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Association Between Prescription Opioid Misuse and Risky Health Behaviors Among High School Students in the U.S.: A Cross-Sectional Study 2017–2021

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Abstract:

Objective: The objective of this study was to investigate the association between prescription opioid misuse and 18 risky health behaviors among high school students in the United States.

Material and Methods: This study utilized the most recent 2017, 2019, and 2021 Youth Risk Behavior Surveillance System (YRBSS) nationally representative data of n=44,329 high school students (Grades 9–12). We created 2 groups based on participants who reported lifetime prescription opioid misuse and those who did not. Bivariate analysis included Pearson's chi-squared tests to compare the baseline differences between the 2 groups. For multivariate analysis, a survey-weighted logistic regression model, which adjusted for socio-demographic factors, was used to explore the association between prescription opioid misuse and selected risky health behaviors.

Results: The adjusted multivariate model showed a significant association between prescription opioid misuse and risky health behaviors related to driving, suicidal ideation, and illicit substance use. Significant associations were found between prescription opioid misuse and suicidal ideation, which included feelings of hopelessness and seriously considering suicide. However, no significant relationship was observed between making plans for suicide and attempting suicide.

Conclusion: The findings highlight that high school students with a history of prescription opioid misuse engaged in other adverse health behaviors. Public health policymakers should consider these findings in order to take a multifaceted approach by working with teachers, counselors, and clinicians to create programs to assist the high school students who are part of this high-risk population.

Keywords: adolescent health, behavioral risk factors, opioid-related disorders, prescription drug misuse, suicide

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Introduction

From 2000–2020, opioid-related overdoses cost more than 500,000 lives in the United States[1–2]. As of 2023, the American Medical Association has referred to the ongoing drug-related overdose epidemic as "deadlier than ever" in the country[3]. In 2022, a total of 107,941 drug overdose deaths occurred nationally, with synthetic opioids such as fentanyl involved in approximately 73,838 of those deaths, representing a 4.1% increase from 2021[4]. More specifically, the opioid epidemic has resulted in more deaths than previous drug epidemics and is unique due to the role played by legal prescription drugs[5].

Several studies were done exploring the broader implications of the opioid epidemic, including policy failures, healthcare system factors, and social determinants[5–7]. However, few have focused on prescription opioid misuse among high school students. Notably, recent studies found associations between opioid misuse and a variety of risky health behaviors among adolescents[8–9]. This is important, as most adults who have a substance use disorder started during their early years, progressing into addiction[10–11]. Adolescents are particularly vulnerable to substance misuse, and initiation of substance use, including opioid use, during this developmental stage has been associated with an increased risk of substance use disorder in adulthood[11–12].

Previous studies have shown that youth who engaged in misuse of prescription opioids were also more susceptible to engaging in risky behaviors related to risky sexual behavior, suicidal behavior, risky driving, and substance use disorder[8–9,12–14]. The Centers for Disease Control and Prevention (CDC) identifies prescription opioid misuse as both a serious health outcome and a contributing risk factor for other adverse behaviors among adolescents[15]. The CDC has called this high-risk substance abuse, which means these substances used by adolescents pose a high risk of adverse outcomes[11]. Additionally, it is important to understand these associations for healthcare policymakers to intervene among high-risk youth. Therefore, understanding these underlying associations will be fundamental to informing US healthcare policymakers as attempts are made to control the ongoing opioid epidemic. Many of these risky behaviors can be intervened in to prevent adverse health outcomes[9].

The primary objective of this study was to investigate the association between prescription opioid misuse and selected risky health behaviors among high school students in the United States. We explored this association using 18 selected risk factors, which included driving-related behaviors, suicide-related behaviors, substance use, and adverse health behaviors identified in previous epidemiological studies as significant factors. These factors were interconnected; therefore, accounting for them in the study design was important to explore independent associations. Additionally, among the a priori selected risk behaviors, we included other illicit substance use behaviors as well. This was another pivotal point to explore, as recent studies were sounding the alarm on the beginning of a new wave of the opioid epidemic centered around polysubstance use[16–17]. Therefore, we focused on further exploring associations between opioid misuse and other illicit substance use. A secondary issue this study delved into was an attempt to understand the associations between prescription opioid misuse and suicide-related responses from the participants. This came at a time when teenage suicide rates in the United States were at an all-time high, with a 62% increase between the years 2007 to 2021. Moreover, prior studies have not examined these associations using post-pandemic data. Therefore, it was crucial to focus on disseminating the underlying associations to get a comprehensive picture of risky adolescent health-related behaviors.

Material and Methods

This study utilized data from the Youth Risk Behavior Surveillance System (YRBSS), a nationally recognized public health surveillance system by the CDC. As a school-

based survey system, YRBSS used a 3-stage, cluster sample design survey of US students in grades 9 to 12[19]. The YRBSS is a comprehensive dataset used to monitor and address issues related to adolescent and school health, which makes it suitable to examine associations with prescription opioid misuse. This cross-sectional study covered all 50 states in the U.S. and the District of Columbia. The YRBSS data are released every 2 years, and for this study we utilized the most recent cycles covering 2017, 2019, and 2021[19-21], containing 44,329 participants. The analysis only included participants with complete cases for all the variables. The study accounted for the complex survey design of the YRBSS and applied survey weights to all the statistical models. This study was exempt from the institutional review board (IRB) as the YRBSS is publicly available, de-identified secondary data from the CDC.

The main outcome variable of interest was "Prescription Opioid Misuse", which was defined based on any reported lifetime prescription opioid misuse. Responses were recorded as "Yes" or "No" to create the binary response outcome variable for Prescription Opioid Misuse. The YRBSS survey questionnaire item asked participants, *"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?[21]"* Two groups were created based on participants who reported prescription opioid misuse (Yes) and those who did not (No). This survey item captures both misuse of prescription opioids not prescribed to the respondent or taken in a manner not intended by the prescriber.

For all the categorical variables, Pearson's chi-squared test was used to investigate any differences between the 2 groups. Multivariate analysis using a survey-weighted logistic regression model was performed to explore the association between prescription opioid misuse and risky health behaviors, adjusting for all other factors, including sex, sexual identity, race, and grade. We reported adjusted odds ratios (aORs), 95% confidence intervals (CIs), and two-sided p-values from the logistic regression. To assess multicollinearity, an adjusted variance inflation factor (VIF) was used, and VIFs for all variables ranged from 1.22 to 2.26, below the accepted threshold of VIF<10[22,23]. Therefore, highly correlated predictors and multicollinearity were not of concern in this study design. All analyses reported two-sided p-values, and a p-value<0.05 was considered statistically significant for the study. All statistical analyses were performed using the R version 3.6.2 (R Project for Statistical Computing) survey package[24].

Results

Table 1 reports the baseline and descriptive statistics and results from the bivariate analysis between the 2 groups. Overall, 10.4% (n=4,766) of participants reported lifetime prescription opioid misuse. Pearson's chi-squared tests indicated significant differences in demographic characteristics. Firstly, the 2 groups were significantly different in terms of age (p-value=0.002), sex (p-value=0.001), sexual identity (p-value<0.001), race (p-value<0.001), and grade (p-value<0.001). Additionally, Table 2, results from Pearson's chi-squared tests, showed that the 2 groups also significantly differed in terms of the selected 18 risky health behaviors. Therefore, to further explore these differences, the adjusted multivariate model was used. The multivariate model allowed for the analysis of independent associations after controlling for all other factors.

Table 3 presents the results from the survey's weighted adjusted logistic regression model. Results in Table 3 were adjusted for demographic covariates: sex, race, age, grade, and sexual identity. After adjusting for all other factors, we found a statistically significant association between 13 adverse health behaviors and prescription opioid misuse. High school students who misused prescription opioids had significantly higher odds of engaging in risky behaviors, including riding with a driver who had been drinking (a.O.R.=1.449, 95% CI=1.166-1.801), driving

while drinking (a.O.R.=1.478, 95% CI=1.058–2.066), texting while driving (a.O.R.=1.283, 95% CI=1.084–1.519), current cigarette use (a.O.R.=1.536, 95% CI=1.128–2.092), current electronic vape use (a.O.R.=1.497, 95% CI=1.140–1.967), current alcohol use (a.O.R.=1.616, 95% CI=1.282–2.036), and current marijuana use (a.O.R.=1.816, 95% CI=1.395–2.366), compared to students who do not misuse prescription opioids. In terms of other illicit substance use, students who misused prescription opioids had significantly higher odds of ever using methamphetamines

Table 1 Demographic characteristics of participants by prescription opioid misuse

Characteristic	Total (n)	Opioid misuse (No) (%)	Opioid misuse (Yes) (%)	p-value[a]
n (%)	44,349	39,583 (89.6)	4,766 (10.4)	
Frequency of lifetime opioid				–
Misuse*				
0 time	39,583	39,583 (89.6)	–	
1–2 times	2,248	–	2,248 (5.1)	
3–9 times	1,133	–	1,133 (2.6)	
10–19 times	542	–	542 (1.2)	
20–39 times	282	–	282 (0.6)	
≥40 times	561	–	561 (1.3)	
Age				0.002
12–14 years old	7,087 (16.1)	6,253 (15.9)	834 (17.6)	
15 years old	11,166 (25.3)	10,072 (25.6)	1,094 (23.1)	
16 years old	11,275 (25.6)	10,061 (25.5)	1,214 (25.6)	
17 years old	10,296 (23.3)	9,208 (23.4)	1,088 (23.0)	
18 years old	4,291 (9.7)	3,785 (9.6)	506 (10.7)	
Sex				0.001
Female	21,974 (50.1)	19,418 (49.5)	2,556 (55.0)	
Male	21,863 (49.9)	19,772 (50.5)	2,091 (45.0)	
Sexual identity				<0.001
Heterosexual	34,486 (81.4)	31,418 (83.0)	3,068 (68.1)	
LGB or Other	7,068 (16.7)	5,756 (15.2)	1,312 (29.1)	
Not Sure	815 (1.9)	688 (1.8)	127(2.8)	
Race/ethnicity				<0.001
NH white	21,455 (49.7)	19,389 (50.2)	2,066 (45.4)	
NH black	6,920 (16.0)	6,180 (16.0)	740 (16.2)	
Hispanic	3,657 (8.5)	3,288 (8.5)	369(8.1)	
Multiple	8,449 (19.6)	7,319 (18.9)	1,130 (24.8)	
Other	2,731 (6.3)	2,481 (6.4)	250 (5.5)	
Grade				<0.001
9th grades	11,813 (26.8)	10,620 (27.0)	1,193 (25.3)	
10th grades	11,591 (26.3)	10,387 (26.4)	1,204 (25.5)	
11th grades	10,697 (24.3)	9,501 (24.2)	1,196 (25.4)	
12th grade	9,817 (22.3)	8,746 (22.3)	1,071 (22.7)	
Other grades	90 (0.2)	41 (0.1)	49 (1.0)	

A associated p-value from weighted Pearson's chi square test, *response categories reflect the question item on lifetime prescription opioid misuse, All values presented as unweighted n (%) for categorical variables. Valid percentages are reported excluding missing counts, weighted statistical tests are used to account for survey weights, and a p-value<0.05 was considered to be statistically significant

(a.O.R.=3.604, 95% CI=2.155–6.026), ecstasy (a.O.R.= 2.705, 95% CI=1.876–3.901), and injecting illegal drugs (a.O.R.=1.323, 95% CI=1.013–1.728).

Table 2 highlights that 36.4% of adolescents (n=15,877), overall, reported persistent feelings of sadness and hopelessness. This proportion was significantly higher among those in the opioid misuse group (61.9% vs 33.4%). Similarly, high percentages were observed for 3 other suicide-related factors between the 2 groups. High school students who misuse opioids reported higher rates of seriously considering suicide (42.4% vs 17%), making a plan about suicide (36.8% vs 13.4%), and attempting suicide (28.5% vs 7.7%). Figure 1 illustrates a breakdown of the results for the suicide-related variables in a forest plot. After adjusting for all the other factors, feeling sad or hopeless (a.O.R.=1.718, 95% CI=1.382–2.137) and seriously considering suicide (a.O. R.=1.493, 95% CI=1.163–1.916) were associated with significantly higher odds of opioid misuse. This suggests that persistent feelings of sadness and hopelessness were associated with an approximately 71.8% increase in the odds of opioid misuse, while seriously considering suicide was associated with an approximately 49.3% increase in the odds of opioid misuse. The 2 other suicide-related variables, made a plan about suicide and

Table 2 baseline characteristics of participants for selected risky health behaviors by prescription opioid misuse

Characteristic	Total (n)	Opioid Misuse (No) (%)	Opioid Misuse (Yes) (%)	p-value[a]
n (%)	44,349	39,583 (89.6)	4,766 (10.4)	
Driving-related behaviors				
Rode with a driver who had been drinking alcohol	6,846(15.8)	5,337 (13.8)	1,509 (32.7)	<0.001
Drove a car or other vehicle when they had been drinking alcohol	1,201(5.1)	731 (3.5)	470 (18.5)	<0.001
Texted or e-mailed while driving a car or other vehicle	8,749(37.3)	7,372 (35.3)	1,377(53.3)	<0.001
Suicide-related behaviors				
Felt sad or hopeless	15,877(36.4)	13,038 (33.4)	2,839 (61.9)	<0.001
Seriously considered suicide	8,575(19.6)	6,624 (17.0)	1,951 (42.4)	<0.001
Made a plan about suicide	6,803(15.8)	5,148 (13.4)	1,655 (36.8)	<0.001
Attempted suicide	3,545(9.9)	2,474 (7.7)	1,071 (28.5)	<0.001
Smoking-related behaviors				
Currently smoke cigarettes	2,504(5.9)	1,568 (4.1)	936 (22.0)	<0.001
Currently use electronic vapor products	8,373(20.6)	6,328 (17.4)	2,045 (48.8)	<0.001
Currently use other tobacco products (smokeless or cigars)	3,052(7.2)	1,970 (5.2)	1,082 (24.1)	<0.001
Alcohol and drug use behaviors				
Current alcohol use	9,212(22.2)	7,108 (19.1)	2104 (49.6)	<0.001
Currently are binge drinking	6,654(18.1)	5,348 (16.2)	1,306 (34.7)	<0.001
Currently use marijuana	6,369(14.6)	4,580 (11.7)	1,789 (39.6)	<0.001
Ever used cocaine	1,646(4.5)	861 (2.6)	785 (19.0)	<0.001
Ever used heroin	911(2.1)	253 (0.7)	658 (14.2)	<0.001
Ever used methamphetamine	1,213(2.8)	431 (1.1)	782 (16.9)	<0.001
Ever used ecstasy	1,866(4.8)	920 (2.6)	946 (22.2)	<0.001
Ever injected illegal drugs	729(2.2)	342 (1.1)	387 (11.2)	<0.001

a associated p-value from weighted Pearson's Chi Square test.
All values presented as unweighted n (%) for categorical variables. Valid percentages are reported excluding missing counts. Weighted statistical tests are used to account for survey weights, and a p-value<0.05 was considered to be statistically significant. Current use was defined based on YRBSS survey items reporting at least 1 day of use during the 30 days before the survey.

Table 3 Adjusted factors associated with prescription opioid misuse from multivariate logistic regression analysis

Variable	aO.R.	95% CI (Lower)	95% CI (Upper)	p-value
Driving-related behaviors				
Rode with a driver who had been drinking alcohol	1.449	1.166	1.801	<0.01
Drove a car or other vehicle when they had been drinking alcohol	1.478	1.058	2.066	<0.05
Texted or e-mailed while driving a car or other vehicle	1.283	1.084	1.519	<0.01
Suicide-related behaviors				
Felt sad or hopeless	1.718	1.382	2.137	<0.001
Seriously considered suicide	1.493	1.163	1.916	<0.01
Made a plan about suicide	1.116	0.813	1.533	0.492
Attempted suicide	1.246	0.924	1.68	0.148
Smoking-related behaviors				
Currently smoke cigarettes	1.536	1.128	2.092	<0.01
Currently use electronic vapor products	1.497	1.140	1.967	<0.01
Currently use other tobacco products (smokeless or cigars)	1.347	0.989	1.835	0.059
Alcohol and drug use behaviors				
Current alcohol use	1.616	1.282	2.036	<0.001
Currently are binge drinking	0.658	0.516	0.839	<0.001
Currently use marijuana	1.816	1.395	2.366	<0.001
Ever used cocaine	1.394	0.897	2.165	0.138
Ever used heroin	1.531	0.648	3.615	0.328
Ever used methamphetamine	3.604	2.155	6.026	<0.001
Ever used ecstasy	2.705	1.876	3.901	<0.001
Ever injected illegal drugs	1.323	1.013	1.728	<0.05

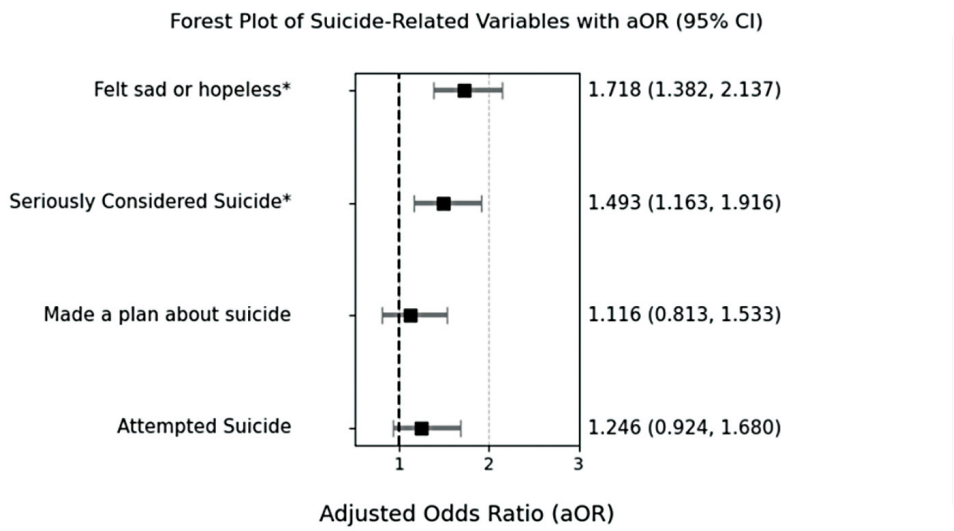
Model adjusted for sex, race/ethnicity, age, grade, and sexual identity, Odds were likelihood or change in value for misusing prescription opioids. p-value<0.05 was considered to be statistically significant. Current use was defined based on YRBSS survey items reporting at least 1 day of use during the 30 days before the survey. aO.R. indicates adjusted odds ratio; 95% CI, 95% Confidence Intervals; estimates are from logistic regression.

attempted suicide, were not statistically significant, as shown in Figure 1.

Discussion

According to previous CDC surveys, 14% of high school students reported misusing prescription opioids[25]. Therefore, the population in our analysis had a slightly lower reported rate of 10.4% prescription opioid misuse. To predict the association between opioid misuse and risky behaviors among adolescents, this study employed a survey-weighted logistic regression model. The findings from the present study were similar to findings by Bhatia et al., who identified a significant relationship between opioid misuse and 22 risky behaviors among adolescents[9]. Additionally, youth who misused prescription opioids showed a higher likelihood of engaging in a wide range of adverse health behaviors.

Consistent with previous findings, we found significant associations between prescription opioid misuse and co-occurring substance use, including alcohol, marijuana, methamphetamine, ecstasy, and injection drugs[9,13]. In contrast, using a larger sample pooled across multiple YRBSS cycles, we did not find any statistically significant association between prescription opioid use and substances such as heroin and cocaine. Bhatia et al. and Clayton et al. both identified higher odds of cocaine use and heroin use among youth who misused prescription opioids compared to their counterparts, those who did not misuse prescription opioids[9,13]. This discrepancy may reflect evolving drug use patterns, with a shift in adolescent substance use



*All p-values<0.05 were considered statistically significant

Figure 1 Forest plot of adjusted odds ratios for suicide-related factors associated with prescription opioid misuse from weighted logistic regression

preferences, or a reduced heroin and cocaine initiation compared to earlier years.

Other illicit substance use and risky health behavior findings were consistent with both studies, showing a positive association. The concerning results highlighted higher rates of associations between prescription opioid misuse and lifetime use of methamphetamine, ecstasy, and injecting illegal drugs. This is alarming due to the substitution effect and the rise of polysubstance use, which is leading up to the fourth wave of the opioid epidemic[26]. Methamphetamine, ecstasy, and injecting other illegal drugs are often described as harder substances and are also the main co-occurring drugs driving the opioid overdose deaths[27]. It is crucial that this high-risk population receives interventions before transitioning to or using multiple other harder substances, which increase their risk of suffering an overdose.

Consistent with previous studies (Bhatia et al. and Clayton et al.), we observed higher odds for driving-related behaviors, suicidal ideation, and persistent feelings of sadness and hopelessness. However, the selected variables in our study were different from those 2 studies, and we found that not all suicide-related factors have a similar effect. Seriously considered suicide and persistent feelings of sadness and hopelessness significantly affected prescription opioid misuse, which was consistent with previous studies[9,13]. In contrast, the present study found that the 2 other suicide-related variables, planned suicide and attempted suicide, were not significant, which is different from previous findings (Bhatia et al. and Clayton et al.).

Regarding mental health, opioid misuse was significantly associated with suicidal ideation and persistent feelings of sadness or hopelessness. Clayton et al. conducted a comprehensive analysis of suicide and violence-related outcomes; that study did not emphasize behaviors such as driving, smoking, and e-cigarette use, areas where our findings support the interconnected nature of substance use and other risky health behaviors in adolescents. Additionally, Wilkins et al. investigated attempted suicide and recency of prescription opioid

misuse, finding that adolescents who misused opioids had a higher prevalence in terms of all suicide related factors compared to those who were not in the opioid misuse group, which was in line with the present findings[28]. In the present study, we investigated suicidal ideation based on the survey question– "During the past 12 months, did you ever seriously consider attempting suicide?"[21]. Youth who misused prescription opioids were highly associated with considering suicide in the past 12 months[21]. While significant associations were found between prescription opioid misuse with suicidal ideation and feelings of hopelessness, no significant relationship was observed in this study with making plans for suicide or attempted suicide, which was different from findings by Wilkins et al.[28]. It may also point to a meaningful behavioral distinction, suggesting that while prescription opioid misuse is strongly linked with suicidal ideation, it may not uniformly translate to suicidal behaviors without other mediating factors. A complex intersection of factors is likely required to predict attempted suicide. This outcome may only be fully understood by accounting for mediating influences, including trauma, access to care, or social support.

In light of these findings, this study makes several contributions to meaningfully advance current discussions in adolescent health and adolescent prescription opioid misuse. Firstly, by pooling YRBSS data from 2017 to 2021, we offer more robust and generalizable estimates than prior studies based on single-year data. Bhatia, et al. and Clayton et al. focused on YRBSS 2017. Thus, the inclusion of the 2021 dataset captures behavioral trends during the post-COVID-19 pandemic period, which is a valuable addition. The post-pandemic dataset captures a time when adolescent mental health challenges and substance use patterns may have shifted significantly, and understanding this is pivotal. In addition, we studied mental health related survey items covering a comprehensive view of suicide-related factors, including suicidal ideation, planning, and attempts. We showed strong associations with ideation but not with planning or attempts, highlighting potential behavioral or reporting distinctions that merit further investigation. Finally, by examining a wider array of risky health behaviors, the present study provides a more comprehensive understanding of the health-risk profile of adolescents who are currently engaged in prescription opioid misuse.

One of the primary limitations was that it is difficult to prove the directionality of the association between the predictors and outcome in prescription opioid misuse. Therefore, reverse causality remains a concern. However, numerous studies have found similar findings showing the existing associations[8–9,13,28–30]. Therefore, regardless of the direction of the associations, a history of prescription opioids could potentially be interconnected with engaging in other risky health-related behaviors among youth. Another hypothesis is that adolescents who misuse opioids may inherently exhibit higher risk-taking behavior, which could partly explain their engagement in adverse health-related activities in the first place. YRBSS collected limited data on socio-demographic factors, especially family characteristics. As a result, the model could only adjust for socio-demographic variables that were available in the dataset, which included age, sex, race, grade, and sexual identity. Important, unmeasured confounders such as family dynamics, mental health history, and prescription access may also influence both misuse and the associated risky health behaviors. These unmeasured confounders may contribute to the omitted variable bias in the statistical model.

Lastly, all the data in YRBSS were self-reported. Therefore, there could potentially be some level of underreporting due to the stigma associated with reporting substance abuse or engaging in illegal activities, especially among adolescents[25]. Stigma may discourage honest reporting among the adolescents being surveyed. This

can be true for behaviors perceived as risky or socially unacceptable. Nevertheless, validation studies of YRBSS have shown that 96% of survey items, including substance-use items, have shown acceptable reliability and validity[31]. Since higher frequency misuse was infrequent in this dataset, we modeled lifetime misuse as a binary outcome to maximize the statistical power of the study. However, future research with larger samples or longitudinal designs should consider analyzing frequency-based misuse patterns to better characterize dose-response risk trajectories.

Conclusion

This paper sheds light on the importance of intervening in this high-risk group to further prevent adverse health outcomes. All the selected 18 risky health behaviors associated with prescription opioid misuse that were included in the study were targetable for intervention. This study offers a more comprehensive analysis by leveraging pooled national data from 2017–2021 to examine a broader range of health risk behaviors. These findings can inform physicians about adverse health behaviors associated with opioid misuse among adolescents. Additionally, this study relayed data to clinicians regarding factors to consider when prescribing opioids to adolescents. Furthermore, the findings provide insights to teachers and counselors about how misuse of opioids can be related to other risky behaviors, such as suicidal ideation. Healthcare policy makers need to take a multifaceted approach by working with teachers, counselors, clinicians, and nurses to create programs to assist high school students who are part of this high-risk population.

Conflict of Interest

All authors have signified that they have no conflicts of interest to declare, financial or otherwise.

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