



Review article

Nonmedical Use of Prescription Medications Among Adolescents in the United States: A Systematic Review

April M. Young, M.P.H.^{a,b,*}, Natalie Glover, M.A.^{b,c}, and Jennifer R. Havens, Ph.D., M.P.H.^b

^a Department of Behavioral Sciences and Health Education, Emory University Rollins School of Public Health, Atlanta, Georgia

^b Center on Drug and Alcohol Research, Department of Behavioral Science, University of Kentucky College of Medicine, Lexington, Kentucky

^c Department of Clinical Psychology, University of Kentucky, Lexington, Kentucky

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 A B S T R A C T

Purpose: The purpose of this review was to systematically summarize research on nonmedical use of prescription medications (NMUPM) among U.S. adolescents, with specific focus on scheduled medications falling into one of the following drug classes: pain relievers, stimulants, sedatives, or tranquilizers.

Methods: Databases were searched for peer-reviewed primary quantitative research published between January 2000 and June 2011 on NMUPM among out-of-treatment U.S. adolescents aged 12–17 years (or age 18 if enrolled in high school).

Results: Thirty publications met inclusion criteria. A total of 25 studies were represented; 15 involved nationally representative samples. The prevalence and correlates of NMUPM varied across studies and by drug class. Nonmedical use of pain relievers was more prevalent than for stimulants, sedatives, and tranquilizers. Female gender was generally associated with pain reliever use and, to a lesser degree, with tranquilizer use. White adolescents also appeared to have a higher prevalence of NMUPM, although there was some evidence to the contrary. Older age, illicit drug use, and delinquency were consistently associated with NMUPM across studies.

Conclusions: This review identified several areas for further research, including that of racially/ethnically diverse samples of adolescents, more focus on sedative and tranquilizer use, and longitudinal research to examine temporal patterns in NMUPM and other illicit drug use, delinquency, and substance abuse and dependence.

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 IMPLICATIONS AND
 CONTRIBUTION

This review highlights several areas for further research. First, longitudinal research is needed to explore the temporality of associations between NMUPM, other illicit drug use, delinquency, and substance abuse and dependence. Research should focus on more ethnically diverse samples of adolescents, and give more attention to sedative and tranquilizer use.

The National Survey on Drug Use and Health (NSDUH) defines nonmedical use of prescription medications (NMUPM) as “use of at least one [prescription-type psychotherapeutic] without a prescription belonging to the respondent, or use that occurred simply for the experience or feeling the drug caused” [1]. It should be noted, however, that there are many definitions of NMUPM. The Drug Enforcement Agency, for example, states, “Abusers of controlled pharmaceuticals are using these medi-

cines for nonmedical purposes in a manner for which they were never intended” [2]. In the past 10 years, numerous studies have explored nonmedical use (NMU) of pain relievers, stimulants, sedatives, and tranquilizers among adolescents. Hundreds of studies appear in response to basic search queries on adolescents and NMUPM, each assessing different classes of drugs and many operationalizing NMUPM in different ways. To our knowledge, there have been four systematic reviews published. One review, published by Wilens et al. [3], focused on NMU of stimulants and included only one study focused solely on adolescents. Two of the other reviews focused on adults (college students [4], adults aged >50 years [5]). Twombly and Holtz provided a review of various types of literature on NMUPM; however, the review was

* Address correspondence to: April M. Young, M.P.H., Department of Behavioral Sciences and Health Education, Emory University Rollins School of Public Health, 1518 Clifton Road, Atlanta, GA 30322.

E-mail address: amyoun2@emory.edu (A.M. Young).

neither systematic nor focused specifically on the academic literature. Rather, the intent was to elucidate the social-ecological context of adolescent NMUPM. The review cited literature from governmental reports, popular media, as well as academic sources to demonstrate influences on adolescents' knowledge and attitudes about NMU of all prescription drugs [6].

Recent studies on adolescent NMUPM suggest that demographic, behavioral, and social correlates of NMU vary considerably by drug class (pain relievers, stimulants, sedatives, and tranquilizers) [7]. Thus, there is a need for a systematic review examining prevalence and correlates of adolescent NMUPM by drug class. The purpose of this review is to provide a thorough systematic overview of the extant literature (published between 2000 and 2011) on NMUPM among out-of-treatment adolescents aged 12–17 years (18-year-old high school seniors were also included). Specifically, the review focuses on NMU of controlled medications falling into one of the four following classes: pain relievers, stimulants, sedatives, or tranquilizers. These classes of drugs are the focus of most nationally representative studies, including those based on NSDUH data. The review discusses prevalence of NMUPM; demographic, behavioral, and social correlates to use; motivations for use; diversion of prescription drugs; sources for prescription drugs; and prescription drug abuse and dependence. This review makes distinctions between nationally representative and non-nationally representative studies and is explicit about the year of data collection, given that temporal trends may influence studies' findings.

Methods

Published manuscripts presenting quantitative data on adolescent NMUPM were sought. Academic Search Premier, CINAHL, MEDLINE, Psychology and Behavioral Sciences Collection, PsycINFO, and Sociological Collection were searched for original quantitative research articles exploring NMUPM among U.S. adolescents aged 12–17 years. School-based studies that included 18-year-old high school seniors were also included. Studies non-inclusive of adolescents in the specified age range or that analyzed combined data from adolescents and children and/or young adults were excluded. Studies examining over-the-counter medications and those focusing on in-treatment populations were also excluded. The review focused specifically on NMU of prescription pain relievers, stimulants, sedatives, and tranquilizers. The search was limited to English-language peer-reviewed manuscripts published between January 2000 and June 2011. The search terms were *adolescen** or *youth* AND *nonmedical use of prescription medications, nonmedical prescription drug abuse, nonmedical prescription drug misuse, [pain reliever AND abuse or misuse], [prescription opioid AND abuse or misuse], [prescription stimulant AND abuse or misuse], [prescription sedative AND abuse or misuse], or [prescription tranquilizer AND abuse or misuse]*. The citations and abstracts identified in the original search were reviewed to identify additional studies meeting the inclusion criteria. After studies were identified, an abstraction form was created to summarize information regarding the research setting, sample characteristics, study design, and key findings. A full demographic description of the studies' samples was not given in most manuscripts. However, gender and race (specifically, white and African American) were reported in most. To elucidate gaps in demographic representation, the average proportion of male/female and white/African American participants across samples is reported. Of note, NMU of

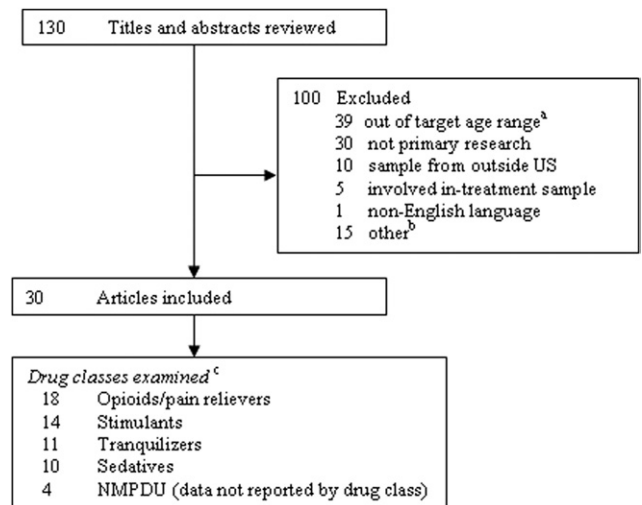


Figure 1. Systematic review of literature from years 2001 to 2011 on adolescent nonmedical use of prescription medications. NMPDU = nonmedical use of prescription medications. ^aStudies were considered to be out of the target age range if they did not include adolescents aged 12–17 years or did not stratify results in a way that conclusions could be drawn about adolescents aged 12–17 years. ^bIncludes studies based on data from nonhuman samples ($n = 3$), poison control centers ($n = 3$), adolescents in juvenile detention ($n = 1$), and insurance claims database ($n = 1$). A pharmacologic study, a case study, a qualitative study, and two studies conducted for the purposes of survey development were also excluded. Two studies that focused solely on over-the-counter drug misuse were also excluded. ^cMost studies examined more than one drug class; therefore, the total number exceeds 30.

pain relievers, stimulants, sedatives, and tranquilizers is hereafter sometimes referred to as pain reliever, stimulant, sedative, and tranquilizer use for the sake of brevity.

Results

Figure 1 describes the articles identified. The original searches yielded 130 citations and abstracts, 100 of which did not meet inclusion criteria; 39 were excluded because study participants were not in the specified age range, 30 were excluded because they were not original research articles (e.g., reviews, editorials, commentaries), 10 were excluded because they were conducted internationally, five because they involved an in-treatment sample, and one because it was not an English-language article. Fifteen were excluded for other reasons (Figure 1). A total of 30 studies were included; all were cross-sectional, except two [8,9].

The search yielded 17 publications based on nationally representative samples (Table 1). Of the 17, 13 were based on NSDUH data; notably, six used 2005 data and three used 2002 data. Three publications involving 2005 NSDUH data were published by one author [13–15] and are hereafter referred to as one study, leaving 15 nationally representative studies. NSDUH data are collected through interview-administered surveys [28]. Other data sources for national studies included the Monitoring the Future (MTF) study [12,23,24] and the National Survey of Adolescents-Replication (NSA-R) [18]. MTF data are collected yearly from students in grades 8, 10, and 12 through self-administered questionnaires [29], and response rates ranged from 82% to 90%. The NSA-R, on the other hand, involved a telephone-administered survey of 3,614 adolescents recruited from a national household probability sample, with a response rate of 54% [18]. Thus, com-

Table 1
Nationally representative studies on NMUPM among U.S. adolescents (age: 12–17 years) published from 2000 to 2011 (in chronological order of year of data collection)

Author	Year, data source	Drugs examined	Correlates to nonmedical use of prescription medications										
			Gender	Older age	Race/ethnicity (-/+ direction of association)	Low income	Poor school performance ^a	Illicit drug use	Peer norms	Parental factors	Delinquency	Other	
Havens et al [10]	2008 NSDUH ^b	NMUPM ^L	M	✓	AA-, H-	ns	✓	✓	-	✓		Rurality, poor self-reported health, major depressive episode	
Wu et al [11]	2005–2006 NSDUH	Pain relievers ^{PY}	F	✓	W+, MR+	ns	✓	-	-	-	-		
McCabe et al [12]	2002–2006 MTF, ^c grade 12	Pain relievers ^{PY,L}	-	-	-	-	-	✓ ^d	-	-	-	Lifetime medical use of prescription pain relievers	
Ford [13–15]	2005 NSDUH	NMUPM ^{PY}	F	✓	ns	✓	-	✓	✓	✓	✓	Living outside of a large metro area, weaker bonds to school	
Schepis and Krishnan-Sarin [16]	2005 NSDUH	Pain relievers ^{PY}	ns	✓	ns	✓	-	✓	✓	✓	✓	Residential instability, recent major depressive episode, past-year mental health treatment, desire for risk taking	
		Stimulants ^{PY}	F	✓	ns	ns	-	✓	ns	✓	✓		
		Sedatives ^{PY}	F	ns	ns	ns	-	✓	ns	✓	✓		
		Tranquilizer ^{PY}	F	✓	W+	✓	-	✓	✓	✓	✓		
		NMUPM ^{PY}	F	✓	AA-, Asian-	-	✓	-	✓	-	✓		✓
		Pain relievers ^{PY}	F	✓	H-, Asian-	-	✓	-	✓	-	✓		✓
		Stimulants ^{PY}	F	✓	AA-, Asian-	-	✓	-	✓	ns	✓		✓
Wu et al [17]	2005 NSDUH	Sedatives ^{PY}	ns	✓	Asian-	-	✓	✓	-	ns	✓	Emergency room use, poor self-reported health, use of mental health services, ^g nonmedical use of stimulants and tranquilizers ^g	
		Tranquilizer ^{PY}	F	✓	AA-, H-, Asian-	-	✓	✓	-	ns	✓		
		Pain relievers ^L	F ^e	✓	W+	✓	✓	✓	-	-	✓ ^f		
		NMUPM ^L	ns	✓	AA-	ns	-	✓	-	-	✓		
McCauley et al [18,19]	2005 NSA-R ^h (n = 3,614)	NMUPM ^L	ns	✓	AA-	ns	-	✓	-	-	✓	Sexual/physical assault, witnessing violence, PTSD	
Simoni-Wastila et al ⁱ [20]	2003 NSDUH	NMUPM ^{PY}	F	✓	ns	ns	ns	✓	-	ns	-	Residential instability, poor health status was negatively associated	
		Pain relievers ^{PY}	ns	✓	ns	ns	✓	✓	-	ns	-		
		Stimulants ^{PY}	ns	ns	W+, AA+, H+	ns	ns	✓	-	ns	-		
		Sedatives ^{PY}	ns	ns	ns	ns	ns	✓	-	ns	-		
		Tranquilizer ^{PY}	F	✓	W+, AA-	ns	ns	✓	-	✓	-		

Table 1
Continued

Author	Year, data source	Drugs examined	Correlates to nonmedical use of prescription medications									
			Gender	Older age	Race/ethnicity (-/+ direction of association)	Low income	Poor school performance ^a	Illicit drug use	Peer norms	Parental factors	Delinquency	Other
Herman-Stahl et al ^j [21]	2002 NSDUH	Stimulants	ns	–	H–	–	–	✓	–	✓		Receipt of mental health treatment, sensation seeking
Sung et al [22]	2002 NSDUH	Pain relievers ^{PY}	F	✓	W+	✓	–	✓	✓	✓	✓	Selling drugs, having received help from school counselors
McCabe et al ^k [23]	2002 MTF, grade 12 (n = 4,522)	Vicodin ^{PY}	M	–	W+	–	✓	✓	–	–	–	Residing in Northeast
		OxyContin ^{PY}	M	–	ns	–	ns	✓	–	–	✓	
McCabe et al ^l [24]	2001 MTF, (n = 12,237)	Ritalin ^{PY}	ns	✓	W+	–	✓	✓	–	–	–	Residing in the south and north central United States (vs. the West)

Other nationally representative studies include Floyd et al [25], Dowling et al [26], and Kroutil et al [27]. These are not included in the table because they did not assess correlates to NMUPM among adolescents. NSDUH = National Survey of Drug Use and Health; MTF = Monitoring the Future study; GUTS = Growing Up Today Study; NMUPM = nonmedical use of prescription medications; W = white; MR = multiracial; AA = African American; H = Hispanic; ✓ = significant; ns = nonsignificant; – = not examined; ^L = lifetime use; ^{PY} = use in the past year; NSA-R = National Survey of Adolescents-Replication; PTSD, post-traumatic stress disorder.

^a Includes school dropout.

^b The NSDUH asks questions about specific drugs for each class and then gives respondents an opportunity to list others. Examples for drug classes are as follows: pain relievers (Darvocet, Darvon, Tylenol with codeine, Percocet, Percodan, Tylox, Vicodin, Lortab, and Lorcet), stimulants (methamphetamine, Desoxyn, Methedrine, prescription diet pills such as amphetamines, Benzedrine, biphedamine, Fastin or phentermine, Ritalin, and methylphenidate), tranquilizers (Valium or diazepam, Xanax or alprazolam, Ativan or lorazepam, and Klonopin or clonazepam), and sedatives (Restoril or temazepam, barbiturates such as Nembutal or pentobarbital, Seconal or secobarbital, butalbital, methaqualone, Sopor, and Quaalude).

^c Examples of pain relievers given include Vicodin, OxyContin, Percodan, Percocet, Demerol, Dilaudid, morphine, opium, and codeine.

^d Only examined among rural adolescents.

^e Among white adolescents.

^f Among male adolescents.

^g Among female adolescents.

^h Drug categories and examples include the following: tranquilizers (e.g., Valium, Librium, Xanax), sedatives (e.g., barbiturates, Seconal, Quaaludes, Sonesta, Ambien, Halcion), stimulants (e.g., Ritalin, speed, Adderall, diet pills), and pain medicines (e.g., Percodan, Darvon, codeine, Demerol, morphine, OxyContin).

ⁱ Associations were adjusted for gender, race, age, urban/rural residence, income, insurance status, having both parents in the home, having moved in the past year, self-rated health, school enrollment, and alcohol and cigarette use.

^j Associations adjusted for gender, race, sensation seeking, religiosity, mental health service use, drug selling, illicit drug use, and conflict with parents.

^k Associations adjusted for gender, race, region of residence, academic performance, and urbanicity.

^l Associations were adjusted for grade level, gender, race, region of residence, academic performance, and urbanicity.

parisons across the nationally representative studies should be made with caution, given that each source of data used a different data collection technique.

Thirteen publications based on non-nationally representative samples were retrieved, three of which were based on a 2005 study of students in Michigan [7,30,31] and two of which were based on a similar 2007 study [32,33] (Table 2). Thus, 10 study samples were represented overall. The gender of participants was described in nine studies, across which male and female subjects were represented equally (49.8% and 50.2%, respectively). On average, the racial/ethnic composition of the samples was 62% white (nine studies reported) and 34% African American (seven studies reported).

Of the 10 non-nationally representative studies represented, eight involved school-based samples. Four of the studies used self-administered questionnaires for data collection [9,34,35,37], whereas all of the studies conducted in Southeast Michigan used Web-based surveys [7,30–33,36,38]. Other studies used a mixed data collection technique [8] or interviews [39].

Definitions of NMU of prescription drugs

The phrasing of questions to assess NMUPM was somewhat inconsistent across studies, as was the use of terms such as pain relievers versus prescription opioids or sedatives versus anxiolytics. For the purposes of this review, we use the terms pain relievers, sedatives, stimulants, and tranquilizers in keeping with the terminology used by the NSDUH. The NSDUH data on NMUPM are collected using the following question: “Have you ever, even once, used [X] that was not prescribed for you or that you took only for the experience or feeling it caused?” The NSDUH contains questions about specific drugs (footnote, Table 1) and then allows respondents to list others.

The other nationally representative studies varied in the wording of their questions. The NSA-R used, “Have you ever taken ‘on your own’ or non-medically (drug category) like (examples of medications in that category)?” (see footnote on Table 1 for examples) [18]. The questions and examples used in MTF differed slightly. For the study based on 2002–2006 MTF, McCabe et al state, “Nonmedical use of prescription opioids was assessed with a series of items asking respondents on how many occasions (if any) they used prescription opioids on their own, without a doctor’s orders.” ([12], p. 740). The examples of pain relievers given in the MTF study differ from those given in the NSDUH surveys (footnote, Table 1). For example, NSDUH includes Darvocet, Darvon, Tylox, Lortab, and Lorcet, whereas MTF includes OxyContin, Demerol, Dilaudid, morphine, and opium. The definition of NMUPM used in most of the non-nationally representative studies was similar to that used in the MTF and NSA-R, in that they specifically queried students about their use of prescription drugs not prescribed to them [7–9,31–33,35,36,38] (Table 2).

Prevalence of NMUPM by drug class

Twelve nationally representative studies and eight non-nationally representative studies provided prevalence estimates for some class of NMUPM (see Table 2 for the latter). The prevalence of past-year [13–16,20] and lifetime [18,19] NMUPM was <10% across all studies, with the exception of two [30,37].

Pain relievers. In nationally representative studies, past-year [11–16,18,20,22] and lifetime [12,17] NMU of prescription pain

relievers was <13%. In non-nationally representative studies, however, the prevalence of lifetime pain reliever use ranged from 15% to 18% [30,32,36] and past-year use ranged from 2% to 14% [7,31–33,35,36]. The longitudinal study by Catalano et al, in particular, provides valuable insight into patterns of pain reliever use. More than one-fourth (28%) of the cohort involved in the study had engaged in pain reliever use at some point during high school. Pain reliever use peaked in grade 12 at 19% and then decreased to 13% by age 20. The average age of initiation was 17 years, and the average duration of use was 2 years [8].

Stimulants. Adolescent NMU of stimulants has been well documented. All of the studies that examined past-year [13–16,18,20,21,24,27] and lifetime NMU of stimulants found a prevalence of <5% [7,13–16,18,20,21,24,27,31,32,35,38]. Of note, in the longitudinal study by Catalano et al, 16% of the cohort reported having used amphetamines nonmedically at some point during high school.

Sedatives. All of the studies assessing past-year [7,13–16,18,20,27,30–32] and lifetime [7,30–32] NMU of sedatives found a prevalence of <4%. Again, the longitudinal research by Catalano et al found a higher prevalence of use; 10% of participants reported having used sedatives nonmedically at some point during high school.

Tranquilizers. None of the nationally representative studies reported lifetime NMU of tranquilizers, but four reported on past-year use. Each of the four studies found a prevalence of 2% for past-year tranquilizer use. In non-nationally representative studies, past-year prevalence of tranquilizer use ranged from 2.5% to 4.9% [7,30–32,35] and lifetime prevalence was 4.5%–5.9% [7,30–32].

Demographic correlates of NMUPM

Twelve of the 15 nationally representative studies (Table 1) and nine of the 10 non-nationally representative studies (Table 3) reported on correlates of adolescent NMUPM.

Gender. Of the 11 nationally representative studies that examined gender, six found that female adolescents were more likely to engage in some class of NMUPM and two found that NMUPM was higher among male adolescents. Findings from the six non-nationally representative studies that examined gender as a correlate to NMUPM were mixed; three found that NMUPM was higher among female adolescents and two found it was higher among male adolescents. Gender differences, particularly in NMU of pain relievers, should be considered in light of motivations. For example, in one study, female gender was associated with NMUPM motivated by self-treatment, but not with NMUPM motivated by sensation seeking [32]. Some research suggests that pain from migraines and menstrual cramps could be underlying female adolescents’ self-treatment motives for NMU of pain relievers [36].

Age. All nine studies that examined age as a correlate found that older age was associated with increased likelihood of engaging in NMUPM. Similar consistency was observed across six non-nationally representative studies; all found a positive association between older age and some class of NMUPM. The trajectory of adolescent NMUPM over time has been largely unexplored. Sev-

Table 2

Non-nationally representative studies of NMUPM among U.S. adolescents (age: 12–17 years) published between 2000 and 2011, listed chronologically by year of data collection

Author(s)	N ^a	Setting/data source	Sample characteristics	Data collection	Definition of NMUPM	Drug examined, prevalence (%)
Boyd et al [32]	912	Students in grades 7–12, southeast Michigan	44% white 54% black .7% Hispanic 1.4% Asian 53% female	2007, Web-based survey RR: 64%	“On how many occasions in [your lifetime/past 12 months] have you used the following types of drugs not prescribed to you?” (sleeping medications, sedative/anxiety medicine, stimulants, pain medications) ^b	PRs: 10 ^{PY} , 15 ^L Stimulants: 1.2 ^{PY} , 1.5 ^L Sedatives: 1.3 ^{PY} , 2.0 ^L Tranquilizer: 2.5 ^{PY} , 4.5 ^L
Young et al [33]	490	Students in grades 7–12, southeast Michigan (but only female participants)	52% black 45% white	2007, Web-based survey RR: 64%	“On how many occasions in [your lifetime/past 12 months] have you used the following types of drugs not prescribed to you?” (sleeping medications, sedative/anxiety medicine, stimulants, pain medications) ^b	NMUPM: 15.5 ^{PY} PRs: 14.1 ^{PY} Stimulants: 1.0 ^{PY} Sedatives: 2.7 ^{PY} Anxiolytics: 1.0 ^{PY}
Temple and Freeman [34]	1,565	Students in grades 9–12, southeast Texas	29% white 31% black 37% Hispanic 54% female	2007, self-administered questionnaire RR: 71%	“Students reported if they had ever used . . . Vicodin or Xanax” ^{c,d}	Not reported
Fleary et al [35]	1,672	Students in grades 7–12, Indiana	48% female	2006, self-administered questionnaire RR: 79%	“Have you ever/how many times in the last year/how many times in the past month (30 days) have you used (Ritalin, tranquilizers, and narcotics [opium, morphine, codeine]) that was non-prescribed?”	PRs: 2.1 ³⁰ , 2.3 ^{PY} Ritalin: 1.2 ³⁰ , 2.4 ^{PY} Tranquilizer: 2.4 ³⁰ , 4.9 ^{PY}
Corliss et al [9]	12,644	Cohort of children of participants in Nurses’ Health Study II	93% white	1999–2005, self-administered questionnaires RR: 63%	Participants were asked if they used any of the following drugs without a doctor’s prescription: sleeping pills, painkillers, stimulants, and benzodiazepines ^{d,e}	NMUPM ^{PY} = 5.2%–31.3 ^f
Boyd et al [7,31]; McCabe et al [30]	1,086	Students in grades 7–12, southeast Michigan/Detroit	52% white 45% black 3% other 54% female	2005, Web-based survey RR: 68%	“On how many occasions in your lifetime (or past 12 months) have you used the following types of drugs, not prescribed to you?” (sleeping medications, sedative/anxiety medicine, stimulants, pain medications) ^g	NMUPM ^L = 20.9 ^h PRs: 12 ^{PY} , 17.7 ^L Stimulants: 2 ^{PY} , 2.4 ^L Sedatives: 2 ^{PY} , 3.5 ^L Tranquilizers: 3 ^{PY} , 5.9 ^L
Catalano et al [8]	912	Cohort of students from Pacific Northwest ⁱ	82% white 5% black 5% Hispanic 7% API 53% male	1993/1994—unknown, interviews, questionnaires, and Web-based surveys RR: 76%	Use of prescription opioids, sedatives, and amphetamines “at least sometimes” without a medical prescription ^d	28% misused opioids in high school, 49% of whom continued use into young adulthood; 10.3% and 15.6% misused sedatives and amphetamines in high school, respectively

Table 2
Continued

Author(s)	N ^a	Setting/data source	Sample characteristics	Data collection	Definition of NMUPM	Drug examined, prevalence (%)
Boyd et al [36]	1,017	Students (age 10–18), Detroit	54% white 43% black 50% female	2003, Web-based survey RR: 87%	“Sometimes people use prescription drugs that were meant for other people, even when their own doctor has not prescribed it for them. Please indicate whether you (have ever/in the past year) used any of the following drugs not prescribed to you: pain medication (e.g. Vicodin, OxyContin, Tylenol 3 with Codeine)”	PRs: 11.0 ^{PY} , 15.9 ^L
Levine et al [37]	849	Students in grades 9–12, rural Vermont	94% white 52% male	2002–2003, self-administered questionnaires RR: 90%	Use of (Percocet, Valium, Tylenol with codeine, OxyContin, Ritalin, Lorcet, Klonopin, Ativan, nitroglycerin, steroids) “just for fun or to get high” ^d	NMUPM: 20.0 ³⁰ , 34.0 ^L
McCabe et al [38]	1,405	Students in grades 6–11, Detroit, MI	57% white 40% black 3% other 51% male	2002, Web-based survey RR: 89%	“Please indicate if you have ever used any of the following drugs not prescribed to you: Ritalin, Dexedrine, Adderall, or other stimulant pill.”	Stimulant: 4.5% ^L
Goldsworthy et al [39]	594	Various urban and suburban locations “throughout the US”	49% white 22% black 21% Hispanic 49% female	Interviews in public spaces (e.g., malls, parks, public streets) RR: unknown	“Have you ever (borrowed/loaned) prescription medication?” (included Darvocet, OxyContin, Paxil, Zoloft, Ritalin, and Valium as examples, among others)	Not reported

NMUPM = nonmedical use of prescription medications; RR = response rate; ^L = prevalence of use during lifetime; ^{PY} = use in the past year; ³⁰ = use in the past 30 days; API = Asian Pacific Islander; PR = pain reliever.

^a Refers to sample size used for analysis.

^b Included the following examples: (a) sleeping medication (e.g., Ambien, Halcion, Restoril); (b) sedative/anxiety medication (e.g., Ativan, Xanax, Valium, Klonopin); (c) stimulant medication (e.g., Ativan, Xanax, Valium, Klonopin); (d) stimulant medication (e.g., Ritalin, Dexedrine, Adderall, Concerta); (e) Pain medication (e.g., Vicodin, OxyContin, Tylenol 3 with codeine).

^c It is unclear from the text of the manuscript as to if nonmedical use was specified.

^d The exact wording of the question used to assess NMUPM was not given.

^e Included the following examples: sleeping pills (Rohypnol, barbiturates, and downers), pain killers (Percodan, codeine, and OxyContin), stimulants (Ritalin and Adderall), and benzodiazepines (Valium, Xanax, and Librium).

^f Prevalence varied significantly by sexuality. Five percent of adolescents who identified as “completely heterosexual” had engaged in NMUPM compared with 15% of “mostly heterosexual,” 31% of “bisexual,” and 19% of “completely homosexual.” Although this study included participants up to age 23, the prevalence statistic that is reported refers only to participants’ use during the period of adolescence (age: 12–17).

^g Included the following examples: (a) sleeping medication (e.g., Ambien, Halcion, Restoril, temazepam, triazolam); (b) sedative/anxiety medication (e.g., Ativan, Xanax, Valium, Klonopin, diazepam, lorazepam); (c) stimulant medication for Attention Deficit Hyperactivity Disorder (e.g., Ritalin, Dexedrine, Adderall, Concerta, methylphenidate); (d) pain medication (i.e., opioids such as Vicodin, OxyContin, Tylenol 3 with codeine, Percocet, Darvocet, morphine, hydrocodone, oxycodone).

^h In all, 17.5% of lifetime nonmedical users, 14.3% of pain reliever users, 1.2% of stimulant users, 2.4% of sedative users, and 3.5% of tranquilizer users were also using the drugs medically.

ⁱ Data are from the Raising Healthy Children Study, which is a longitudinal study of students from the Pacific Northwest followed from grade 1/2 (years 1993–1994) into young adulthood (~age 21). Of note, the prevalence statistic that is reported refers only to participants’ use during high school.

Table 3

Correlates of U.S. adolescent NMUPM as identified in non-nationally representative studies published from 2000 to 2011

Author(s)	Drug examined	Correlates to NMUPM					Other findings
		Gender	Older age	Race/ethnicity	Illicit drug use	Delinquency	
Boyd et al [32]	NMUPM	F ^a	√ ^b	W ^b	√ ^b	√ ^b	
Young [33]	NMUPM, pain relievers, stimulants, sedatives, anxiolytics	–	–	–	–	–	Sexual victimization was associated with NMUPM, sedatives, and pain relievers
Temple et al [34]	Xanax, Vicodin	–	–	–	–	–	Significant association between dating violence victimization and misuse of Xanax and Vicodin ^c
Fleary et al [35]	Pain relievers, Ritalin, tranquilizers	ns	√	–	√	–	Popularity and having friends who engage in prosocial behavior were negatively associated with Ritalin and tranquilizer misuse; having friends who engage in delinquent behavior was positively associated with tranquilizer and Ritalin misuse; impulse control was negatively associated with tranquilizer misuse; mastery of external world was negatively associated with Ritalin misuse
Corliss et al [9]	NMUPM	–	–	–	–	–	Compared with adolescents who identified as completely heterosexual, those who identified as mostly heterosexual and bisexual had a significantly higher prevalence of past-year NMUPM
Boyd et al [7,31]; McCabe et al [30]	NMUPM, pain relievers, stimulants, sedatives, tranquilizers	F ^d	√ ^e	W ^f	–	–	Positively associated with medical use
Catalano et al [8]	Pain relievers	–	√	–	√	√	In crude analyses, lifetime use was associated with having a current drug use disorder, mood disorder, and poor health
Boyd et al [36]	Pain relievers	F	√	ns	√	–	Lifetime medical use was associated with opioid misuse ^g
Levine et al [37]	NMUPM	M	√	W ^h	√	–	
McCabe et al [38]	Stimulants	M	–	W	√	–	Higher among students with no plans for attending college
Goldsworthy et al [39]		ns					5% had loaned pain relievers, 2% had loaned "mood medications." The same percentages had borrowed the medications.

NMUPM = nonmedical use of prescription medications; F = female; M = male; W = white; ns = association not significant; – = not assessed; √ = significant.

^a Associated with NMUPM motivated by self-treatment.

^b Associated with NMUPM motivated by sensation seeking.

^c Only after controlling for other substance use, age, gender, parents' education, and living situation.

^d For NMUPM and pain relievers.

^e For sedatives and pain relievers.

^f For sedatives and stimulants.

^g Adjusting for gender, race, and grade level.

^h For stimulant use.

eral studies have noted that NMU of pain relievers increases with age [17,30]. Cross-sectional national data have shown that the average age of onset for NMU of pain relievers was approximately the same as for alcohol (e.g., 13 years) [17]. However, a recent longitudinal study conducted by Catalano et al found that prevalence of NMU of pain relievers peaks at age 17 years [8].

Race. Eleven studies examined race as a correlate to a class of NMUPM, but comparisons are difficult, given that referent categories varied or were sometimes not specified. However, a clear trend emerged in which either white race was associated with a higher prevalence of NMUPM or nonwhite race was associated with decreased NMUPM.

Income. Seven nationally representative studies examined the association between low income and NMUPM. Three found that low income was associated with NMU of pain relievers [13,17,22], and one found it to be associated with NMU of tranquilizers [13]. It has been noted that the relationship between adolescent NMUPM and family income is complicated by differences in access to health care, as uninsured adolescents have limited legal access to prescription drugs [13].

School performance. Six nationally representative studies examined school performance and/or school enrollment as a correlate to NMUPM. Five found an association between low academic performance, school dropout, or lack of "school-bonding" and

elevated the prevalence of NMUPM. School bonding, assessed by Ford, was based on students' report that they liked going to school, that their school work was meaningful, that classes were important and interesting, and that teachers praised their work [13].

Other individual-level correlates. Studies have identified several other correlates of adolescent NMUPM, including residential instability [16,20], rurality [10,13,17], poor self-reported health [8,10,17], recent major depressive episode [10,16], post-traumatic stress disorder [18], mood disorder [8], mental health service utilization [16,17,21], and emergency room use [17]. NMUPM, particularly that of sedatives and pain relievers, has also been associated with sexual victimization [33,34]. Personality characteristics, such as desire for risk taking [16], sensation seeking [21], low impulse control [35], and lessened perceived mastery of external world [35], have also been reported. The prevalence of NMUPM has also been found to differ by sexual orientation; in one study, the prevalence of NMUPM was significantly lower among adolescents who identified as completely heterosexual than among those who were "mostly heterosexual," bisexual, or "completely homosexual" [9].

Familial and social influences

Parental factors were associated with NMUPM in several studies. Adolescents residing in a two-parent household were significantly less likely to report any NMUPM [10,16], pain reliever use [16], or tranquilizer use [20]. Parental bonding (i.e., receipt of parental praise, parental monitoring, parental disapproval of drug use) was negatively associated with all classes of NMUPM in two studies [13,22], and adolescents' reported level of conflict with parents was associated with stimulant use in another study [21].

Peer attitudes supportive of drug use and/or peers' use of illicit drugs have also been associated with NMUPM, specifically tranquilizers [15] and pain relievers [15,22]. In a study of students in Indiana, popularity was negatively associated with NMU of Ritalin and tranquilizers [35]. Ritalin and tranquilizer use was positively associated with having friends who engage in delinquent behavior and negatively associated with having friends who engage in prosocial behavior [35].

Behavioral correlates of NMUPM

Other illicit drug use. Each of the 12 studies that examined the association between NMUPM and other illicit drug use found a positive association. Six non-nationally representative studies also reported a positive association between illicit drug use and NMUPM [8,32,35–38]. Notably, in one study, illicit drug use was associated with NMUPM motivated by sensation seeking, but not with NMUPM motivated by self-treatment [32].

Delinquency. Four nationally representative studies found that NMUPM was associated with delinquency [14,16,18,22,23]. Longitudinal research showed that property crimes and violent behavior were associated with pain reliever use [8]. Another study of students in Michigan found an association between delinquency and NMUPM motivated by sensation seeking, but not by self-treatment [32].

Motives

Research has shown that there are two distinct categories of adolescent NMUPM: self-medication and recreational (to experiment or to get high). The latter group appears to be at a higher risk for other substance abuse problems [7]. As expected, motives are generally consistent with therapeutic indications for the drugs (i.e., students abuse tranquilizers to treat insomnia, pain relievers to treat physical pain, and so on) [7,10,12,40]. Stimulant use may be an exception, however, as the motivation to use stimulants experimentally or to get high may be just as common as use to increase concentration and alertness [7]. In fact, motivations for stimulant use generally fall into two classes: recreational and academic use. Students often report using stimulants to study, stay awake, improve their alertness, get high, "party," and to experiment [41], and some research has shown that NMU of stimulants is lower among those with no plans to attend college [38] and higher among those prone to "sensation-seeking" [21].

Diversion and sources of prescription medications

Several of the studies included in the review explored the diversion of prescription medications. One study conducted in Detroit found that 23% of middle and high school students had been approached to sell, trade, or give away their prescription stimulants [38]. In a similar study, 10%–15% of students reported trading their medications, and fewer reported selling their medications. Nearly a quarter of students with a legal prescription had given away or loaned their medications to someone else. Giving away or loaning pain relievers, stimulants, and sleeping medications was more common (20%–25%), as compared with sedative medication (10%). Notably, female adolescents were more likely than male adolescents to give away or loan medications, and were more likely to divert medications to their female friends than to male friends. Likewise, male adolescents were more likely to divert their medications to male friends. Few students overall (<14%) reported having ever had their medications taken against their will [31]. A study of rural high school students in Vermont found that nonmedical users of prescription drugs were acquiring medications from a variety of sources. Overall, a common source was one's own prescription, followed by friends. Many students also reported buying and stealing medications, and some reported that they had simply found the medications [37].

Another study also found that loaning of medications was not an uncommon practice among adolescents [39]. Nearly 24% of adolescents had loaned pain relievers, and 27% had borrowed pain relievers. This study was the only one to examine the impact of sharing medications on care seeking. Results indicate that 74% of medication borrowers reported doing so in lieu of making an appointment with a health care provider, and among those who eventually sought care (32%), only 5% told their physician that they had borrowed medications [39]. Whether these trends are apparent in borrowers of pain, stimulant, sedative, and tranquilizer medications is currently unknown, and is certainly an area in need of further research.

Drug dependence and abuse

Several studies have explored the association between adolescent NMUPM and prescription drug abuse and/or dependence

[7,8,11,16,20,27,30]. All of the studies use Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria, with the exception of two, which use the Drug Abuse Screening Test (DAST-10) [7,30]. The validity and reliability of the DAST-10 have not been thoroughly evaluated among adolescents [41], and the studies that use these measures identify adolescents who have “probable” drug abuse or dependence [30] or who are at moderate “risk of substance abuse” [7].

Using 2005 and 2006 NSDUH data and DSM-IV criteria, Wu et al found that .5% of adolescents met criteria for past-year pain reliever abuse and .6% for dependence. Simoni-Wastila estimated that 357,000 adolescents in the United States in 2005 met DSM-IV criteria for a prescription drug problem (PDP), defined as meeting DSM-IV criteria for drug abuse and/or dependence. Schepis and Krishnan-Sarin found that 3% of adolescents had at least one symptom of a PDP; .8% met DSM-IV criteria for dependence, and .6% for abuse. The study also found that of those who met criteria for a PDP, 64% did so solely owing to NMU of pain relievers, 6.5% for tranquilizers, 6.4% for stimulants, and 2.1% for sedatives. A study based on 2000/2001 NSDUH data found that approximately 3% of adolescent nonmedical users of prescription stimulants met criteria for dependence and 7% for abuse. The study also found that 2% of nonmedical users of medicines for Attention Deficit Hyperactivity Disorder (ADHD) met criteria for dependence and 4% for abuse [27].

Simoni-Wastila et al evaluated correlates to having a PDP by drug class. The study found that female gender was associated with PDPs originating from NMU of pain relievers, but not from NMU of stimulants or tranquilizers [20]. Rather than investigating PDPs compositely, Wu et al investigated correlates of abuse, subthreshold dependence (without abuse), and dependence (regardless of abuse) separately. Using 2005 and 2006 NSDUH data and DSM-IV criteria, the authors found that .5% of adolescents met criteria for past-year pain reliever abuse and .6% met criteria for dependence. More than one-third of nonmedical users of pain relievers reported one or more symptoms of abuse or dependence [16]. The one longitudinal study that evaluated the association between NMUPM and abuse/dependence came to a different conclusion, however [8]. Catalano et al found that NMU of pain relievers was associated with greater odds of having a current drug use disorder in unadjusted analyses. However, after adjustment for other illicit drug use, the association was no longer significant [8]. This finding highlights the need for further research and underscores the importance of conducting longitudinal research on outcomes associated with NMUPM.

Summary and Implications

Among the 25 studies represented by the 30 publications included in this review, the findings on the prevalence of and correlates to NMUPM varied, particularly by drug class (Table 4). NMU of pain relievers was more prevalent than of stimulants, sedatives, and tranquilizers. Female gender was most consistently associated with pain reliever use and, to a lesser degree, with tranquilizer use. The association between gender and other classes of NMU was somewhat unclear. Generally, white adolescents had a higher prevalence of NMUPM, whereas nonwhite race/ethnicity was associated with decreased NMUPM. Other correlates consistent in their association with NMUPM included older age, illicit drug use, and delinquency. Given the strong association between NMUPM and other illicit drug use, readers should keep in mind that consequences that are reported to

Table 4
Summary of major findings on prevalence and correlates of NMUPM among U.S. adolescents (age: 12–17)

Prevalence (past-year)	
Pain relievers	
Nationally representative studies	4%–11%
Other studies	2%–14%
Stimulants	
Nationally representative studies	1.7%–3%
Other studies	1%–2.4%
Sedatives	
Nationally representative studies	1.7%–3.0%
Other studies	1.0%–2.4%
Tranquilizers	
Nationally representative studies	.4%–2.0%
Other studies	1.3%–2.7%
Selected correlates	
Pain relievers	
Gender	Female [7,11,16,17,22,36] Male [23,37] No significant difference [13,20,35]
Race ^a	White [17,22,23] Hispanic—negative association [16] No significant differences [13,20,30,36,37]
Income	Positive association [13,17,22] No association [11,20]
Stimulants	
Gender	Female [13,16] Male [38] No significant difference [20,21,24,30,35]
Race ^a	White [20,38] African American [20] Hispanic—positive association [20] Hispanic—negative association [21] No significant difference [13] No significant differences [13,20]
Income	No significant differences [13,20]
Sedatives	
Gender	Female [13] No significant differences [7,16,20]
Race ^a	White [30] Asian—negative association [16] No significant differences [13,20] No association [13,20]
Income	No association [13,20]
Tranquilizers	
Gender	Female [13,16,20] No significant difference [30,35]
Race ^a	White [13,20] African American—negative association [16,20] Hispanic—negative association [16] Asian—negative association [16]
Income	Low income [13] No association [20]

^a Studies differed in their choice of a referent group.

result from NMUPM may in fact be arising from polydrug use [8]. Also of note, comparisons of prevalence and correlates across studies should be made with caution, as some studies examined adolescents' use of medications not prescribed to them and/or their use of the medications for the feeling they caused, whereas others focused only on the former. In addition to differing definitions of NMUPM, some differences in prevalence and correlates may be accounted for by differences in data collection techniques.

While more research on all classes of adolescent NMUPM is needed, there are currently relatively few studies on NMU of sedatives and tranquilizers. This despite evidence from some

studies that NMU of tranquilizers may be more prevalent than that of stimulants [7,30–32,35]. Future research should also examine whether adolescent nonmedical users of prescription medications are administering the drugs through nonoral routes of administration. Only one study included in this review examined route of administration [12]. The study found that while few (<5%) nonmedical users of prescription pain relievers who were motivated by pain relief used nonoral routes of administration, almost 50% of those motivated by non-pain relief motives used nonoral routes, 35% through intranasal administration [12]. This study was also the only one to examine coingestion of prescription medications with alcohol. The study found that significantly more nonmedical users of prescription pain relievers with non-pain relief motives coingested the medications with alcohol (58%) compared with 11% of those who were motivated only by pain relief [12]. Coingestion of prescription medications with alcohol and other illicit drugs is certainly an area in need of further research.

More longitudinal studies are needed to gain a better understanding of the temporal association between NMUPM, delinquency, and illicit drug use, as it is unclear whether these behaviors are co-occurring or sequential. Longitudinal research is also needed to better understand the association of NMUPM with the development of substance abuse and dependence. Also of note, seven of the 17 studies included in this review were conducted in southeast Michigan; more research is needed to investigate the particularities of NMUPM (motivations, correlates, diversion) in other populations, including under-represented ethnic and racial groups such as Asian Americans and American Indians and Alaskan Natives.

Implications for treatment and prevention

The complexity of adolescent NMUPM may present challenges to the development of prevention and treatment programs. This review demonstrates that factors at multiple levels influence adolescent NMUPM, ranging from familial stability [10,13,21,22] to health service utilization [16,17,21], and that problems associated with NMUPM can manifest in various settings, especially in school attendance and performance [10,11,16,17,23,24]. It is clear, then, that strategies should involve families, schools, and clinicians (see review by Twombly and Holtz for a thorough discussion of suggested multilevel interventions for prevention of adolescent NMUPM). For example, pharmaceutical marketing practices should be examined for their contribution to the perception of NMUPM as safe and normative [7]. Greater awareness is needed regarding the dangers of NMU of prescription drugs [42], including their contraindications and drug interactions [36]. Prevention messages should emphasize the danger of the sharing of prescription drugs among families and friends [36]. Parents should also be encouraged to monitor the frequency/dosage of children's medication and to be cautious about leaving medications in unsecured areas [36]. Schools should also implement rules regarding the storage and dispensation of medication to students [36,42].

A multifaceted approach is necessary to improve parents' and adolescents' awareness about these and other risks of NMUPM [6]. For example, prescribing providers must take care to educate adolescent patients and caregivers about the risks of misuse and diversion of prescription drugs, and pharmacists should reiterate messages and monitor for abnormal prescription and refill patterns to assist in prevention. Actions on the part of policymakers

are also needed, as officials should prioritize the establishment of diversion and control systems that support reasonable oversight of prescribing practices and restrict the availability of drugs only to those with a legitimate medical need [43]. Notably, the development of NMUPM intervention programs at any level should take care not to jeopardize appropriate pain management [44] and treatment, as inadequate pain management for the treatment of some conditions can increase adolescent self-medication [43].

This review highlights the need to address drug abuse and dependence arising from NMUPM and polydrug use [7,8,11,16,20,27,30]. Primary prevention strategies must be coupled with secondary actions to increase accessibility, affordability, and availability of adolescent prescription drug abuse treatment programs. Several studies in this review demonstrated that adolescents engaging in NMUPM often have underlying mental health problems [8,10,16,18]. Access to treatment for underlying psychological issues that place adolescents at increased risk for NMUPM must also be improved, particularly for those who have other risk factors, such as troubled environments, traumatic histories, delinquent behavior, or polysubstance use [18,45–48]. Thus, the complexity of treating and preventing adolescent NMUPM requires effort from multiple stakeholders at various levels. Ongoing assessment, research, policy implementation, and educational programs designed to further understand, treat, and reduce future adolescent NMUPM will be needed [44].

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