Medical Use and Misuse of Prescription Opioids in US 12th-Grade Youth: School-Level Correlates

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abstract

BACKGROUND AND OBJECTIVES: Opioid misuse and overdose remains a leading US public health concern, and many youth are first exposed to opioids via medical use. In this study, we examine school-level prevalence and correlates of medical use and misuse of prescription opioids among US 12th-grade students.

METHODS: A sample of 228 507 US 12th-graders in 1079 public and private schools from 2002 to 2017 from the Monitoring the Future study was used to identify school-level prevalence and correlates associated with medical use and misuse of prescription opioids.

RESULTS: The past-year prevalence of prescription opioid misuse was 7.6% and ranged from 0% to 73% across US high schools. Lifetime medical use of prescription opioids was 16.9% and ranged from 0% to 85% across US high schools. The odds of prescription opioid misuse were higher at schools with higher proportions of male students, more white students, higher rates of marijuana use, and more medical use of prescription opioids. Students attending schools with the highest rates of medical use of prescription opioids had 57% increased odds of past-year prescription opioid misuse compared with schools with no medical use (adjusted odds ratio = 1.57, 95% confidence interval = 1.35–1.83); this association was found to weaken in recent years.

CONCLUSIONS: Differences exist in the prevalence of prescription opioid misuse among US high schools. The association between greater school-level medical use of prescription opioids and higher prevalence of prescription opioid misuse, although declining, indicates a key risk factor to target for prevention efforts.

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WHAT'S KNOWN ON THIS SUBJECT: Prescription opioid misuse remains a major public health concern in the United States. To date, no researchers have assessed the school-level prevalence and correlates associated with medical use and misuse of prescription opioids among US adolescents.

WHAT THIS STUDY ADDS: We show that greater rates of medical use of prescription opioids within schools is directly associated with higher prevalence of prescription opioid misuse among students. School-level assessments should be used to guide prevention efforts to reduce prescription opioid misuse.

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Prescription opioids are one of the most used and misused controlled substances among US adolescents and young adults.[1] Approximately 1 in every 3 young adults (aged 18–25 years) and 1 in every 5 adolescents (aged 12–17 years) report past-year medical use or misuse of prescription opioids.[2] Although prescription opioids are highly efficacious when used appropriately, the risks associated with prescription opioid misuse (POM) concern public health experts.[3–11] Despite declines in the prevalence of POM since 2015 among adolescents and adults, there remain tremendous concerns regarding acute and long-term adverse health effects associated with POM.[1] This is evidenced by significant rises in emergency department visits and overdoses involving POM in the past decade.[3–7] Long-term consequences such as substance use disorders, health problems, and poor functional outcomes are among the most concerning risks associated with POM.[9–11]

Previous researchers have demonstrated significant differences in alcohol, tobacco, and marijuana use by school-level characteristics, yet little is known about the school-level contextual factors associated with POM among US adolescents, such as racial composition (eg, percentage of white students in a school), urbanicity (urban versus rural), or school type (public versus private).[12–15] Additionally, although evidence exists in which peers are shown as the leading source of POM among US adolescents, there has been no research examining medical availability of prescription opioids at the school level (ie, percentage of students in a school who are prescribed opioids) as a potential correlate of POM.[16–19] The variation in POM prevalence across US secondary schools and how such variation relates to school-level correlates remain unknown. School-level correlates of POM may shed light on important modifiable influences associated with POM.

To address existing knowledge gaps, in the current study, we used data from the Monitoring the Future (MTF) study, a multicohort survey of nationally representative samples of US secondary school students attending public and private schools, to improve our understanding of school-level prevalence and correlates of POM. Our main objectives in this study were to (1) examine school-level prevalence of medical use of prescription opioids and POM from 2002 to 2017 and (2) determine the correlates of POM in terms of school-level characteristics (eg, public versus private, urban versus rural, percentage of students prescribed opioids) and individual-level characteristics (eg, demographic characteristics, substance use behaviors).

METHODS

Study Design

The MTF study is an annual survey with a nationally representative sample of 12th-grade students in US secondary schools since 1975.[5] The MTF study uses a 3-stage sampling procedure that yields an overall cross-sectional sample of roughly 130 public and private schools, with ~15 000 12th-grade students each year. The survey is a self-administered paper-and-pencil questionnaire completed in the respondents' classrooms. The average 12th-grade student response rate for the MTF is 82.5%. The MTF project design, protocol, and sampling methods are described in greater detail elsewhere.[5]

In the current study, we used MTF data from 2002 to 2017. Questions regarding medical use of prescription opioids and POM were updated in 2002; because of these changes, the current study had 2002 as the initial year of the analytic sample. The 2002 to 2017 sample was composed of 228 507 students in 1079 unique public and private schools. The average number of 12th-grade students who participated per school was 113 students (SD = 71.4). Students within each school were randomly assigned to 1 of 6 possible survey forms to cover a wide range of topics and relieve respondent burden. With 1 exception, all variables used in this analysis were on all 6 forms; lifetime prescribed medical use of opioids was asked on only 1 of the 6 forms. Thus, the total number of respondents for the analytic sample was 38 238 when assessing individual-level lifetime medical use.

Measures

Individual-level measures

Past-year POM was determined by asking 12th-grade respondents, "On how many occasions (if any) have you taken narcotics other than heroin on your own–that is, without a doctor telling you to take them during the last 12 months?" Respondents were provided a list of brand and generic examples of prescription opioids (eg, Vicodin, OxyContin, codeine). The 7 response options ranged from "0 occasions" to "40 or more occasions." For analysis, the responses were recoded as a binary variable that indicated "no past-year POM" versus "past-year POM." Lifetime medical use of prescription opioids was determined by asking respondents "Have you ever taken any narcotics other than heroin because a doctor told you to use them?" The 3 response options included the following: "no," "yes, but I had already tried them on my own," and "yes, and it was the first time I took any." Medical use responses were recoded as a binary variable.

Binge drinking was measured by asking respondents to indicate, regarding the last 2 weeks, "How many times have you had five or more drinks in a row?" Response options ranged from "None" to "'Ten

or more times." Cigarette smoking was measured by having respondents indicate "How frequently have you smoked cigarettes during the past 30 days?" Response options ranged from "Not at all" to "Two packs or more per day." Marijuana use was measured by having respondents indicate "On how many occasions have you used marijuana (weed, pot) or hashish (hash, hash oil)…during the last 30 days?" Response options ranged from "0 occasions" to "40 or more occasions." All substance use variables were recoded as binary variables.

Individual-level sociodemographic characteristics included several measures such as sex (male versus female), race and ethnicity (white Non-Hispanic versus other race), highest level of parental education (at least 1 parent has a college degree or higher versus no parents have a college degree), and grade point average (average grade of a C+ or lower versus average grade of a B− or higher). These individual-level characteristics can be found in Table 1.

School-level measures

School-level characteristics were determined with a set of questions aimed at both the school level and aggregated from measures at the individual level (12th-grade students), consistent with previous work.[14,15,17] The school-level items included public or private, urbanicity (ie, rural, suburban, urban), region (ie, Northeast, Midwest, South, West), and school size (based on the number of students sampled within schools as determined by school size).

As shown in Table 2, the school-level demographic characteristics that were aggregated from the individual-level measures included the percentage of the 12th-grade student body with a C+ or lower, percentage who was male, percentage with at least 1 parent with a college degree or higher, and percentage who was white. Aggregated measures were equally divided into tertiles to have adequate sample sizes at the school level (Table 2).

School-level substance use was determined from individual-level variables and included the percentage of the 12th-grade student body who engaged in past-year POM, indicated lifetime medical use of prescription opioids, engaged in binge drinking during the past 2 weeks, used cigarettes during the past month, and used marijuana during the past month. The aggregated measures were equally divided into tertiles (Table 2). Cohort year (ie, survey conducted in 2002–2005, 2006–2009, 2010–2013, or 2014–2017) was an additional covariate included at the individual and school-level.

Data Analysis

All analyses were design-based, fully accounting for the MTF sampling weights and complex sampling design when estimating parameters for the target MTF individual-level population. Schools were the primary sampling unit and were used to correct for the clustering of students within schools. First, we performed descriptive statistics assessing the

TABLE 1 Demographics for Individual-Level Characteristics

N = 228 507	*n* (%)
Sex	
Female	109 197 (51.4)
Male	103 210 (48.6)
Race and ethnicity	
White	139 724 (61.7)
Other race	88 783 (38.3)
Parental education	
Less than a BA	99 693 (48.9)
BA or higher	111 003 (51.1)
Grade point average	
B− or higher	177 625 (82.8)
C+ or lower	35 855 (17.2)
Binge drinking	
No	160 383 (76.4)
Yes	50 831 (23.6)
Cigarette use	
No	179 747 (81.0)
Yes	41 553 (19.0)
Marijuana use	
No	170 824 (78.9)
Yes	46 583 (21.1)
Medical use, lifetime[a]	
No	28 770 (82.9)
Yes	5825 (17.1)
POM, past year	
No	199 809 (92.1)
Yes	16 951 (7.9)
Cohort year	
2002–2005	59 344 (26.0)
2006–2009	58 791 (25.7)
2010–2013	57 505 (25.2)
2014–2017	52 867 (23.1)

The following items had missing data: sex (7.0% missing across the 12th-grade sample), highest level of parental education (7.8% missing across the 12th-grade sample), grade point average (6.6% missing across the 12th-grade sample), past 2 wk binge drinking (7.6% missing across the 12th-grade sample), past 30 d marijuana use (4.9% missing across the 12th-grade sample), past 30 d cigarette use (3.1% missing across the 12th-grade sample), past-year POM (5.1% missing across the 12th-grade sample), and lifetime medical use of prescription opioids (9.5% missing across the 12th-grade sample). BA, bachelor's degree; *n*, unweighted sample size; %, weighted percent (only at the individual level).

[a] Lifetime prescribed medical use of opioids was asked on only 1 of the 6 forms for 12th-graders. Accordingly, the total number of respondents for the analytic sample when specifically assessing individual-level lifetime medical use was 38 238.

TABLE 2 Demographics for School-Level Characteristics

School Level[a] (Aggregated Individual-Level) n = 1079	n (%)
Percentage male	
Low, 0%–46%	222 (33.4)
Medium, 47%–51%	337 (33.2)
High, 52%–100%	520 (33.4)
Percentage white	
Low, 0%–57%	337 (32.6)
Medium, 58%–86%	341 (34.3)
High, 87%–100%	401 (33.1)
Parental education, percent with a BA or higher	
Low, 0%–42%	308 (33.4)
Medium, 43%–58%	356 (33.3)
High, 59%–100%	415 (33.3)
Percentage with low grades, C+ or lower	
Low, 0%–11%	266 (33.0)
Medium, 12%–19%	350 (33.7)
High, 20%–71%	463 (33.3)
Percentage binge drinking	
None, 0%	8 (1.2)
Low, 1%–17%	261 (32.9)
Medium, 18%–27%	348 (33.1)
High, 28%–72%	462 (32.8)
Percentage cigarette use	
None, 0%	6 (1.2)
Low, 1%–14%	282 (33.3)
Medium, 15%–22%	336 (32.7)
High, 23%–75%	455 (32.9)
Percentage marijuana use	
None, 0%	9 (1.9)
Low, 1%–16%	253 (32.7)
Medium, 17%–24%	354 (32.7)
High, 25%–78%	463 (32.7)
Private status	
Public school	915 (84.5)
Private school	164 (15.5)
Urbanicity of school	
City	339 (31.0)
Suburban	417 (39.1)
Rural	323 (29.9)
US Census region	
Northeast	235 (20.9)
Midwest	268 (25.7)
South	370 (34.2)
West	206 (19.2)
School size[b]	
Small, 1–66 students	321 (33.4)
Medium, 67–136 students	362 (33.3)
High, 137 or more	396 (33.3)
Percent medical use of prescription opioids	
None, 0%	120 (18.1)
Low, 1%–14%	232 (29.3)
Medium, 15%–24%	290 (25.6)
High, 25%–85%	437 (27.0)
Percentage POM	
None, 0%	45 (7.2)
Low, 1%–5%	226 (30.8)
Medium, 6%–10%	327 (31.1)
High, 11%–73%	441 (30.9)

[a] Additional school-level information: percentage male, mean = 48.4%, SD = 0.121; percentage white, mean = 64.2%, SD = 0.304; parental education, mean = 51.1%, SD = 0.192; percentage with low grades, mean = 16.5%, SD = 0.097; percentage binge drinking, mean = 23.4%, SD = 0.118; percentage cigarette use, mean = 19.3%, SD = 0.105; percentage marijuana use, mean = 20.4%, SD = 0.098; percentage POM, mean = 7.6%, SD = 0.055; percentage medical prescription opioid use, mean = 16.9%, SD = 0.136.

[b] The minimum number of 12th-grade students in a school was 9, and the maximum number was 483. It should be noted that 10 schools had fewer than 20 sampled respondents. Only 2 schools had <15 sampled respondents.

associations between key school-level characteristics (Table 3) and both past-year POM and lifetime medical use of prescription opioids at the school level. School-level rates of POM and medical use of prescription opioids were treated as continuous measures for this descriptive analysis. Additionally, an examination of the association between individual-level characteristics and both past-year POM and lifetime medical use of prescription opioids was assessed at the individual-level (Table 4). It should be noted that the school-level bivariate analysis did not use the individual-level weights provided by the MTF, given that these weights only reflect the 12th-grade population in the United States and not schools (the MTF does not provide school-level weights). Accordingly, the MTF weights were only used at the individual-level. Second, multivariable logistic regression models were fitted to estimate the association between past-year individual-level POM and the individual- and school-level characteristics. Design-based approaches and robust SEs were used when fitting these models to help correct for bias due to clustering within schools. Accordingly, 3 models were estimated: 1 model was used to assess the association between past-year individual-level POM and individual-level characteristics, a second model was used to assess the association between past-year individual-level POM and school-level characteristics, and a third model included both the individual- and school-level characteristics to predict past-year individual-level POM. Finally, given recent declines in both medical use and misuse of prescription opioids,[4] additional exploratory analyses were used to assess historical variation in the associations between school-level rates of medical use and misuse at both the school- and individual-level through stratifying the analyses by cohort year (ie, 2002–2005,

2006–2009, 2010–2013, 2014–2017). No school-level data were missing. Roughly 19.7% of the analytic sample was excluded in the full multivariable models when assessing past-year individual-level POM due to missing data (Table 5). Models using full information maximum likelihood estimation found similar results. Accordingly, we report results on the models using listwise deletion for simplicity and for ease of replication. Stata 15.0 was used for all analyses.

RESULTS

With regard to the school-level prevalence of past-year POM and lifetime medical use of prescription opioids, there was wide variation across US high schools (Table 2). Across schools, the percentage of the student body who engaged in past-year POM ranged from 0% to 73%, with an average prevalence across schools of 7.6% (SD = 0.055); past-year individual-level prevalence of POM was 7.9% (SE = 0.001). Moreover, the percentage of the student body who engaged in lifetime medical use of prescription opioids ranged from 0% to 85%, with an average across schools of 16.9% (SD = 0.136) and 17.1% (SE = 0.003) at the individual level.

The school-level prevalence of past-year POM across schools differed significantly as a function of several school-level sociocontextual characteristics (Table 3). The school-level prevalence of past-year POM was highest among public schools (7.7%), schools located in suburban areas (8.1%), and schools located in the Midwestern and Western regions of the United States (8.3%). Schools with a high percentage of students who indicated having poor grades (7.9%), who were male (8.5%), having ≥1 parent who obtained a college degree (8.1%), and are white (9.1%) had the highest prevalence of past-year POM.

For lifetime medical use of prescription opioids, school-level prevalence was highest among private schools (19.5%), schools located in suburban areas (18.3%), schools located in the Midwestern and Western regions of the United States (19.0% and 18.1%, respectively), schools with a low percentage of students who indicated having poor grades (18.7%), schools with a higher percentage of students who were male (18.1%), schools with a high percentage of students who have ≥1 parent who obtained a college degree (20.4%), and schools with a high percentage of students who are white (21.2%).

Schools with a high prevalence of binge drinking, cigarette smoking, and marijuana use had the highest school-level prevalence of past-year POM and lifetime medical use of prescription opioids (Table 3). Schools with the highest levels of lifetime medical use of prescription opioids also had the highest school-level prevalence of past-year POM (10.2%). Similarly, schools with the highest levels of past-year POM had the highest school-level lifetime medical use of prescription opioids (22.6%).

The prevalence of past-year POM differed significantly as a function of several individual-level characteristics (Table 4). Prevalence of past-year POM was higher for students who were male (9.3%), were white (9.7%), had grade point averages of C+ or below (12.1%), binge drank (20.3%), smoked cigarettes (24.1%), used marijuana (24.7%), and were in earlier MTF cohorts (9.0% and 9.1%). Similarly, the prevalence of lifetime medical use of prescription opioids was higher for students who were female (18.1%), were white (21.4%), had ≥1 parent with a college degree or higher (19.6%), had grade point averages of B− or higher (17.7%), binge drank (24.3%), smoked cigarettes (23.7%), used marijuana (22.9%), and were in earlier MTF cohorts (18.1%).

Multivariable regression analyses confirmed many of the bivariate associations at the individual-level (model 1, Table 5). Only parental level of education failed to reach statistical significance. In particular, individual-level substance use was strongly associated with past-year POM. For instance, the odds of past-year POM was >4 times greater (adjusted odds ratio [aOR] = 4.51; 95% confidence interval [CI] = 4.26–4.77, $P < .001$) among students who reported past-month marijuana use when compared with their peers who did not.

With respect to the school-level characteristics, there were several consistent associations with past-year POM, with and without controlling for individual-level characteristics (models 2 and 3, Table 5). Students who attended schools in suburban areas; schools in the Midwest, South, and West; schools where the majority of students were male (aOR = 1.13, 95% CI = 1.04–1.22); and schools that had the highest percentage of students who were white (aOR = 1.20, 95% CI = 1.08–1.34) had higher odds of POM. Moreover, students who attended schools with a larger percentage of students who reported past-month marijuana use had higher odds of POM compared with students who attended schools where no students engaged in past-month marijuana use. Finally, students who attended schools with the highest rates of lifetime medical use of prescription opioids had ∼1.5 times greater odds of indicating POM during the past year when compared with students who attended schools where no students indicated lifetime medical use of prescription opioids (highest medical use: aOR = 1.57, 95% CI = 1.35–1.83; medium medical use: aOR = 1.37, 95% CI = 1.17–1.60). A sensitivity analysis was conducted to assess the odds of POM among respondents who indicated that their

TABLE 3 School-Level Prevalence of POM and Medical Use of Prescription Opioids by School-Level Characteristics, 2002–2017

School-Level Characteristics (12th Grade)	Past-Year POM,[a] % (95% CI)	P^b	Lifetime Medical Use of Prescription Opioids,[a] % (95% CI)	P^b
Private status		<.05		<.01
Public school	7.7 (7.4–8.0)		16.4 (15.8–17.1)	
Private school	6.8 (6.3–7.4)		19.5 (17.9–21.2)	
Urbanicity of school		<.001		<.001
Urban	6.5 (6.1–6.9)		13.9 (13.0–14.9)	
Suburban	8.1 (7.7–8.5)		18.3 (17.4–19.2)	
Rural	8.0 (7.5–8.5)		18.2 (17.0–19.4)	
School size		.298		.229
Small	7.2 (6.7–7.7)		18.8 (16.5–19.2)	
Medium	7.7 (7.3–8.1)		16.4 (15.5–17.3)	
High	7.8 (7.5–8.1)		16.5 (15.8–17.2)	
US Census region		<.001		<.001
Northeast	7.2 (6.6–7.6)		14.9 (13.7–16.0)	
Midwest	8.3 (7.7–8.8)		19.0 (17.8–20.2)	
South	7.0 (6.6–7.3)		15.9 (14.9–16.9)	
West	8.3 (7.6–8.8)		18.1 (16.7–19.6)	
Percentage with low grades		<.001		<.001
Low	6.9 (6.5–7.3)		18.7 (17.7–19.8)	
Medium	7.9 (7.6–8.3)		17.0 (16.0–18.0)	
High	7.9 (7.4–8.3)		15.0 (14.0–16.1)	
Percentage male		<.001		<.001
Low	6.3 (5.9–6.7)		15.0 (14.0–16.1)	
Medium	8.0 (7.6–8.4)		17.6 (16.6–18.6)	
High	8.5 (8.0–8.9)		18.1 (17.0–19.2)	
Parental education (percentage with a BA or higher)		<.001		<.001
Low	6.7 (6.2–7.1)		12.4 (11.4–13.3)	
Medium	8.0 (7.5–8.4)		17.9 (16.9–19.0)	
High	8.1 (7.7–8.4)		20.4 (19.4–21.4)	
Percentage white		<.001		<.001
Low	4.8 (4.5–5.1)		10.5 (9.7–11.4)	
Medium	8.7 (8.3–9.1)		18.8 (17.9–19.8)	
High	9.1 (8.6–9.5)		21.2 (20.1–22.3)	
Percentage binge drinking		<.001		<.001
None	2.5 (1.3–3.7)		13.9 (7.8–20.1)	
Low	4.7 (4.5–5.0)		13.4 (12.4–14.5)	
Medium	7.9 (7.5–8.2)		17.4 (16.3–18.3)	
High	10.3 (9.8–10.8)		20.1 (19.1–21.1)	
Percentage cigarette use		<.001		<.001
None	2.6 (1.3–3.9)		10.9 (4.6–17.3)	
Low	4.5 (4.2–4.7)		13.9 (12.9–14.9)	
Medium	7.7 (7.4–8.1)		16.8 (15.9–17.8)	
High	10.7 (10.3–11.3)		20.2 (19.1–21.3)	
Percentage marijuana use		<.001		<.05
None	2.1 (1.1–3.1)		17.9 (11.6–24.2)	
Low	5.6 (5.3–6.0)		16.0 (14.9–17.1)	
Medium	7.8 (7.4–8.1)		16.4 (15.5–17.4)	
High	9.6 (9.1–10.1)		18.3 (17.2–19.3)	
Percentage medical use of prescription opioids (lifetime)		<.001		
None	4.8 (4.3–5.3)		—	
Low	6.1 (5.8–6.4)		—	
Medium	8.5 (8.1–8.9)		—	
High	10.2 (9.6–10.7)		—	
Percentage POM (past-year)				<.001
None	—		10.3 (7.7–12.8)	
Low	—		12.2 (11.2–13.2)	
Medium	—		17.4 (16.4–18.4)	
High	—		22.6 (21.6–23.6)	

BA, bachelor's degree; —, not applicable.

[a] Percentage POM, mean = 7.6%, SD = 0.055; percentage medical use of prescription opioids, mean = 16.9%, SD = 0.136.

[b] F-test *P* values indicate whether rates of POM and medical use of prescription opioids significantly vary by school-level characteristics.

TABLE 4 Prevalence of POM and Medical Use of Prescription Opioids by Individual-Level Characteristics, 2002–2017

Individual-Level Characteristics	Past-Year POM, % (95% CI)	χ^2 P^a	Lifetime Medical Use of Prescription Opioids, % (95% CI)	χ^2 P^a
Sex		<.001		<.001
Female	6.6 (6.3–6.9)		18.1 (17.3–18.9)	
Male	9.3 (8.8–9.6)		16.0 (15.2–16.9)	
Race and ethnicity		<.001		<.001
White, non-Hispanic	9.7 (9.3–10.0)		21.4 (20.6–22.2)	
Other race	4.7 (4.4–4.9)		9.1 (8.4–9.8)	
Highest parental education		.759		<.001
Less than a BA	8.0 (7.6–8.3)		15.1 (14.3–15.9)	
BA or higher	8.0 (7.7–8.4)		19.6 (18.8–20.5)	
Grade point average		<.001		<.001
B− or higher	7.0 (6.7–7.3)		17.7 (17.0–18.4)	
C+ or lower	12.1 (11.5–12.8)		14.9 (13.7–16.2)	
Binge drinking		<.001		<.001
No	4.1 (4.0–4.3)		15.6 (15.0–16.3)	
Yes	20.3 (19.6–21.0)		24.3 (22.9–25.6)	
Cigarette use		<.001		<.001
No	4.2 (4.0–4.4)		15.8 (15.1–16.4)	
Yes	24.1 (23.4–24.9)		23.7 (22.4–25.1)	
Marijuana use		<.001		<.001
No	3.5 (3.4–3.7)		15.7 (15.1–16.4)	
Yes	24.7 (23.8–25.6)		22.9 (21.7–24.2)	
Medical use of prescription opioids, lifetime		<.001		
No	3.2 (3.0–3.5)		—	
Yes	26.6 (25.2–28.1)		—	
POM, past-year				<.001
No	—		13.4 (12.9–14.0)	
Yes	—		62.4 (60.2–64.7)	
Cohort year		<.001		<.001
2002–2005	9.0 (8.4–9.7)		18.1 (16.8–19.3)	
2006–2009	9.1 (8.5–9.7)		17.3 (16.1–18.6)	
2010–2013	8.1 (7.6–8.6)		17.9 (16.7–19.3)	
2014–2017	5.1 (4.7–5.5)		14.6 (13.4–15.8)	

BA, bachelor's degree; —, not applicable.

[a] χ^2 P values indicate differences in prevalence rates of POM and medical use of prescription opioids by individual-level characteristics.

first time using opioids was medical use, with no previous misuse (Supplemental Table 6). In this analysis, it was found that higher rates of lifetime medical use at the school level, excluding reports of misuse previous to medical use, are associated with an increased risk of individual-level POM. Moreover, additional analyses (Supplemental Table 7) that include a covariate for individual-level lifetime medical use of prescription opioids (aOR = 9.25, 95% CI = 8.11–10.5) did not alter results with respect to the variable assessing school-level rates of lifetime medical use of prescription opioids (medium: aOR = 1.69, 95% CI = 1.12–2.54; highest: aOR = 1.70, 95% CI = 1.14–2.53) when predicting past-year POM.

An exploratory analyses that stratified the analyses by cohort years (ie, 2002–2005, 2006–2009, 2010–2013, and 2014–2017) found similar bivariate results with respect to the combined sample. Schools with the highest levels of lifetime medical use of prescription opioids also have the highest school-level prevalence of past-year POM. Similarly, schools with the highest levels of past-year POM also had the highest school-level lifetime medical use of prescription opioids. However, school-level POM declined substantially within schools with low, medium, and high rates of medical use of prescription opioids in the 2014 to 2017 cohorts (Supplemental Tables 8–12).

The stratified multivariable regression analyses by cohort years confirmed that respondents who attended schools with higher rates of lifetime medical use of prescription opioids had greater odds of past-year POM for the 2002 to 2005, 2006 to 2009, and 2010 to 2013 cohorts when controlling for key individual- and school-level characteristics (Supplemental Tables 13–16). However, the association between school-level rates of medical use and individual-level POM was not significant for the 2014 to 2017 cohorts (Supplemental Table 16). For instance, for the 2002 to 2005 cohort, students who attended schools with the highest rates of lifetime medical use of prescription opioids had ~2 times greater odds of indicating POM during the past year when compared with students who attended schools where no students indicated lifetime medical use of prescription opioids (highest medical use: aOR = 2.13, 95% CI = 1.66–2.74; medium medical use: aOR = 1.79, 95% CI = 1.40–2.29; low medical use: aOR = 1.75, 95% CI = 1.35–2.27). However, these differences in the odds of POM were nonsignificant between these 4 school-level medical opioid groups for the 2014 to 2017 cohort (highest medical use: aOR = 1.06, 95% CI = 0.792–1.43; medium medical use: aOR = 1.05, 95% CI = 0.797–1.39; low medical use: aOR = 0.860, 95% CI = 0.659–1.12; reference group was no medical use). Finally, it should be highlighted that interaction effects between cohort year and the different levels of medical prescription opioid use (Supplemental Table 17) confirmed the stratified results. In particular, the association between individual-level POM and different levels of medical opioid use at the school-level for both

TABLE 5 Correlates of Individual-Level POM by Individual- and School-Level Characteristics

	Past-Year POM (Individual-Level Correlates Only), Model 1 (n = 183 479), aOR (95% CI)	Past-Year POM (School-Level Correlates Only), Model 2 (n = 216 757), aOR (95% CI)	Past-Year POM (Full Model), Model 3 (n = 183 479), aOR (95% CI)
Individual level			
Sex			
Female	Reference	—	Reference
Male	1.13 (1.07–1.18)***	—	1.10 (1.05–1.15)***
Race and ethnicity			
White	Reference	—	Reference
Nonwhite	0.568 (0.530–0.610)***	—	0.630 (0.589–0.675)***
Highest parental education			
Less than a BA	Reference	—	Reference
BA or higher	0.973 (0.926–1.02)	—	0.966 (0.921–1.01)
Grade point average			
B− or higher	Reference	—	Reference
C+ or lower	1.22 (1.15–1.29)***	—	1.21 (1.14–1.28)***
Binge drinking			
No	Reference	—	Reference
Yes	2.10 (1.99–2.21)***	—	2.11 (2.01–2.23)***
Cigarette use			
No	Reference	—	Reference
Yes	2.87 (2.70–3.04)***	—	2.85 (2.70–3.02)***
Marijuana use			
No	Reference	—	Reference
Yes	4.51 (4.26–4.77)***	—	4.51 (4.26–4.78)***
Cohort year (individual and school)			
2002–2005	Reference	Reference	Reference
2006–2009	1.14 (1.03–1.26)**	1.09 (1.02–1.17)*	1.14 (1.05–1.25)**
2010–2013	0.999 (0.901–1.10)	0.963 (0.889–1.04)	0.962 (0.872–1.06)
2014–2017	0.709 (0.631–0.797)***	0.787 (0.703–0.881)***	0.743 (0.654–0.845)***
School level			
Private status			
Public school	—	Reference	Reference
Private school	—	0.977 (0.883–1.08)	0.969 (0.860–1.09)
Urbanicity of school			
Urban	—	Reference	Reference
Suburban	—	1.08 (1.01–1.15)*	1.11 (1.02–1.21)**
Rural	—	1.05 (0.976–1.14)	1.10 (1.00–1.22)*
School size			
Small	—	Reference	Reference
Medium	—	0.982 (0.901–1.07)	1.00 (0.903–1.11)
High	—	0.935 (0.857–1.02)	0.969 (0.872–1.07)
US Census region			
Northeast	—	Reference	Reference
Midwest	—	1.10 (1.01–1.21)*	1.14 (1.02–1.27)*
South	—	1.19 (1.09–1.29)***	1.29 (1.16–1.42)***
West	—	1.37 (1.24–1.52)***	1.54 (1.37–1.74)***
Percentage with low grades			
Low	—	Reference	Reference
Medium	—	1.06 (0.991–1.14)	1.04 (0.957–1.13)
High	—	1.07 (0.991–1.16)	1.03 (0.935–1.13)
Percentage male			
Low	—	Reference	Reference
Medium	—	1.06 (1.00–1.13)*	1.05 (0.981–1.14)
High	—	1.13 (1.06–1.21)***	1.13 (1.04–1.22)**

the 2010 to 2013 and 2014 to 2017 cohorts were significantly weaker when compared with the 2002 to 2005 cohort.

DISCUSSION

This is the first national study in which school-level prevalence and correlates associated with the medical use and misuse of prescription opioids are examined. With the findings, we provide compelling evidence that there are major differences in the prevalence of medical use and misuse of prescription opioids among US secondary schools. The prevalence of past-year POM across secondary schools varied considerably, from 0% to 73%. Based on the variation found between schools, the findings in the current study suggest that schools work with professionals to obtain school-level assessments rather than relying solely on state or national assessments to guide prevention efforts.

The robust association between school-level medical use of prescription opioids and POM is consistent with evidence showing the largest sources of prescription opioids among adolescents are peers and leftover medication.[1,5,18,19] Moreover, the majority of POM is motivated by a desire to relieve physical pain, and adolescents most often obtain prescription opioids from friends at the same school or their own leftover medication.[1,16,20,21] In the current study, an association of school-level medical use with individual-level POM was also found. These findings reinforce the importance of assessing unique student bodies to guide interventions aimed at reducing POM at the school level, including consideration of screening for pain and appropriate pain management. In addition, prescribers, school health professionals (eg, nurses, social workers), teachers, school

TABLE 5 Continued

	Past-Year POM (Individual-Level Correlates Only), Model 1 (n = 183 479), aOR (95% CI)	Past-Year POM (School-Level Correlates Only), Model 2 (n = 216 757), aOR (95% CI)	Past-Year POM (Full Model), Model 3 (n = 183 479), aOR (95% CI)
Parental education (percentage with a BA or higher)			
Low	—	Reference	Reference
Medium	—	1.03 (0.960–1.10)	1.01 (0.933–1.10)
High	—	1.03 (0.950–1.13)	1.01 (0.915–1.12)
Percentage white			
Low	—	Reference	Reference
Medium	—	1.32 (1.22–1.43)***	1.12 (1.01–1.23)*
High	—	1.46 (1.34–1.60)***	1.20 (1.08–1.34)***
Percentage binge drinking			
None	—	Reference	Reference
Low	—	1.04 (0.673–1.61)	0.811 (0.489–1.34)
Medium	—	1.18 (0.760–1.83)	0.808 (0.486–1.34)
High	—	1.27 (0.815–1.97)	0.762 (0.456–1.27)
Percentage cigarette use			
None	—	Reference	Reference
Low	—	1.41 (0.797–2.50)	1.00 (0.523–1.92)
Medium	—	1.90 (1.07–3.39)*	1.11 (0.578–2.13)
High	—	2.10 (1.18–3.76)*	1.05 (0.547–2.04)
Percentage marijuana use			
None	—	Reference	Reference
Low	—	2.73 (1.75–4.24)***	1.90 (1.14–3.16)*
Medium	—	3.76 (2.42–5.86)***	2.16 (1.29–3.61)**
High	—	4.32 (2.76–6.76)***	2.09 (1.24–3.53)**
Percentage medical use of prescription opioids			
None	—	Reference	Reference
Low	—	1.12 (0.984–1.29)	1.12 (0.969–1.31)
Medium	—	1.34 (1.16–1.54)***	1.37 (1.17–1.60)***
High	—	1.53 (1.33–1.76)***	1.57 (1.35–1.83)***

"Reference" refers to the reference category. Sample sizes vary because of missing data. BA, bachelor's degree; —, variable not included in the model.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

administrators, parents, coaches, and other health professionals in schools with high medical use should install multifaceted prevention programs and disposal programs to address the key modifiable risk factors that can be targeted at the school and community levels. Beneficial school-based programs could educate youth and their families about appropriate medical use, responsible monitoring and storage, safe medication disposal, and the risks of medication diversion.

In the current study, we found that the association between medical use of prescription opioids and POM appears to be weakening in recent years. This decline may be evidence that the increased prevention efforts to address POM have had an impact. The decrease could also indicate that adolescents are turning to more easily obtained substances (eg, marijuana, heroin) as prescription opioids become less available.[5] Regardless, the current study identified multiple school-level influences, particularly marijuana use, that influence POM prevalence. There are other mechanisms (eg, school-level risk perceptions of POM) that are worthy of research attention.

Multivariable regression analyses revealed several school-level variables that were associated with POM after controlling for individual-level variables. The school-level variables associated with higher odds of past-year POM were schools located in nonurban areas, schools located in non-Northeastern geographical regions, schools with a higher proportion of male students, schools with a higher proportion of white students, schools with higher prevalence of marijuana use, and schools with a higher prevalence of lifetime medical use of prescription opioids. We found that US schools with higher proportions of white students were more likely to have a higher prevalence of POM. These findings are in line with a study that found US secondary schools with a majority of Black students typically had the lowest prevalence of substance use at every grade level.[15] The increased risk of POM and medical use of prescription opioids found at schools in less urban areas and non-Northeastern geographical regions is consistent with national patterns in prescription opioid use and misuse.[1,5] The higher rates of POM at schools with a higher proportion of male students is in line with research showing male students are more likely to engage in peer-to-peer diversion (eg, sharing, trading, selling) of prescription opioids with friends from the same school than their female peers.[16] Taken together, these findings reinforce the importance of understanding school-level contextual factors when examining prescription opioid use and misuse among adolescents.

This study has strengths and limitations that should be taken into account when weighing the

implications of the findings. The primary strengths are the large nationally representative samples of public and private secondary schools in the United States, providing large enough samples to estimate school-level prevalence and correlates associated with prescription opioid use and misuse. One limitation is that the MTF study does not include students who were home-schooled, dropped out, or were absent on the day of data collection.[5] Additionally, although the MTF measures are reliable and valid, there is some evidence that adolescents may misclassify or underreport sensitive substance use behaviors.[22] The sole reliance on lifetime medical use of prescription opioids is another limitation that warrants future research with more recent time frames. Finally, we only had 12th-grade respondents to construct aggregate measures, and this could potentially capture peer-, grade- and school-level effects.

CONCLUSIONS

The findings of the current study reveal a wide range in the school-level prevalence of medical use of prescription opioids (0%–85%) and POM (0%–73%) across US secondary schools. Overall, there was a significant association between school-level medical use of prescription opioids and POM; however, the association appears to be weakening in recent years. School-level medical use of prescription opioids is a factor that should be closely monitored and incorporated into preventive and disposal interventions to reduce POM.

ABBREVIATIONS

aOR: adjusted odds ratio
CI: confidence interval
MTF: Monitoring the Future
POM: prescription opioid misuse

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