Non-medical prescription opioid use among high school students in 38 U.S. States

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ABSTRACT

Background: Lifetime prevalence of non-medical prescription opioid use (NMPOU) among adolescents exceeds 10%. Building on that work, we estimate lifetime and recent (i.e., past 30-day) NMPOU and examine associations with alcohol and cannabis use.
Methods: We used 2019 YRBS data from 38 states with a question on lifetime NMPOU (n = 151,910), a subsample of 8 states also inquired about recent NMPOU (n = 28,439). We estimated the prevalence and frequency of NMPOU for boys and girls in each state. Multivariable logistic regression was used to derive odds ratios (OR) and 95% confidence intervals (CIs) representing recent NMPOU in association with alcohol and cannabis use adjusting for state, race/ethnicity, and grade.
Results: The prevalence of lifetime NMPOU ranged from 9.4% to 22.7% for girls and 8.6% to 23.2% for boys; significant sex difference in Florida. Recent NMPOU among lifetime users ranged from 33.0% to 50.7% for girls and 40.7% to 52.3% for boys, no significant sex differences. Students reporting recent NMPOU had significantly higher odds of recent alcohol (OR: 5.1, 95% CI: 4.3–6.1) and cannabis use (OR: 3.7, 95% CI: 2.8–4.8). Higher frequency (1–2 and $\geq$ 3 times vs. 0 times) of NMPOU had significantly greater odds of alcohol (3–9-fold) and cannabis use (3–5-fold). The magnitude of association was higher for boys compared to girls.
Conclusion: The prevalence of recent NMPOU among lifetime users is high and is associated with alcohol and cannabis use. NMPOU can be a steppingstone towards other forms of opioid use therefore, opioid prevention programs should emphasize prescription drug misuse and consider socio-contextual and geographical variations.

1. Introduction

Non-medical prescription opioid use (NMPOU) can lead to fatal or nonfatal overdose (Gaither et al., 2018; Mattson et al., 2018; Wilson et al., 2020), and can also be a stepping stone to heroin use and drug injection (Cerdá et al., 2015; Jones et al., 2020; McCabe et al., 2021). As described below, large, nationally representative surveys of adolescents suggest that estimates of lifetime and annual NMPOU are high. Given the risks posed by adolescent NMPOU, this present study provides a more comprehensive understanding of the epidemiology of use to inform prevention strategies.

The 2019 National Youth Risk Behavior Survey (YRBS) indicates that 14% of US high school students report lifetime NMPOU, with significantly higher prevalence among girls (16%) compared to boys (12%) (Centers for Disease Control and Prevention, n.d.). Data from the 2021

Monitoring the Future survey shows that the past 12-month prevalence of non-medical Oxycontin use among high school seniors is 0.9% (Johnston et al., 2022). Finally, a study based on the 2015–2016 National Survey on Drug Use and Health (NSDUH) data reported that the annual prevalence of NMPOU among 12–17-year-olds was 21%. The study further showed that at least half of the youth reporting past-year NMPOU had also used tobacco or cannabis (Hudgins et al., 2019).

Given the high prevalence of NMPOU, there is a clear need to develop a more comprehensive understanding of the epidemiology of adolescent opioid use. In particular, estimates of the frequency of past 30-day use could provide insights about the scope of the problem. This information is not known because questions to assess current use have not historically been included in behavioral health surveys. Additionally, there is limited clarity about demographic or geographic sub-populations that might be at higher risk for NMPOU. Boys are more

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likely to report use of all of the commonly used drugs, but a few studies on past 12-month NMPOU noted that there were no sex differences (Jones et al., 2019; Carmona et al., 2020). A few studies noted variation in NMPOU across different cities, whereas others noted higher prevalence in states with large rural areas (Keyes et al., 2014; Lipari et al., 2017). To address knowledge gaps and generate information to guide program and policy development, we describe sex differences in adolescent NMPOU, and also summarize variation in use across states.

The main purpose of this study is to examine NMPOU among US high school students, with focus on frequency of lifetime and past 30-day use. Several states participating in the YRBS asked about past 30-day NMPOU for the first time in 2019, enabling an examination of recent NMPOU. Secondarily, we consider whether recent NMPOU may be part of a constellation of polysubstance use by assessing recent NMPOU in association with recent use of alcohol and cannabis (Jessor, 2018; Tomczyk et al., 2016). Our objectives were to: [1] identify states with high prevalence of lifetime and past 30-day NMPOU, with a focus on examining sex differences in use; and [2] examine past 30-day NMPOU in association with alcohol and cannabis use.

2. Methods

2.1. Youth Risk Behavior Survey (YRBS)

To monitor a broad range of health behaviors, including substance use, the Centers for Disease Control and Prevention (CDC) supports the Youth Risk Behavior Survey. The YRBS includes biennial, school-based surveys of high school students, and data are representative of 9th-12th graders at the national, state, and district levels. We used data from the 2019 State YRBS. State YRBS samples are generated based on a two-stage cluster sampling design, with schools and classrooms within schools selected for participation. Analysis was deemed exempt from review by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

2.2. Measures

Lifetime NMPOU was assessed using 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?"* Past 30-day NMPOU was assessed using the question *"During the past 30 days, 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?"* Both instructed respondents to "*Count drugs such as Codeine, Vicodin, Oxy-Contin, Hydrocodone, and Percocet."* Response options for both items included: 0 times, 1–2 times, 3–9 times, 10–19 times, 20–39 times, and 40 or more times. We derived binary measures for both variables, i.e., any versus no lifetime NMPOU and any versus no past 30-day NMPOU. We also created a new variable representing number of times used in the past 30-days as 0, 1–2, or 3 or more.

Covariates includes alcohol use, cannabis use, and demographic factors. Alcohol and cannabis use were derived from responses to questions about frequency of recent alcohol use (i.e., *"During the past 30 days, on how many days did you have at least one drink of alcohol?"*) and cannabis use (i.e., *"During the past 30 days, how many times did you use marijuana?"*). We used binary measures of past 30-day use of alcohol and cannabis. Demographic measures included sex (male or female), grade level (9th, 10th, 11th, 12th), and race/ethnicity (Hispanic/Latino youth of any race, non-Hispanic White, non-Hispanic Black, and all others). The "other" category included youth who identified as Multi-Racial, Native Hawaiian or Other Pacific Islander, American Indian/Alaska Native, and Asian.

Table 1
Sample demographics and substance use across all 38 states (n = 151,910) and eight states (n = 28,439).

	Full Sample (38 States) Weighted % (95% CI)	Subsample (8 States) Weighted % (95% CI)
Sex		
Girls	49.0 (48.0, 49.9)	49.2 (47.0, 51.4)
Boys	51.0 (50.1, 52.0)	50.8 (48.6, 53.0)
Race/Ethnicity		
White non-Hispanic	46.7 (44.1, 49.3)	52.1 (47.5, 56.6)
Black non-Hispanic	15.1 (13.6, 16.5)	20.3 (16.2, 24.5)
Hispanic/Latino	28.3 (25.2, 31.4)	16.6 (14.6, 18.6)
Other non-Hispanic	9.9 (8.9, 10.9)	11.0 (10.0, 12.0)
Grade Level		
9th	26.7 (24.4, 28.9)	27.2 (24.4, 30.0)
10th	25.6 (23.8, 27.4)	25.6 (22.6, 28.6)
11th	24.1 (22.5, 25.8)	23.8 (21.7, 26.0)
12th	23.6 (21.9, 25.4)	23.4 (20.4, 26.4)
Lifetime NMPOU		
0 times	85.1 (84.5, 85.6)	83.9 (82.5, 85.3)
1–2 times	6.9 (6.5, 7.3)	7.9 (6.8, 9.0)
≥ 3 times	8.0 (7.7, 8.4)	8.2 (7.5, 8.9)
Past 30-day NMPOU		
0 times	—	91.3 (90.0, 92.6)
1–2 times	—	4.5 (4.1, 5.0)
≥ 3 times	—	4.2 (3.1, 5.3)
Current Alcohol Use		
Yes	24.9 (24.2, 25.7)	23.0 (21.2, 24.7)
No	75.1 (74.3, 75.8)	77.0 (75.3, 78.8)
Current Cannabis Use		
Yes	18.6 (17.8, 19.4)	18.5 (17.0, 20.0)
No	81.4 (80.6, 82.2)	81.5 (80.0, 83.0)

Note. The full sample includes: AL, AK, AZ, AR, CA, CO, CT, FL, GA, HI, ID, IL, IA, KS, KY, LA, ME, MD, MI, MS, MO, MT, NE, NV, NM, NC, ND, OK, PA, RI, SC, SD, TN, TX, UT, VT, WV, WI; the subsample includes: AK, GA, HI, MI, MO, NE, NV, and NM.

2.3. Statistical analysis

2.3.1. Lifetime NMPOU across states (38 States)

The first set of analyses focused on state estimates of lifetime NMPOU among boys and girls. The analytic sample was comprised of 38 states. Of the 12 states not in the sample, four did not participate in the YRBS (i.e., MN, OR, WA, WY), two (DE, IN) did not achieve a sufficiently high response rate to be included in YRBS data (i.e., 60%), two did not provide permission to distribute (MA, OH), and four (NH, NJ, NY, VA) did not include the item on lifetime NMPOU (Underwood et al., 2020). We pooled the data and presented descriptive analyses. Using state-specific data, we generated estimates of lifetime NMPOU in each state for boys and girls, and conducted chi-square tests to determine whether sex differences were statistically significant. We present weighted prevalence estimates and 95% confidence intervals (CIs).

2.3.2. Past 30-day NMPOU (8 States)

The analytic sample for analyses of recent NMPOU included a subsample of the 38 states that included an item on past 30-day use. Data from the 8 states (i.e., AK, GA, HI, MI, MO, NE, NV, NM) were pooled. After descriptive analyses, we generated prevalence estimates for past 30-day NMPOU for the full sample and for each state separately. Next, we restricted the sample to those reporting any lifetime use and conducted sex-stratified, multi-variable logistic regression to estimate the odds of recent NMPOU in association with recent use of alcohol and cannabis. We generated odds ratios (ORs) and 95% CIs, and models were adjusted for race/ethnicity, grade, and state. All analyses were conducted in SAS Studio version 3.7 using the sampling weights in the YRBS data to account for sampling probabilities and nonresponse (Brener et al., 2013).

a. Girls

b. Boys

Fig. 1. Prevalence quartiles of lifetime non-medical prescription opioid use for girls and boys across 38 states (N = 151,910). *Indicates states that report lifetime and past 30-day non-medical prescription opioid use.

Table 2
Past 30-day non-medical prescription opioid use among high school students who reported any lifetime use in eight states, by sex (N = 28,439).

	Girls % (95% CI)	Boys % (95% CI)
AK	33.0 (25.3, 40.7)	40.7 (31.6, 49.9)
GA	48.8 (41.5, 56.1)	51.1 (42.8, 59.4)
HI	45.5 (34.8, 56.3)	50.0 (43.6, 56.3)
MI	40.6 (33.7, 47.5)	42.4 (35.0, 49.7)
MO	37.0 (14.0, 59.9)	45.7 (26.3, 65.1)
NE	37.1 (28.1, 46.1)	44.7 (34.8, 54.5)
NV	44.6 (36.6, 52.5)	45.8 (34.7, 56.9)
NM	50.7 (47.3, 54.1)	52.3 (46.8, 57.7)
Median (Range)	42.6 (33.0–50.7)	45.8 (40.7–52.3)

Note: Chi-square tests did not indicate that sex differences were statistically significant.

3. Results

3.1. Description of samples

There were 151,910 high school students in the full sample (lifetime NMPOU) and 28,439 in the subsample (recent NMPOU). Both samples were balanced on sex and grade level (Table 1). In the full sample, 46.7% were White, 28.3% were Hispanic/Latino, and 15.1% were Black. The composition by race in the subsample was slightly different; 52.1% were White, 20.3% were Black, and 16.6% were Hispanic/Latino.

In the full sample, the large majority reported no lifetime NMPOU (85.1%), 8% reported having used three or more times, and 6.9% reported having used just once or twice. In the subsample, 91.3% reported no past 30-day NMPOU, 4.5% reported having used once or twice, and 4.2% reported having used three or more times. Past 30-day use of alcohol and cannabis were similar in both samples; more than one-fifth reported alcohol use and approximately 18% reported cannabis use.

3.2. Lifetime NMPOU (38 States)

Prevalence estimates of lifetime NMPOU varied widely by state, with a range of 8.6–23.2%. The range in state prevalence estimates was 9.4–22.7% for girls and 8.6–23.2% for boys (Fig. 1). Eight states were in the top quartile for both girls and boys; those states were: Nevada, Arizona, and New Mexico in the West; Missouri in the Midwest; and Arkansas, Louisiana, Mississippi, and Alabama in the South. In most states, there was no difference in lifetime NMPOU among girls compared to boys. Point prevalence estimates were 1.1 to 1.6 times higher among girls versus boys (*p* < 0.05) in 11 of the 38 states (i.e., CA, FL, GA, ID, MD, MT, NE, NV, ND, PA, TX), but interval estimates overlapped for 10 of those 11 states. The exception was Florida, where girls were significantly more likely to report lifetime NMPOU than boys, i.e., 16.2% (95% CI: 14.3, 18.0) versus 11.6% (95% CI: 10.3, 12.9).

3.3. Past 30-day NMPOU (8 States)

Eight states included an item on past 30-day use, i.e., AK, GA, HI, MI, MO, NE, NV, and NM. Among students in those states, 45% of those reporting any lifetime NMPOU also reported past 30-day NMPOU. Table 2 shows the past 30-day prevalence of NMPOU among those reporting lifetime use. Estimates ranged from 33.0% to 50.7% for girls (median = 42.6%) and 40.7% to 52.3% for boys (median = 45.8%). For both girls and boys, the state prevalence estimates were highest in New Mexico (50.7% for girls, 52.3% for boys). There were no statistically significant sex differences in past 30-day NMPOU in any of the states.

Estimates of the frequency of past 30-day NMPOU among girls and boys who reported any lifetime NMPOU in the eight states are presented in Fig. 2. For most states, more than 50% of students reported no past 30-day NMPOU. The exceptions were New Mexico for girls (49.2%), and

Georgia and New Mexico for boys (48.9% and 47.7%). Among girls in three states (i.e., MO, NV, and NM), more than one-fifth indicated having used three or more times in the past 30 days. Among boys, over one-fifth reported having used 3 or more times in the past 30 days in seven states, the exception being Alaska. Georgia was the only state where there were statistically significant sex differences in past 30-day frequency of NMPOU. One-third of girls in Georgia reported having used 1–2 times and 15.8% reported using 3 or more times. By contrast, 18.8% of boys reported having used 1–2 times and 32.3% reported using 3 or more times.

### 3.4. Past 30-day NMPOU in association with alcohol and cannabis use

Analysis of past 30-day NMPOU in association with alcohol and cannabis use were restricted to students who reported any lifetime NMPOU. Regression analyses indicate that past 30-day NMPOU was significantly associated with past 30-day alcohol and cannabis use for boys and girls (Table 3). The odds of past 30-day alcohol use among students who reported any past 30-day NMPOU (versus no recent use) was 5.1 (95% CI: 4.3, 6.1). The magnitude of the association was higher for boys (OR: 8.5; 95% CI: 6.5, 11.0) than for girls (OR: 3.5; 95% CI: 2.8, 4.4). The odds of past 30-day cannabis use were 3.7 (95% CI: 2.8, 4.8) among those who reported past 30-day NMPOU (versus no use). As with alcohol, magnitude of the association was higher among boys (OR: 5.1; 95% CI: 3.6, 7.2) than girls (OR: 2.8; 95% CI: 2.0, 3.9).

The next series of analyses estimates odds of past 30-day alcohol and cannabis use in association with the frequency of past 30-day NMPOU among students who reported any lifetime use, with statistical adjustment for grade, sex, state, and race/ethnicity. Results indicate strong associations between NMPOU and alcohol or cannabis use. Students who reported having used prescription opioids non-medically just 1–2 times in the past 30 days had 3.4 times the odds of past 30-day alcohol use (95% CI: 2.5, 4.7), and 2.9 times the odds of past 30-day cannabis use (95% CI: 2.1, 4.0) relative to those with no past 30-day NMPOU. Odds ratios were higher for students who reported more frequent NMPOU (i.e., 3 or more times), i.e., 9.2 for alcohol (95% CI: 6.6, 12.8) and 4.9 for cannabis (95% CI: 2.8, 8.6). The magnitude of the associations of NMPOU with alcohol and cannabis were higher among boys than girls. In fact, the odds of alcohol use among boys reporting 3 or more times of NMPOU (OR: 18.4; 95% CI: 10.4, 32.6) was over three-fold higher than the odds for girls (OR: 5.2; 95% CI: 3.3, 8.0). The odds of past 30-day cannabis use among students reporting 3 or more times of NMPOU was twice as high among boys (OR: 7.5; 95% CI: 3.9, 14.6) than girls (OR: 3.2; 95% CI: 1.8, 5.8).

4. Discussion

Our goal was to present new information about patterns of non-medical prescription opioid use (NMPOU) among US high school students. Using data from CDC's State YRBS program (2019), we investigated the prevalence of NMPOU, and also estimated associations between NMPOU with past 30-day alcohol and cannabis use. The lifetime and past 30-day prevalence estimates for NMPOU were high, respectively 15% and 9%. We observed a strong and statistically significant association between recent NMPOU and alcohol or cannabis use for boys and girls.

Data from all states combined show that the vast majority of US high school students reported no lifetime NMPOU. Of the 15% who did, 7% used once or twice only and 8% used three or more times. There was substantial variation in lifetime NMPOU among high school students across the 38 states, with estimates ranging from 9% to 23%. States with estimates of lifetime NMPOU in the top quartile (greater than 17%) were Nevada, Arizona, New Mexico, Missouri, Arkansas, Louisiana, Mississippi, and Alabama. The only state with a statistically significant sex difference was Florida, where girls had a higher prevalence of use than boys.

a. Girls

b. Boys
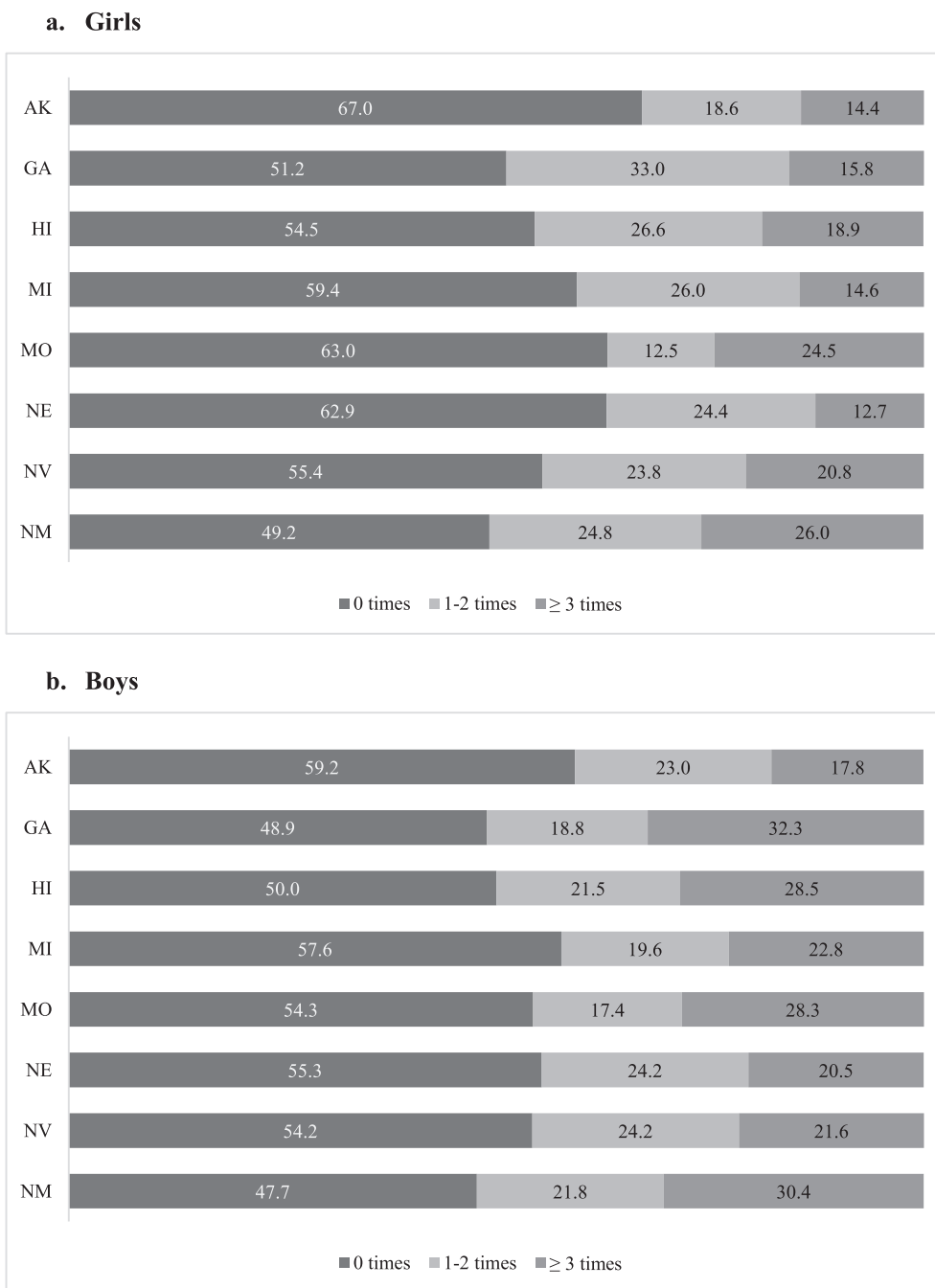
Fig. 2. Prevalence estimates of frequency of past 30-day non-medical prescription opioid use among high school students reporting lifetime non-medical prescription opioid use across eight states, for girls and boys (N = 28,439).

Data from the 8 states with information on past 30-day NMPOU provide new information about recent use. The state-pooled data show that 45% of lifetime users also reported recent use, and 4% of students reporting recent use indicated having used 3 or more times in the past 30 days. Statewide estimates of recent use among students who reported lifetime use ranged from 33% to 51% for girls (median = 43%) and 41% to 52% for boys (median = 46%). Past 30-day use among lifetime users exceeded 50% among girls in New Mexico, and among boys in Georgia, Hawaii, and New Mexico.

These findings suggest that nearly one-half of high school students who misuse prescription opioids in their lifetime have used multiple times and also that they have used in the past 30 days. The frequency and recency of NMPOU should raise public health concern about the likelihood of escalation in use or progression to other opioids, especially in states with the highest prevalence of use. Our results highlight the importance of examining more detailed measures of NMPOU and also of state and local surveillance of adolescent NMPOU.

We observed strong and statistically significant associations between alcohol use and cannabis use. Students who reported past 30-day NMPOU were more than three times more likely to report past 30-day use of alcohol (95% CI: 4.3, 6.1) and cannabis (95% CI: 2.8, 4.8). Associations were stronger for boys than for girls. We also observed a dose response relationship, higher frequency of NMPOU was associated with increased odds of alcohol and cannabis use. These findings provide initial evidence that NMPOU may be part of a constellation of polysubstance use, meaning that NMPOU could be associated with use of multiple drugs. This finding is consistent with previous studies (Carmona et al., 2020; Fiellin et al., 2013), and emphasizes that NMPOU

Table 3
Non-medical prescription opioid use (NMPOU) and odds of alcohol and cannabis use among US high school students in 8 states, by sex (n = 28,439).

	Current Alcohol Use OR (95% CI)	Current Cannabis Use OR (95% CI)
Any past 30-day NMPOU		
Total		
No use	Ref.	Ref.
Any use	5.1 (4.3, 6.1)	3.7 (2.8, 4.8)
Girls		
No use	Ref.	Ref.
Any use	3.5 (2.8, 4.4)	2.8 (2.0, 3.9)
Boys		
No use	Ref.	Ref.
Any use	8.5 (6.5, 11.0)	5.1 (3.6, 7.2)
Frequency of past 30-day NMPOU		
Total		
0 times	Ref.	Ref.
1–2 times	3.4 (2.5, 4.7)	2.9 (2.1, 4.0)
$\geq$ 3 times	9.2 (6.6, 12.8)	4.9 (2.8, 8.6)
Girls		
0 times	Ref.	Ref.
1–2 times	2.8 (1.9, 4.0)	2.5 (1.6, 4.1)
$\geq$ 3 times	5.2 (3.3, 8.0)	3.2 (1.8, 5.8)
Boys		
0 times	Ref.	Ref.
1–2 times	4.8 (3.1, 7.3)	3.4 (2.3, 4.9)
$\geq$ 3 times	18.4 (10.4, 32.6)	7.5 (3.9, 14.6)

Note. Analyses are restricted to students who reported any lifetime and past 30-day NMPOU. Models are adjusted for sex (male vs. female), grade (9th vs. other), race/ethnicity (non-Hispanic White vs. other), and state (New Mexico vs. other). Models stratified by sex are not adjusted for sex.

should be included in strategies for the primary prevention of substance use.

These findings provide new information about NMPOU among adolescents but are not representative of all US high school students or of all US adolescents. Findings for lifetime NMPOU reflect data from high school students in 38 states. States that did not participate in the YRBS were excluded, as were participating states that did not achieve a response rate of 60% and/or that did not include a question on lifetime NMPOU. Findings on past 30-day NMPOU were further limited to 8 states that inquired about recent use. Additionally, results cannot be generalized to adolescents who are not attending high school, a population with higher levels of substance use. However, 95% of youth aged 14 to 17 years were enrolled in school in 2019 (National Center for Education Statistics, n.d.).

This study has some limitations. We cannot differentiate between students who misused prescription opioids for medical purposes (additional pain relief) from those who misused them for recreational purposes. Additionally, the questions assessing lifetime and current prescription opioid misuse refer to prescription pain medicine; however, the questions provide examples of opioid-containing prescription medications only. Therefore, if students considered nonopioid prescription pain medications when answering, an overestimation of prescription opioid misuse prevalence might have occurred. Finally, although the strong association between alcohol use and prescription opioid use represents a risk for overdose, YRBS data provide information about concurrent use but not simultaneous use. We cannot address the question of whether adolescents co-use alcohol and prescription opioids.

Nonetheless, the prevalence of past 30-day NMPOU among students reporting lifetime NMPOU is high and its association with alcohol and cannabis use suggest implications for practice. The findings indicate the need for communicating with youth about misuse of prescription opioids. School and community-based programs are important avenues for primary prevention, as are clinical settings. Screening for opioid misuse is recommended as part of clinical examination, particularly among youth who report alcohol and cannabis use. Several studies have showed that screening and brief interventions (SBI) are effective in reducing

adolescent alcohol and cannabis use in schools, primary care settings, and emergency departments (Bernstein et al., 2009; D'Amico et al., 2018; Lunstead et al., 2017). Although more needs to be known about the effectiveness of SBI for NMPOU among adolescents, it may help prevent youth from initiation or escalation of opioid use (Hadland, 2019).

Our study contributes to the growing literature on the opioid crisis among adolescents, particularly NMPOU. These findings underscore the need for youth-focused clinical, prevention and intervention strategies. A better understanding of geographical variations in NMPOU, as well as how socio-contextual factors relate to adolescent opioid use is needed to help address the root causes of opioid use among adolescents. Additional research should also identify factors that increase risk for use, escalation, and/or that increase availability, such as prescribing rates, outlier prescribing, and widespread overprescribing. Finally, state priority and public health planning for opioid prevention should include youth.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data were derived from the following resources available in the public domain: Youth Risk Behavior Surveillance System (YRBSS) available at YRBSS Data and Documentation (cdc.gov).

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.abrep.2023.100498.

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