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## Perceived racial discrimination and polysubstance use among racial/ethnic minority adolescents in the United States

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### ABSTRACT

**Objective:** Polysubstance use among adolescents is a significant public health concern, yet most studies on adolescent substance use focus on a singular substance. This study is one of the first to investigate the association between perceived racial discrimination (PRD) in school and polysubstance use among racial/ethnic minority adolescents using a nationally representative sample.

**Methods:** Data was from the 2021 Adolescent Behaviors and Experiences Survey. The sample included 4145 racial/ethnic minority adolescents (52.8% female). Hierarchical binary logistic regression was used to examine the association between PRD in school and polysubstance use among racial/ethnic minority adolescents.

**Results:** About 12% of racial/ethnic minority adolescents engaged in polysubstance use and 23.4% reported experiencing PRD in school sometimes/most of the time/always. Controlling for other factors, experiencing PRD in school sometimes/most of the time/always was associated with 1.52 times higher odds of polysubstance use when compared to adolescents who never experienced PRD in school ( $OR=1.52$ ,  $p=.044$ , 95%  $CI=1.01-2.30$ ). Cyberbullying victimization, symptoms of depression, and being emotionally abused by a parent during COVID-19 were also associated with polysubstance use.

**Conclusion:** Controlling for demographic characteristics and psychosocial stressors, PRD in school was significantly associated with higher odds of polysubstance use among racial/ethnic minority adolescents. The findings of this study could inform clinicians and policymakers of the association between PRD in school and polysubstance use, which could contribute to early identification of polysubstance use among racial/ethnic minority adolescents.

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## 1. Introduction

Polysubstance use among adolescents in the United States (U.S.) remains a significant public health concern for researchers, policy-makers, and clinicians (Moss et al., 2014; Silveira et al., 2019). The term polysubstance use is often generally defined to mean the use of two or more different substances either on separate occasions or at the same time (Connor et al., 2014). Consistent with past studies (Bobashev and Warren, 2022; Connor et al., 2014; Litt et al., 2021; Schick et al., 2021; Stanley and Swaim, 2018), this study defines polysubstance as the use of two or more substances over any time period within the past 30 days. Prevalence estimates of polysubstance use among adolescents in the U.S. vary depending on the definition and reporting period (i.e., past month use, past year use, or lifetime use) (Tomczyk et al., 2016). Studies have found that about 8–10% of adolescents engage in polysubstance use (Bohnert et al., 2014; Conway et al., 2013; Silveira et al., 2019). However, higher rates have also been reported in other studies (Cleveland et al., 2010; Shin et al., 2010; Stanley and Swain, 2018). A recent scoping review conducted by Goodwin et al. (2022) also found that between 2002 and 2018, 16.3% of adolescent males and 11.2% of adolescent females engaged in polysubstance use in the past year.

Most studies on adolescent substance use have focused on one substance (Baiden, Cavazos-Rehg, et al., 2023; Baiden, Morgan, et al., 2022; Baiden and Tadeo, 2019; Garrett et al., 2017; Tache et al., 2020). Yet, empirical studies (Compton et al., 2021; Connor et al., 2014; McCabe et al., 2015) and systematic reviews (Goodwin et al., 2022; Tomczyk et al., 2016) show that single substance use is less common than polysubstance use among adolescents. For instance, McCabe et al. (2015) examined data from the Monitoring the Future (MTF) study and found that among adolescents who misused prescription opioids in the past year, 51% co-used prescription opioids with cannabis, and 48% co-used prescription opioids with alcohol. Focusing on one type of substance use instead of polysubstance may hamper the development of effective treatment interventions for adolescents at risk of polysubstance use.

One important factor that has been found to be associated with substance use among adolescents is psychosocial stressors. Studies have found that psychosocial stressors such as school bullying (Glassner and Cho, 2018; Hong et al., 2022; Tretyak et al., 2022), cyberbullying (McField et al., 2023), dating violence (Orpinas et al., 2017; Taylor and Sullivan, 2021), sexual violence (Mulla et al., 2020), or neighborhood and community violence (Tache et al., 2020) to be associated with adolescent substance use as a means of managing distress. Other psychosocial stressors such as food insecurity (Nagata et al., 2021; Turner et al., 2022), child maltreatment (Yoon et al., 2022), and social isolation (Bonar et al., 2022) have also been found to be associated with substance use among adolescents. However, one important psychosocial stressor that has received less research attention in terms of its association with polysubstance use is perceived racial discrimination (PRD; Pachter et al., 2018).

PRD is generally defined as an individual's subjective experiences of unfair and unfavorable treatment because of their race. PRD can be at an institutional or personal level and can manifest in both overt (e.g., derogatory remarks directed towards people of color) and subtle (e.g., getting ignored or dismissed) forms (Williams et al., 2019). Studies suggest that Black adolescents experience more discrimination than individuals of other racial/ethnic identities, especially at school (Forest-Bank and Jenson, 2015; Lemay Jr and Teneva, 2020). Various studies among adults (Carter et al., 2017; Chambers et al., 2020), and to a lesser degree, among preschoolers (Aboud et al., 2012; Priest et al., 2012), and adolescents (Baiden, LaBrenz, et al., 2022; Bernard et al., 2021; Sanders-Phillips et al., 2014) have consistently documented PRD as a critical social determinant of health (Gee and Ford, 2011; Mpofu et al., 2022; Trent et al., 2019). In parallel, PRD may be influenced by contextual and structural factors. For example, ongoing structural disparities such as residential segregation and inequitable access to resources can negatively impact health and health risk behaviors

(Williams and Mohammed, 2009). Racism may also be more prevalent in certain contexts, such as schools for Black adolescents (Ortega-Williams et al., 2022). Furthermore, historical and family contexts may contribute to collective or historical trauma which impacts how an individual responds to PRD (Vines et al., 2017).

Among adolescents, systematic reviews and meta-analyses have found a significant association between PRD and poor mental health, low self-esteem, and delinquency (Cave et al., 2020; Priest et al., 2012). Some studies have also found a similar significant association between PRD and substance use behaviors among adolescents (Fuller-Rowell et al., 2012; Sanders-Phillips et al., 2014). For instance, Fuller-Rowell et al. (2012) followed 417 African American adolescents in Maryland and investigated the link between PRD and substance use and found that higher levels of PRD at Wave 3 were significantly associated with increases in substance use at Wave 4. Sanders-Phillips et al. (2014) examined data on 567 African American high school students from the U.S. and found PRD significantly predicted depressive symptoms, which in turn predicted past month alcohol and marijuana use. Systematic reviews and meta-analytic studies have also found a similar association between PRD and substance use among adolescents (Cave et al., 2020; Cénat et al., 2023; Sanderson et al., 2020). One limitation of such research on PRD and substance use behaviors among adolescents, however, involves the use of small and unrepresentative samples or samples from specific geographical locations, which limits the generalizability of the findings.

### 1.1. Theoretical frameworks

This study is guided by Minority Stress Theory (MST; Meyer, 1995, 2003), Race-Based Traumatic Stress model (RBTS; Carter, 2007; Carter et al., 2020), and Self-Medication Theory (SMT; Khantzian, 1997). MST posits that individuals from minority social groups, such as sexual, gender, and/or racial/ethnic minorities, experience additional and unique stress due to their minority status, which can negatively affect their physical and mental health outcomes (Meyer, 2003), including substance use behaviors. Minority stress stems from existing structures, institutions, and processes beyond an individual's general stressors or innate biological characteristics (Szymanski et al., 2014). Meyer (2003) viewed minority stress processes as existing along a continuum from distal stressors to proximal personal stressors. MST captures both distal stressors such as discrimination, prejudice, and harassment as well as proximal stressors as they relate to one's subjective responses to exposure to discrimination (Meyer, 2003). Though originally developed to apply to sexual minorities (Meyer, 2003), MST has been applied to racially/ethnically marginalized individuals (Baiden, LaBrenz, et al., 2022; Cyrus, 2017).

RBTS model posits that traumatic stress (e.g., stress from emotional pain; Carlson, 1997) from racism can impact psychological outcomes for people of color. Carter (2007) theorized that racism and racial discrimination could account for the disproportionate rates of PTSD among people of color compared to white individuals. Carter suggests that negative race-based encounters can create extreme levels of stress in a person and lead to traumatic reactions (Carter and Pieterse, 2020). RBTS model is supported by previous literature including a meta-analysis that demonstrated racism was associated with poorer mental health (Paradies et al., 2015). Emerging studies are beginning to highlight the relationship between RBTS and its association with alcohol misuse (Johnson et al., 2023), but further studies on substance misuse are needed.

In addition to MST and RBTS, SMT posits that substance use may be part of an individual's response to emotional or psychological distress, or that an individual's decision to use a particular substance is based on the substance's effect on the subjective affect regulation mechanism (Khantzian, 1997). Applying SMT to the present study, polysubstance use may be viewed as a response to the emotional or psychological distress arising out of the experience of PRD. This line of reasoning is

supported by prior research that found that adolescents who experienced PRD are at increased risk of experiencing higher levels of emotional distress, loneliness, sadness, and hopelessness (Presseau et al., 2019; Priest et al., 2017).

## 1.2. Current study

Although various studies have examined the association between PRD and substance use among adolescents, to our knowledge, no study has investigated the association between PRD in school and polysubstance use among racial/ethnic minority adolescents using a large, nationally representative sample. Understanding the association between PRD in school and polysubstance use among racial/ethnic minority adolescents is critical to addressing equitable health outcomes and developing targeted substance use interventions for racial/ethnic minority adolescents. Moreover, we were interested in exploring the association of PRD in school and polysubstance use among racial/ethnic minority adolescents for the following three reasons: 1) there is not enough literature on health risk behaviors focusing only on racial/ethnic minority adolescents, 2) the need to understand what might work in terms of intervention considering differences among racial/ethnic minority adolescents, and 3) the comparison to White may be perpetuating the status quo that White is the standard (the optimal reference group of comparison) against which all other racial/ethnic identities should be measured. Therefore, the purposes of this study are twofold: 1) to examine the prevalence of PRD and polysubstance use among racial/ethnic minority adolescents, and (2) to investigate the cross-sectional association between PRD and polysubstance use among racial/ethnic minority adolescents. We hypothesized that controlling for the effects of demographic characteristics, and psychosocial stressors, racial/ethnic minority adolescents who experienced PRD would have higher odds of reporting current polysubstance use than their counterparts who did not experience PRD.

## 2. Methods

### 2.1. Data source

Data for this study came from the 2021 Adolescent Behaviors and Experiences Survey (ABES). The ABES was a one-time online survey conducted between January to June 2021 by the CDC to provide nationally representative data at a time when many students were attending school virtually due to the COVID-19 pandemic. The objectives, methodology, and sampling procedure for the ABES have been described elsewhere (Rico et al., 2022). The ABES was designed to: 1) assess the health impact of the COVID-19 pandemic, 2) determine the prevalence of health risk behaviors, and 3) examine the co-occurrence of health risk behaviors (Rico et al., 2022). The 2021 ABES used a three-stage cluster sample design to produce a nationally representative sample of 9th through 12th grade students in public, Catholic, and other private schools in the U.S. The online ABES questionnaire gathered data on experiences and behaviors, including emotional well-being, suicidal behaviors, experiences related to perceived racism, behaviors that contribute to violence and unintentional injuries, and substance use, among others. The 2021 ABES was approved by the CDC's Institutional Review Board (IRB), and the de-identified data are publicly available.

### 2.2. Sample

All public, Catholic, and other private schools that serve students in grades 9 through 12 in the 50 States and the District of Columbia were included in the sampling frame for the 2021 ABES. Schools were selected systematically with probability proportional to enrollment in grades 9 through 12 using a random start. The 2021 ABES had a school response of 37.8%. Of the eligible students, 16,037 were sampled, of which 7998 completed the 2021 ABES. After data cleaning, 7705 questionnaires

were found usable, producing a student response rate of 48%, and an overall response rate of 18% (Rico et al., 2022). The low response rates for the 2021 ABES increase the potential for nonresponse bias. However, sample weights were adjusted to account for nonresponding schools, minimizing potential nonresponse bias (Rico et al., 2022). The analytic sample for the current study included 4145 adolescents who self-identified as a racial/ethnic minority.

### 2.3. Variables

#### 2.3.1. Outcome variable

The outcome variable examined was polysubstance use and was measured as a binary variable. Polysubstance use was computed based on a positive response to having used any of the following substances during the past 30 days: cigarette smoking, alcohol use, electronic vaping products use, marijuana use, and prescription medication misuse. A sum of polysubstance use was computed by summing these five substances with scores ranging from 0 to 5. Adolescents who currently use at least two of these substances were recoded as 1; otherwise, they were coded as 0.

#### 2.3.2. Explanatory variable

The main explanatory variable examined was PRD, measured with a single item from the Perceptions of Racism in Children and Youth (PRaCY) scale (Pachter et al., 2010). Adolescents were asked, "During your life, how often have you felt that you were treated badly or unfairly in school because of your race or ethnicity?" with the following response options "Never," "Rarely," "Sometimes," "Most of the time," and "Always." Adolescents who indicated "Sometimes," "Most of the time," or "Always" were grouped together and coded as 2. Adolescents who indicated "Rarely," were coded as 1, whereas adolescents who indicated "Never" were coded as 0. Several other studies have also measured PRD among adolescents using this single item from the PRaCY (Baiden, LaBrenz, et al., 2022; Forke et al., 2019; Gee and Ponce, 2010; Mpofu et al., 2022; Pachter et al., 2010, 2018).

#### 2.3.3. Covariates

The covariates examined were cyberbullying victimization, symptoms of depression, food insecurity during COVID-19, physical abuse by a parent during COVID-19, emotional abuse by a parent during COVID-19, and social isolation during COVID-19. These covariates were operationalized following the recommendation of the CDC (Krause et al., 2022). The exact wording of the questions and analytic coding for each covariate are provided in Table 1.

#### 2.3.4. Demographic characteristics

Demographic characteristics included age measured in years, sex (0 = Female versus 1 = Male), sexual identity (0 = Straight, 1 = Lesbian/gay, 2 = Bisexual, and 3 = Other/questioning), and race/ethnicity (0 = Non-Hispanic Black, 1 = Hispanic, 2 = Asian, 3 = American Indian/Native Hawaiian/Pacific Islander (AI/NH/PI), and 4 = Other), with 0 serving as the reference category for each respective categorical variable.

### 2.4. Data analyses

Data were analyzed using descriptive and multivariable analytic techniques. Descriptive statistics were first conducted to examine the general distribution of all the variables included in the analysis. For the main analysis, we used binary logistic regression to examine the cross-sectional association between PRD and current polysubstance use while controlling for demographic characteristics and psychosocial stressors. Three hierarchical binary logistic regression models were fitted, with explanatory variables added in a hierarchical order. In Model 1, we regressed polysubstance use on PRD. In Model 2, we regressed polysubstance use on PRD while simultaneously adjusting for

**Table 1**  
List of covariates derived from the 2021 ABES.

Variable name	Survey question	Analytic coding
Victim of cyberbullying	During the past 12 months, have you ever been electronically bullied? (Count being bullied through texting, Instagram, Facebook, or other social media.)	No versus Yes
Symptoms of depression	During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?	No versus Yes
Food insecurity during COVID-19	During the COVID-19 pandemic, how often did you go hungry because there was not enough food in your home?	No (never) versus Yes (rarely, sometimes, most of the time, always)
Physical abuse by a parent during COVID-19	During the COVID-19 pandemic, how often did a parent or other adult in your home hit, beat, kick, or physically hurt you in any way?	No (never) versus Yes (rarely, sometimes, most of the time, always)
Emotional abuse by a parent during COVID-19	During the COVID-19 pandemic, how often did a parent or other adult in your home swear at you, insult you, or put you down?	No (never) versus Yes (rarely, sometimes, most of the time, always)
Social isolation during COVID-19	During the COVID-19 pandemic, how often were you able to spend time with family, friends, or other groups, such as clubs or religious groups, by using a computer, phone, or other device?	Yes (never or rarely) versus No (sometimes, most of the time, always)

demographic characteristics. In the fully adjusted model, we regressed polysubstance use on PRD while adjusting for demographic characteristics, and psychosocial stressors. Missing data were handled using Multiple Imputation Chained Equations (Van Buuren, 2018). Odds ratios (ORs) and adjusted odds ratios (AORs) are reported together with their 95% Confidence Intervals (CI). Variables were considered significant if the *p*-value was less than .05. Stata’s “svyset” command was used to account for the weighting and complexity of the cluster sampling design employed by the ABES. All analyses were performed using STATA 17 MP (Stata Corp., College Station, Texas, USA).

### 3. Results

#### 3.1. Sample characteristics

Table 2 below shows the general distribution of the study variables. About 12% of adolescents engaged in polysubstance use. About one in four (23.4%) racial/ethnic minority adolescents reported experiencing PRD sometimes/most of the time/always, 25.8% reported rarely experiencing PRD, and 50.8% have never experienced PRD in school. The majority of the sample (52.8%) were female. About one in four racial/ethnic minority adolescents self-identified as a sexual minority (11.3% questioning, 10.2% bisexual, and 3.1% gay/lesbian). Close to one in two racial/ethnic minorities self-identified as Hispanic (48.9%), 28.5% as non-Hispanic Black, 8.4% as Asian, 2.7% as AI/NH/PI, and 11.5% as “Other.” About one in nine racial/ethnic minority adolescents (11.3%) were victims of cyberbullying, and 44.1% reported symptoms of depression. Over one in four (28.5%) adolescents reported experiencing household food insecurity during COVID-19, 13.8% were physically abused by a parent during COVID-19, 53.4% were emotionally abused by a parent during COVID-19, and 31.8% experienced social isolation during COVID-19.

**Table 2**  
Sample characteristics (*N* = 4145).

Variables	N (%)
<b>Outcome variable</b>	
Engage in polysubstance use	
No	3651 (88.1)
Yes	494 (11.9)
<b>Main explanatory variable</b>	
Experienced perceived racial discrimination	
Never	2106 (50.8)
Rarely	1069 (25.8)
Sometimes/Most of the time/Always	970 (23.4)
<b>Control variables</b>	
Age	
14 years	500 (12.1)
15 years	1005 (24.3)
16 years	1067 (25.7)
17 years	997 (24.0)
18 years	576 (13.9)
Sex	
Male	1957 (47.2)
Female	2188 (52.8)
Sexual orientation	
Straight	3124 (75.4)
Lesbian/gay	127 (3.1)
Bisexual	424 (10.2)
Questioning	470 (11.3)
Race/ethnicity	
Non-Hispanic Black	1182 (28.5)
Hispanic	2027 (48.9)
Asian	347 (8.4)
AI/NH/PI	113 (2.7)
Other	476 (11.5)
Victim of cyberbullying	
No	3677 (88.7)
Yes	468 (11.3)
Symptoms of depression	
No	2308 (55.7)
Yes	1837 (44.3)
Food insecurity during COVID-19	
No	2965 (71.5)
Yes	1180 (28.5)
Physical abuse by a parent during COVID-19	
No	3573 (86.2)
Yes	572 (13.8)
Emotional abuse by a parent during COVID-19	
No	1930 (46.6)
Yes	2215 (53.4)
Did not feel connected to others at school during COVID-19	
No	2827 (68.2)
Yes	1318 (31.8)

#### 3.2. Logistic regression results examining the association between perceived racial discrimination and polysubstance use

The multivariable logistic regression results examining the association between PRD in school and polysubstance use are presented in Table 3. In the unadjusted models, we found a significant association between PRD in school and polysubstance use. Compared to adolescents who had never experienced PRD in school, rarely experiencing PRD in school was associated with 1.72 times higher odds of polysubstance use (*OR*=1.72, *p*=.004, 95% *CI*=1.20–2.46) and experiencing PRD in school sometimes/most of the time/always was associated with 2.84 times higher odds of polysubstance use (*OR*=2.84, *p*<0.001, 95% *CI*=1.97–4.09). This significant effect was partially attenuated with the addition of demographic characteristics in Model 2, and psychosocial stressors in Model 3. Controlling for the effects of demographic characteristics and other psychosocial stressors in Model 3, experiencing PRD in school sometimes/most of the time/always was associated with 1.52 times higher odds of polysubstance use when compared to adolescents who never experienced PRD in school (*OR*=1.52, *p*=.044, 95% *CI*=1.01–2.30). Adolescents who rarely experienced PRD in school were not significantly different from their counterparts who had never experienced PRD in school in terms of polysubstance use.

**Table 3**  
Multivariate logistic regression results examining the association between perceived racial discrimination and polysubstance use (N = 4145).

Variables	Model 1		Model 2		Model 3	
	OR (95% C.I.)	P-value	AOR (95% C.I.)	P-value	AOR (95% C.I.)	P-value
Experienced perceived racial discrimination (Never)						
Rarely	1.72 (1.20–2.46)	0.004	1.66 (1.18–2.35)	0.005	1.20 (0.84–1.73)	0.313
Sometimes/Most of the time/Always	2.84 (1.97–4.09)	<0.001	2.70 (1.84–3.97)	<0.001	1.52 (1.01–2.30)	0.044
Age in years			1.39 (1.17–1.65)	<0.001	1.47 (1.24–1.75)	<0.001
Sex (Male)						
Female			1.33 (0.95–1.84)	0.092	1.08 (0.77–1.52)	0.649
Sexual identity (Straight)						
Lesbian/gay			2.41 (1.04–5.58)	0.041	1.92 (0.84–4.36)	0.116
Bisexual			2.11 (1.36–3.29)	0.001	1.34 (0.87–2.07)	0.175
Questioning			1.06 (0.60–1.87)	0.842	0.83 (0.46–1.52)	0.541
Race/ethnicity (non-Hispanic Black)						
Hispanic			1.17 (0.74–1.85)	0.505	1.06 (0.66–1.69)	0.817
Asian			0.40 (0.18–0.87)	0.023	0.39 (0.17–0.87)	0.024
AI/NH/PI			1.71 (0.71–4.09)	0.222	1.42 (0.55–3.68)	0.468
Other			1.47 (0.84–2.60)	0.175	1.29 (0.72–2.30)	0.385
Victim of cyberbullying (No)						
Yes					2.06 (1.34–3.19)	0.002
Symptoms of depression (No)						
Yes					2.28 (1.52–3.41)	<0.001
Food insecurity during COVID-19 (No)						
Yes					1.18 (0.81–1.71)	0.384
Physical abuse by a parent during COVID-19 (No)						
Yes					1.35 (0.84–2.15)	0.206
Emotional abuse by a parent during COVID-19 (No)						
Yes					2.08 (1.42–3.05)	<0.001
Did not feel connected to others at school during COVID-19 (No)						
Yes					0.94 (0.70–1.28)	0.707

Controlling for the effects of demographic characteristics and psychosocial stressors, each additional increase in age by one year was associated with 1.47 times higher odds of polysubstance use (AOR = 1.47,  $p = <0.001$ , 95% CI = 1.24–1.75). Other factors associated with polysubstance use included: history of cyberbullying victimization (AOR = 2.04,  $p = .002$ , 95% CI = 1.34–3.19), symptoms of depression (AOR = 2.28,  $p = <0.001$ , 95% CI = 1.52–3.41), and being emotionally abused by a parent during COVID-19 (AOR = 2.08,  $p = <0.001$ , 95% CI = 1.42–3.05).

#### 4. Discussion

Drawing on MST, RBTS model, and SMT, the objectives of this study were to examine the prevalence of PRD in school and polysubstance use, and the cross-sectional association between PRD in school and polysubstance use among racial/ethnic minority adolescents. It should be noted that it is not only racial/ethnic minority individuals who experience discrimination based on their racial/ethnic identity. With the attacks on diversity, equity, and inclusion (DEI) efforts and racial tension in the U.S., it is possible that some White adolescents may be feeling a sense of "othering." However, we were interested in exploring the association of PRD in school and polysubstance use among racial/ethnic minority adolescents given their historical exclusion and disparate outcomes.

We found that a little over one in ten racial/ethnic minority adolescents engaged in polysubstance use during the past 30 days, and about one in two racial/ethnic minority adolescents ever experienced PRD in school. In addition, we found an association between PRD in school and polysubstance use among racial/ethnic minority adolescents. The proportion of adolescents who engaged in polysubstance use found in this study is consistent with some other studies (Bohnert et al., 2014; Conway et al., 2013; Silveira et al., 2019) but at the same time slightly lower than what other studies have found (Cleveland et al., 2010; Connell et al., 2009; Dierker et al., 2007; Shin et al., 2010; Stanley and Swain, 2018). Stanley and Swain (2018) defined polysubstance use as the use of any other substance in addition to alcohol, marijuana, and cigarettes during the past 30 days and found that 28.8% of adolescents

in grades 9–12 used marijuana and cigarette, and 14.2% used alcohol, marijuana, and cigarette during the past 30 days. These differences in prevalence estimates of polysubstance use could be due to how polysubstance use was operationalized as the present study employed five substances, the reporting period (i.e., past month use, past year use, or lifetime use) (Tomczyk et al., 2016).

It is important to emphasize that focusing on one substance use instead of polysubstance use risks losing the interactions between substances, which has the potential to hamper the development of effective treatment interventions for adolescents who might be at risk of polysubstance use. Indeed, polysubstance use has consistently been found to be associated with worse treatment outcomes among individuals, including poor adherence to treatment (Fendrich et al., 2021), revert to substance use (Branson et al., 2012), and mortality (Friedman et al., 2022). Simultaneous use of opioids and depressants has been found to be associated with fatal and non-fatal overdose due to synergistic respiratory issues (Barocas et al., 2018; Pizzicato et al., 2020).

The findings of the present study indicate that about one in two racial/ethnic minority adolescents reported ever experiencing PRD at school. It is important to note that using a single item to measure PRD has the potential to underestimate the full range of discrimination, such as subtle versus overt discrimination (Landrine et al., 2006). Using a more comprehensive instrument made up of multiple items to measure PRD in school settings may help capture different dimensions of PRD. In addition, the use of multiple items to measure PRD in school settings may help us understand discrimination by different actors such as teachers, school authorities, or peers (e.g., discrimination by peers in the classroom, during recess, or on the school bus) that might be missed by the use of a single item (Gee and Ponce, 2010). Thus, it is possible that our estimates of PRD may have been higher had the 2021 ABES assessed PRD using multiple items. Moreover, PRD is developmentally salient in adolescence and more subtle forms of discrimination might be missed with the use of a single item to measure PRD in school as there are multiple sources where discrimination can lie in the life of an adolescent (e.g., teachers, other students, observing their parents face discrimination, etc.).

We found support for our hypothesis that controlling for the effects

of other factors, racial/ethnic minority adolescents who experienced PRD would have higher odds of engaging in polysubstance use than their counterparts who did not experience PRD. Various research has documented the harmful effects of PRD on mental health among adolescents (Sanders-Phillips et al., 2009). Prior research has also suggested that PRD increases substance use behaviors (Fuller-Rowell et al., 2012; Garrett et al., 2017), which is employed as a coping mechanism in response to stress that stems from such experiences (Chaplin et al., 2012; Sanders-Phillips et al., 2014). Nevertheless, to the best of our knowledge, this is the first study to investigate the association between PRD and polysubstance use among racial/ethnic minority adolescents.

The positive association between PRD and polysubstance use found in this study lend support to SMT that posits that substance use may be part of an individual's response to emotional or psychological distress, or an individual's decision to use a particular substance is based on the substance's effect on the subjective affect regulation mechanism (Khantzian, 1997). Indeed, our finding also aligns with MST, RBTS model, and SMT in that, adolescents who experience PRD may turn to substance use as a means of coping with the psychological toll of discrimination. In support of the SMT and RBTS model, Baiden and Tadeo (2019) also found that racial/ethnic minority adolescents who experienced persistent harassment in school showed more severe responses to symptoms of posttraumatic stress, depression, and frequently had thoughts about killing themselves, which in turn, made them more vulnerable to increased use of alcohol and prescription opioid misuse.

Specific to the RBTS model, Gibbons et al. (2010) found that racial discrimination was associated with increased substance use which included alcohol and cannabis use in both lifetime and last five years for adolescents, and this relationship was mediated by feelings of anger—a common response to trauma (Amstadter and Vernon, 2008). Furthermore, in alignment with RBTS model, it is also possible that racial/ethnic minority adolescents who experienced PRD may resort to the use of multiple substances to regulate the pain and trauma from such experiences. Researchers have long conceptualized PRD as an adverse life event with pain that sometimes lasts for years (Sanders-Phillips et al., 2009). Other scholars have described experiences of PRD as a social pain (Deska et al., 2020; Goosby et al., 2018); a term that refers to “the psychological distress caused by aversive and upsetting social experiences that damage social worth and interpersonal relationships (e.g., rejection, disrespect, embarrassment, loss of valued relationships) (Deska et al., 2020, p. 1). Importantly, Chen et al. (2008) made a distinction between social pain and physical pain, noting that “individuals can relive and re-experience social pain more easily and more intensely than physical pain” (p. 789). This coincides with RBTS model as racial discrimination is seen as events that can cause traumatic stress, rather than simply increasing stress (Carter, 2007).

Goldbach et al. (2014) found that LGBTQ adolescents had an increased risk of substance use, attributing this to increased stress based on their sexual orientation; our findings coincide in that LGBTQ adolescents had higher odds of polysubstance use as well as those who had experienced racial/ethnic discrimination. Therefore, it could be important to consider the intersection of social identities such as sexual orientation, race/ethnicity, and gender identity, and how multiple levels of discrimination may contribute to risk behaviors such as substance use. Experiencing PRD may lead to physiological changes in the brain, including hyperarousal, changes in neuroendocrine, and immune system function (see (Krieger, 2016; Sanders-Phillips et al., 2009) for comprehensive reviews) which may increase the likelihood of polysubstance use to self-medicate and regulate emotion (Chaplin et al., 2012).

The finding that adolescents who were victims of cyberbullying or had symptoms of depression were more likely to engage in polysubstance use is consistent with SMT (Khantzian, 1997). Applying the SMT to the present study, polysubstance use may be viewed as a response to the trauma arising from PRD or cyberbullying victimization. More importantly, PRD and cyberbullying victimization are related to symptoms of depression (Shi et al., 2022), and research shows that

adolescents with symptoms of depression turn to substance use to self-medicate (Baiden and Tadeo, 2019; Cela et al., 2023; Chaplin et al., 2012; Sanders-Phillips et al., 2014). Notably, when we did not control for cyberbullying victimization, symptoms of depression, and other psychosocial factors, we found that racial/ethnic minorities who were lesbian/gay or bisexual were more likely to engage in polysubstance use. One recent study found that exposure to online racism increased the risk of alcohol among BIPOC adults (Keum and Cano, 2021). Although certain online spaces and platforms may offer a community for LGBTQ individuals, they can also serve as an environment that fosters harassment, especially given the anonymity that goes with cyberbullying.

The finding regarding the association between experiencing emotional abuse during the COVID-19 pandemic and polysubstance use may suggest the potency of emotional abuse on health risk behaviors. Numerous studies (Kobulsky et al., 2016; Sartor et al., 2013; Snyder et al., 2015; Strathearn et al., 2020) and systematic reviews and meta-analyses (Fletcher, 2021; Friedman et al., 2011; Halpern et al., 2018; Norman et al., 2012) have documented the adverse effects of physical and sexual abuse on adolescent substance use behaviors. However, few studies have focused on emotional abuse notwithstanding the high prevalence of emotional abuse in child abuse and neglect cases (Glaser, 2002). The relatively little research on the impact of emotional abuse on adolescents' health risk behaviors could be due to challenges in conceptualizing and measuring emotional abuse, including how to substantiate it among survivors (Spinazzola et al., 2014; Watts et al., 2020). The findings of the present study and that of prior studies (Kim and Cicchetti, 2010; Spinazzola et al., 2014) underscore the high prevalence of emotional abuse and its adverse impact, which some scholars have described as equivalent to or worse than the impact of physical or sexual abuse (Watts et al., 2020).

#### 4.1. Study implications

Consistent with earlier reports, the findings of this study suggest a relatively high prevalence of PRD among racial/ethnic minority adolescents and that PRD was associated with a greater propensity for polysubstance use. Thus, the key findings of this study have some implications for multi-sectorial and multi-contextual prevention and intervention efforts. Our findings call for increased attention to the connection between racial discrimination and polysubstance use among racial and ethnic minority youth. We recommend that there is a need to address the issue of racial discrimination and polysubstance use within the school setting. Although substance use in adolescents is heterogeneous (ranging from cigarette smoking to illicit drugs), adverse effects of substance use during this critical development phase are often similar (Squeglia et al., 2009) and can include poor academic performance, cognitive issues, violence, injuries, and poor mental health (Basile et al., 2020). Therefore, early interventions that emphasize behavioral and psychological principles such as motivational interviewing techniques or on screening, prevention, or regulatory policies have been found to be effective across a range of adolescent substance use (Jensen et al., 2011; Toumbourou et al., 2007).

Collaborative interventions that focus on educating students, school staff and parents on the impact of racialized stress on racial/ethnic minority adolescents are warranted. Interventions should also support adolescents by connecting them to supportive services both within and outside of the school setting to assist them in coping with experiences of discrimination. Relatedly, our observations call for substance use prevention efforts in school settings. Youths exposed to discrimination should be screened for substance use and mental disorders and subsequently referred to mental health and behavioral specialists for early interventions. Also, programs that educate students on emotion regulation and how to mobilize coping strategies could be helpful in managing distress due to discrimination and may also prevent the use of substances to cope with discrimination.

#### 4.2. Limitations

There are some limitations to this study that are worth mentioning. First, the use of cross-sectional data limits our ability to make any causal inferences between PRD and polysubstance use. It is possible that some adolescents may have engaged in polysubstance use prior to them experiencing PRD or being exposed to psychosocial stressors. Also, polysubstance use was measured in reference to the past 30 days, PRD was measured in reference to lifetime, cyberbullying victimization and symptoms of depression were measured in reference to the past year, and food insecurity during COVID-19, physical abuse by a parent during COVID-19, emotional abuse by a parent during COVID-19, and social isolation during COVID-19 were measured in reference to the past 6 months. This difference in reference time points means that only association can be inferred. A study that employs longitudinal design is needed to establish the temporal association between PRD, cyberbullying victimization, symptoms of depression, and the onset and maintenance of polysubstance use. Also, longitudinal studies might help to empirically test how these health risk behaviors are interrelated and what interventions might be helpful in breaking the link between PRD and polysubstance use. Second, the use of secondary survey data limits our ability to examine other theoretically relevant factors associated with polysubstance use, such as a family history of substance, household income, peer influence, access to and perception of substances at home, and exposure to neighborhood violence. Similarly, we were unable to assess other forms of PRD that may be more prevalent among out-of-school adolescents such as mass incarceration and hyperpolicing. Also, we were unable to examine the unintentional use of substances. These are all important avenues for future research considerations. Third, although nationally representative, data for this study is based on self-reports and may be subject to recall bias. Fourth, examining PRD using a single item has the potential to affect the prevalence estimate of PRD reported in this study. Fifth, a critical limitation of the current study is that the findings may not be generalizable to out-of-school adolescents in the U.S., including truants and home-schooled adolescents. Finally, notwithstanding the fact that the 2021 ABES is nationally representative, like the national YRBS, questions remain about the racial/ethnic representativeness of the results of the 2021 ABES.

#### 4.3. Conclusion

In conclusion, drawing on a large nationally representative sample of racial/ethnic minority adolescents, the findings of the present study demonstrate an association between PRD and polysubstance use that is independent of victims of cyberbullying, symptoms of depression, and demographic factors. Understanding the association between PRD and polysubstance use could contribute to the early identification of racial/ethnic adolescents who are likely to engage in polysubstance use and identify targets for intervention.

#### CRediT authorship contribution statement

All authors contributed significantly to the interpretation of the findings, the writing of the manuscript, and approval of the final version. **Philip Baiden:** Conceptualization, Data curation, Formal analysis, Writing – review & editing. **Henry K. Onyeaka:** Conceptualization, Visualization, Writing – original draft. **Kammarauche Aneni:** Visualization, Writing – original draft. **Bethany Wood:** Writing – original draft. **Catherine A. LaBrenz:** Writing – original draft. **Chioma Muoghalu:** Writing – original draft. **JaNiene E. Peoples:** Writing – original draft. **Hannah S. Szlyk:** Writing – original draft. **Edinam C. Gobodzo:** Writing – review & editing. **John F. Baiden:** Writing – review & editing. **Yvonne Adeku:** Writing – review & editing. **Vera E. Mets:** Writing – review & editing. **Fawn A. Brown:** Writing – review & editing. **Patricia Cavazos-Rehg:** Writing – review & editing.

#### Declaration of Competing Interest

The authors declare that they have no conflicts of interests with respect to the authorship and/or the publication of this paper.

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