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Not just heroin: Extensive polysubstance use among US high school seniors who currently use heroin

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ABSTRACT

Background: Heroin-related deaths are on the rise in the US and a large portion of heroin overdoses involve co-use of other drugs such as benzodiazepines. A better understanding of heroin polysubstance use patterns could help discern better prevention measures.

Methods: Data were examined from past-month ("current") heroin users from a nationally representative sample of high school seniors in the Monitoring the Future study (2010–2016, $n = 327$). We examined how past-month use and frequency of use of various drugs relate to frequency of current heroin use using chi-square and multivariable ordinal logistic regression.

Results: Prevalence of any past-month use of various other drugs (and past-month use 10+ times) tends to increase as the frequency of heroin use increases; however, other drug use tends to decline among those reporting the use of heroin 40+ times in the past month. In multivariable models controlling for demographic characteristics, most levels of alcohol use were associated with decreased odds of higher-frequency heroin use ($ps < .05$). Nonmedical opioid (aOR = 5.84, $p = .037$) and tranquilizer (aOR = 14.63, $p = .045$) use 40+ times in the past month were associated with increased odds of higher-frequency heroin use.

Conclusions: High school seniors who use heroin also use multiple other drugs. Increases in the frequency of heroin use are associated with shifts in the nature and frequency of polysubstance use, with a higher frequency of heroin use associated with the highest percentage and frequency of use of depressants (nonmedical opioid and benzodiazepine use), compounding the risk of overdose. Prevention measures should consider polysubstance use patterns among heroin-using adolescents.

1. Introduction

Heroin use has risen in the United States (US), with the prevalence of past-year use having more than doubled between 2002 and 2016 (Center for Behavioral Health Statistics and Quality, 2017). This increase has been rather marked in recent years despite a decrease in the nonmedical use of prescription opioids (Dart et al., 2015). In 2016, an estimated half-million Americans aged 12 or older were current heroin users (defined as having used in the past month) (Center for Behavioral Health Statistics and Quality, 2017), and over 15,000 heroin-related deaths were reported—a five-fold increase since 2010 (Centers for Disease Control and Prevention, 2017a). Heroin use is also associated with high rates of dependence, increased likelihood of transmission of HIV or HCV, and social marginalization (Brown, 2015; Hser et al., 2015; Zhou et al., 2015), making heroin among the most dangerous of illegal drugs.

A significant body of literature demonstrates a strong link between nonmedical use of opioids and heroin use, and research suggests that nonmedical prescription opioid users in particular—especially frequent users—are at high risk for heroin use (Cerdá et al., 2015; Jones et al., 2015; Mateu-Gelabert et al., 2015; Palamar and Shearston, 2017; Surratt et al., 2017). The incidence of heroin initiation, for example, was found to be 19 times greater among those who reported prior nonmedical opioid use than those who did not (Muhuri et al., 2013), and prescription opioid abuse and dependence is strongly related to heroin abuse or dependence as well (Jones et al., 2015).

While the relationship between nonmedical prescription opioid use and heroin use has been investigated extensively, fewer recent epidemiologic studies have examined potential links between heroin use and the use of other drugs. Benzodiazepines, for example, are now

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commonly co-used with heroin (Mateu-Gelabert et al., 2017), and are involved in approximately a quarter (23%) of heroin-related overdose deaths in the US (Centers for Disease Control and Prevention, 2017b). Concurrent use of various types of other sedatives, such as barbiturates, is also prevalent among current heroin users (Moses et al., 2018), while current marijuana use appears to be lower among heroin users than primary users of cocaine or methamphetamine (Brecht et al., 2008). Furthermore, past studies have found a positive association between cocaine use and heroin use (Brecht et al., 2008; Leri et al., 2003; Leri et al., 2005; Wang et al., 2017), attributable, in part, to the co-use of heroin and cocaine in the form of "speedball", or sequential use of cocaine after heroin use to enhance euphoria and/or reduce withdrawal symptoms (Leri et al., 2003). In contrast, an inverse relationship between concurrent alcohol and heroin use has been observed (Anglin et al., 1989; Brecht et al., 2008; Wang et al., 2017). Nevertheless, polysubstance use remains an important problem among users of heroin.

Insofar as patterns or trajectories of heroin use are related to use of other drugs, then, it may be inadequate to tackle heroin-related problems in isolation. Rather, it may prove beneficial to consider users' overall drug use profiles, in part because concurrent use with other drugs can exacerbate the dangers and adverse health effects associated with heroin use (Coffin et al., 2003; Jones et al., 2012; Meacham et al., 2015; Verdejo-Garcia et al., 2007), and because polysubstance use, in general, is an established risk factor for overdose death (Jones et al., 2013; Warner et al., 2009). Indeed, over half (59%) of heroin-related overdose deaths in the US involve at least one other drug (Jones et al., 2015). Notably, researchers have documented high rates of polysubstance use among adolescents that use heroin (Gandhi et al., 2006; Hopfer et al., 2002; Motamed et al., 2008). Furthermore, adolescents using heroin may be quicker to transition from initial use to dependence when compared with heroin users who initiated during adulthood (Mills et al., 2004). Therefore, this young demographic may represent an important and potentially understudied subpopulation as it relates to current heroin and polysubstance use.

In short, heroin use is becoming more of a public health threat in the US. Heroin users are increasingly reporting abuse of or dependence on other substances, and many heroin-related deaths now involve co-use of other drugs. It is thus important to investigate the extent and patterns of current use of other drugs among current heroin users in order to inform appropriate prevention, intervention, and harm reduction strategies. To this end, we analyze data from a nationally representative sample of high school seniors to better understand how use and frequency of use of other drugs relate to the frequency of current heroin use, which can serve as an indicator for severity of use.

2. Methods

2.1. Procedure

Monitoring the Future (MTF) is a nationally representative cross-sectional study of high school seniors. Approximately 15,000 are surveyed each year from approximately 130 public and private schools throughout 48 states. A multi-stage random sampling procedure is used; geographic areas are selected, then schools within, and then classes within schools are selected. Since the main outcome (past-month heroin use) was rare, these analyses focused on aggregated data collected from the seven most recent cohorts (2010–2016). MTF protocols were approved by the University of Michigan Institutional Review Board (IRB), and the authors' IRB deemed this secondary analysis exempt from review.

2.2. Demographic variables

Students reported their age (predefined as < 18, ≥18 years), sex, and race/ethnicity (i.e., black, white, Hispanic). Students were also asked about the level of educational attainment of each parent and answer options were 1) grade school, 2) some high school, 3) high school graduate, 4) some college, 5) college graduate, and 6) graduate school. We recoded responses to indicate the highest level of education completed by either parent (as applicable) as an indicator of socioeconomic status. Students were also asked whether their mother (or female guardian) and/or father (or male guardian) resides with them in their household and we recoded responses into residing with 1) no parents, 2) one parent, and 3) two parents. Students were asked how much money they earn during the average week from 1) a job or other work, and 2) from other sources. We recoded responses into 1) $0, 2) $1-125, and 3) > $125 for each variable. MTF also categorized population density of students as non-metropolitan statistical area (non-MSA), small MSA, or large MSA.

2.3. Drug use

Students were asked about past-month use of various drugs including heroin, alcohol, marijuana, LSD, other psychedelics, powder cocaine, crack, ecstasy (MDMA, Molly), nonmedical use of amphetamine (or other prescription stimulants; e.g., Adderall, Ritalin), sedatives (e.g., phenobarbital, Nembutal), tranquilizers (e.g., Valium, Xanax), and opioids (e.g., Vicodin, OxyContin). Nonmedical use was defined as using a prescription drug on one's own without a doctor telling one to use it. Answer options for each drug were use on 1) 0 occasions, 2) 1–2 occasions, 3) 3–5 occasions, 4) 6–9 occasions, 5) 10–19 occasions, 6) 20–39 occasions, and 7) 40+ occasions. After extensive sensitivity analyses we collapsed responses into 1) 0 occasions (for drugs other than heroin), 2) 1–2 occasions, 3) 3–9 occasions, 4) 10–39 occasions, and 5) 40+ occasions.

2.4. Analyses

Analyses focused on the 327 students who reported past-month ("current") heroin use out of the full sample (N = 92,242), although we first compared demographic and other drug use characteristics between the analytic sample of current heroin users and the full MTF sample. For survey year, we also examined whether a linear trend was present regarding the prevalence of past-month heroin use. This was done by estimating the odds of past-month use as a linear function of time (year) as a continuous predictor. We then examined how demographic characteristics and survey year differ according to the frequency of heroin use using chi-square. Similar analyses were conducted to examine potential differences in frequency of heroin use according to 1) any past-month use of any other drug, and 2) use of any other drug 10+ times in the past month. Sensitivity tests suggested 10+ times as the optimal cutoff as the use of some drugs was too infrequent to cut-off at 20+ or 40+ times.

We then examined associations between frequency of heroin use and frequency of use of other drugs. Specifically, we first determined whether the frequency of use of any of the 11 other drugs was significantly related to the frequency of heroin use in separate bivariable ordinal regression models. Drug frequency variables that were significant were then fit into a multivariable model simultaneously, controlling for survey year and demographic covariates determined to be significantly related to the frequency of heroin use via chi-square. Aside from controlling for a potential cohort or secular trends in use in these models, missing data indicators were entered into the multivariable model for demographic variables with missing data in order to prevent casewise deletion of these cases. For example, MTF does not provide race/ethnicity data on students other than those identifying as white, black, or Hispanic, so the 24.5% with missing data were accounted for in the models by including an indicator for a fourth level of the variable (Palamar et al., 2016; Terry-McElrath et al., 2015; Terry-McElrath et al., 2017). Analyses were design-based for survey data (Heeringa et al., 2010) and sample weights were utilized. Stata 13 SE (StataCorp,