



Investigating the co-occurrence of marijuana use and prescription opioid misuse with multiple suicide attempts among adolescents with a history of suicidal ideation

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ABSTRACT

This study investigated the co-occurrent association of marijuana use and prescription opioid misuse with multiple suicide attempts among adolescents with a history of suicidal ideation. Data came from the 2019 Youth Risk Behavior Survey. The sample was comprised of adolescents ages 14–18 who reported suicidal ideation during the past year ($n = 2,562$). Multinomial logistic regression was used to examine the co-occurring association of marijuana use and prescription opioid misuse with multiple suicide attempts. Of the 2,562 adolescents who experienced suicidal ideation, 19.2 % also attempted suicide multiple times during the past year and 19.0 % reported ever using marijuana and misusing prescription opioids, 8.8 % misused prescription opioids only, and 33.3 % used marijuana only. In the multivariate model, for adolescents who used marijuana and misused prescription opioid, the risk of attempting suicide once was 1.77 times higher ($RRR = 1.77$, 95 % CI = 1.22–2.59) and the risk of multiple suicide attempts was 3.23 times higher ($RRR = 3.23$, 95 % CI = 1.95–5.33) when compared to adolescents who had never used marijuana nor misused prescription opioid. The risk of multiple suicide attempts was greater for bisexual and racial/ethnic minority adolescents and adolescents who felt sad or hopeless. Interventions that prevent prescription opioid misuse among adolescents may be effective in mitigating suicide attempts.

1. Introduction

Globally, suicide has been identified as one of the leading causes of death, responsible for 8.5 % of all-cause mortality among adolescents and young adults (Cha et al., 2018). In the United States (U.S.), suicide ranks as the second leading cause of death among children and adolescents aged 10–24 years (Centers for Disease Control and Prevention (CDC), 2022). Data from the CDC indicates that although the rate of

suicide among adolescents in the U.S. peaked in 2018 before declining in 2019 and 2020 (Ehlman, 2022), suicidal thoughts and behaviors (i.e., suicidal ideation, suicide planning, and suicide attempts) (Nock et al., 2009) among adolescents remain a significant public health concern (Bridge et al., 2018; Hill et al., 2021; Lindsey et al., 2019). Suicidal ideation refers to the presence of thoughts and ideas of engaging in a behavior with the purpose of killing oneself. Suicidal ideation is different from the persistent preoccupation of one's mind with thoughts

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of death or dying. A suicide plan refers to taking the extra step of formulating a plan of action through which one expects to carry out the attempt (Nock and Favazza, 2009). Suicide attempt refers to a non-fatal directed potentially injurious behavior with the intent to die. A suicide attempt may or may not result in injury (Crosby et al., 2011).

Ivey-Stephenson et al. (2020) examined data from the 2019 Youth Risk Behavior Survey (YRBS) and found that 18.8 % of adolescents in grades 9 through 12 seriously considered attempting suicide in the past year, 15.7 % made a suicide plan, and 8.9 % attempted suicide. One of the strongest predictors of suicide attempts and death by suicide is suicidal ideation (Klonsky et al., 2018; Nock et al., 2018). For instance, Jacobson et al. (2013) examined reasons for attempting suicide among a community sample of 99 adolescents from New York State and found that more than half of the adolescents reporting thinking about suicide before they made their suicide attempt. They also found that those who had premeditations about suicide were 15 times more likely to endorse wanting to die as the reason for attempting suicide than those who had not been thinking about suicide before the attempt. Franklin et al. (2017) conducted a meta-analysis that included 365 studies to identify risk factors associated with suicidal thoughts and behaviors and found that prior non-suicidal self-injury and suicidal ideation were the strongest predictors of suicide attempts, outperforming prior suicide attempts.

That notwithstanding, not all individuals who experience suicidal ideation go on to attempt suicide (Klonsky et al., 2018; Klonsky and May 2014). Mortier et al. (2018) examined data from 13,984 first-year students (mean age = 19.3, SD = 0.59) across 19 colleges in 8 countries (Australia, Belgium, Germany, Mexico, Northern Ireland, South Africa, Spain, and the U.S.) and found that only 24.4 % of lifetime ideators transitioned to an attempt during the past 12 months. Stewart et al. (2019) in their study on life stressors and suicidal thoughts and behaviors noted that most of the correlates and predictors of suicidal thoughts and behaviors among adolescents were strongly associated with suicidal ideation, and only weakly associated with suicide attempts. Another meta-analysis on what distinguishes suicide ideators from suicide attempters found that feelings of hopelessness and symptoms of depression were strongly associated with suicidal ideation, but were poorly associated with suicide attempts among those with a history of suicidal ideation (May and Klonsky, 2016). As a result, Klonsky et al. (2021) bemoaned the fact that “currently, not even a single strong predictor of suicide attempts among ideators has been identified” (439).

Although firearm remains one of the most common methods of death by suicide in the U.S. (Kivisto et al., 2021; Osborne et al., 2021; Stanley et al., 2017), intentional overdose and prescription opioid misuse have been found to account for a greater number of suicide attempts and death by suicide among adolescents each year (Bortz, 2019; Caupp et al., 2018; Gaither et al., 2016; Roehler et al., 2021). For instance, Gaither et al. (2018) found that the mortality rate attributed to opioid misuse among children and adolescents in the U.S. increased from 0.22 in 1999 to 0.81 per 100,000 lives in 2016, representing an increase of 268.2 %, with the highest annual rates occurring among adolescents aged 15 to 19 years. The recent unprecedented increase in opioid-related overdose deaths among adolescents presents a major public health concern about the harmful effects of prescription opioid misuse on suicidal behaviors (Baiden et al., 2019a). One study found that most drug-related hospital emergency department (ER) visits by adolescents relating to suicide attempts involve on average 1.8 drugs (Substance Abuse and Mental Health Services Administration, 2013).

Moreover, studies have described the effects of marijuana overdose among adolescents (Hughes et al., 2023; Richards et al., 2017; Thomas et al., 2021). Other studies show that marijuana is one of the most common illicit substances among adolescents (Johnston et al., 2022; Substance Abuse and Mental Health Services Administration, 2019) and has the potential to increase the risk of suicide attempts among adolescents (Esposito-Smythers et al., 2011; Kahn and Wilcox, 2022; Sellers et al., 2019). Adolescents with high levels of distress are more likely to

report experiencing suicidal ideation (Hong et al., 2023) or attempt suicide (Lee et al., 2022), and are also more likely to use marijuana to cope with distress (Bujarski et al., 2012). Respiratory depression, altered memory, increased heartbeat, drowsiness, ataxia, and hypotonia are some of the most frequently reported signs and symptoms of marijuana use (Kaczor et al., 2021; Thomas and Mazor, 2017).

Previous studies have examined the associations between marijuana use and suicide attempts (Esposito-Smythers et al., 2011; Gobbi et al., 2019; Kahn and Wilcox, 2022; Schmidt et al., 2020; Sellers et al., 2019) or prescription-opioid-misuse and suicide attempts (Baiden et al., 2019a; Chan et al., 2022; Sampasa-Kanyinga et al., 2021; Zullig et al., 2015) among adolescents separately. Sellers et al. (2019) examined effects of alcohol use and marijuana use on suicidal ideation and attempts among a sample of 50 adolescents (mean age, 15.8) from an inpatient psychiatric hospital in the northeastern U.S. and found that controlling for all other variables, the odds of endorsing suicidal ideation increased by 48 % and the odds of attempting suicide increased by 94 % on a day when they used marijuana. Kahn and Wilcox (2022) also examined pooled data from the 2011–2017 YRBS and found that marijuana use was more strongly associated with suicide attempts than suicidal ideation. With respect to the association between prescription opioid misuse and suicide attempt, Zullig et al. (2015) examined the link between nonmedical use of prescription opioids and suicidality among a sample of 4148 adolescents in grades 9–12 enrolled in five public high schools in the U.S. and found that nonmedical use of prescription opioids was associated with 1.61 times higher odds of suicide attempts among males and 2.06 times higher odds of suicide attempts among females. Furthermore, Sampasa-Kanyinga et al. (2021) examined data on 5582 adolescents (mean age: 15.3 years) from Ontario, Canada and found that controlling for demographic and other correlates of suicidal thoughts and behaviors, the odds of making suicide attempts during the past year were threefold higher among adolescents who had ever misused prescription opioid when compared to their counterparts who have never misused prescription opioid.

However, there is a dearth of research examining the co-occurrence of marijuana use and prescription-opioid-misuse either concurrently or sequentially with suicide attempts among adolescents. Examining the co-occurrence association of marijuana use and prescription-opioid-misuse with suicide attempts among adolescents with a history of suicidal ideation is important for several reasons. First, marijuana is the most prevalent illicit substance among adolescents in the U.S. (Hammond et al., 2020; Johnston et al., 2022; Substance Abuse and Mental Health Services Administration, 2019). Second, available research has shown that the use of marijuana often co-occurs with other substances including prescription opioids which can have additive effects on adolescent mental health and suicidal behaviors (McCabe et al., 2012; Olsson et al., 2018; Sellers et al., 2019). Indeed, analyzing data from the Monitoring the Future study, McCabe et al. (2015) found that among adolescents who misused prescription opioids in the past year, 51 % co-ingested prescription opioids with marijuana. Third, recent advances in developmental neurobiology have enhanced our understanding that the prefrontal cortex of the adolescent brain is not fully developed until about age 25 (Giedd, 2015; Spear, 2013). As a result, the co-occurrence of marijuana use with prescription-opioid-misuse could have long-term adverse consequences on brain functioning and overall mental well-being (Cancelliere et al., 2018; deShazo et al., 2019). Fourth, understanding the co-occurrence of marijuana use and prescription opioid misuse with suicide attempts among adolescents with a history of suicidal ideation could help inform future suicide prevention strategies among adolescents.

Moreover, few studies on suicide attempts have focused on differentiating multiple suicide attempters from other suicidal adolescents. The existing few studies have found that younger in age, female sex, suicidal ideation, family suicide history, symptoms of depression and anxiety, loneliness, hopelessness, and substance use predicted multiple suicide attempts among adolescents (Guo et al., 2019; Merchant et al.,

2009; Pengpid and Peltzer, 2021; Smith et al., 2021). Merchant et al. (2009) found that feelings of hopelessness were more prevalent among adolescent multiple attempters than first-time attempters. Smith et al. (2021) examined correlates of multiple suicide attempts among adolescents from 61 countries in Africa, Asia, and the Americas and found that loneliness, substance use, and sleep problems were the strongest correlates of multiple suicide attempts. Adolescents suffering from mental health problems who feel hopeless may self-mediate themselves with marijuana, prescription opioids, or illicit substances (Baiden and Tadeo, 2019). Moreover, consumption of substance use may increase the risk for multiple suicide attempts as they have been found to be associated with memory and judgment impairment (Mizoguchi and Yamada, 2019; Volkow et al., 2014). Therefore, it is important to understand factors associated with multiple suicide attempts among adolescents with a history of suicidal ideation and develop suicide prevention strategies focusing on this vulnerable population.

1.1. Current study

Notwithstanding the fact that single substance use among adolescents is less common than polysubstance use (Goodwin et al., 2022; McCabe et al., 2015; Tomczyk et al., 2016), previous research that have examined the association between marijuana use and suicide attempts (Esposito-Smythers et al., 2011; Gobbi et al., 2019; Kahn and Wilcox, 2022; Schmidt et al., 2020; Sellers et al., 2019) or prescription-opioid-misuse and suicide attempts (Baiden et al., 2019a; Chan et al., 2022; Sampasa-Kanyinga et al., 2021; Zullig et al., 2015) among adolescents have done so separately. Drawing on a large nationally representative sample of adolescents, this study seeks to add to the literature on substance use and suicide attempts by examining the co-occurring association of marijuana use and prescription-opioid-misuse with multiple suicide attempts among adolescents with a history of suicidal ideation. Based on the extant literature, we hypothesized that the co-occurrence of marijuana use and prescription-opioid-misuse would be associated with multiple suicide attempts, net the effects of demographic characteristics and feelings of sadness or hopelessness.

2. Methods

2.1. Data source and sample

Data were obtained from the 2019 Youth Risk Behavior Survey (YRBS). The YRBS is a cross-sectional school-based national survey conducted by the Centers for Disease Control and Prevention (CDC) every two years to examine health-risk behaviors that contribute to the leading causes of death and disability among adolescents in the U.S. The objectives, methodology, and sampling procedure for the YRBS have been described elsewhere (Brener et al., 2013; Kann et al., 2018; Underwood et al., 2020) and in other publications by the authors (Baiden et al., 2020, 2021, 2022, 2023). The YRBS was approved by the CDC's Institutional Review Board (IRB), and the de-identified data are publicly available. The initial sample size for the 2019 national YRBS was 13,677 adolescents aged 12–18 years. Adolescents aged 12 and 13 were excluded from the analysis due to small sample size (unweighted $n = 159$). Of the 13,677 adolescents, 2562 were between the ages of 14 and 18 years and reported experiencing suicidal ideation during the past year and constituted the analytic sample for this study.

2.2. Variables

2.2.1. Outcome variable

The outcome variable investigated in this study was multiple suicide attempts and was measured based on response to the question, "During the past 12 months, how many times did you actually attempt suicide?" with the following response options "0 times," "1 time," "2 or 3 times,"

"4 or 5 times," and "6 or more times." Adolescents who attempted suicide multiple times during the past 12 months were coded as 2, adolescents who attempted suicide once during the past 12 months were coded as 1, whereas adolescents who did not attempt suicide during the past 12 months were coded as 0.

2.2.2. Explanatory variable

The main explanatory variable examined in this study was marijuana use and prescription-opioid-misuse. Marijuana use was measured based on responses to the question, "During your life, how many times have you used marijuana?" Adolescents who used marijuana one or more times during their lifetime were recoded as 1, otherwise, they were recoded as 0. Prescription-opioid-misuse was measured as a binary variable based on responses to the question, "During your life, how many times have you taken prescription pain medicine without a doctor's prescription or differently than how a doctor told you to use it? (Count drugs such as Codeine, Vicodin, OxyContin, Hydrocodone, and Percocet)" Adolescents who took prescription pain medicine without a doctor's prescription at least once were recoded as 1, otherwise, they were coded as 0. Based on these two variables, a nominal variable with four categories was created: "0 = never used marijuana and never misused prescription opioid," "1 = marijuana use only," "2 = prescription-opioid-misuse only," and "3 = marijuana use and prescription-opioid-misuse."

2.2.3. Demographic characteristics and covariates

Age, sex, sexual identity, and race/ethnicity were included as demographic characteristics, and feeling sad or hopeless as a covariate. Age was measured in years, whereas sex was coded as "0 = male" versus "1 = female." Sexual identity was measured as a nominal variable into "Straight," "Gay/lesbian," "Bisexual," and "Not sure/Questioning." Race/ethnicity was coded as a nominal variable into the following categories: "non-Hispanic White," "non-Hispanic Black," "Hispanic," and "Other." Lastly, feeling sad or hopeless was measured as a binary variable based on the question, "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?" Adolescents who answered "yes" were coded as 1, whereas those who answered "no" were coded as 0.

2.3. Data analyses

Data were analyzed using descriptive and multivariable analytic techniques. First, missing data analyses were conducted to assess whether adolescents with observed data on one variable were significantly different from adolescents with missing data on another variable. The percentage of missing data ranged from less than 1 % (feelings of sadness or hopelessness) to 20 % (multiple suicide attempt). We found that data were missing completely at random (MCAR), that is, the probability of missingness on one variable is not dependent on any observed data (Van Ginkel et al., 2020). Given that data were MCAR, Multiple Imputation using Chained Equations (MICE) was chosen as the most appropriate technique to impute complete data (Van Buuren, 2018). Multiple imputation is a simulation-based approach for analyzing missing data that replaces missing values with multiple sets of simulated values to complete the dataset and adjust for missing data uncertainty (Rubin, 1996). A similar approach has been used by the authors in handling missing data in previous studies (Baiden et al., 2020, 2021, 2022, 2023). The results indicates that 39.1 % of the total sampling variance is attributable to missing data.

The general distribution of all the variables included in the analysis was then examined using percentages. First, we conducted ordinal logistic regression to examine the association between the co-occurrence of marijuana use and prescription-opioid-misuse with multiple suicide attempts given that our outcome variable (i.e., multiple suicide attempts) was measured as an ordinal variable into categories of "no

attempt,” “one attempt,” and “multiple attempts.” However, we found that the proportional odds assumption was violated when we conducted ordinal logistic regression. Therefore, we elected to conduct multinomial logistic regression. Relative risk ratios (RRRs) were reported together with their 95 % Confidence Intervals (CI). Variables were considered significant if the *p*-value was less than 0.05, or if the 95 % CI did not contain 1.00. Stata’s “svyset” command was used to account for the weighting and complexity of the cluster sampling design employed by the YRBS. All analyses were performed using STATA 17 MP (Stata Corp., College Station, Texas, USA).

3. Results

3.1. Sample characteristics

Table 1 shows the general distribution of the study variables. Of the 2562 adolescents who experienced in suicidal ideation during the past year, about one in five (19.2 %) also made multiple suicide attempts during the past year, 21.9 % attempted suicide once during the past year, and 58.9 % did not attempt suicide during the past year. About one in five (19.0 %) adolescents with a history of suicidal ideation reported ever using marijuana and misusing prescription opioids, 8.8 % misused prescription opioids only, 33.3 % used marijuana only, and 38.9 % have never used marijuana or misused prescription opioids. About two in three (65.5 %) adolescents with a history of suicidal ideation were females. About five out of six adolescents with a history of suicidal ideation (83.6 %) reported feeling sad or hopeless almost every day for two weeks or more in a row that they stopped doing some usual activities.

Table 1
Sample characteristics (N = 2562).

| Variables | Frequency (weighted %) |
|--|------------------------|
| Outcome variable | |
| Suicide attempt | |
| None | 1509 (58.9) |
| One attempt | 562 (21.9) |
| Multiple attempts | 491 (19.2) |
| Main explanatory variable | |
| Marijuana use and prescription opioid misuse | |
| Neither marijuana use nor prescription opioid misuse | 997 (38.9) |
| Marijuana use only | 854 (33.3) |
| Prescription opioid misuse only | 225 (8.8) |
| Both marijuana use and prescription opioid misuse | 486 (19.0) |
| Control variables | |
| Age | |
| 14 years | 325 (12.7) |
| 15 years | 654 (25.5) |
| 16 years | 713 (27.8) |
| 17 years | 584 (22.8) |
| 18 years | 286 (11.2) |
| Sex | |
| Male | 884 (34.5) |
| Female | 1678 (65.5) |
| Sexual identity | |
| Straight | 1676 (65.4) |
| Gay/lesbian | 149 (5.8) |
| Bisexual | 564 (22.0) |
| Other/questioning | 173 (6.8) |
| Race/ethnicity | |
| Non-Hispanic White | 1290 (50.4) |
| Non-Hispanic Black | 357 (13.9) |
| Hispanic | 551 (21.5) |
| Other | 364 (14.2) |
| Felt sad or hopeless | |
| No | 421 (16.4) |
| Yes | 2141 (83.6) |

3.2. The co-occurrence association of marijuana use and prescription-opioid-misuse with multiple suicide attempts

Table 2 shows the multivariable multinomial logistic regression results examining the co-occurring association of marijuana use and prescription-opioid-misuse with multiple suicide attempts among adolescents with a history of suicidal ideation while controlling for the effects of demographic characteristics and feelings of sadness or hopelessness. The global *F* statistic of the model was significant indicating that the overall model was fit $F(24, 48.5) = 8.02, p < .001$. Controlling for the effects of demographic characteristics and feeling sad or hopeless, for adolescents who use marijuana and misuse prescription opioid, the risk of attempting suicide once was 1.77 times higher ($RRR = 1.77, p = .004, 95\% \text{ CI} = 1.22\text{--}2.59$) and the risk of multiple suicide attempts was 3.23 times higher ($RRR = 3.23, p < .001, 95\% \text{ CI} = 1.95\text{--}5.33$) when compared to adolescents who have never used marijuana nor misuse prescription opioid. Use of marijuana only was not associated with single or multiple suicide attempts. However, misuse of prescription opioid only was significantly associated with multiple suicide attempts ($RRR = 2.48, p = .005, 95\% \text{ CI} = 1.34\text{--}4.59$) but not with single suicide attempt.

Age and sex were not significantly associated with multiple suicide attempts. The risk of multiple suicide attempts was higher among adolescents who self-identified as bisexual when compared to their counterparts who self-identified as straight ($RRR = 1.64, p = .011, 95\% \text{ CI} = 1.13\text{--}2.38$). Controlling for the effects of other factors, the risk of multiple suicide attempts was 2.64 times higher for adolescents who self-identified as non-Hispanic Black ($RRR = 2.64, p < .001, 95\% \text{ CI} =$

Table 2

Co-occurring association of marijuana use and prescription opioid misuse with multiple suicide attempts among adolescents with a history of suicidal ideation (N = 2562).

| Variables | One attempt | | Multiple attempts | |
|--|---------------------|-----------------|---------------------|-----------------|
| | RRR (95 % C.I.) | <i>p</i> -value | RRR (95 % C.I.) | <i>p</i> -value |
| Marijuana use and prescription opioid misuse (Neither) | | | | |
| Marijuana use only | 1.37 (0.96–1.94) | .080 | 1.14 (0.70–1.84) | .594 |
| Prescription opioid misuse only | 1.57 (0.89–2.78) | .118 | 2.48 (1.34–4.59) | .005 |
| Both marijuana use and prescription opioid misuse | 1.77 (1.22–2.59) | .004 | 3.23 (1.95–5.33) | <0.001 |
| Age in years | 0.90 (0.80–1.01) | .085 | 0.95 (0.84–1.08) | .441 |
| Sex (Male) | | | | |
| Female | 0.92 (0.67–1.28) | .627 | 0.87 (0.60–1.26) | .451 |
| Sexual identity (Straight) | | | | |
| Gay/lesbian | 0.77 (0.37–1.61) | .479 | 1.47 (0.78–2.78) | .229 |
| Bisexual | 1.14 (0.78–1.66) | .489 | 1.64 (1.13–2.38) | .011 |
| Other/questioning | 0.91 (0.48–1.74) | .776 | 1.24 (0.65–2.37) | .504 |
| Race/ethnicity (Non-Hispanic White) | | | | |
| Non-Hispanic Black | 1.13 (0.68–1.89) | .625 | 2.64 (1.67–4.18) | <0.001 |
| Hispanic | 1.06 (0.74–1.53) | .738 | 1.63 (1.12–2.38) | .012 |
| Other | 0.97 (0.67–1.39) | .850 | 1.92 (1.22–3.02) | .006 |
| Felt sad or hopeless (No) | | | | |
| Yes | 2.52 (1.57–4.03) | <0.001 | 1.96 (1.15–3.34) | .014 |

$F(24, 48.5)=8.02, p < .001$.

NB: Reference category is indicated in parenthesis.

1.67–4.18), 1.63 times higher for Hispanic ($RRR = 1.63, p = .012, 95\% \text{ CI} = 1.12\text{--}2.38$), and 1.92 times higher for adolescents who self-identify as “Other” ($RRR = 1.92, p = .006, 95\% \text{ CI} = 1.15\text{--}3.02$) when compared to adolescents who self-identified as non-Hispanic Whites. Race/ethnicity was not significantly associated with attempting suicide once. Lastly, for adolescents who felt sad or hopeless, the risk of attempting suicide once was 2.52 times higher ($RRR = 2.52, p < .001, 95\% \text{ CI} = 1.57\text{--}4.03$), and the risk of multiple suicide attempts was 1.96 times higher ($RRR = 1.96, p = .014, 95\% \text{ CI} = 1.15\text{--}3.34$) when compared to adolescents who do not feel sad or hopeless.

4. Discussion

Drawing on a large nationally representative sample of adolescents from the U.S., this is one of the first studies to investigate the co-occurring association of marijuana use and prescription-opioid-misuse with multiple suicide attempts among adolescents with a history of suicidal ideation. We found that among adolescents with a history of suicidal ideation, about one in five made multiple suicide attempts, 21.9% attempted suicide once during the past 12 months, and about one in five reported ever using marijuana and misusing prescription opioid. Given the increasing rates of suicide attempts among adolescents in the U.S. (CDC, 2021; Lindsey et al., 2019), and the dearth of research on the transition from suicidal ideation to suicide attempts (Klonsky et al., 2018), it is important to understand factors associated with multiple suicide attempts among adolescents with a history of suicidal ideation and develop suicide prevention strategies that focus on this vulnerable population. It is important to note that the 2019 YRBS was conducted in the spring of 2019 before the official start of the COVID-19 pandemic. However, it is important to bear this in mind when interpreting the findings of the present study.

Controlling for the effects of demographic characteristics and feeling sad or hopeless, adolescents with suicidal ideation who only misused prescription opioids, and those who used marijuana and misused prescription opioids, had higher odds of making multiple suicide attempts. The findings of this study extend past research that have found an association between marijuana use separately (Esposito-Smythers et al., 2011; Kahn and Wilcox, 2022; Sellers et al., 2019) and prescription-opioid-misuse (Baiden et al., 2019a; Zullig et al., 2015) with suicide attempts among adolescents. Some reasons have been offered that may help explain the association between marijuana use and prescription-opioid-misuse with suicide attempt. First, Case and Deaton (2017) posited that rising incidents of opioid use in the U.S. could be attributed to cumulative disadvantage that makes some individuals use opioids to cope with feelings of hopelessness. Opioid use then exacerbates the onset and maintenance of depressive symptoms which can then lead to suicide attempts and overdose death (Case and Deaton, 2017). Second, marijuana use and misuse of prescription opioid could adversely impact social relations (Oviedo-Joekes et al., 2011) leading to alienation and rejection from family, friends, and other valued social groups. Such feelings of alienation and rejection with no one to turn to particularly in times of crises may make some adolescents feel that they are a burden unto others thereby triggering a suicide attempt.

Notably, findings from our study did not find a significant association between marijuana use by itself and suicide attempts among adolescents with a history of suicidal ideation. However, the co-occurrence of marijuana use and prescription opioid misuse increased the odds of suicide attempt over three-fold. This finding builds upon research that has found co-occurring marijuana use and other illicit substance use to have negative effects on adolescent mental health, including suicidal behaviors (McCabe et al., 2012; Sellers et al., 2019). This is also concerning as one recent study found that over half of adolescents who misused prescription opioids in the past year had co-ingested opioids with marijuana (McCabe et al., 2015), which could further exacerbate mental health issues. The finding that adolescents who self-identified as

non-Hispanic Black, Hispanics, and “Other” were more likely to report making multiple suicide attempts extends past studies (Baiden et al., 2019b; Ivey-Stephenson et al., 2020). Whereas suicidal ideation is more prevalent among non-Hispanic White adolescents than non-Hispanic Black adolescents (Kann et al., 2018; Lorenzo-Luaces and Phillips, 2014), this pattern is reversed when looking at suicide attempts with non-Hispanic Black and Native American adolescents having the highest risk of suicide attempts (Bridge et al., 2018; Lindsey et al., 2019). Some scholars have attributed this racial paradox in suicidal behaviors to perceived racial discrimination (Walker et al., 2014). Exposure to everyday racial discrimination, neighborhood and community violence are associated with marijuana use (Ahuja et al., 2022; Steele, 2016) and opioid misuse among Black adolescents (Nicholson et al., 2022), which may contribute to suicide attempts as found in this study. Additionally, the finding that bisexual adolescents had higher odds of multiple suicide attempts compared to their straight counterparts corroborate and extend previous literature, which has attributed this disparity to forms of marginalization including bi-erasure or bi-invisibility (Salway et al., 2019).

4.1. Implications

Findings from this study highlight the importance of screening for multiple types of substance misuse and implementing preventive programming for adolescents. Furthermore, it is important to integrate mental health and substance use prevention and intervention programming for adolescents. This could include coordinated, interdisciplinary community-level systems (Beardslee et al., 2011) such as partnerships between school systems, mental health providers, and other healthcare providers. In parallel, given that the YRBS is administered at schools, it could also be beneficial to have school-based screening, and then target prevention and early intervention for adolescents who report mental health issues and/or substance use. Indeed, a prior review of mental health interventions for youth found an increased uptick in service utilization when services were provided within the school setting (Dunne et al., 2017). Finally, our findings have implications for future research and policy as marijuana continues to be legalized. While marijuana use itself was not associated with suicide attempt among adolescents in our sample, its co-occurrence with prescription opioid misuse did increase the likelihood of multiple suicide attempts. Therefore, as legalization of marijuana continues to be rolled out in different counties and states, it is important to continue to examine the impact of changing policy on its use and co-use with other substances. This is important among adolescents and young adults as the brain continues to develop and be particularly susceptible through age 25 (Giedd, 2015; Spear, 2013).

4.2. Limitations

This study has some limitations. First, this is a cross-sectional study hence, no casual inferences could be made. Only association can be inferred. It is possible that some adolescents may have attempted suicide prior to using marijuana or misusing prescription opioids. Also, we were unable to ascertain the temporal sequencing between use of marijuana and prescription opioid misuse. An adolescent could be using marijuana daily, and misused prescription once two years ago, then attempted suicide in the past year while completely sober. In addition, there were no measures of lifetime suicidal ideation or suicide attempts to enable us to ascertain whether the suicide attempt within the past year occurred after a history of lifetime suicidal ideation. Longitudinal studies are needed to address these limitations and establish the temporal order between the co-occurrence of marijuana use and prescription-opioid-misuse with multiple suicide attempts. Second, the use of a single item in measuring suicidal ideation and suicide attempts is subject to misclassification since adolescents have to draw on their own definition of what constitutes ideation or attempt (Hom et al., 2016). Third, the use

of secondary data limits our ability to examine other theoretically relevant factors that might be associated with multiple suicide attempts (e.g., history of family suicide attempts and self-harm). Moreover, the 2019 YBRS made no specific mention of the type of opioid that was misused. Future studies should examine the misuse of opiates (i.e., Codeine, Vicodin, OxyContin, Hydrocodone, Percocet) that are commonly linked to overdose deaths as many adolescents use these drugs to cope with mental and emotional problems (Baiden et al., 2019a).

5. Conclusion

This study found that certain groups of adolescents are at elevated risk of multiple suicide attempts and the co-occurring use of marijuana and prescription-opioid-misuse among adolescents is associated with multiple suicide attempts among adolescents with a history of suicidal ideation. Policymakers and clinicians should be aware that as more adolescents are able to access marijuana due to its legalization, the likelihood of suicide attempts might increase among adolescents who also misuse prescription opioids. Interventions that prevent prescription-opioid-misuse among adolescents may be especially effective in mitigating suicide attempts.

Disclosure

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