

Prescription opioid misuse and comorbid substance use: Past 30-day prevalence, correlates and co-occurring behavioral indicators in the 2016 National Survey on Drug Use and Health

Timothy J. Grigsby, PhD^{1*} & Jeffrey T. Howard, PhD¹

¹Department of Kinesiology, Health, & Nutrition, University of Texas at San Antonio

*Contact information for T. J. Grigsby:

Department of Kinesiology, Health, & Nutrition
University of Texas at San Antonio
One UTSA Circle
San Antonio, TX 78249
Office: Main Building (MB) 3.408
Email: timothy.grigsby@utsa.edu
Phone: + 1 210 458 6719

Abstract word count: 250

Narrative word count: 3,245

of Tables: 3

of Figures: 1

of references: 35

Background and objectives: Prescription opioid misuse has not been well examined in the context of comorbid substance use in representative samples of substance users. Past 30-day comorbid prescription opioid misuse and recreational substance use (e.g., alcohol, marijuana, cocaine, etc.) was studied in a representative sample of substance users in the United States using the 2016 National Survey on Drug Use and Health (NSDUH).

Methods: Prevalence of prescription opioid misuse with and without comorbid substance use was estimated with the 2016 NSDUH. Generalized linear modeling was used to describe demographic correlates of opioid and comorbid substance use and explore the relation of opioid and comorbid substance use with social and behavioral health indicators.

Results: The majority of past month prescription opioid misusers reported use of other substances including cigarettes, alcohol, marijuana, or hard drugs (cocaine, methamphetamine, etc.). Males and younger respondents had a significantly higher risk of reporting past month prescription opioid misuse with illicit drug or polydrug use (p 's <0.01). Prescription opioid and polydrug users had the greatest odds of stealing property, selling drugs, having suicidal ideations, major depressive episode, and perceived treatment need in the past year compared to all other categories of prescription opioid misuse categories.

Conclusions and scientific significance: Prescription opioid misuse is likely a part of a larger set of psychological, behavioral, and mental health problems. More attention should be given to the profiles of recreational (non-medical) substance use involving prescription opioids to curtail the current opioid crisis and prevent other similar epidemics in the future.

Keywords: non-medical prescription drug use, opioid, alcohol, cigarette, marijuana, polydrug, NSDUH

Prescription opioid misuse and comorbid substance use: Past 30-day prevalence, and co-occurring behavioral indicators in the 2016 National Survey on Drug Use and Health

There has been a steadily growing interest in research on prescription drug misuse in the wake of the opioid epidemic¹ and rising concerns of misuse of other prescribed drugs, such as benzodiazepines.² Prescription drug misuse is the use of prescription medications outside the parameters of its prescribed use such as using in greater amounts, for prolonged periods of time, or for purposes other than prescribed. Prescription opioid misuse, in particular, has been declared a public health emergency in the United States. While opioid prescription rates have decreased steadily over the past several years³, deaths involving prescription opioids have more than quadrupled between 1999 and 2015 based on analyses of the National Vital Statistics multiple cause-of-death mortality files.^{4,5} Data from the National Survey of Drug Use and Health (NSDUH) have evidenced that drug overdose death rates involving prescription opioids increased among adults from 4.5 per 100,000 (95% CI, 4.42-4.61) in 2003 to 7.8 per 100,000 (95% CI, 7.64-7.89) in 2013 (absolute difference, 3.3; 95% CI, 3.09-3.41).⁶ Use and abuse of recreational substances—drugs used for their psychoactive effects without medical justification (e.g., alcohol, tobacco, marijuana, cocaine, etc.)—has been correlated to prescription opioid use in adolescent⁷ and adult samples.^{8,9} However, patterns of past month prescription opioid misuse and recreational substance use has not been well characterized or described in relation to sociodemographic characteristics or social and behavioral health indicators.

Han and colleagues⁹ examined rates and correlates of prescription drug misuse and abuse using the 2015 National Survey on Drug Use and Health (NSDUH), a nationally representative cross-sectional survey. The authors noted, among other findings, a high percentage of prescription opioid misusers also reported previous or current substance use disorders in the past year. However, the use of past year responses makes it difficult to determine whether or not

prescription and recreational drugs are used in a comorbid fashion or if users transitioned from opioids to other substances or vice versa. This has important implications for public health research, policy development and clinical intervention.

Combining prescription opioids with recreational drugs, such as alcohol, can interact to produce a harmful and potentially lethal chemical effects for the user,^{10,11} and increase the risk for overdose—though previous research shows concurrent prescription opioid and illicit drug users perceive risk as low.¹² The combination of prescription opioids and benzodiazepines has been a primary area of concern given their potential for harm,^{13,14} but less attention has focused on prescription opioid and comorbid use of recreational substances despite the prevalence of recreational drug use of substances—such as alcohol, tobacco, and marijuana—is higher than prescription drug misuse.¹⁵

Misuse of prescription opioids and recreational substance use behaviors is consistent with research indicating that prescription drug misuse is associated with an increased risk of mental health problems, including substance use disorders.^{9,16,17} Prescription opioid misuse, specifically, has been assessed in relation to major depression¹⁶ and suicidal ideation.¹⁸ While these studies adjusted for lifetime or past year substance use and substance use disorder, they did not examine the comorbid use of prescription opioids and other substances. Similarly, there is little evidence to the knowledge of the authors regarding current comorbid use of prescription opioids and recreational substances and its relation to social and behavioral problems such as risky sexual practices and outcomes, stealing property, or engaging in illicit drug activity such as selling drugs. Among substance users entering treatment, national data suggests that approximately 41% report using both drugs and alcohol¹⁹ suggesting that individuals in need of substance use

treatment are engaged in polydrug use—the use of two or more drugs within a specified time frame.²⁰

The aim of the present investigation was to (a) identify the profiles of past month prescription opioid misuse in the context of other substance use behavior, (b) describe demographic correlates of opioid misuse and comorbid substance use types, (c) explore the relationship between opioid and comorbid substance use with other social and behavioral health indicators, and (d) examine differences in the source of prescription pain medication.

Methods

Study population

Data were analyzed from the National Survey on Drug Use and Health (NSDUH) a yearly cross-sectional data collection effort on the use of legal and illegal substances, mental health and other correlates. The study is described in-depth elsewhere.²¹ Briefly, a multistage area probability sample (N=67,942) was conducted for each of the 50 states and the District of Columbia to represent the U.S. male and female civilian non-institutionalized population aged ≥ 12 years. Data were collected from respondents by computer-assisted personal interviewing conducted by an interviewer and audio computer-assisted self-interviewing. NSDUH data collection was approved by the institutional review board at RTI International. Verbal informed consent was received from each study participant. Data for the current analysis (2016 survey) were extracted from the public data portal (www.datafiles.samhsa.gov/), and is the most recently available data. In 2016, the weighted response rate for completed household interviews was 68.4% with an overall response rate of 53.3% for people ages 12 and older. Multiple imputation was used to account for missing data.²¹

Measures

Prescription opioid misuse profiles. To classify prescription opioid misuse types, the sample was first limited to only respondents who reported past month recreational substance use (alcohol, tobacco, marijuana, hard drugs) or prescription opioid misuse (N=26,033). We then create profiles of prescription opioid misuse as respondents reporting: (a) prescription opioid misuse only, (b) prescription opioid misuse and past month alcohol or cigarette use, (c) prescription opioid misuse and past month use of one illicit drug (marijuana, cocaine, crack, heroin, LSD, PCP, ecstasy, ketamine, DMT/AMT/FOXY, salvia, inhalants, methamphetamine), (d) prescription opioid misuse and use of more than one recreational drug in the past month, and (e) past month recreational drug users reporting no prescription opioid misuse. The recreational drug users reporting no prescription opioid misuse group was the referent category for all analyses. Prescription opioid and comorbid substance use profiles were examined in the past month rather than past year.

Sociodemographic covariates. Gender was coded 0=female and 1=male. Age was categorized as 12-17 years old, 18-25 years old and 26 years and older. Race/ethnicity was categorized as Non-Hispanic White, Non-Hispanic African/American or Black, Hispanic, Asian, Native American or Alaskan Native, Hawaiian or Pacific Islander and two or more. Due to small cell sizes final analyses collapsed ethnic groups into Non-Hispanic White, Non-Hispanic African/American or Black, Hispanic, other and two or more. Annual income was grouped as less than \$20,000, \$20,000-\$39,999, \$40,000-\$74,999 and \$75,000 or more.

Social and behavioral health indicators: Items asked about past year major depressive episode, stealing of property worth \$50 or more, selling illegal drugs, having any sexually transmitted disease, suicidal ideation (among adult respondents) and perceived treatment need for alcohol or drug use problems. Two items (selling illegal drugs and major depressive episode)

were assessed with separate items for adolescents and adults but were coded consistently as yes/no indicators. Items were dichotomized as yes (1) and no (0) responses.

Source of pain medication. One item assessed source of pain medications among prescription opioid misusers. Possible responses included one doctor; more than one doctor; stealing from a doctor's office clinic, hospital or pharmacy; getting from a friend or relative (for free, through purchase or by stealing); buying from a dealer or stranger, or some other way..

Sample weights were applied to yield nationally representative estimates which are represented as percentages in this report. First, prevalence estimates were derived and bivariate associations were assessed across the profiles of prescriptions opioid misusers with covariates. A multinomial logistic regression model was used to examine the relationships between demographic correlates of prescription opioid misuse profiles. Separate logistic regression models were used to assess the relationship between prescription opioid misuse profiles with other self-reported outcomes (stealing property, selling drugs, STD infection, suicidal ideation, and perceived substance use treatment need). Analyses were conducted with Stata version 14.0 (StataCorp, 2015) using the SVY command to account for the complex sample design and sampling weights of NSDUH data. NSDUH suppression rules were followed in accordance with the Methodological Summary and Definitions guidelines.²¹ Results are presented as Relative Risk Ratios (RRR) or Adjusted Odds Ratios (AOR) with 95% confidence intervals (95% CI).

Results

Based on 26,033 respondents reporting past 30-day substance use, it was estimated that 2.5% (95% CI = 2.2%-2.7%) of this population are past month prescription opioid misusers. The majority reported prescription opioid and polydrug use (0.67%, 95% CI = 0.56%-0.79%) followed by prescription opioid only use (0.63%, 95% CI = 0.51%-0.77%), prescription opioid

and alcohol use (0.48%, 95% CI = 0.34%-0.61%), prescription opioid and marijuana use (0.44%, 95% CI = 0.35%-0.53%), prescription opioid and cigarette use (0.19%, 95% CI = 0.11%-0.27%), and prescription opioid and hard drug use (0.03%, 95% CI = 0.01%-0.06%). The cigarettes and alcohol categories were combined into a ‘prescription opioid and licit drug’ category while the marijuana and hard drug categories were combined into a ‘prescription opioid and illicit drug’ category. The analytic sample was 51.5% female, predominantly non-Hispanic White (63.4%), age 26 or older (77.9%), with 37.5% reporting an annual income of \$75,000 or more (Table 1).

Compared to past month substance users who did not report prescription opioid use, the risk of reporting prescription opioid use only was higher for participants ages 12-17 (RRR=5.17, 95% CI=3.38-7.90) and those with an annual income of \$20,000 or less (RRR=2.47, 95% CI=1.24-4.92). Males were 1.63 times more likely than females to report prescription opioid and use of one illicit drug (95% CI=1.09-2.44) and 1.46 times more likely to report prescription opioid and polydrug use (95% CI=1.04-2.04). Additionally, compared to those with an annual income between \$40,000-\$74,999 the risk of prescription opioid and polydrug use was higher for those reporting an annual income of \$20,000 or less (RRR=2.38, 95% CI=1.35-4.19) and lower for those reporting an income of \$75,000 or more (RRR=0.42, 95% CI=0.24-0.75) (Table 2).

Social and behavioral health indicators were examined in relation to past month opioid use profiles after adjusting for gender, age, race/ethnicity, and income (Table 3). Past year major depressive episode was associated with an increased risk of all past month prescription opioid use profiles relative to past month substance use that did not involve prescription opioids. Compared to past month substance users who did not report prescription opioid use, those reporting prescription opioid use only had a greater odds of stealing property worth \$50 dollars or more (AOR=2.65, 95% CI=1.18-5.96), suicidal ideation (AOR=2.82, 95% CI=1.65-4.80), and

perceived need of substance use treatment AOR=3.03, 95% CI=1.99-4.61). Different profiles of prescription opioid and comorbid substance use were associated with several negative social and behavioral indicators. Of note, prescription opioid and polydrug users were at the greatest odds of stealing property worth \$50 dollars or more (AOR=8.90, 95% CI=5.22-15.19), selling illegal drugs (AOR=13.06, 95% CI=8.69-19.62), and having a sexually transmitted disease (AOR=3.84, 95% CI=1.72-8.58). Suicidal ideation in adult respondents (AOR=3.00, 95% CI=1.93-4.66), and perceived need of substance use treatment (AOR=16.75, 95% CI=11.27-24.89) was also highest among past month prescription opioid and polydrug users. All past month prescription opioid use profiles were associated with an increased risk of past year major depressive episode.

Sources of pain medication was examined for prescription opioid only users compared to prescription opioid and comorbid substance users (Figure 1). Getting pain medication from a friend or relative for free was the primary source for both prescription opioid only users (43.9%) and prescription opioid and comorbid substance users (33.2%). A chi-square test of independence was performed to examine the relation between type of prescription opioid user (opioid only or opioid and comorbid substance use) and different sources of pain medication. There was a significant relationship between type of prescription opioid user and buying from a friend or relative ($\chi^2 (1,821) = 21.51, p<0.0001$) and buying from a drug dealer or other stranger ($\chi^2 (1,821) = 10.14, p<0.0015$).

Discussion

High rates of past month prescription opioid and comorbid substance use was observed in the 2016 NSDUH sample. This is especially concerning given the potential health risks that combining substances poses to the user. Sociodemographic variables were examined as correlates of past month prescription opioid and comorbid substance use profiles. Notably, males

and younger respondents (adolescents aged 12-17 and young adults aged 18-25) were more likely to report prescription opioid and illicit, or polydrug use.

Our findings are limited to discussing comorbid, and not combined, profiles of use. Individuals reporting past 30-day comorbid prescription opioid misuse and recreational substance use reflect one of three types of comorbid substance users: *simultaneous* users—who consume multiple drugs in the same session motivated by the enhanced high achieved by combining multiple psychoactive substances²², *concurrent* users who report the use of multiple drugs at different times motivated by availability and substitution practices²⁰, and *transitional* users who move from one drug to another (e.g., prescription opioid to heroin) or one route of administration to another (e.g., non-injection to injection) due to financial reasons or heightened intensity of the drug effect.²³ Due to the nature of the NSDUH data, it was not possible to conduct an event level analysis of prescription opioid and comorbid substance use behaviors. Nevertheless, the risks from combining substances is important to consider. Combining prescription opioids with some substances, such as alcohol can be lethal,¹⁰ but there is no evidence of harm due to the combined use of prescription opioids with cigarette use, for example. Timeline Followback assessment, a retrospective calendar-based measure of substance use, is a reliable method for assessing recent daily use of alcohol²⁴ and other substances.²⁵ Incorporating these strategies into national survey inventories will strengthen the ability of researchers to determine event level patterns of comorbid prescription opioid misuse and recreational substance use and better understand the physical, psychological, and behavioral consequences of disparate use patterns.

Prescription opioid and comorbid substance use was a significant correlate of several past year social and behavioral health indicators when compared to substance users with no self-

reported prescription opioid use. Relative to prescription opioid only users, polydrug users reporting prescription opioid use had an increase in the odds of past-year stealing, selling illegal drugs, having an STD, suicidal ideation or needing substance use treatment. NSDUH data indicate that the primary reason for misuse of prescription pain killers is pain (62.6%).²⁶ Individuals with existing physical, behavioral, and mental health problems may be at a higher risk of prescription opioid misuse due to associated pain related symptoms or as a coping mechanism for psychological and behavioral problems.¹⁷ Without a biological test of pain assessment, patients are left to self-report their pain levels and those experiencing other behavioral or mental health problems may report pain as a symptom needing treatment. Alternatively, there is a possibility that prescription opioid misusers have an underlying, comorbid personality disorder that heightens the risk for prescription drug misuse and abuse,²⁷ and their propensity for experiencing adverse behaviors and related outcomes.²⁸ Individuals misusing or abusing multiple substances might be especially vulnerable to other social or behavioral problems. Davis¹⁶ proposed that the relationship between mental illness and prescription opioid misuse is likely bidirectional and this may be true with suicidal ideation as well. Kuramoto¹⁸ found that individuals who no longer reported using prescription opioids were more likely to report suicidal ideation. More longitudinal research is needed to disentangle these relationships. While screening for depression is recommended before prescribing prescription opioids for pain management, screening is strongly encouraged when physicians suspect or are aware of other substance use behaviors.

National data suggests that nearly half of all individuals who misuse prescription opioids procure the medication from a friend or relative for free, by stealing, or paying.²⁹ The same study suggested that family and friends serve as a primary source for securing prescription pain

medication. However, one report³⁰ demonstrated that source of prescription opioids varied by frequency of past-year nonmedical use. The results indicated that while this was true for the lowest frequency users (1-29 days), the highest frequency users (200-365 days) were more likely than those with the lowest frequency of use to obtain opioids from a physician's prescription or from a drug dealer. In light of these findings, and given the current widespread opioid abuse problem, physicians should consider encouraging patients to dispose of unused opioid medications especially when other household members may be at risk for misuse if they are able to access the drugs. Similar to high frequency opioid misusers,³⁰ prescription opioid and comorbid substance users were more likely to buy prescription opioids from a friend or relative which could be a sign of heightened drug seeking behavior and requires further investigation. Drug seeking behavior refers to a wide range of behaviors including pressuring doctors for drugs, forging prescriptions, or obtaining the drugs from illicit sources that is frequently indicative of increasing dependence. This data also suggests that prescription opioid users engaged in other substance use behaviors are more likely to purchase opioids from strangers or drug dealers. This finding is startling as these individuals can be exposed to other risks associated with purchasing illicit drugs—such as unintentionally consuming laced drugs. Future research should consider if and how frequency of prescription opioid misuse contributes to the health outcomes of comorbid use observed in this analysis.

This analysis should be considered in light of several limitations. First, due to the cross-sectional nature of the data we cannot assume causal relationships between the variables under study. We also observed variables with different time intervals (past month, past year) further limiting our ability to derive temporal sequencing of events. However, the research design and sample weights improve the confidence that the relationships observed in this analysis are

representative of substance users in the United States. Second, the design of the survey does not allow us to examine event level substance use or distinguish between simultaneous and concurrent opioid and drug users. Past month use was examined and it is possible that some users engaged in comorbid prescription opioid and substance use previously but weren't captured in the present analysis. Moreover, we included past month cigarette use but not general tobacco use due to the high overlap in use of multiple tobacco products among cigarette smokers. Replication analyses using any past month tobacco use produced near identical findings. Third, this sample was limited to non-institutionalized individuals and limits our generalizability when discussing subpopulations including, but not limited to, active duty military personnel and prisoners. These populations warrant further exploration given their risk for substance use and misuse relative to the general population^{31,32} and need for specific health care issues. Fourth, we categorized licit (cigarettes and alcohol) and illicit (marijuana, cocaine, etc.) substances based on the national legal status of the substances and their availability for purchase and possession. However, youth cannot purchase licit drugs due to age restrictions, but this population would have increased access to these products through peer networks or availability in their households. Finally, responses were self-reported and susceptible to recall bias which may affect the validity of the findings.

Public health and clinical experts continue to debate the best practices for opioid prescribing and pain management through policy or system level intervention,³³ abuse deterrent formulas,³⁴ or patient level interventions such as developing addiction vaccines³⁵ or exploring alternative treatments for chronic pain management. The findings of this study suggest that prescription opioid misuse is likely a part of a larger set of physical, psychological and behavioral problems facing patients at risk of an opioid use disorder or overdose. Addressing the

entire clinical picture, including co-occurring substance use and other medical issues or associated health behaviors, will be necessary to end the prescription opioid epidemic and prevent another one from unfurling in the future.

Declaration of interest

The author reports no conflicts of interest. The author alone is responsible for the content and writing of this paper.

References

1. Nelson LS, Juurlink DN, Perrone J. Addressing the opioid epidemic. *JAMA*. 2015;314(14):1453-1454. doi:10.1001/jama.2015.12397.
2. Schmitz A. Benzodiazepine use, misuse, and abuse: a review. *Ment Health Clin*. 2016;6(3):120-126.
3. Guy GP, Zhang K, Bohm MK, et al. Vital signs: changes in opioid prescribing in the United States, 2006–2015. *MMWR Morbid Mortal W*. 2017;66(26):697-704. doi:C10.15585/mmwr.mm6626a4.
4. Rudd RA, Seth P, David F, Scholl L. Increases in drug and opioid-involved overdose deaths — United States, 2010–2015. *MMWR Morbid Mortal W*. 2016;65(5051):1445-1452.
5. Seth P, Scholl L, Rudd RA, Bacon S. Overdose deaths involving opioids, cocaine, and psychostimulants — United States, 2015–2016. *MMWR Morbid Mortal W*. 2018;67(12):349-358.
6. Han B, Compton WM, Jones CM, Cai R. Nonmedical prescription opioid use and use disorders among adults aged 18 through 64 years in the United States, 2003-2013. *JAMA*. 2015 Oct 13;314(14):1468-78.
7. Sung, H. E., Richter, L., Vaughan, R., Johnson, P. B., & Thom, B. (2005). Nonmedical use of prescription opioids among teenagers in the United States: Trends and correlates. *Journal of Adolescent Health*, 37(1), 44-51.
8. Becker WC, Sullivan LE, Tetrault JM, Desai RA, Fiellin DA. Non-medical use, abuse and dependence on prescription opioids among US adults: psychiatric, medical and substance use correlates. *Drug Alcohol Depen*. 2008 Apr 1;94(1):38-47.

9. Han B, Compton WM, Blanco C, Crane E, Lee J, Jones CM. Prescription opioid use, misuse, and use disorders in U.S. adults: 2015 National Survey on Drug Use and Health. *Ann Intern Med.* 2017;167(5):293.
10. Castle IJ, Dong C, Haughwout SP, White AM. Emergency department visits for adverse drug reactions involving alcohol: United States, 2005 to 2011. *Alcohol Clin Exp Res.* 2016 Sep;40(9):1913-25.
11. National Institute on Alcohol Abuse and Alcoholism (NIAAA) Harmful interactions: mixing alcohol with medicines. NIAAA, National Institutes of Health; Bethesda, MD.: 2014. NIH Publication No. 13-5329
[http://pubs.niaaa.nih.gov/publications/Medicine/Harmful Interactions.pdf](http://pubs.niaaa.nih.gov/publications/Medicine/Harmful_Interactions.pdf). Accessed May 8, 2018.
12. Deering DEA, Adamson SJ, Sellman JD, et al. Potential risk for fatal drug overdose perceived by people using opioid drugs. *Drug Alcohol Rev.* 2017;37:S309-S313.
13. Jones JD, Mogali S, Comer SD. Polydrug abuse: A review of opioid and benzodiazepine combination use. *Drug Alcohol Depen.* 2012;125(1-2):8-18.
14. Bouvier BA, Waye KM, Elston B, Hadland SE, Green TC, Marshall BD. Prevalence and correlates of benzodiazepine use and misuse among young adults who use prescription opioids non-medically. *Drug Alcohol Depen.* 2018;183:73-77.
15. National Institute of Drug Abuse. National Survey on Drug Use and Health: Trends in prevalence of various drugs for ages 12 or older, ages 12 to 17, ages 18 to 25, and ages 26 or older; 2015 – 2016. <https://www.drugabuse.gov/national-survey-drug-use-health>. Accessed May 11, 2018.

16. Davis MA, Lin LA, Liu H, Sites BD. Prescription opioid use among adults with mental health disorders in the United States. *J Am Board Fam Med.* 2017;30(4):407-417.
17. Reyes-Gibby CC, Anderson KO, Todd KH. Risk for opioid misuse among emergency department cancer patients. *Acad Emerg Med.* 2016;23(2):151-158.
18. Kuramoto SJ, Chilcoat HD, Ko J, Martins SS. Suicidal ideation and suicide attempt across stages of nonmedical prescription opioid use and presence of prescription opioid disorders among US adults. *J Stud Alc Drg.* 2012 Mar;73(2):178-84.
19. Substance Abuse and Mental Health Services Administration. Behavioral Health Barometer: United States, Volume 4: Indicators as measured through the 2015 National Survey on Drug Use and Health and National Survey of Substance Abuse Treatment Services. HHS Publication No. SMA-17-BaroUS-16. Rockville, MD: Substance Abuse and Mental Health Services Administration: 2017. Accessed May 10, 2018.
20. Subbaraman MS, Kerr WC. Simultaneous versus concurrent use of alcohol and cannabis in the National Alcohol Survey. *Alcohol Clin Exp Res.* 2015;39(5):872-879.
21. Center for Behavioral Health Statistics and Quality. *2016 National Survey on Drug Use and Health.* <https://www.samhsa.gov/data/sites/default/files/NSDUH-MethodSummDefs-2016/NSDUH-MethodSummDefs-2016.htm>. Accessed April 6, 2018.
22. Terry-Mcelrath YM, O'Malley PM, Johnston LD. Simultaneous alcohol and marijuana use among US high school seniors from 1976 to 2011: trends, reasons, and situations. *Drug Alcohol Depen.* 2013;133(1):71-79.
23. Des Jarlais DC, Arasteh K, Perlis T, Hagan H, Heckathorn DD, Mcknight C, Bramson H, Friedman SR. The transition from injection to non-injection drug use: long-term outcomes among heroin and cocaine users in New York City. *Addiction.* 2007 May;102(5):778-85.

24. Sobell, L. C., Brown, J., Leo, G. I., & Sobell, M. B. (1996). The reliability of the Alcohol Timeline Followback when administered by telephone and by computer. *Drug & Alcohol Dependence*, 42(1), 49-54.
25. Robinson, S. M., Sobell, L. C., Sobell, M. B., & Leo, G. I. (2014). Reliability of the Timeline Followback for cocaine, cannabis, and cigarette use. *Psychology of Addictive Behaviors*, 28(1), 154-162.
26. Hughes A, Williams MR, Lipari RN, Bose J, Copello EA, Kroutil LA. Prescription drug use and misuse in the United States: Results from the 2015 National Survey on Drug Use and Health. NSDUH Data Review. 2016 Sep:A1-24.
27. Verheul R. Co-morbidity of personality disorders in individuals with substance use disorders. *European Psychiatry*. 2001 Aug 1;16(5):274-82.
28. Bogdanowicz KM, Stewart R, Broadbent M, Hatch SL, Hotopf M, Strang J, Hayes RD. Double trouble: Psychiatric comorbidity and opioid addiction—all-cause and cause-specific mortality. *Drug Alcohol Depen*. 2015;148:85-92.
29. Lipari RN, Hughes A. *How people obtain the prescription pain relievers they misuse*. The CBHSQ Report: January 12, 2017. Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration, Rockville, MD.
30. Jones CM, Paulozzi LJ, Mack KA. Sources of prescription opioid pain relievers by frequency of past-year nonmedical use: United States, 2008-2011. *JAMA internal medicine*. 2014;174(5):802-3.
31. Hoggatt KJ, Lehavot K, Krenek M, Schweizer CA, Simpson T. Prevalence of substance misuse among US veterans in the general population. *Am J Addict*. 2017;26(4):357-365.

32. Fazel S, Yoon IA, Hayes AJ. Substance use disorders in prisoners: an updated systematic review and meta-regression analysis in recently incarcerated men and women. *Addiction*. 2017;112(10):1725-1739.
33. Holton D, White E, McCarty D. (2018). Public health policy strategies to address the opioid epidemic [published online January 31, 2018]. *Clin Pharmacol Ther*.
<https://doi.org/10.1002/cpt.992>
34. Dart RC, Iwanicki JL, Dasgupta N, Cicero TJ, Schnoll SH. Do abuse deterrent opioid formulations work?. *J Pain Res Manag*. 2017;13(6):365-378.
35. Hwang CS, Janda KD. A vision for vaccines: combating the opioid epidemic. *Biochemistry-US*. 2017;56(42):5625-5627.

Table 1. Prevalence and demographic correlates of non-medical prescription drug and other substance use (Unweighted $N = 26,033$).

	Total sample	Opioid only 0.6% ($N = 214$)	Opioid + licit drug (cigarette or alcohol) 0.6% ($N = 158$)	Opioid + illicit drug (marijuana or other) 0.7% ($N = 186$)	Opioid + polydrug 0.7% ($N = 264$)	Drug use only 97.5% ($N = 25,211$)
	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)
Age						
12-17	9.2 (0.1)	12.3 (2.0)	2.8 (1.0)	7.7 (1.6)	6.6 (1.2)	2.3 (0.1)
18-25	12.8 (0.2)	10.4 (2.0)	10.0 (2.6)	28.1 (4.4)	25.4 (2.9)	14.3 (0.3)
26 or older	77.9 (0.2)	77.3 (2.9)	87.2 (2.9)	64.2 (5.0)	68.0 (3.1)	83.4 (0.3)
Race						
White	63.4 (0.4)	62.9 (5.2)	76.8 (5.4)	76.8 (4.0)	71.3 (3.6)	70.3 (0.5)
Black	12.0 (0.3)	12.6 (3.1)	8.6 (2.9)	8.9 (2.2)	10.8 (2.8)	9.9 (0.3)
Hispanic	16.5 (0.3)	19.8 (3.8)	12.5 (4.1)	10.4 (3.0)	14.6 (2.4)	13.5 (0.4)
Asian	5.4 (0.2)	0.6 (0.6)	0.6 (0.6)	0.5 (0.3)	0.1 (0.1)	3.6 (0.2)
AI/AN	0.6 (0.1)	0.5 (0.3)	0.6 (0.4)	--	1.1 (0.8)	0.5 (0.1)
Hawaiian/PI	0.4 (0.1)	0.2 (0.2)	0.2 (0.2)	0.7 (0.7)	0.1 (0.1)	0.4 (0.1)
2 or more	1.8 (0.1)	3.5 (1.3)	0.8 (0.5)	2.7 (0.6)	2.1 (0.7)	1.8 (0.1)
Gender						
Female	51.5 (0.3)	54.4 (5.5)	58.9 (5.0)	38.2 (4.1)	41.3 (4.1)	48.2 (0.4)
Male	48.5 (0.3)	45.6 (5.5)	41.1 (5.0)	61.8 (4.1)	58.7 (4.1)	51.8 (0.4)
Income						
<\$20k	16.8 (0.3)	31.1 (5.4)	16.0 (3.7)	21.8 (4.1)	30.8 (4.4)	14.1 (0.4)
\$20k-\$39,999	29.8 (0.3)	28.9 (4.1)	30.4 (5.0)	41.7 (5.3)	38.0 (4.3)	26.4 (0.5)
\$40k-\$74,999	15.8 (0.3)	14.5 (3.9)	17.9 (4.9)	13.4 (3.1)	14.2 (3.0)	15.9 (0.4)
$\geq 75k$	37.5 (0.5)	25.5 (4.4)	35.7 (6.3)	23.1 (3.5)	16.9 (2.9)	43.7 (0.6)

Note: Percentages are weighted, N's are not. Percents may not add up to 100 due to rounding error. MDE = major depressive episode. Dashes represent suppression of estimates where power was too small for estimation or the data failed NSDUH suppression rule.

Table 2. Demographic correlates of past month prescription opioid and comorbid substance use (reference outcome = past month recreational drug use only—no prescription opioid use).

	Opioid only		Opioid + licit drug		Opioid + illicit drug		Opioid + polydrug	
	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Gender								
Female	Ref	--	Ref	--	Ref	--	Ref	--
Male	0.84	0.56, 1.25	0.67	0.41, 1.08	1.63 [^]	1.09, 2.44	1.46 [^]	1.04, 2.04
Age								
12-17	5.17**	3.38, 7.90	1.19	0.58, 2.46	4.52**	2.75, 7.40	3.47**	2.20, 5.48
18-25	0.60 [^]	0.37, 0.98	0.64	0.39, 1.06	2.29**	1.50, 3.50	1.70*	1.16, 2.48
26 or older	Ref	--	Ref	--	Ref	--	Ref	--
Race								
White	0.76	0.43, 1.37	1.20	0.57, 2.52	2.03 [^]	1.05, 3.94	1.35	0.88, 2.08
Black	0.79	0.40, 1.55	0.88	0.33, 2.36	1.20	0.54, 2.67	0.98	0.52, 1.82
Hispanic	Ref	--	Ref	--	Ref	--	Ref	--
Other	0.24 [^]	0.07, 0.78	0.34	0.09, 1.26	0.43	0.10, 1.80	0.34	0.10, 1.16
Two or more	1.15	0.50, 2.67	0.47	0.11, 1.92	1.96	0.70, 5.54	1.04	0.44, 2.44
Income								
<\$20k	2.47 [^]	1.24, 4.92	1.11	0.51, 2.40	1.73	0.86, 3.50	2.38*	1.35, 4.19
\$20k-\$39,999	1.17	0.62, 2.23	1.06	0.52, 2.16	1.86	0.94, 3.59	1.58	0.92, 2.71
\$40k-\$74,999	Ref	--	Ref	--	Ref	--	Ref	--
>75k	0.65	0.33, 1.29	0.72	0.36, 1.45	0.61	0.30, 1.22	0.42*	0.24, 0.75

[^]p<0.05, *p<0.01, **p<0.001. RRR = Relative Risk Ratio, 95% CI = 95% confidence interval. MDE = major depressive episode. Alcohol or cigarette use collapsed into single category of 'Opioid + licit drug' and marijuana or hard drug use collapsed into single category of 'Opioid + illicit drug.'

Table 3. Association between past month opioid and comorbid substance use with other social and behavioral health indicators in past 12 months controlling for age, gender, race/ethnicity, and income (referent group = past month recreational drug use only – no opioid use).

	Stole property worth \$50 or more		Sold illegal drugs		Had a sexually transmitted disease		Any thoughts or plans of suicide		Major depressive episode		Needed treatment of alcohol or drug use	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Prescription opioid use profile												
Drug use, no opioid	Ref	--	Ref	--	Ref	--	Ref	--	Ref	--	Ref	--
Opioid only	2.65 [^]	1.18, 5.96	2.06	0.73, 5.81	2.61	0.99, 6.85	2.82 ^{**}	1.65, 4.80	3.34 ^{**}	2.01, 5.55	3.03 ^{**}	1.99, 4.61
Opioid + licit drug	7.93 ^{**}	2.86, 22.04	3.46 [^]	1.10, 10.85	0.96	0.29, 3.13	2.20 [*]	1.22, 3.97	3.63 ^{**}	1.93, 6.83	7.92 ^{**}	4.88, 12.86
Opioid + illicit drug	4.07 ^{**}	2.15, 7.68	7.63 ^{**}	4.58, 12.73	1.75	0.75, 4.07	1.89 [^]	1.11, 3.20	2.87 ^{**}	1.73, 4.77	8.57 ^{**}	5.60, 13.12
Opioid + polydrug	8.90 ^{**}	5.22, 15.19	13.06 ^{**}	8.69, 19.62	3.84 [*]	1.72, 8.58	3.00 ^{**}	1.93, 4.66	3.72 ^{**}	2.34, 5.91	16.75 ^{**}	11.27, 24.89

[^]p=0.05, ^{*}p<0.01, ^{**}p<0.001. AOR = Adjusted Odds Ratio, 95% CI = 95% confidence interval. Alcohol or cigarette use collapsed into single category of ‘Opioid + licit drug’ and marijuana or hard drug use collapsed into single category of ‘Opioid + illicit drug.’ The suicidal ideation item was only assessed among adult respondents.

Figure 1. Source of prescription pain medication comparing opioid only users to opioid and comorbid substance users. Asterisks indicate a significant ($p < 0.05$) chi-square of independence test.

