dual/polytobacco & cannabis	0.99 (0.88–1.11)	1.24 (1.16–1.32)	1.06 (0.97–1.15)	0.95 (0.79–1.14)
Past-year DSM-5 tobacco and cannabis use disorders ^{d, e}				
Individual tobacco use disorder only	1.04 (1.02–1.07)	1.13 (1.10–1.15)	1.06 (1.04–1.08)	1.08 (1.03–1.14)
Individual cannabis use disorder only	1.04 (0.97–1.11)	1.12 (1.03–1.22)	1.10 (1.05–1.14)	1.13 (1.03–1.24)
Joint tobacco and cannabis use disorders	1.06 (1.00–1.13)	1.24 (1.17–1.31)	1.13 (1.09–1.18)	1.11 (0.99–1.24)

Bolded text indicates statistical significance ($p < 0.05$).^a Each racial/ethnic category represents a separate model for each outcome.^b Adjusted odds ratios (OR) and 95 % confidence intervals (CI) adjusted for age, quadratic age, sex, highest educational attainment, annual household income, urbanicity, and geographic region.^c P -value for the two-way interaction between discrimination and race/ethnicity for each level of the outcome in interaction models: individual tobacco & non-cannabis ($p < 0.001$), individual tobacco & cannabis ($p = 0.002$), individual cannabis & non-tobacco ($p = 0.37$), dual/polytobacco & non-cannabis ($p = 0.002$), and dual/polytobacco & cannabis ($p < 0.001$).^d P -value for the two-way interaction between discrimination and race/ethnicity for each level of the outcome in interaction models: individual tobacco use disorder ($p < 0.001$), individual cannabis use disorder ($p = 0.09$), and joint tobacco & cannabis use disorders ($p < 0.001$).^e The outcome referent group: never/former use of both tobacco and cannabis, no tobacco or cannabis use disorders.

effect modification in AI/AN and A/NH/OPI respondents revealed stark between-group differences. Discrimination was associated with each use disorder category for A/NH/OPI respondents but findings for AI/AN respondents were null, indicating that adults who identify as Asian or Native Hawaiian/Other Pacific Islander or multiracial were driving the relationship between discrimination and use disorders for the “another race/ethnicity” group. Further work must unpack these exposure-outcome relationships for populations often overlooked in disparities research. These findings also corroborate previous research promoting the importance of inclusivity while defining and operationalizing race/ethnicity for tobacco use outcomes (Mattingly, Hirschtick, et al., 2020).

Several potential explanations exist for why associations between discrimination and substance use differentially affect racial/ethnic groups in the United States. These explanations derive from the concept that each racial/ethnic population represents a collection of experiences rather than a monolithic identity (Hicken et al., 2018). One theory is that varying availability of psychosocial and social resources may drive racial/ethnic disparities in substance use as a response to stress (Mezuk et al., 2013; Pearlin & Schooler, 1978). Another theory is that cultural resilience plays a role in protecting racial/ethnic groups from using tobacco products amid experiencing discrimination. We define cultural resilience as the developed coping ability of people from those racial and ethnic groups with histories of responding to racial/ethnic discrimination (Andrade et al., 2021; Handlovsky et al., 2018; Kessler, 1979; Neighbors, 1984; Neighbors et al., 2011; Spence et al., 2016). Cultural resilience against racial discrimination in the United States may protect against the negative health consequences of stress in the short term, although long-term implications likely occur over the life course for racial/ethnic minoritized populations (Churchwell et al., 2020; Cobbinah & Lewis, 2018; Williams et al., 2019). Thus, in the long run, eliminating racism will result in the best potential public health outcomes.

Federal and state-level policies and interventions must appropriately address problematic forms of tobacco and cannabis use to promote health equity. From a regulatory standpoint, use and misuse of both tobacco and cannabis increases the complexity of addressing disparities, given that the FDA does not have regulatory authority over cannabis (Deyton, 2011; Food & Drug Administration, 2016; Mead, 2019). As the intersection between tobacco and cannabis use become more complicated, interventions and policies aimed at reducing nicotine use among US adults may have to additionally consider the interacting effects of cannabis use. Tobacco and cannabis use are interrelated as use of one substance may lead to use of the other (Azagba et al., 2020; Goodwin et al., 2018; Lemyre et al., 2019; Rabin & George, 2015; Strong et al., 2018; Weinberger et al., 2021), complicating tobacco regulatory recommendations. For example, cannabis use is associated with difficulty quitting tobacco, tobacco use relapse, and tobacco use intensity (Rabin & George, 2015). If a substantial proportion of people who use tobacco also use cannabis, efforts to reduce tobacco use are undermined through the legalization of cannabis use, thereby enabling tobacco use to continue. Thus, we must consider the intersection of tobacco and cannabis use, and how facilitating the use of cannabis runs counter to the public health goal of reducing the use of tobacco. We need better coordination across the regulation of both tobacco and cannabis to better improve public health and reduce associated racial inequities.

4.1. Limitations

Our study has several limitations. First, the cross-sectional nature of the data precludes our ability to infer causal relationships. Second, we captured all measures via self-reported interviews and are potentially prone to survey biases, such as underestimating substance use due to social desirability or differentially assigning meaning to discriminatory experiences by individuals, researchers, or policymakers. The purpose of measuring social phenomena via self-report is to capture the variability in assigning meaning to, in this case, discriminatory experiences. Thus, some people will not perceive certain experiences as discriminatory. In a

similar vein, some people who experience discrimination will not attribute those experiences to their race/ethnicity, but to other personal identities such as gender, age, or socioeconomic status. These factors explain why such a high proportion of respondents (72.7 %) in the analytic sample reported that they had not experienced any discrimination in the past year. Third, the social and political landscapes surrounding tobacco and cannabis use have changed since 2012–2013. For tobacco, use patterns have likely changed since 2012–2013 with new products entering the market and shifting regulations (Pacek et al., 2019). However, findings related to dual/polytobacco use are relevant given that dual/polytobacco use continues to be a public health problem. For cannabis, a handful of states have recently legalized use potentially altering use patterns (Carliner et al., 2017; Mead, 2019), with a recent study suggesting that cannabis use has increased alongside legalization among people who smoke cigarettes (Weinberger et al., 2022). Fourth, due to the NESARC-III survey design and sample size limitations, it was not possible to determine whether respondents were using tobacco and cannabis simultaneously or using these substances separately but within the past 30 days. Fifth, we were unable to disaggregate dual/polytobacco use groups due to sample size limitations. Sixth, we did not have adequate statistical power to detect each association in models stratifying race/ethnicity to the extent we would have liked. In addition, NESARC-III study investigators aggregated multiracial respondents with either NH AI/AN or NH A/NH/OPI respondents in the data, (Grant et al., 2014), disallowing us to stratify these groups further. Thus, results from this sensitivity analysis should be interpreted with caution as it is difficult to tell whether multiracial respondents are driving associations between discrimination and use. Last, discrimination in this study represent interpersonal accounts and not structural forms of racism that can impact health behaviors and cause health inequities (Churchwell et al., 2020; Cobbinah & Lewis, 2018).

5. Conclusion

This study found that experiencing more racial/ethnic discrimination was associated with two tobacco and cannabis use outcomes. Our results also show that these associations varied by race/ethnicity. For example, NH White and NH Black respondents had higher odds of dual/polytobacco and cannabis use and joint TUD and CUD. The detriments of racial/ethnic discrimination might differentially affect adults' propensity to use substances as a coping mechanism. While research on discrimination and health suggests that the long-term effects of discrimination are more harmful to racial/ethnic minoritized groups than NH White individuals in the US (Amaro et al., 2021; Cobbinah & Lewis, 2018; Williams, 2018; Williams et al., 2019), findings from our study suggest that these relationships are stronger for NH White adults in the United States for tobacco and cannabis use. We should explore factors that lead racial/ethnic minoritized groups to experience worse health outcomes associated with discrimination, and whether these mechanisms function through tobacco and cannabis use. Furthermore, clinicians who provide behavioral health treatments, such as tobacco cessation interventions, may benefit from our study findings in two ways. One, our findings provide further evidence that discrimination is associated with tobacco and cannabis use outcomes, including co-use and joint use disorders. Two, the use of cannabis may lead to less successful tobacco treatment outcomes, and vice versa, calling for further consideration of ways to limit co-use in addition to addressing salient social determinants of health such as discrimination. How clinicians should help to reduce their patients' exposure to racial discrimination remains unclear. However, all clinicians must interrogate and uncover the client's view of the role that racial discrimination may have played in their substance use and focus the therapeutic intervention explicitly on how such clients can build stronger personal coping capacity to protect against the inevitable onslaught of racial discrimination.

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CRediT authorship contribution statement

Delvon T. Mattingly: Conceptualization, Data Curation, Methodology, Formal Analysis, Writing—Original Draft Preparation, Writing—Review and Editing. **Harold W. Neighbors:** Conceptualization, Writing—Review and Editing. **Briana Mezuk:** Conceptualization, Writing—Review and Editing. **Michael R. Elliott:** Conceptualization, Writing—Review and Editing. **Nancy L. Fleischer:** Conceptualization, Writing—Review and Editing, Funding Acquisition, Supervision.

Declaration of competing interest

The authors report there are no competing interests to declare.

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Appendix A. Supplementary data

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