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Discordant reporting of nonmedical amphetamine use among Adderall-using high school seniors in the US

Joseph J. Palamar[1] and **Austin Le**[2]

[1]Department of Population Health, New York University Langone Medical Center, New York, NY

[2]New York University College of Dentistry, New York, NY

Abstract

Background—Amphetamine is the most prevalent prescription stimulant in the United States, both medically and nonmedically. Reliable data on nonmedical use is needed to continue to inform prevention. To determine whether adolescents accurately self-report nonmedical amphetamine use, we compared self-reports of nonmedical amphetamine use and nonmedical Adderall use in a national sample.

Methods—We examined self-reported nonmedical Adderall and amphetamine use in a nationally representative sample of 24,740 high school seniors in the Monitoring the Future study (2010–2015). We examined prevalence and correlates of discordant responses among past-year Adderall users, defined as reporting past-year nonmedical Adderall use, but not reporting past-year nonmedical amphetamine use.

Results—While 6.9% reported nonmedical Adderall use and 7.9% reported nonmedical amphetamine use, over a quarter (28.7%) of these Adderall users reported no amphetamine use. Those at highest risk for Adderall use tended to be at lower odds of providing a discordant response. Older students (aged ≥18), black students, and those with parents of lower educational attainment were more likely to report no amphetamine use, despite reporting Adderall use. Lifetime use of various drugs was associated with decreased odds of providing a discordant response; however, only nonmedical opioid use was associated with significant decreased odds in

Correspondence: Joseph J. Palamar, Department of Population Health, 227 E. 30th Street, 7th Floor, New York, NY 10016, joseph.palamar@nyumc.org, Telephone: 646-501-2884.

Contributors

Both authors are responsible for this reported research. J. Palamar conceptualized and designed the study, and conducted the statistical analyses. A. Le and J. Palamar drafted the initial manuscript, and both authors interpreted results, and critically reviewed and revised the manuscript. Both authors approved the final manuscript as submitted.

Conflict of Interest

No conflict declared.

Author Disclosures

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multivariable models. Disapproval towards amphetamine use increased odds of providing a discordant response, while higher exposure to users decreased odds of providing a discordant response.

Conclusion—Prevalence of nonmedical amphetamine use may be underreported on some surveys, particularly among specific subpopulations. Future surveys must ensure accurate and consistent responses.

Keywords

amphetamine; Adderall; reliability of self-report; adolescents

1. Introduction

Amphetamine-based prescription stimulants are a first-line option for pharmacotherapy of attention-deficit/hyperactivity disorder (Chen et al., 2016). In 2015, two-thirds (65.7%) of any past-year use of prescription stimulants among Americans aged ≥12 involved amphetamine (Hughes et al., 2016). Adderall, a commercial name for a combination of amphetamine salts, has been linked to enhanced cognitive function and academic performance, which in part, has led to nonmedical use among high school and college students (Cassidy et al., 2012; Spencer et al., 2015). In 2015, an estimated 5.3 million Americans aged ≥12 engaged in such nonmedical use of amphetamine-like prescription stimulants; of these, 4.8 million used amphetamine, corresponding to approximately 1.8% of the population (Hughes et al., 2016).

Nonmedical use of amphetamine warrants concern due to high potential for abuse and dependency (O'Malley and O'Malley, 2003; Rasmussen, 2015) as well as potential adverse effects associated with use including cardiovascular events, seizures, and psychosis (Fitzgerald and Bronstein, 2013; Lakhan and Kirchgessner, 2012). In addition, nonmedical users of prescription stimulants are more likely to engage in other drug use and risky behaviors (McCabe et al., 2005). Considering the popularity and potential dangers associated with use of specific amphetamine-based stimulants such as Adderall, it is essential to assess the accuracy of reporting nonmedical amphetamine use.

Discordant responses regarding stimulant use have been found on national surveys. For example, a study focusing on the National Household Survey on Drug Abuse (NHSDA) found that reporting of cocaine use increased when participants were provided multiple chances to report use (Lessler et al., 2000). To our knowledge, studies have not examined discordant reporting of amphetamine use, although studies utilizing biological measures have detected unknown/unintentional use of amphetamine as it is often present in drugs such as ecstasy (Palamar et al., 2017; Vidal Gine et al., 2016). A recent study found that in a national sample of high school seniors, 37% of those reporting nonmedical Vicodin use and 28% of those reporting nonmedical OxyContin use did not report overall nonmedical opioid use (Palamar et al., 2016). Thus, it is important to investigate self-report of nonmedical use of other highly-abused prescription drugs such as amphetamine. Reliable data are needed to continually inform appropriate policy and prevention.

In this analysis, we seek to determine the extent of underreporting of nonmedical amphetamine use in a national survey, as it is hypothesized that many adolescents are unaware that Adderall is an amphetamine and/or simply not fully attentive to survey questions about amphetamine.

2. Methods

2.1. Procedure

MTF is a nationally representative cross-sectional study of high school students in the US. Approximately 15,000 high school seniors are surveyed each year from approximately 130 public and private schools throughout 48 states. MTF utilizes a multi-stage random sampling procedure: geographic areas are selected first, then schools within those areas, and then classes within schools. We aggregated data from the six most recent cohorts (2010–2015). MTF randomly distributes six different survey forms. Our analyses are limited to Forms 3 and 6 as these are the only forms that query nonmedical Adderall use. MTF protocols were approved by the University of Michigan Institutional Review Board (IRB), and this secondary data analysis is exempt from IRB review at the authors' institution.

2.2. Measures

2.2.1. Amphetamine and Adderall Use—Before querying nonmedical amphetamine use, the survey explained that "amphetamines are sometimes prescribed by doctors for people who have trouble paying attention, are hyperactive, have ADHD, or have trouble staying awake". The survey further explained that these drugs include Adderall and Ritalin and that "drugstores are not supposed to sell with without a prescription from a doctor." It also explained that amphetamines do not include nonprescription drugs such as over-the-counter stay-awake or diet pills. Students were then asked how many occasions, if any, in the past 12 months they had used amphetamines "on their own", "without a doctor telling them to take them". It should be noted that while these questions on Form 6 only specified amphetamines, Form 3 contained the same information, but specified "amphetamines and other stimulant drugs". Later in the survey, students were asked how many occasions in the last 12 months (if any) they had used Adderall without a doctor's orders. Both Adderall and amphetamine use variables were coded into dichotomous variables indicating whether the drug was reportedly used. We also coded a variable indicating discordant report, which was defined as reporting Adderall use, but not amphetamine use.

On Form 3 only, students were also asked if they disapprove of people (aged ≥18) "trying an amphetamine (uppers, speed, Adderall, Ritalin, etc.) once or twice". Likewise, on Form 3 only, students were asked how often in the past 12 months they had been around people taking "amphetamines (uppers, speed, Adderall, Ritalin, etc.)" to get high.

2.2.2. Other Drug Use—Students were also asked about lifetime use of cigarettes, marijuana, LSD, cocaine, ecstasy, and nonmedical use of opioids and tranquilizers.

2.2.3. Student Characteristics—MTF asked students about their age, sex, and race/ethnicity. They were also asked about parents' educational attainment, which was used as a

proxy for socioeconomic status (SES) (Wallace et al., 2009). Students were also asked about the number of evenings per week they usually go out for fun and recreation.

2.3. Analyses

We first examined characteristics of past-year nonmedical Adderall users, and utilizing the full sample (*N*=24,740), we used chi-square to determine whether there were significant differences between users and non-users with regard to each covariate. We then examined the extent of overlap in self-reported nonmedical amphetamine use among nonmedical Adderall users (*N*=1,689). Using binary logistic regression, we computed odds ratios to determine which covariates were related to discordant reporting in a bivariable manner. We then computed two multivariable logistic regression models—the first contained all covariates assessed in both survey forms, while the second also contained the disapproval and exposure to user variables, which were only included in Form 3 (thus the second model was limited to half of Adderall users). All analyses were conducted using Stata 13.1 software (StataCorp, College Station, TX) and all statistics were design-based for survey data (Heeringa, 2010), using sample weights provided from MTF.

3. Results

In the full sample, 6.9% of students reported past-year nonmedical Adderall use and 7.9% reported past-year nonmedical amphetamine use. However, among those reporting nonmedical Adderall use, 28.7% did not report nonmedical amphetamine use. Thus, over a quarter of nonmedical Adderall users provided a discordant report by not reporting nonmedical amphetamine use.

In the full sample, nonmedical Adderall users were more likely to identify as male, white, and go out multiple evenings per week for fun (*p*s<.001). They also tended to have parents with higher educational attainment (*p*=.001), and were more likely to report lifetime use of each of the other drugs, no disapproval towards amphetamine use, and more frequent exposure to users (*p*s<.001).

With regard to discordant reporting of no amphetamine use by those reporting nonmedical Adderall use (Table 1), older students were consistently at higher odds of providing a discordant report (*p*s<.05). Black students were consistently at increased odds of providing a discordant report (compared to white students; *p*s<.01). Students with parents with higher education were at only half the odds of providing a discordant report (*p*s<.05), and lifetime use of each drug was associated with decrease in odds of providing a discordant report until controlling for all other covariates (*p*s<.001). In the multivariable models, nonmedical opioid use was the only drug to consistently remain significant, with users at only half the odds of providing a discordant report (*p*s<.05). With all else being equal, students reporting any disapproval toward amphetamine use were at more than double the odds of providing a discordant report (AOR=2.46, p<.001). More frequent exposure to users was associated with a decrease in odds of providing a discordant report, with “occasional” or “often” exposure being associated with a decrease in odds of providing a discordant report (AOR=0.29, *p*<.001).

4. Discussion

It is important that survey-takers are able to correctly identify and classify specific drugs within a broader category, given that nonmedical users of amphetamine tend to use specific drugs such as Adderall. Accurate data on prevalence of drug use is needed to inform prevention, as over- or under-estimation may result in incommensurate public health responses. In our analysis of a nationally representative sample of high school seniors, we found that over a quarter (28.7%) of the students who reported nonmedical Adderall use reported no nonmedical amphetamine use. Thus, the current estimated past-year prevalence of nonmedical amphetamine use of 7.9% may be an underestimate; it may be as high as 9.8% (one out of ten high school seniors) when considering discordant reporting of nonmedical Adderall use.

Students who were most likely to use Adderall were generally at lower odds of denying amphetamine use. For example, students with parents of higher educational attainment, a common indicator of higher SES, were at half the odds of discordant reporting. Similarly, users of each drug examined were not only at high risk for nonmedical Adderall use, but also at lower odds of discordant reporting, though only opioid use remained consistently significant after controlling for other covariates. One potential explanation is that nonmedical opioid users, who may have greater exposure to common prescription opioids (e.g., Vicodin, OxyContin), are more knowledgeable about psychotherapeutic drug names and classes and hence less likely to provide a discordant response due to information bias. Similarly, greater experience and drug knowledge may help explain why students who reported more frequent exposure to amphetamine users were also at significantly lower odds of discordant reporting.

Students who were disapproving of others trying amphetamine were at notably higher odds of discordant reporting. While further research is needed, we hypothesize that this may be due to social desirability bias. Black students were also more likely to provide a discordant response than white students. This race finding adds to recent findings showing a higher prevalence of discordance among black students reporting nonmedical opioid use (Palamar et al., 2016). However, while older students were more likely to provide a discordant response in this study, age was not a significant factor for providing a discordant response regarding opioid use in the other study. In addition, in the other study, females were more likely than males to provide a discordant response regarding opioids, and marijuana and nonmedical tranquilizer users were less likely to provide a discordant response for opioids, but these factors were not consistently significant in this study focusing on Adderall use. Further research is needed to examine why there are such differences in discordant responding with regard to stimulants and opioids.

Many surveys are now administered electronically, which has the advantage of enabling the use of skip-logic. Based on a respondent's response to a survey question, skip-logic—whether implemented electronically or via an interviewer—determines whether or not follow-up questions will be asked (Hughes et al., 2016). Therefore, irrelevant follow-up questions can be avoided, thereby reducing the burden on participants and enabling researchers to more easily query a wide variety of phenomena (Swanson et al., 2014).

However, studies have found that measurement error can occur when skip-patterns are used (Palamar et al., 2017). For example, a study focusing on the NHSDA found that prevalence of past-year self-reported cocaine use increased when participants were provided multiple chances to report use (Lessler et al., 2000). Skip-logic is beneficial, but researchers must ensure that it is utilized appropriately. While discordant responses are certainly problematic, results from the MTF data examined here provided a unique and important opportunity to examine concordant versus discordant responses.

4.1 Limitations

MTF does not assess students who dropped out of high school, and MTF data are cross-sectional, so we were unable to compare self-report over time to further assess validity of responses. MTF does not ask about lifetime or past-month nonmedical use of Adderall, so analyses were limited to past-year use. It is also unknown which students over- or under-reported use of amphetamine and/or Adderall. It is also unknown whether these students were unaware that Adderall is an amphetamine-based product (despite this being explained before the questions), or were simply inattentive to specific survey questions.

5. Conclusion

A large proportion of high school seniors who report past-year nonmedical Adderall use denied nonmedical amphetamine use, suggesting that overall estimates of general use of prescription stimulants may be underestimated in some studies, particularly among certain subpopulations. Future research can explore the reasons underlying such discordant reporting, while tests of validity may be required to ensure that respondents are able to correctly identify and provide appropriate responses for the use of substances assessed. While more research is needed, researchers conducting drug surveys may benefit from providing images of specific substances (similar to what is done in the National Survey of Drug Use and Health; Center for Behavioral Health Statistics and Quality, 2016)—both to help participants recognize which pill is which and to help them identify the drug class.

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Highlights

- We examined nonmedical-Adderall use among students denying nonmedical amphetamine use
- Over a quarter (28.7%) of nonmedical Adderall users denied nonmedical amphetamine use
- Discordant reports were more likely among older and black students
- Users of other drugs (e.g., opioids) were less likely to provide a discordant report
- Prevalence of nonmedical amphetamine use may be underreported on some surveys

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Table 1

Characteristics of Students Reporting Past-Year Nonmedical Adderall Use, but Not Nonmedical Amphetamine Use (N = 1,689)

		Discordant Reporting of Amphetamine Use among Adderall Users						
		Univariable	Bivariable		Model 1		Model 2+	
	Characteristics of Adderall Users % (95% CI)	Prevalence of Discordant Report % (95% CI)	OR	95% CI	AOR	95% CI	AOR	95% CI
Age, years								
<18	41.3 (38.6, 44.1)	24.9 (21.2, 29.1)	1.00		1.00		1.00	
>18	58.7 (55.9, 61.4)	30.9 (27.7, 34.4)	1.34*	(1.03, 1.75)	1.72*	(1.13, 2.64)	1.77*	(1.11, 2.83)
Sex								
Male	55.5 (52.6, 58.3)***	30.3 (26.8, 33.9)	1.00		1.00		1.00	
Female	44.5 (41.7, 47.4)	25.2 (21.6, 29.2)	0.77	(0.59, 1.01)	0.95	(0.61, 1.48)	0.92	(0.57, 1.48)
Race								
White	83.6 (81.2, 85.7)***	24.2 (21.5, 27.1)	1.00		1.00		1.00	
Black	6.66 (5.27, 8.40)	68.2 (57.1, 77.5)	6.71***	(4.07, 11.0)	4.76***	(2.30, 9.83)	4.08**	(1.74, 9.54)
Hispanic	9.72 (8.08, 11.6)	36.4 (27.5, 46.4)	1.79**	(1.15, 2.79)	0.83	(0.38, 1.82)	0.92	(0.39, 2.16)
Parent Education								
Low	26.3 (23.8, 28.8)**	33.2 (28.1, 38.7)	1.00		1.00		1.00	
Moderate	29.7 (27.2, 32.4)	27.0 (22.5, 32.0)	0.74	(0.53, 1.04)	0.73	(0.41, 1.29)	0.76	(0.41, 1.39)
High	44.0 (41.3, 46.8)	26.0 (22.5, 29.9)	0.71*	(0.52, 0.96)	0.49*	(0.28, 0.86)	0.52*	(0.29, 0.90)
Evenings Out Per Week								
0–1	17.0 (14.9, 19.2)***	35.4 (29.1, 42.3)	1.00		1.00		1.00	
2–3	46.4 (43.6, 49.1)	29.1 (25.5, 33.0)	0.74	(0.53, 1.05)	1.09	(0.59, 2.01)	1.09	(0.52.06)
4–7	36.7 (34.0, 39.4)	24.1 (20.3, 28.5)	0.58**	(0.40, 0.83)	1.42	(0.76, 2.66)	1.38	(0.69, 2.77)
Lifetime Drug Use								
Cigarettes								
No	22.8 (20.6, 25.3)***	42.0 (36.3, 47.9)	1.00		1.00		1.00	
Yes	77.2 (74.7, 79.4)	24.7 (22.1, 27.6)	0.45***	(0.34, 0.60)	0.79	(0.45, 1.40)	0.81	(0.45, 1.45)

		Discordant Reporting of Amphetamine Use among Adderall Users						
		Univariable	Bivariable		Model 1		Model 2+	
	Characteristics of Adderall Users % (95% CI)	Prevalence of Discordant Report % (95% CI)	OR	95% CI	AOR	95% CI	AOR	95% CI
Marijuana								
No	10.3 (8.59, 12.3)***	55.5 (46.0, 64.6)	1.00		1.00		1.00	
Yes	89.7 (87.7, 91.4)	24.1 (21.6, 26.7)	0.25***	(0.76, 0.38)	0.77	(0.32, 1.81)	0.95	(0.33, 2.73)
LSD								
No	77.2 (74.5, 79.6)***	29.6 (26.5, 32.9)	1.00		1.00		1.00	
Yes	22.8 (20.4, 25.5)	17.4 (13.3, 22.4)	0.50***	(0.35, 0.71)	0.74	(0.39, 1.39)	0.79	(0.39, 1.57)
Tranquilizers (Nonmedical)								
No	59.8 (57.1, 62.5)***	36.4 (32.9, 40.0)	1.00		1.00		1.00	
Yes	40.2 (37.5, 42.9)	17.2 (14.3, 20.6)	0.36***	(0.28, 0.47)	0.94	(0.56, 1.56)	0.94	(0.53, 1.64)
Opioids (Nonmedical)								
No	48.6 (45.8, 51.4)***	40.1 (36.2, 44.2)	1.00		1.00		1.00	
Yes	51.4 (48.6, 54.2)	17.4 (14.6, 20.6)	0.31***	(0.24, 0.41)	0.42**	(0.25, 0.71)	0.51*	(0.29, 0.89)
Cocaine								
No	75.6 (73.2, 77.9)***	33.8 (30.8, 37.0)	1.00		1.00		1.00	
Yes	24.4 (22.1, 26.8)	13.0 (9.95, 16.8)	0.29***	(0.21, 0.40)	0.45*	(0.25, 0.84)	0.55	(0.28, 1.07)
Ecstasy								
No	64.6 (61.2, 67.8)***	34.9 (30.7, 39.2)	1.00		1.00		1.00	
Yes	35.4 (32.2, 38.8)	16.7 (13.0, 21.1)	0.37***	(0.26, 0.52)	0.80	(0.47, 1.34)	0.82	(0.47, 1.44)
Disapproval Towards Trying Amphetamine								
No	61.0 (57.1, 64.8)***	13.6 (10.6, 17.3)	1.00		-	-	1.00	
Yes	39.0 (35.2, 42.9)	44.4 (38.1, 50.9)	5.08***	(3.45, 7.48)	-	-	2.46***	(1.50, 4.01)
Exposure to Amphetamine Users					-	-		
None	21.1 (18.0, 24.5)***	58.3 (49.5, 66.6)	1.00		-	-	1.00	
1–2 Times	18.5 (15.8, 21.6)	27.8 (20.8, 36.2)	0.27***	(0.16, 0.46)	-	-	0.49*	(0.27, 0.89)

		Discordant Reporting of Amphetamine Use among Adderall Users						
		Univariable	**Bivariable**		**Model 1**		**Model 2+**	
	Characteristics of Adderall Users % (95% CI)	**Prevalence of Discordant Report % (95% CI)**	**OR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**
Occasionally / Often	60.4 (56.5, 64.1)	13.5 (10.3, 17.6)	0.11***	(0.07, 0.17)	-	-	0.29***	(0.15, 0.55)

Note. Percentages in the column presenting characteristics of Adderall users are within the Adderall-using subsample, but *p*-values were computed via chi-square using the full sample (N = 24,740). Univariable statistics, bivariable statistics, and Model 1 were estimated from students reporting nonmedical Adderall use (N = 1,689).

+Model 2 is limited to half the sample of Adderall users (N = 856) as disapproval and exposure variables were only queried in one of two survey forms. While discordance was not significantly different by survey year (p=.824), we also computed models including indicators for year and multivariable results were identical.

OR, odds ratio; AOR, adjusted OR; CI, confidence interval.

*$P < 0.05$,

**$P < 0.01$,

***$P < 0.001$