MEDICAL AND NONMEDICAL USE OF PRESCRIPTION STIMULANTS AMONG YOUTH 10 TO 18 YEARS OF AGE

By

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To my Mom and Dad

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Prescription stimulants are the first-line treatment for attention deficit/hyperactivity disorder (ADHD). Although stimulant medications are effective, the increase in ADHD diagnosis and associated prescriptions written have raised public health concerns about potential nonmedical use and abuse of these medications.

The National Monitoring of Adolescent Prescription Stimulants Study (N-MAPSS) recruited 11,048 youth aged 10 to 18 years from entertainment venues in 10 US metropolitan areas. Using data from N-MAPSS, we assessed the past 30-day prevalence of medical and nonmedical use of prescription stimulants, reported different forms of nonmedical use, and investigate different characteristics associated with Medical Users Only, Nonmedical Users Only, and prescription stimulant users who reported both medical and nonmedical use (MU+NMU youth).

The results revealed that 750 (6.8%) adolescents used prescription stimulants in the past 30 days, with 334 (3.0%) reporting Medical Use Only (MU Only), 121 (1.1%) reporting Both Medical and Nonmedical Use (MU+NMU), and 277 (2.5%) reporting Nonmedical Use Only (NMU Only). Use prescription stimulants that belonged to someone else was the most frequently reported form of nonmedical use (88.4%),

followed by use more than prescribed (38.9%). And use outside of the prescribed route was the least reported (32.2%). Being Caucasian, having close friends who had tried Adderall, and reporting conduct problem behaviors were common predictors for MU Only, MU+NMU, and NMU Only. Medical Users Only and MU+NMU youth did not differ from Non-Users in cigarette smoking, alcohol use, or illicit drug use. MU+NMU youth tended to have a higher number of conduct problem behaviors compared to Medical Users Only ($p = 0.0011$) and Nonmedical Users Only ($p = 0.0132$). Compared to MU+NMU youth, Nonmedical Users Only were more likely to have friends who had tried Adderall ($p = 0.0123$), endorse binge drinking ($p = 0.0118$) and to have a history of illicit drug use ($p < 0.0015$).

Future research should look at how nonmedically used stimulants were diverted, and preventive activities could be targeted towards the source. Prevention and intervention programs need to acknowledge the differences between MU+NMU youth and Nonmedical Users Only, and employ different strategies to prevent nonmedical prescription stimulant use among these subgroups.

CHAPTER 1
INTRODUCTION

Prescription stimulants are commonly used psychotropic medications among children, and they are the first-line therapeutic option for attention-deficit/hyperactivity disorder (ADHD).[1] Resent study estimated that use of this type of medication continued to rise steadily.[2] National Survey of Children's Health estimated that 7.2% of children aged 4-17 years had a current ADHD diagnosis at the time of survey in 2007, and this rate increased to 8.8% (5.1 million) in 2011. It was estimated that about two-thirds of children with current ADHD diagnosis were taking medication for treatment during the same period, and the percentage increased from 4.8% in 2007 to 6.1% (3.5 million) in 2011 with an average annual increase of about 7%.[3]

Although stimulant medications are effective in improving symptoms when used properly, the increase in ADHD diagnosis and associated prescription rates have raised public health concerns because of the potential for nonmedical use and abuse of these medications, and subsequent adverse consequences. Abuse of stimulant drugs increases the risk of health complications including severe hypertension, tachycardia, respiratory failure, and cardiac arrest.[4–6] In 2010, an estimated 3,461 emergency department visits involved ADHD stimulant medications for adolescents aged 12 to 17 years, and over half (52.9%, 1,830) of the visits were related to the nonmedical use of ADHD stimulants.[7] Besides the adverse health effects, nonmedical use of prescription stimulants also increases the risk for other substance use.[8] Given that the median age of ADHD diagnosis was 6.2 years among children with current ADHD[3], and individuals who initiated nonmedical use of prescription stimulants earlier in their adolescence were more likely to develop stimulant abuse and dependence disorder[9], there is a strong

need for epidemiological research to track the trend of this nonmedical use behavior among adolescents.

National studies reported the prevalence of prescription stimulant nonmedical use among adolescents remained stable during the past few years. The Monitoring the Future (MTF) national survey reported that the annual prevalence of "Ritalin" use not under a doctor's order was 1.1%, 1.8%, and 2.3%, and that of nonmedical use of "Adderall" was 1.8%, 4.4%, and 7.4% in 8th, 10th, and 12th grades, respectively.[10] Studies using 2005 data from the National Survey on Drug Use and Health (NSDUH) reported that 2.0% of adolescents aged 12 to 17 years nonmedically used prescription stimulants in the past year.[11,12] However, the difference in survey method, question wording, formulation assessed limits the direct comparison across studies.

Prescription nonmedical use has been defined based on prescription status (e.g., any non-prescribed use), motives for use (e.g., use for euphoric effect), abuse or dependence criteria (e.g., DSM-IV), dose and frequency of use (e.g., use more than prescribed), and route of administration (e.g., use in ways not prescribed).[4,13,14] Most studies on nonmedical use among adolescents only adopted one definition and failed to describe different forms of inappropriate use. However, understanding the magnitude of different forms of nonmedical use is important for prevention program design.

Prior research has identified a number of individual characteristics and risk factors associated with nonmedical use of prescription stimulants among adolescents.[8,12,15–31] However, there remains a lack of research assessing differences among youth who took their stimulants as prescribed (Medical User Only), individuals who had a prescription/refill and reported nonmedical use (MU+NMU youth), and those

who only used stimulants nonmedically (Nonmedical User Only). Youth who have a prescription and at the same time report nonmedical use have not been well distinguished from those youth who only use stimulants nonmedically. MU+NMU youth are indicative of future nonmedical use and diversion, because they could be the source of diversion of prescription stimulants. More research is needed to understand why they initiate nonmedical use (e.g., self-treatment) and the form of nonmedical use (e.g., use more than prescribed, use in ways not prescribed), since they have already had health problems that need treatment and the nonmedical use of prescription stimulants may cause further health risks. While Nonmedical Users Only may be poly-substance users, or they use stimulants as a substitute for illicit drugs which are harder to get access to. Distinguish these two subgroups of nonmedical users could help design tailored preventive-interventions.

The purpose of this study was to: 1) assess the past 30-day prevalence of medical and nonmedical use of prescription stimulants (Adderall® or Adderall XR®; Concerta®; Daytrana®; Ritalin®, Ritalin LA® or Ritalin SR®; and Vyvanse®) among youth 10 to 18 years of age from urban, suburban, and rural areas in 10 US cities, 2) report different forms of past 30-day nonmedical prescription stimulant use, and 3) investigate whether Medical Users Only, Nonmedical Users Only, and MU+NMU youth differ in their demographic characteristics, family and peer influences, conduct problem behaviors, and substance use behaviors.

CHAPTER 2
METHODS

Study Design

The National Monitoring of Adolescent Prescription Stimulants Study (N-MAPSS) was an entertainment venue intercept study that assessed use and misuse of prescription stimulants among youth 10 to 18 years of age in 10 cities in the United States.[32] This cross-sectional study was carried out in four waves (Fall 2008, Spring 2009, Fall 2010, and Spring 2011). Standard federal regions were selected according to the US Office of Management and Budget. Within each region, states with the highest volume of stimulant prescriptions dispensed and city within each with the highest dispensing volume were identified using the IMS Health database. Four N-MAPSS cities represented the eastern US (Boston, MA; New York, NY; Philadelphia, PA and Tampa, FL), three represented the central US (St. Louis, MO; Cincinnati, OH and Houston, TX), and three represented the western US (Denver, CO; Los Angeles, CA and Seattle, WA). N-MAPSS employed an entertainment-venue intercept method to approach and recruit potential participants, and administered surveys in youth friendly entertainment venues (e.g., shopping malls, skate parks, playgrounds, and etc.). Using this recruitment technique resulted in a more diverse sample compared to school-based sampling, which does not include homeschooled adolescents, drop-outs, and those who are absent from school on the day of the study.[32]

Sample

During the four N-MAPSS waves, 21,444 youth were approached. Among the approached, 24.7% (5,201/21,444) declined to talk to the interviewer, leaving 75.3% (16,143/21,444) potentially eligible. Additionally, 21.1% (3,403/16,143) were ineligible

due to age, language, or zip code criteria, and another 10.0% (1,272/12,740) refused to participate.[32] After eliminating poor quality responses (3.7%, 420/11,468), the final sample included 11,048 youth.

In the final sample, 12.7% were between the ages of 10 and 12, 39.7% were between the ages of 13 and 15, and 47.6% were between the ages of 16 and 18 years. Nearly half (47.6%) resided in urban areas, 37.3% resided in suburban areas, and 15.1% resided in rural areas. Overall, 52.2% of participants were female, 43.0% were Caucasian, 19.8% were African American, 18.4% were Hispanic/Latino, 7.8% were Asian, and 11.0% were from other racial group.

Measures

The N-MAPSS 2-part full-color paper assessment took about 20 minutes to complete. Part I contained socio-demographic characteristics, general health information, and medication recognition questions with picture. Part II assessed use, misuse, and diversion of prescription stimulants as well as tobacco, alcohol, and illicit drug use.

N-MAPSS assessed the past 30-day use of 5 brand-name prescription stimulants (Adderall® or Adderall XR®; Concerta®; Daytrana®; Ritalin®, Ritalin LA® or Ritalin SR®; and Vyvanse®) by asking participants: “In the last 30 days, have you taken [specific brand name]? Examples are pictured above.” All formulations (immediate and extended release) and the common dosage were queried with pictures of particular tablets, capsules, and patches.

Nonmedical use was assessed by: 1a) use other than by mouth (for Adderall, Concerta, Ritalin and Vyvanse: “In the last 30 days, what are all the ways you used [specific brand name]?”) or 1b) use other than prescribed (“In the last 30 days, have you

used Daytrana in a way other than prescribed?"), 2) use of someone else's medication ("In the last 30 days, have your used [specific brand name] that belonged to …?" or "In the last 30 days, how many days did you use [specific brand name] that belonged to someone else?"), and/or 3) more than prescribed ("In the last 30 days, how many days did you use [specific brand name] more than prescribed?"). Past 30-day medical users were identified as those who only took their prescription stimulants as prescribed.

Respondents who answered "Yes" to the question "In the last 30 days, have you gotten a prescription or refill for [specific brand name] from a psychiatrist or your doctor?" were defined as having a prescription. Users who reported both medical and nonmedical prescription stimulant use (MU+NMU youth) were identified as those who had a prescription and at the same time reported nonmedical use, or those who reported nonmedical use of one or more brands but medical use of another brand. In this study, there were four mutually exclusive groups of past 30-day prescription stimulant use: (1) individuals who did not use any prescription stimulant (Non-User); (2) individuals who only used prescription stimulants as prescribed (Medical User Only); (3) individuals who reported both medical and nonmedical use (MU+NMU youth); and (4) individuals who exclusively used prescription stimulants nonmedically (Nonmedical User Only).

Demographic characteristics included gender, age, race/ethnicity (Caucasian, African American, Asian, Hispanic/Latino, and Others), and area of residence. Family and social characteristics included living with both parents at the same time in the last 7 days, and having close friends who tried Adderall or Adderall XR. Conduct problem behavior was considered present if youth had been suspended from school, received

tickets or warnings from police, been arrested, got into a lot of trouble at home or at school or ran away from home overnight, or used a weapon or threatened someone with a weapon. Cigarette use was measured by asking respondents if they smoked cigarettes at the time of the survey, and if respondents answered “Yes”, they were asked if they smoked cigarettes everyday or some days. Alcohol use was assessed by asking respondents how many days they drank alcohol in the last 30 days. Binge drinking was defined as reporting five or more alcoholic drinks within a few hours. Lifetime illicit drug use included use of marijuana, cocaine, crack, heroin, club drugs (like ecstasy), hallucinogens (like LSD or mushrooms), anabolic steroids, cough syrup/‘purple drank’ to get high, methamphetamine, and/or inhalants (like gasoline or paint).”

Statistical Analysis

First, we computed descriptive statistics to summarize the data and report the frequencies of past 30-day prescription stimulant use. Second, we report the rate of different forms of nonmedical use and examine the difference between Nonmedical Users Only and MU+NMU youth in their forms of nonmedical use. Third, we performed global chi-square tests and ANOVA test to compare selected characteristics across the four mutually exclusive groups of past 30-day prescription stimulant users (Non-User, Medical User Only, MU+NMU youth, Nonmedical User Only). This step included post hoc tests to study the differences between each pair of stimulant use status with Bonferroni adjustment and Tukey’s honestly significant difference test to control the Type I error rate. Fourth, Multinomial logistic regression analyses with ‘No Use’ as the reference were conducted to examine the association of past 30-day prescription stimulant use status with the potential predictors: demographic characteristics (age,

gender, race/ethnicity, and area of residence), family and social influence (living with both parents, and having friends who tried Adderall), number of conduct problem behaviors, and substance use (cigarette, alcohol, and illicit drug). Adjusted odds ratios (AORs) with 95% confidence interval (CI) were presented. The final analytic sample selection procedure is shown in Figure 2-1. SAS software version 9 (SAS Institute Inc, Cary, North Carolina) was used to perform all analyses.

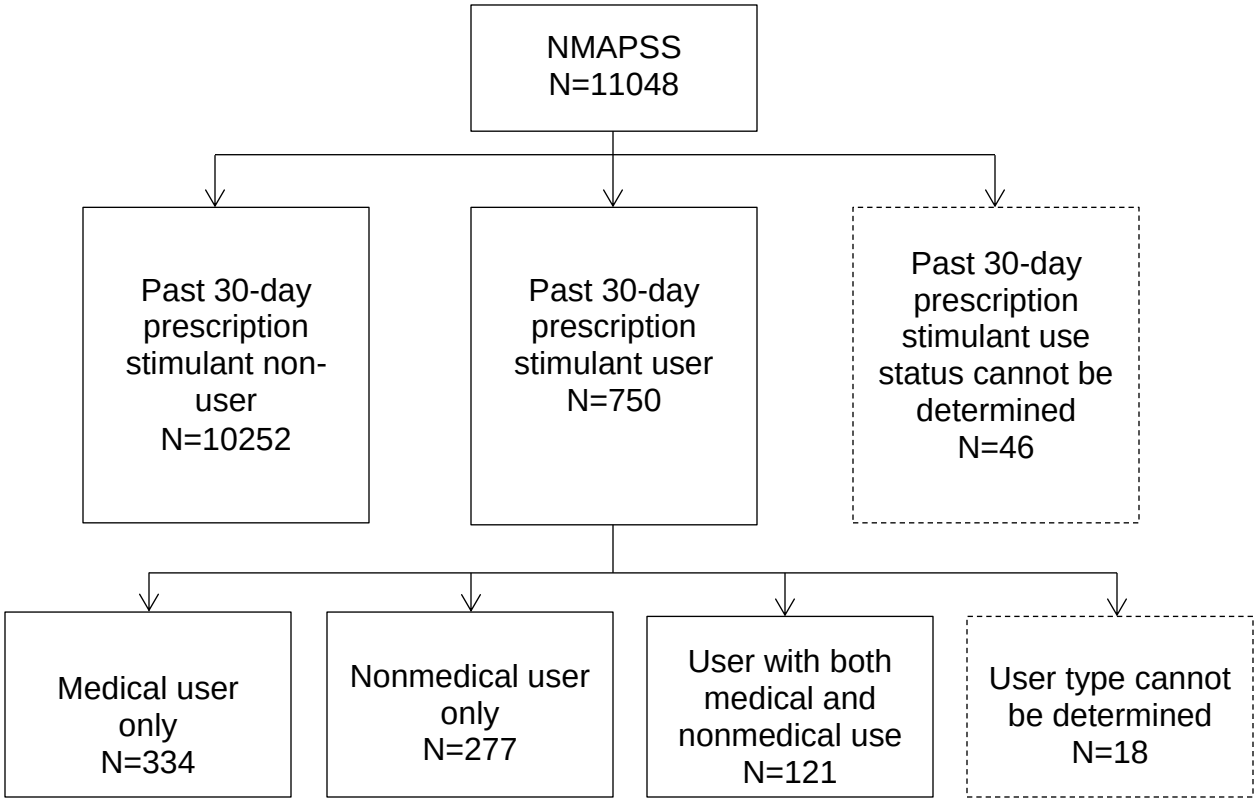

Figure 2-1. Final analytic sample selection. Individuals in the dotted box were excluded from the bivariate and multivariate analysis.

CHAPTER 3
RESULTS

There were 750 individuals who reported prescription stimulant use in the past 30 days. Of the 750 past 30-day prescription stimulant users, 45.6% (n = 334) reported medical use only (MU Only), 54.4% (n = 398) reported some type of nonmedical use, and 56.2% (n = 415) reported having a prescription or refill in the last 30 days. Of the 398 youth who reported past 30-day nonmedical use, 69.6% (n = 277) were Nonmedical Users Only, while 30.4% (n = 121) reported both medical and nonmedical use (MU+NMU).

Table 3-1 illustrates different types of prescription stimulant nonmedical use. Use from a source other than one's own prescription was the most frequently reported type of nonmedical use (88.4%), followed by use more than prescribed (38.9%), and use not by mouth or in ways other than prescribed (32.2%). There was no significant difference between MU+NMU youth (27.3%) and Nonmedical Users Only (34.3%) in use deviating from the prescribed route. Nonmedical Users Only were more likely to report use of someone else's prescription stimulants (97.5% vs. 67.5%, $p < 0.0001$), but less like to report use more than prescribed (29.3% vs. 61.0%, $p < 0.0001$) than MU+NMU youth.

Although not shown, there were significant demographic differences in the past 30-day prescription stimulant use. A greater percentage of males reported use of prescription stimulants in the past 30 days than females (7.6% vs. 6.1%, $p = 0.0013$). Past 30-day prescription stimulant users (Mean [M] = 15.5; Standard Deviation [SD] = 2.1) were significantly older than Non-Users (M = 15.1; SD = 2.1; $p < 0.0001$). Caucasian respondents were more likely to report past 30-day prescription stimulant use when compared to the other races (9.8% vs. 4.6%, $p < 0.0001$). A larger

percentage of respondents from rural area reported use of prescription stimulants in the past 30 days than those from urban or suburban areas (9.1% vs. 6.4%, $p < 0.0001$).

Table 3-2 illustrates the participant characteristics across four prescription stimulant use status. Results showed that Medical Users Only were the youngest (M = 14.75, SD = 2.27) among the four groups of past 30-day prescription stimulant users, followed by Non-Users (M = 15.08, SD = 2.12). Nonmedical Users Only were the oldest (M = 16.22, SD = 1.76), followed by MU+NMU youth (M = 16.06, SD = 1.62). A large majority of MU+NMU youth were male and Caucasian compared to all others. Medical Users Only reported living in suburban and rural areas at higher rates than all the other groups.

Compared to Non-Users (56.2%), Medical Users Only (49.4%), MU+NMU youth (43.8%), and Nonmedical Users Only (47.3%) were less likely to live with both parents. The percentage of reporting having close friends who had tried Adderall was highest among Nonmedical Users Only (88.2%), which was over three times that of Non-Users (24.7%).

Medical Users Only (M = 1.24 SD = 1.36) endorsed more conduct problem behaviors than Non-Users (M = 0.91, SD = 1.21), but less than MU+NMU youth (M = 2.24, SD = 1.59) and Nonmedical Users Only (M= 2.23, SD = 1.57). Specifically, being suspended, getting into trouble at home/school or running away from home overnight, or being arrested were most likely to occur among MU+NMU youth, while using a weapon or threatening someone with a weapon, or receiving tickets/warnings from police were most likely to occur among Nonmedical Users Only.

For current daily cigarette use, the percentage (nearly 30%) among Nonmedical Users Only was the highest endorsed of all other groups. Interestingly, Non-Users reported daily smoking at a significantly lower rate (3.64%). Half of the Nonmedical User Only group reported binge drinking, five times more than the Non-User group. The proportion reporting lifetime illicit drug use, comprised of marijuana, cocaine, crack, heroin, club drugs, hallucinogens, anabolic steroids, cough syrup/'purple drank' to get high, methamphetamine, and inhalants, was higher among Nonmedical Users Only compared to all other groups. Nearly all (88.7%) Nonmedical Users Only reported lifetime illicit drug use. The percentage of illicit drug use among Medical Users Only (40.5%) was considerably greater than that among Non-Users (29.6%), but lower than that among MU+NMU youth (68.4%).

We summarized results from the multinomial logistic regression in Table 3-3. Younger age (AOR = 0.84; CI = 0.793, 0.89; $p < 0.0001$), residing in a rural area (AOR = 1.367; CI = 1.033, 1.808; $p = 0.0285$), and not living with both parents (AOR = 1.315; CI = 1.044, 1.656; $p = 0.020$) were significantly associated with past 30-day prescription stimulant MU Only, but not with MU+NMU, or NMU Only. Medical Users Only were significantly younger than MU+NMU youth ($p = 0.0006$) and Nonmedical Users Only ($p = 0.0354$), after adjusting for all other variables. Gender did not emerge as a significant predictor of MU Only, MU+NMU, or NMU Only. Caucasians were significantly more likely than other race groups to use prescription stimulants medically only (AOR = 1.863; CI = 1.467, 2.367; $p < 0.0001$), both medically and nonmedically (AOR = 2.167; CI: 1.430, 3.284; $p = 0.0003$), and nonmedically only (AOR = 1.329; CI = 1.004, 1.758; $p = 0.0467$).

Having close friends who had tried Adderall was found to predict past 30-day prescription stimulant MU Only (AOR = 3.404; CI = 2.647, 4.378; $p < 0.0001$), MU+NMU (AOR = 3.985; CI: 2.514, 6.316; $p < 0.0001$), and NMU Only (AOR = 8.670; CI = 5.775, 13.017; $p < 0.0001$). Additionally, individuals having close friends who had tried Adderall were over two times as likely to report NMU Only versus reporting MU Only ($p = 0.0001$) or MU+NMU ($p = 0.0123$). The increasing number of conduct problem behaviors was predictive of past 30-day prescription stimulant MU Only (AOR = 1.127; CI = 1.024, 1.241; $p = 0.0149$), MU+NMU (AOR = 1.484; CI = 1.292, 1.704; $p < 0.0001$), and NMU Only (AOR = 1.209, 95% CI = 1.100, 1.329, $p < 0.0001$). The odds of MU+NMU increased with the number of conduct problem behaviors endorsed when compared with MU Only ($p = 0.0011$), or NMU Only ($p = 0.0132$). Past 30-day Medical Users Only and MU+NMU youth did not differ from Non-Users in cigarette smoking, alcohol use, and illicit drug use, while Nonmedical Users Only were more likely to report substance use relative to Non-Users, Medical Users only, and MU+NMU youth. The odds of NMU Only for individuals who reported currently everyday cigarette use were greater than that for those who smoked cigarettes some days, and the odds of NMU Only for individuals who reported past 30-day binge drinking were greater than that for those who reported past 30-day alcohol use but not binge drinking. Individuals with lifetime history of illicit drug use were about three times more likely to report NMU Only versus reporting MU Only ($p < 0.0001$) or MU+NMU ($p = 0.0015$).

Table 3-1. Patterns of past 30-day nonmedical prescription stimulant use, n = 398

Nonmedical use form	Total (n = 398) n	%	MU+NMU (n = 121) n	%	NMU Only (n = 277) n	%	*p* Value
Not mutually exclusive							
A: From a source other than own prescription	350	88.38	81	67.50	269	97.46	<.0001
B: More than prescribed	152	38.87	72	61.02	80	29.30	<.0001
C: In ways other than prescribed	128	32.16	33	27.27	95	34.30	0.1676
Mutually exclusive							
A	157	40.15	30	25.42	127	46.52	<.0001
A & B	78	19.95	29	24.58	49	17.95	0.1322
A & C	73	18.67	8	6.78	65	23.81	<.0001
A & B & C	37	9.46	12	10.17	25	9.16	0.7537
B	33	8.44	28	23.73	5	1.83	<.0001
C	9	2.30	8	6.78	1	0.37	0.0004
B & C	4	1.02	3	2.54	1	0.37	0.0840
Indeterminable	7	-	3	-	4	-	-

Note: MU = Medical Use; NMU = Nonmedical Use

Table 3-2. Prescription stimulant use status and characteristics of N-MAPSS youth who report them

Characteristics	No Use (n = 10,252) N (%)	MU Only (n = 334) N (%)	MU+NMU (n = 121) N (%)	NMU Only (n = 277) N (%)	*p* Value
Age*	15.08[a] (2.12)	14.75[a] (2.27)	16.06[b] (1.62)	16.22[b] (1.76)	<.0001
10 to 12	1324 (12.91)	60 (17.96)	5 (4.13)	12 (4.33)	
13 to 15	4128 (40.27)	134 (40.12)	30 (24.79)	67 (24.19)	
16 to 18	4800 (46.82)	140 (41.92)	86 (71.07)	198 (71.48)	
Male	4857 (47.38)	175 (52.4)	71 (58.68)	144 (51.99)	0.0105
Race/Ethnicity					<.0001
Caucasian	4240 (41.58)	201 (60.54)	80 (67.23)	173 (62.45)	
African American	2070 (20.3)	53 (15.96)	13 (10.92)	31 (11.19)	
Hispanic/Latino	1948 (19.11)	27 (8.13)	10 (8.4)	26 (9.39)	
Asian	824 (8.08)	14 (4.22)	3 (2.52)	13 (4.69)	
Other	1114 (10.93)	37 (11.14)	13 (10.92)	34 (12.27)	
Residence area					<.0001
Urban	4939 (48.18)	115 (34.43)	55 (45.45)	118 (42.6)	
Suburb	3802 (37.09)	146 (43.71)	47 (38.84)	103 (37.18)	
Rural	1511 (14.74)	73 (21.86)	19 (15.7)	56 (20.22)	
Live in 2-parent household	5763 (56.23)	165 (49.4)	53 (43.8)	131 (47.29)	<.0001
Have close friends had tried Adderall	2516 (24.7)	179 (53.92)	84 (71.19)	239 (88.19)	<.0001
# of Conduct problem behaviors*	0.91[a] (1.21)	1.24[b] (1.36)	2.24[c] (1.59)	2.23[c] (1.57)	<.0001
Suspension	3021 (29.5)	122 (36.64)	74 (61.16)	142 (51.45)	<.0001
Ticket/warning	1832 (18.03)	74 (22.16)	47 (39.83)	144 (52.36)	<.0001
Arrest	856 (8.36)	40 (11.98)	40 (33.33)	83 (30.07)	<.0001
Have trouble at home or school/run away overnight	2416 (23.58)	125 (37.43)	71 (58.68)	157 (56.68)	<.0001
Use weapon	1160 (11.33)	53 (15.87)	35 (28.93)	88 (31.77)	<.0001
Current cigarette smoking					<.0001
No current use	9342 (91.56)	282 (84.94)	80 (67.8)	141 (51.46)	
Use some days	490 (4.8)	32 (9.64)	17 (14.41)	54 (19.71)	
Use everyday	371 (3.64)	18 (5.42)	21 (17.8)	79 (28.83)	

Table 3-2. Continued

Characteristics	No Use (n = 10,252) N (%)	MU Only (n = 334) N (%)	MU+NMU (n = 121) N (%)	NMU Only (n = 277) N (%)	*p* Value
Past 30-day alcohol use					<.0001
No use	7596 (74.65)	236 (71.52)	56 (47.46)	62 (22.79)	
Use but not binge drinking	1662 (16.33)	51 (15.45)	22 (18.64)	74 (27.21)	
Binge drinking	918 (9.02)	43 (13.03)	40 (33.9)	136 (50)	
Lifetime illicit drug use	3022 (29.61)	135 (40.54)	80 (68.38)	243 (88.69)	<.0001

* Mean (Standard Deviation), F test p< 0.001; Means with the same superscript letter are not significantly different from each other based on post-hoc comparisons.
Note: MU = Medical Use; NMU = Nonmedical Use.

Table 3-3. Multinomial logistic regression results for past 30-day prescription stimulant MU Only, MU+NMU, and NMU Only

	MU Only vs No Use	MU+NMU vs No Use	NMU Only vs No Use	MU+NMU vs MU Only	NMU Only vs MU Only	NMU Only vs MU+NMU
	AOR (95% CI)	**AOR (95% CI)**	**AOR (95% CI)**	***p* Value**	***p* Value**	***p* Value**
Age	0.84 (0.793, 0.89) ***	1.051 (0.936, 1.18)	0.937 (0.859, 1.023)	0.0006	0.0354	0.1126
Male	1.152 (0.915, 1.45)	1.113 (0.745, 1.662)	0.867 (0.66, 1.138)	0.8832	0.1087	0.2969
Caucasian	1.863 (1.467, 2.367) ***	2.167 (1.43, 3.284) ***	1.329 (1.004, 1.758) *	0.5321	0.0651	0.0491
Living in rural area	1.367 (1.033, 1.808) *	0.784 (0.458, 1.341)	1.181 (0.846, 1.647)	0.0671	0.4951	0.1887
Not living w/ both parents	1.315 (1.044, 1.656) *	1.193 (0.805, 1.767)	0.951 (0.726, 1.246)	0.6705	0.0659	0.3354
Having close friends had tried Adderall	3.404 (2.647, 4.378) ***	3.985 (2.514, 6.316) ***	8.67 (5.775, 13.017) ***	0.5526	0.0001	0.0123
# of Conduct problem behaviors	1.127 (1.024, 1.241) *	1.484 (1.292, 1.704) ***	1.209 (1.1, 1.329) ***	0.0011	0.2871	0.0132
Current cigarette smoking						
No current use	1 [Reference]	1 [Reference]	1 [Reference]	-	-	-
Use some days	1.478 (0.963, 2.27)	1.396 (0.779, 2.504)	1.487 (1.033, 2.142) *	0.8741	0.9817	0.8516
Use everyday	0.896 (0.521, 1.54)	1.039 (0.576, 1.873)	1.975 (1.389, 2.809) ***	0.7087	0.0121	0.0548
Past 30-day alcohol use						
No use	1 [Reference]	1 [Reference]	1 [Reference]	-	-	-
Use but not binge drinking	0.713 (0.506, 1.004)	0.803 (0.468, 1.379)	1.742 (1.195, 2.538) **	0.7093	0.0004	0.0184
Binge drinking	0.798 (0.536, 1.188)	1.296 (0.776, 2.164)	2.845 (1.965, 4.119) ***	0.133	<.0001	0.0118
Lifetime illicit drug use	1.204 (0.893, 1.623)	1.494 (0.901, 2.477)	4.408 (2.813, 6.906) ***	0.4658	<.0001	0.0015

* $p < .05$; ** $p < 0.01$; *** $p < .001$ based on multinomial logistic regression results.

Note: AOR = Adjusted Odds Ratio; CI = Confidence Interval; MU = Medical Use; NMU = Nonmedical Use

CHAPTER 4
DISCUSSION

The purpose of this study was to assess the past 30-day prevalence of prescription stimulant use, explore different forms of nonmedical use, and investigate the differences among four groups: Non-User, Medical User Only, MU+NMU youth, and Nonmedical User Only. Findings are: 1) the past 30-day prevalence of prescription stimulant use was 6.8%, and that of nonmedical use was 3.6%; 2) use of someone else's prescription stimulants was the most frequently reported type of nonmedical prescription stimulant use (88.4%), followed by use more than prescribed (38.9%), and use deviating from the prescribed route being the least (32.2%); 3) younger age, residing in a rural area, and not living with both parents were associated with past 30-day prescription stimulant MU Only, but not independently associated with MU+NMU, or NMU Only; 4) MU+NMU youth endorsed more conduct problem behaviors compared to all other groups; 5) Medical Users Only and MU+NMU youth did not differ from Non-Users in cigarette smoking, alcohol use, and illicit drug use history, while Nonmedical Users Only were more likely to use alcohol and illicit drugs than all other groups.

Definition and Prevalence of Prescription Stimulant Medical and Nonmedical Use

The definition of prescription stimulant nonmedical use varies from study to study. Some studies defined it as non-prescription use (without a doctor's order),[10] while others used the NSDUH criteria (used a prescription stimulant without a prescription or took it only for the experience or feeling it caused) (Substance Abuse and Mental Health Services Administration, 2014).[33] Neither of these two commonly used definitions captured individuals who use a prescription stimulant more than prescribed. Some studies defined individuals who used too much of their own prescription stimulants or

used them to intentionally get high as ‘medical misusers’,[34,35] and those who used without prescriptions as ‘nonmedical users’.[35] The inconsistent definition of ‘nonmedical use’ does not permit the comparison across studies. Previous studies usually defined ‘both medical and nonmedical users’ as individuals who use one or more prescription stimulants as prescribed by their physicians, as well as prescription stimulants that are not prescribed to them.[23,36] This definition did not include individuals who use their own prescription deviating from prescribed route, or took it more than prescribed. Another problem is that previous studies only reported lifetime ‘both medical and nonmedical use’. Therefore, there may be a big gap between when medical use and nonmedical use happened. The characteristics of this group may not represent individuals who use prescription drugs medically and nonmedically at the same period of time.

In the present study, prescription stimulant nonmedical use was defined as use without a prescription, use of a prescribed stimulant at a higher than recommended dose, or use deviating from the prescribed route. The past 30-day prevalence of prescription stimulant use assessed in N-MAPSS was 6.8%, with 3.0% reporting MU Only, 1.1% reporting MU+NMU, and 2.5% reporting NMU Only. The MTF national survey estimated that 2.7% of adolescents reported the past 30-day nonmedical use of “amphetamine” (including methamphetamine) in 2013, while our study found this rate for 5 brand-name prescription stimulants to be 3.6% (2.5% NMU Only + 1.1% MU+NMU).[10] Since the N-MAPSS sampled the areas with the highest dispensing volume of stimulant prescriptions, our stimulant use estimates seemed to be higher compared to national studies. Additionally, N-MAPSS employed an entertainment-venue intercept sampling method to approach and recruit potential participants, and

administer surveys in youth friendly entertainment venues (e.g., shopping malls, skate parks, playgrounds, and etc.). This recruitment technique helped to reach a more diverse sample compared to school-based sampling, which did not include homeschooled adolescents, those suspended or who dropped out, and those who might be absent from school on the day the study was taken.[32] Because of different definitions of nonmedical prescription stimulant use and recruitment methods, and limited study on past 30-day prescription stimulant use, direct comparison with other studies is more difficult, thus, estimates should be interpreted with caution.

Type of Prescription Stimulant Nonmedical Use

We found that among stimulant nonmedical users, using someone else's prescription was the most frequently reported type of nonmedical prescription stimulant use (88.4%), followed by use more than prescribed (38.9%). Use deviating from the prescribed route was the least reported (32.2%). In our study, among the youth who had a prescription or a refill during the past 30 days, 28.9% reported nonmedical use. Among MU+NMU youth, 67.5% reported using other's stimulants, 61.0% reported use more than prescribed in the last 30 days, and 27.3% reported use not by mouth or in a way other than prescribed. Compared to Nonmedical Users Only, MU+NMU youth were more likely to report using more than prescribed, but less likely to report use of someone else's stimulant. Nonmedical Users Only and MU+NMU youth similarly reported using stimulants outside of the prescribed route (e.g., smoked, snorted or sniffed).

Demographic Predictors

Consistent with the literature, we found increasing age was associated with nonmedical prescription stimulant use. A potential explanation is that older adolescents

may have lower levels of parental supervision and greater access to substances.[17] However, age did not emerge as significant correlates of nonmedical use when comparing to non-users after we adjust for other covariates. Similar to previous research, we found that Caucasian adolescents were more likely to report receiving prescription stimulants, and were at significantly higher risk for nonmedical prescription stimulant use, compared to the other race groups.[12,21,22,24,25] White families may have been more likely to have access, or to be able to afford the treatment for ADHD/ADD which provided access.[31,37] On the other hand, some studies reported that income and prescription stimulant nonmedical use was not significantly related.[18,29] More research is needed to further explore race/ethnicity difference in nonmedical use by examining access, social network, or socioeconomic status.

Although some studies reported that adolescents living in rural areas were more likely to report nonmedical prescription drug use (any type including pain relievers, tranquilizers, stimulants, and sedatives), we did not observe this difference for stimulant-type medications.[18,20] Instead, we found that youth from rural areas were more likely to report medical use of prescription stimulants. A previous study found that rural children were as likely as urban children to have an ADHD diagnosis; however, rural children tended to receive more prescriptions but less consulting services compared to their urban counterparts.[38]

Family and Peer Influence

In the present study, not living with both parents was not significantly associated with prescription stimulant nonmedical use. Findings from nationally representative studies that examined parental bond or involvement as a correlate to nonmedical prescription drug use were mixed.[12,16,19,29,39]

It was reported that adolescents whose friends engaged in substance use were more likely to report nonmedical prescription drug use.[16,19,39] We observed a similar pattern in this study. Furthermore, we found that Nonmedical Users Only were more likely to have close friends who had tried Adderall compared to Medical Users Only and MU+NMU youth. However, Medical Users Only and MU+NMU youth did not differ in having friends who had tried Adderall. One possible explanation is that Medical Users Only and MU+NMU youth may belong to the same network because both groups were on medication and were more likely to have friends who also had prescriptions. On the other hand, the friends that Nonmedical Users Only had may be the ones from whom they asked for the medication or those who also nonmedically used the prescription. However, we did not know if these 'friends' used Adderall for medical reasons or used them nonmedically. Therefore, we could not explain finding from current study through social learning theory[18] or ecological source of risk-taking behaviors[17], suggesting that adolescents whose friends engage in delinquent behaviors are more likely to engage in the same behaviors such as nonmedical use of prescription medication.[39,40]

Conduct Problem Behaviors

As expected, conduct problem behaviors were associated with MU Only and MU+NMU, since health problems need stimulant treatment are often co-morbid with a variety of comorbid mental illness, and emotional and behavior problems.[41] It was reported that nonmedical prescription drug use was associated with self-reported conduct problem behaviors (e.g., suspension, skipping school, jail/detention, delinquency, arrest, conflict with parents, etc.), because youth misusing prescription drugs likely got these drugs through delinquent behaviors, or friends engaging in norm violations.[11,12,21,26,39,40] However, most studies compared adolescents who reported any

prescription medication nonmedical use with those who never used prescription drug and/or those properly took their medication together, instead of exploring whether the association existed between nonmedical users who were on medication (MU+NMU youth) and those who took their medication as prescribed (Medical User Only), especially among younger adolescents. The present study found the odds of past 30-day MU+NMU increased with the number of conduct problem behaviors endorsed as compared with MU Only after adjusting for the other covariates. We also found Nonmedical Users Only had fewer conduct problem behaviors than MU+NMU youth. This warrants further research to better understand the difference between the conduct problem behaviors co-occurring with ADHD and those delinquent behaviors not associated with ADHD in prescription stimulant nonmedical use. This knowledge would lead to different intervention strategies to target these subgroups to prevent prescription stimulant nonmedical use.

Substance Use Behaviors

Consistent with the literature, we found that the illicit substance use was higher among prescription stimulant nonmedical users.[8,18,19,25] However, it is noteworthy that substance use differentiated Nonmedical Users Only from Non-Users, but did not differentiate Medical Users Only or MU+NMU youth from Non-Users. The significantly higher risk for NMU Only found among youth with lifetime history of substance use is not surprising and supported by the Problem-Behavior Theory, which states that involvement in any one problem behavior increases the likelihood of involvement in other problem behaviors.[42] Studies also have suggested that nonmedical use of prescription drug may be another class of substance used by poly-substance using

youth. These youth were familiar with other substance, and had more opportunities to access either prescription drug or other substance.[15,31,40]

Our results revealed that cigarette smoking, alcohol use, and illicit drug use were not independently associated with MU Only. This finding supports previous regional and national studies among adolescents that found no difference between medical users and non-users in other substance use.[8,15]

Interestingly, we found that the odds of being in MU+NMU group were not increased by cigarette smoking, alcohol use, and illicit drug use history. It suggests that this group of youth may just use stimulants nonmedically to achieve better performance.[15,43] Our finding is different from previous studies of adolescents that indicated other substance use was associated with both medical and nonmedical use of prescription stimulants.[8,23] This difference could be attributed to the different measures of prescription stimulant use and differences in analytic models. Previous studies measured the 'lifetime' both medical and nonmedical use of prescription stimulant. By this definition, taking the medication according to doctor's order and using stimulants nonmedically may occur at different time periods. Instead, we measured MU+NMU in the last 30-day period prior to the survey, which better represents the co-occurring medical and nonmedical use. McCabe and West[8] discovered that the odds of substance use behaviors for adolescents who reported medical use before nonmedical use were considerably lower than those who reported nonmedical use before medical use. Besides the investigation into the difference between two subgroups that initiated nonmedical use before or after medical use of prescription stimulants, more research is

needed to distinguish youth who were persistent or non-persistent medical and nonmedical users of prescription stimulants.

Limitations

This study has several limitations. First, recruitment at entertainment venues is not random sampling, and we may miss kids that stayed home and never went out. Second, to examine sample generalizability, the 11,048 youth in the 10 N-MAPSS cities were compared with that of the 2010 US Census for each of the cities. The sample was found to be highly representative, though there were slightly fewer men, Hispanics, and African-Americans in several cities.[32] However, our study sample was drawn from metropolitan areas with higher prescription stimulant dispensing volume, it may limit the generalizability of this study to those areas. Third, we acknowledged that there was a city-to-city variability in some covariates; however, we were unable to further assess this variability due to the small sample size in each city. Fourth, the cross-sectional nature of this study prevents us from determining the causal relationship between each prescription stimulant use pattern and the covariates.

Implications

The findings from this study have important implications for future practice and epidemiological research. This study found 6.8% of youth aged 10 to 18 years used prescription stimulants during the past 30-day period, with half reporting some type of nonmedical use. We found that 67.5% of MU+NMU youth used stimulants not prescribed to them, 61.0% used the stimulants more than prescribed, and 27.3% used the stimulants not according to the prescribed routes. Adolescents with prescriptions should be cautioned against using other's stimulants or diverting their own prescriptions. When prescribing prescription stimulants, a screening for the history of problem

behaviors should be given to adolescents. Health care providers need to reinforce the importance of following the exact instructions on how to administer the prescription stimulants. They also need to inform young patients and their parents of the potential risk of misusing prescription stimulants, as well as diverting their stimulants to others. Parents should closely monitor their children's medication use behavior, such as dose and frequency, route of administration, to detect potential nonmedical use. For Nonmedical Users Only, almost all of them reported using stimulants that belonged to someone else. In the future, we may look at the specific source where they got the nonmedically used stimulants from, and how these stimulants were diverted to them. Prevention activities should be targeted towards the source.

Future research may also characterize nonmedical users into other subgroups based on motivation and frequency of the nonmedical use (e.g., self-treater vs. sensation-seekers, and experimenters vs. frequent misusers), poly-substance use behaviors, or the formulations of stimulants (e.g., immediate release vs. extended release, oral vs. transdermal) in order to better understand the underlying mechanisms of nonmedical use and design tailored interventions.

In conclusion, findings from the present study provide evidence that MU+NMU youth and Nonmedical Users Only are different in their form of nonmedical use and characteristics associated with nonmedical use behaviors. This new knowledge will guide the development of preventive interventions with tailored strategies to prevent nonmedical use among adolescents.

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BIOGRAPHICAL SKETCH

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