



# Prevalence, correlates and patterns of heroin use among young adults in the United States



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## HIGHLIGHTS

- From 2011–2013, lifetime, past-year and past-month heroin use in young adults was 18.4, 7.3 and 3.3 per 1000, respectively
- Young adults initiated heroin use at an early age and used other substances along with heroin
- Sniffing heroin was the single most common route of use, but combination of different routes of use was reported
- Use of non-prescribed opioid analgesics, illicit drugs, smoking and being arrested and booked were correlates of heroin use
- Comprehensive programs that target young adult heroin users and address important risk factors for heroin use are needed.

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## ABSTRACT

**Introduction:** The prevalence of heroin use, abuse, and dependence has increased considerably over the past decade. This increase has largely been driven by young adults (18–25 years). This study aims to improve the understanding of heroin use among young adults by determining the prevalence, correlates, patterns and attitude of heroin use among young adults in the US.

**Methods:** The 2011–2013 National Survey on Drug Use and Health was analyzed. Study population included 55,940 young adults with valid interviews. Self-reported lifetime, past-year and past-month use of heroin were examined. Descriptive statistics and adjusted odds ratios were estimated in accordance with the complex survey design.

**Results:** Of the respondents, 18.4 per 1000 (95% CI = 16.8–20.0) used heroin at some time in their lives, and 7.3 per 1000 (95% CI = 6.3–8.3) and 3.3 per 1000 (95% CI = 2.6–4.0) used heroin in the past year and past month, respectively. The single most common route of heroin use was by sniffing. Majority of young adults reported using heroin in combination with other substances. Users of non-prescribed opioid pain relievers, cigarette smokers, illicit drug users and those arrested and booked for breaking the law, had higher odds of using heroin during their lifetime, in the past-year and past-month.

**Conclusion:** Fewer than 2% reported ever using heroin, and 82% of those reported no use in the past month. Majority were polysubstance users and sniffed heroin in combination with other routes of use. Comprehensive programs that target young adult heroin users and address important risk factors for heroin use are needed.

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## 1. Introduction

The prevalence of heroin use, abuse, and dependence in the US has seen a considerable increase over the past decade (Jones, Logan, Gladden, & Bohm, 2015). Data from the National Survey on Drug Use and Health (NSDUH) show a significant increase in the total number

of past-year heroin users in 2013 from 2002 to 2008 (Lipari & Hughes, 2015). In 2013, about 460 people aged 12 or older initiated heroin use each day (Lipari & Hughes, 2015). Furthermore, from 2010 through 2012, there was a doubling in death rate of people aged 12 or older due to heroin overdose (Hedegaard, Chen, & Warner, 2015). In fact, the age-adjusted rate for drug poisoning deaths involving heroin in people aged 12 or older nearly quadrupled from 0.7 deaths per 100,000 in 2000 to 2.7 deaths per 100,000 in 2013 (Hedegaard et al., 2015).

The significant increase in heroin use in the US has been driven mostly by the population of young adults (18 to 25 years). Data from the NSDUH indicate that the rate of heroin initiation in young adults

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was approximately two to seven times higher than the initiation rates in adolescents (12 to 17 years) and older adults (26 to 49 years), from 2002 to 2011 (Muhuri, Gfroerer, & MC, 2013). Additionally, in 2013, young adults (18 to 25 years) in the US had the highest prevalence rate of past year heroin use (7.0 per 1000) compared to adolescents (12 to 17 years) and older adults ( $\geq 26$  years) with prevalence rates of 1.0 and 2.0 per 1000, respectively (Lipari & Hughes, 2015). A comparison of the prevalence rates of past-year heroin use between 2002 to 2004 and 2011 to 2013 among adolescents (12 to 17 years), young adults (18 to 25 years) and older adults ( $\geq 26$  years) revealed that young adults experienced the greatest increase in rates [108.6% (i.e., 3.5 to 7.3 per 1000)] compared to adolescents [−11.1% (i.e., 1.8 to 1.6 per 1000)] and older adults [58.3% (i.e., 1.2 to 1.9 per 1000)] (Jones et al., 2015). Moreover, from 2000 through 2013, young adults had the highest increase in the rate of drug-poisoning deaths involving heroin (Hedegaard et al., 2015). Rates increased 4.9-fold from 0.8 to 3.9 per 100,000 for young adults, and for older adults (25 to 44 years), the rate increased 4.2-fold from 1.3 to 5.4 per 100,000. Likewise, for those aged 45 to 64 years, rates increased 3.8-fold from 0.8 to 3.0 per 100,000.

Despite the burden of heroin use in the population of young adults, there is a paucity in research examining correlates and patterns of heroin use in this population. A substantial body of literature has examined heroin use, abuse and dependence in the general population and have reported correlates of heroin abuse and dependence such as residence in large urban areas, annual household income of less than \$20,000, having no health insurance or having Medicaid, and past-year abuse or dependence on alcohol, marijuana, cocaine, or opioid pain relievers (Jones et al., 2015). However, there is evidence to suggest that among young adults, the decision to use a drug is based on a rational appraisal process, rather than a passive reaction to the context in which a substance is available (Boys et al., 2000; Boys, Marsden, & Strang, 2001). Correlates of heroin use among young adults may therefore differ from the general population. Furthermore, many of the studies which examined heroin use among young adults have been limited to subsamples of the US population and as such, cannot be nationally generalized. Pugatch, et al. examined heroin use among young adult heroin users in detoxification facilities in Rhode Island (Pugatch, Strong, Has, et al., 2001). Due to restriction of the study sample to heroin users in treatment facilities in the state, findings from the study cannot be generalized to young adult heroin users in the US. Similarly, Perry and Duroy, in an exploratory study examined differences between adolescent and young adult heroin users and their non-heroin-using peers in a long-term, step-down therapeutic community (Perry & Duroy, 2004). Findings from this study were also limited by the inability to generalize them to US adolescents and young adults. Thus, examining the correlates, patterns and attitudes of heroin use among a nationally-representative sample of young adults is warranted. Improving the understanding of heroin use, abuse, and dependence in the population of young adults by identifying correlates, patterns and attitudes of heroin use can help tailor prevention and treatment efforts in the population of young adults. This study aims to (1) determine the lifetime, past-year and past-month prevalence of heroin use among young adults in the US from 2011 to 2013, (2) describe patterns and attitudes towards heroin use among US young adults, and (3) identify correlates of lifetime, past-year and past-month heroin use among young adults in the US.

## 2. Material and methods

### 2.1. Data source and study participants

This study combined data from the 2011 to 2013 National Survey of Drug Use and Health (United States Department of Health and Human Services, 2011, 2012, 2013). The NSDUH is an annual survey sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA) to measure prevalence and correlates of drug use among

members of the noninstitutionalized US civilian population aged 12 or older. It utilizes a multistage, stratified sampling design to collect data from a nationally-representative sample of people residing in the US. The NSDUH employs a computer-assisted personal interviewing and audio self-interviewing methodology to collect data. Data were weighted to account for sampling design, nonresponse, and noncoverage. The weighted interview response rates for 2011, 2012 and 2013 were 74.4%, 73.0% and 71.7%, respectively. Missing data arising from item nonresponse in the NSDUH data were imputed using the predictive mean neighborhood method. A detailed description of the NSDUH sampling and survey methodology is available elsewhere (Center for Behavioral Health Statistics and Quality, 2013). The current analysis included valid interviews with 55,940 respondents aged 18 to 25 years.

### 2.2. Measures

#### 2.2.1. Heroin use

Heroin use was assessed using responses to questions on lifetime, past-year and past-month use. For lifetime heroin use, participants were asked, "Have you ever, even once, used heroin?" Participants who answered "Yes" to the question were categorized as having used heroin in their lifetime and those who answered "No" were classified as not having used heroin in their lifetime. Past-year and past-month heroin use were also measured as dichotomous variables (yes or no) using questions on the survey. Past-year heroin use was defined as use of heroin within the 12 months prior to the survey and past-month heroin use, as use of heroin within the 30 days preceding the survey.

#### 2.2.2. Sociodemographic factors

Sociodemographic variables included in the analysis include gender (male or female); race/ethnicity (non-Hispanic (NH) White, NH Black, Hispanic, and NH other); education (less than high school, high school, or college and more); current enrolment in school (yes or no); marital status (married, widowed, divorced or separated, and never married) and health insurance status [private, public (Medicaid, Medicare, TRICARE, CHAMPUS, CHAMPVA, the Veterans Affairs, or military health insurance) or uninsured] (Ko, Farr, Tong, Creanga, & Callaghan, 2015). Other sociodemographic factors include household income (less than \$20,000, \$20,000 to \$49,999, and \$50,000 and above); employment status (full-time, part-time, unemployed, or other [disabled, keeping house full time, in school/training, or retired]) and geographic residence (large-, small- or non-metropolitan county areas).

#### 2.2.3. Other substance use, risky sexual behavior and other factors

Alcohol use and cigarette smoking in the past year were both defined as dichotomous variables (yes or no) based on respondent's use in the past year. Use of marijuana, illicit substances (cocaine, hallucinogens and stimulants) and non-prescribed opioid pain relievers in the past year were also categorized as dichotomous variables (yes or no) based on participant's use. Lifetime episode of major depressive disorder (yes or no), arrest and booking for breaking the law (yes or no), involvement in religious activities in the past year (yes or no), and participant's report of sexually transmitted disease in the past year (yes or no) were also examined.

#### 2.2.4. Pattern and attitudes towards heroin use

Participants were asked about the age at which they initiated heroin use. Heroin abuse and/or dependence in the past year was assessed based on criteria listed in the Diagnostic and Statistical Manual of Mental Disorders, fourth Edition (DSM-IV) (American Psychiatric Association, 1994) and was defined as a dichotomous variable (yes or no). Furthermore, routes of heroin use (smoked only, sniffed only, injected only, smoked and sniffed, sniffed and injected, smoked and injected, smoked, sniffed and injected, and other (e.g. orally), as well as concurrent heroin use with alcohol, cigarette, marijuana, non-

prescribed opioid pain relievers and other illicit substances (cocaine, hallucinogens and stimulants) were examined. Difficulty in obtaining heroin (impossible or very difficult, fairly difficult, or fairly or very easy) and perceived risk of heroin use once or twice a week (great, moderate, slight, or no risk) were assessed.

### 2.2.5. Statistical analysis

Data analysis was conducted using survey procedures in SAS 9.3 (SAS Institute, Cary, NC) utilizing appropriate weights to account for the complex survey design. Descriptive analysis of the study population was conducted and the lifetime, past-year and past-month prevalence rates of heroin use were estimated for the total study population and also by sample characteristics. Chi-square tests were conducted to test for statistical differences in the prevalence of heroin use (lifetime, past-year and past-month) between the different categories of each sample characteristic (i.e., across column). Among heroin users, descriptive analyses were conducted to examine the patterns and attitudes towards heroin use. Multiple logistic regression analyses were conducted to determine correlates of lifetime, past-year and past-month use of heroin. Regression models were fit by including sociodemographic variables, substance use variables, sexually transmitted disease, major depressive episodes, engagement in religious activities, and being arrested and booked for breaking the law in the model. Results are presented using odds ratios (ORs) and 95% confidence intervals (CIs) and are based on analyses of weighted data.

## 3. Results

The study population comprised of approximately equal proportion of male and female young adults (49.9% vs 50.1%) (Table 1). Over half of the study sample were NH Whites (56.6%), unmarried (88.4%), fully employed (52.0%) and had private health insurance (55.4%). The majority of the study population (85.7%) resided in metropolitan county areas and over a third (34.4%) had household income of \$50,000 and above.

### 3.1. Prevalence of heroin use

In the study population, 18.4 per 1000 (95% CI, 16.8–20.0) young adults reported using heroin at some time in their lives and 7.3 per 1000 (95% CI, 6.3–8.3) and 3.3 per 1000 (95% CI, 2.6–4.0) reported using heroin in the past year and past month, respectively (Fig. 1). Male young adults reported statistically significant higher prevalence rates of lifetime, past-year and past-month use of heroin than female young adults (23.2 vs 13.6, 9.7 vs 4.8 and 4.7 vs 1.9, respectively) (Table 2). In the same vein, NH White young adults reported statistically significant higher prevalence rates of lifetime, past-year and past-month use of heroin than NH Black, Hispanic and other NH racial/ethnic young adults. No statistically significant difference in lifetime, past-year or past-month prevalence of heroin use was observed between young adults with private, public or no insurance, as well as between young adults residing in large, small or non-metropolitan county areas. There was however, statistically significant higher lifetime, past-year and past-month prevalence of heroin use between young adults users versus non-users of cigarettes (39.8 vs 3.5, 17.0 vs 0.5, and 7.7 vs 0.2, respectively), alcohol (21.5 vs 7.9, 8.7 vs 2.5, and 3.8 vs 1.6, respectively), marijuana (43.7 vs 6.9, 19.9 vs 1.5 and 8.6 vs 0.9, respectively), non-prescribed opioid pain relievers (104.3 vs 9.3, 60.3 vs 1.6 and 27.6 vs 0.7, respectively) and other illicit drugs (96.9 vs 9.0, 52.0 vs 1.9 and 22.6 vs 1.0, respectively) (Table 2). Young adults who experienced at least one episode of major depressive disorder or were booked and arrested for breaking the law at some time in their lives reported statistically significant higher prevalence rates of lifetime, past-year and past-month heroin use.

**Table 1**

Characteristics of study population, National Survey of Drug Use and Health, 2011–2013.

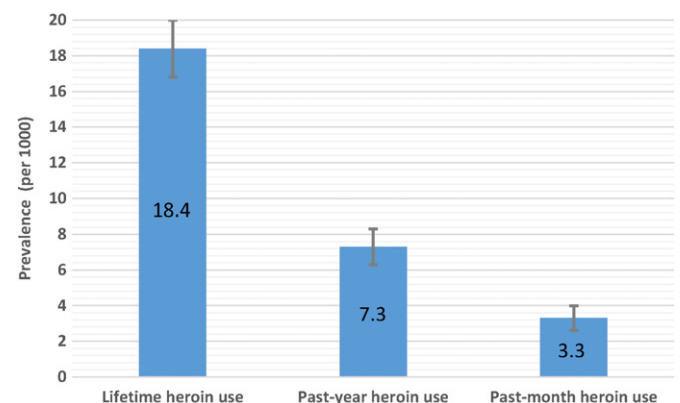
Characteristics	18–25 years N = 55,940 <sup>a</sup> %
Gender	
Male	50.1
Female	49.9
Race/ethnicity	
Non-Hispanic white	56.6
Non-Hispanic black	14.1
Hispanic	20.7
Non-Hispanic other <sup>b</sup>	8.7
Education	
Less than high school	1.6
High school	48.6
College or more	49.7
Currently enrolled in school	48.5
Marital status	
Married	10.1
Widowed, divorced or separated	1.6
Never married	88.4
Household income	
Less than \$20,000	32.1
\$20,000 - \$49,999	33.5
\$50,000 and above	34.4
Health insurance	
Private	55.4
Public <sup>c</sup>	16.7
Uninsured	27.9
Employment status	
Employed full-time	52.0
Employed part-time	11.7
Unemployed	4.4
Other	31.9
Geographic residence	
Large metropolitan county area	54.2
Small metropolitan county area	31.5
Non-metropolitan county area	14.3
Cigarette smoking, past year	41.0
Marijuana use, past year	31.3
Alcohol use, past year	77.1
Use of non-prescribed opioid pain relievers, past year	9.6
Illicit drug use, past year <sup>d</sup>	32.7
Arrested and booked for breaking the law, life time	17.0
Engagement in religious activities, past year	58.5
Major depressive episode, life time	14.3
Sexually transmitted disease in past year	2.2

<sup>a</sup> Unweighted N.

<sup>b</sup> Non-Hispanic Native American/Alaska Native, Native Hawaiian/Other Pacific Islander, Asian, and multiple race.

<sup>c</sup> Medicaid, Medicare, TRICARE, CHAMPUS, CHAMPVA, Veterans Affairs, and military health insurance.

<sup>d</sup> Cocaine, stimulants and hallucinogens.



**Fig. 1.** Prevalence of heroin use among young adults in the US, National Survey of Drug Use and Health, 2011–2013.

Table 2

Prevalence of lifetime, past-year and past-month heroin use among young adults in the US by sample characteristics, National Survey of Drug Use and Health, 2011–2013.

Characteristics	18–25 years		
	N = 55,940 <sup>a</sup>		
	Lifetime heroin use, prevalence rate <sup>b</sup>	Past year heroin use, prevalence rate <sup>b</sup>	Past month heroin use, prevalence rate <sup>b</sup>
	(95% CI)	(95% CI)	(95% CI)
	n = 55,940 <sup>a</sup>	n = 55,940 <sup>a</sup>	n = 55,940 <sup>a</sup>
Gender			
Male	23.2 (20.8–25.6)*	9.7 (8.0–11.5)*	4.7 (3.5–5.8)*
Female	13.6 (11.8–15.3)	4.8 (3.9–5.7)	1.9 (1.3–2.5)
Race/ethnicity			
Non-Hispanic white	26.9 (24.4–29.4)*	10.6 (9.0–12.1)*	4.5 (3.6–5.4)*
Non-Hispanic black	2.1 (0.2–4.0)	1.2 (0.0–2.9)	1.1 (0.0–2.8)
Hispanic	9.5 (6.6–12.5)	3.5 (2.3–4.6)	1.5 (0.4–2.6)
Non-Hispanic other <sup>c</sup>	10.4 (6.5–14.3)	4.7 (1.5–7.8)	3.0 (0.2–5.9)
Education			
Less than high school	22.9 (10.4–35.5)*	10.8 (3.7–17.9)*	3.6 (0.0–7.3)*
High school	23.3 (20.9–25.8)	9.5 (8.0–11.0)	4.2 (3.3–5.1)
College or more	13.4 (11.2–15.7)	5.0 (4.1–6.0)	2.4 (1.5–3.2)
Currently enrolled in school			
Yes	9.9 (8.0–11.8)*	3.7 (2.5–4.9)*	2.2 (1.1–3.2)*
No	26.4 (23.9–28.9)	10.7 (9.1–12.2)	4.3 (3.5–5.2)
Marital status			
Married	11.9 (8.5–15.4)*	2.2 (1.0–3.4)*	1.0 (0.0–1.9)*
Widowed, divorced or separated	45.7 (22.9–68.5)	13.8 (2.4–25.2)	10.4 (0.0–21.0)
Never married	18.7 (16.9–20.5)	7.7 (6.7–8.8)	3.4 (2.7–4.1)
Household income			
Less than \$20,000	18.0 (15.3–20.8)	7.5 (5.4–9.5)	3.2 (1.8–4.5)*
\$20,000 - \$49,999	18.5 (16.0–21.0)	5.6 (4.1–7.0)	2.2 (1.2–3.2)
\$50,000 and above	18.7 (15.9–21.5)	8.8 (6.7–10.9)	4.4 (3.3–5.6)
Health Insurance			
Private	17.3 (15.2–19.3)	7.0 (5.8–8.2)	3.4 (2.5–4.3)
Public <sup>d</sup>	19.1 (15.5–22.7)	8.1 (5.6–10.6)	2.8 (1.6–4.1)
Uninsured	21.1 (17.8–24.3)	7.8 (5.9–9.7)	3.7 (2.2–5.1)
Employment status			
Employed full-time	19.2 (17.0–21.4)*	5.9 (4.6–7.1)*	2.4 (1.6–3.1)*
Employed part-time	15.5 (12.5–18.5)	5.4 (3.9–7.0)	2.1 (1.0–3.2)
Unemployed	27.4 (22.6–32.2)	14.8 (11.1–18.4)	7.3 (4.6–10.0)
Other	15.7 (13.0–18.4)	7.8 (5.8–9.9)	4.0 (2.4–5.6)
Geographic residence			
Large metropolitan county area	18.1 (15.8–20.3)	8.0 (6.5–9.5)	3.7 (2.7–4.6)
Small metropolitan county area	17.9 (14.8–21.1)	6.3 (4.5–8.0)	2.7 (1.6–3.9)
Non-metropolitan county area	20.8 (17.4–24.2)	6.8 (4.1–9.5)	3.0 (0.8–5.1)
Cigarette smoking, past year			
Yes	39.8 (36.0–43.6)*	17.0 (14.6–19.5)*	7.7 (6.1–9.4)*
No	3.5 (2.6–4.4)	0.5 (0.3–0.8)	0.2 (0.0–0.3)
Marijuana use, past year			
Yes	43.7 (39.5–48.0)*	19.9 (17.1–22.6)*	8.6 (6.8–10.4)*
No	6.9 (5.8–8.0)	1.5 (1.0–2.1)	0.9 (0.4–1.4)
Alcohol use, past year			
Yes	21.5 (19.6–23.4)*	8.7 (7.6–9.9)*	3.8 (3.0–4.6)*
No	7.9 (5.6–10.2)	2.5 (1.1–3.8)	1.6 (0.4–2.9)
Use of non-prescribed opioid pain relievers, past year			
Yes	104.3 (92.4–116.1)*	60.3 (50.6–69.9)*	27.6 (20.5–34.7)*
No	9.3 (8.0–10.6)	1.6 (1.2–2.1)	0.7 (0.4–1.0)
Illicit drug use, past year <sup>e</sup>			
Yes	96.9 (86.7–107.0)*	52.0 (45.0–59.1)*	22.6 (17.6–27.5)*
No	9.0 (7.8–10.1)	1.9 (1.4–2.4)	1.0 (0.5–1.4)
Arrested and booked for breaking the law, lifetime			
Yes	59.8 (53.3–66.4)*	26.3 (21.8–30.9)*	11.5 (8.5–14.5)*
No	9.8 (8.6–11.1)	3.3 (2.7–4.0)	1.6 (1.1–2.0)
Engagement in religious activities, past year			
Yes	12.7 (11.0–14.5)*	4.7 (3.6–5.8)*	1.9 (1.3–2.6)*
No	26.0 (23.4–28.6)	10.6 (8.8–12.4)	5.0 (3.7–6.3)
Major depressive episode, lifetime			
Yes	34.7 (28.7–40.8)*	14.0 (10.3–17.8)*	6.8 (4.5–9.2)*
No	15.6 (13.8–17.3)	6.0 (5.0–7.0)	2.6 (1.9–3.3)
Sexually transmitted disease in past year			
Yes	29.9 (17.3–42.5)	16.6 (6.8–26.5)	5.4 (0.9–10.0)
No	17.9 (16.2–19.6)	6.9 (5.9–7.9)	3.2 (2.5–0.38)

<sup>a</sup> Unweighted N.<sup>b</sup> Rate is per 1000 population.<sup>c</sup> Non-Hispanic Native American/Alaska Native, Native Hawaiian/Other Pacific Islander, Asian, and multiple race<sup>d</sup> Medicaid, Medicare, TRICARE, CHAMPUS, CHAMPVA, Veterans Affairs, and military health insurance.<sup>e</sup> Cocaine, stimulants and hallucinogens.\* Statistically significant difference (p value for  $\chi^2 < 0.05$ ) in prevalence of heroin use between categories of sample characteristic.

### 3.2. Patterns and attitudes towards heroin use among heroin users

Among heroin users, the mean age of heroin use initiation in lifetime, past-year and past-month users were 18.6, 19.1 and 18.7 years, respectively (Table 3). The most common route of heroin use among lifetime heroin users was sniffing (28.1%). Among past-year heroin users, the most common route of heroin use was a combination of sniffing, injecting and smoking (22.3%), while sniffing and injecting (33.5%) of heroin was the most common route of use among past-month users. Among lifetime, past-year and past-month young adult heroin users, 27.7%, 64.8% and 73.3% met diagnostic criteria for past-year heroin abuse and/or dependence, respectively. Majority of lifetime, past-year and past-month heroin users reported concurrent use of other substances (alcohol, cigarettes, marijuana, non-prescribed opioid pain relievers, and other illicit drugs) with heroin use. Furthermore, majority of lifetime (61.9%), past-year (80.6%) and past-month (93.6%) heroin users reported that it was fairly or very easy to obtain heroin. Most lifetime (82.6%), past-year (72.6%) and past-month (62.3%) heroin users perceived a great risk of harm from using heroin once or twice a week.

### 3.3. Correlates of heroin use

Race/ethnicity, education, current school enrolment, marital status, employment status, cigarette smoking, alcohol intake, use of marijuana, non-prescribed opioid pain relievers, and illicit drugs, arrested and

**Table 3**  
Patterns and attitudes of heroin use among young adult heroin users in the US, National Survey of Drug Use and Health, 2011–2013.

	18–25 years		
	N = 55,940 <sup>a</sup>		
	Lifetime heroin use	Past-year heroin use	Past-month heroin use
	(%)	(%)	(%)
	n = 55,940 <sup>a</sup>	n = 55,940 <sup>a</sup>	n = 55,940 <sup>a</sup>
<b>Patterns of heroin use</b>			
Age of heroin use initiation (years) [mean(SE)]	18.6 (0.1)	19.1 (0.2)	18.7 (0.3)
<b>Route of heroin use</b>			
Smoked	14.7	11.8	7.3
Sniffed	28.1	19.7	24.0
Injected	6.1	5.3	4.9
Smoked and sniffed	10.2	8.3	2.4
Sniffed and injected	16.9	21.8	33.5
Smoked and injected	6.9	10.3	4.4
Smoked, sniffed and injected	15.4	22.3	21.9
Other routes <sup>b</sup>	1.6	0.4	1.7
Heroin abuse and/or dependence in past year <sup>c</sup>	27.7	64.8	73.3
<b>Heroin use with:</b>			
Alcohol, past year	90.2	92.3	88.6
Cigarettes, past year	88.7	95.8	96.8
Marijuana, past year	74.3	85.4	81.9
Non-prescribed opioid pain relievers, past year	54.4	79.5	80.8
Illicit drugs, past year	56.4	76.7	73.8
<b>Attitudes towards heroin use</b>			
<b>Difficulty in obtaining heroin</b>			
Impossible or very difficult	21.5	8.6	2.6
Fairly difficult	16.6	10.8	3.8
Fairly or very easy	61.9	80.6	93.6
<b>Perceived risk of heroin use once or twice a week</b>			
Great risk	82.6	72.6	62.3
Moderate risk	12.0	17.3	20.1
Slight risk	3.4	6.0	10.1
No risk	2.0	4.1	7.4

<sup>a</sup> Unweighted N.

<sup>b</sup> Orally, etc.

<sup>c</sup> DSM-IV criteria for heroin abuse and/or dependence.

booked for breaking the law, and having a major depressive episode were associated with heroin use in young adults at some point in their lives (Table 4). Correlates for past-year heroin use include race/ethnicity, current school enrolment, marital status, employment status, cigarette smoking, use of non-prescribed opioid pain relievers and illicit drugs, and arrested and booked for breaking the law. Gender, marital status, employment status, cigarette smoking, alcohol intake, use of non-prescribed opioid pain relievers and illicit drugs, arrested and booked for breaking the law, and having a major depressive episode were significant correlates of past-month heroin use. Correlates of heroin use in young adults for lifetime, past year and past month use include cigarette smoking, use of non-prescribed opioid pain relievers and illicit drugs, and being arrested and booked for breaking the law.

## 4. Discussion

In this study sample, 7.3 per 1000, 3.3 per 1000 and 18.4 per 1000 young adults used heroin during the past year, past month and at some time during their lives, respectively. The prevalence rates of heroin use were similar to those reported for young adults in other nationally-representative studies for the period between 2011 and 2013 (Lipari & Hughes, 2015; Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2014). Consistent with recent nationally-representative studies, the prevalence of heroin use in the current study was higher in males and NH Whites (Jones et al., 2015; Cicero, Ellis, Surratt, & Kurtz, 2014). However, there were no statistically significant differences in the prevalence of heroin use between young adults residing in metropolitan and non-metropolitan county areas, as well as by insurance status. This lack of differences in heroin use among young adults with respect to sociodemographic status may suggest a current increase in heroin use among sociodemographic groups who historically had lower prevalence of heroin use. This finding is consistent with those from recent nationally-representative studies which reported that the use of heroin in the general population over the past decade has spread to include people from higher socioeconomic status (SES) groups who previously were less likely to use heroin (Jones et al., 2015; Cicero et al., 2014).

Among young adults who smoked cigarettes, drank alcohol, used marijuana, non-prescribed opioid pain relievers and other illicit drugs, there was an elevated prevalence of heroin use. In fact, majority of young adults who used heroin also reported concomitant use of other substances. Polysubstance use among heroin users has been well documented in the literature over the past two decades (Darke & Hall, 1995; Petry & Bickel, 1998; Leri, Bruneau, & Stewart, 2003; Darke, 2011). Heroin users often use other substances concurrently to improve the effects of heroin or to help manage its negative effects. This is of clinical importance as majority of heroin-related deaths involve the use of multiple substances. The Centers for Disease Control and Prevention (CDC) reported that in 2013 over half of heroin-related deaths in the US involved at least one other drug (Centers for Disease Control and Prevention (CDC), 2015). Additionally, young adult heroin users in this study reported initiating heroin use at an early age (18 to 19 years). This was lower than the mean age of heroin initiation (24.5 years) reported in the general population (Substance Abuse and Mental Health Services Administration (SAMHSA), 2014). Existing studies have shown that an early age of substance use initiation increases the risk of abuse and dependence (Chen, Storr, & Anthony, 2009; McCabe, West, Morales, Cranford, & Boyd, 2007). This was clearly evident among heroin users in this sample of young adults as a large proportion of heroin users met the DSM-IV criteria for heroin abuse and/or dependence.

The single most common route of use among young adult heroin users was through sniffing. This was in contrast to the most common route of heroin use (injection) reported in the general population (Novak & Kral, 2011). This finding was supported by findings from a previous study which reported that injection heroin users were more likely to be older adults (35 years and older) than non-injection heroin users (Novak & Kral, 2011). However, young adult heroin users in this

**Table 4**

Correlates of lifetime, past-year and past-month heroin use in young adults in the US, National Survey of Drug Use and Health, 2011–2013.

Correlates	18–25 years		
	N = 55,940 <sup>a</sup>		
	Lifetime heroin use	Past-year heroin use	Past-month heroin use
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
	n = 55,940 <sup>a</sup>	n = 55,940 <sup>a</sup>	n = 55,940 <sup>a</sup>
Gender			
Male	1.12 (0.93–1.35)	1.33 (0.94–1.87)	1.69 (1.02–2.80)*
Female	Ref.	Ref.	Ref.
Race/ethnicity			
Non-Hispanic white	Ref.	Ref.	Ref.
Non-Hispanic black	0.12 (0.05–0.31)***	0.22 (0.06–0.92)*	0.58 (0.13–2.72)
Hispanic	0.45 (0.31–0.66)***	0.53 (0.34–0.82)**	0.56 (0.27–1.15)
Non-Hispanic other <sup>b</sup>	0.61 (0.39–0.97)*	0.92 (0.37–2.27)	1.43 (0.44–4.65)
Education			
Less than high school	0.94 (0.43–2.04)	1.30 (0.44–3.86)	0.59 (0.10–3.59)
High school	1.31 (1.03–1.66)*	1.29 (0.97–1.71)	1.23 (0.87–1.74)
College or more	Ref.	Ref.	Ref.
Currently enrolled in school			
Yes	Ref.	Ref.	Ref.
No	1.86 (1.43–2.41)***	2.06 (1.31–3.24)**	1.20 (0.67–2.17)
Marital status			
Married	Ref.	Ref.	Ref.
Widowed, divorced or separated	2.11 (1.07–4.15)*	3.09 (1.11–8.64)*	5.92 (1.35–25.91)*
Never married	1.08 (0.74–1.58)	2.26 (1.22–4.16)**	1.75 (0.57–5.39)
Household income			
Less than \$20,000	1.02 (0.77–1.35)	0.84 (0.56–1.26)	0.72 (0.46–1.14)
\$20,000 - \$49,999	1.07 (0.84–1.37)	0.65 (0.42–1.00)	0.58 (0.32–1.04)
\$50,000 and above	Ref.	Ref.	Ref.
Health Insurance			
Private	Ref.	Ref.	Ref.
Public <sup>c</sup>	1.22 (0.89–1.67)	1.30 (0.78–2.17)	0.87 (0.40–1.90)
Uninsured	0.97 (0.76–1.24)	0.85 (0.60–1.20)	0.97 (0.58–1.61)
Employment status			
Employed full-time	Ref.	Ref.	Ref.
Employed part-time	1.05 (0.80–1.36)	1.25 (0.83–1.89)	1.24 (0.59–2.59)
Other	1.37 (1.07–1.75)*	2.59 (1.66–4.06)***	3.11 (1.69–5.74)***
Unemployed	1.21 (0.92–1.59)	2.14 (1.43–3.22)***	2.82 (1.61–4.96)***
Geographic residence			
Large metropolitan county area	1.23 (0.98–1.56)	1.43 (0.89–2.31)	1.47 (0.69–3.14)
Small metropolitan county area	1.02 (0.78–1.32)	0.94 (0.54–1.65)	0.97 (0.43–2.23)
Non-metropolitan county area	Ref.	Ref.	Ref.
Cigarette smoking, past year			
Yes	3.29 (2.34–4.62)***	6.48 (3.39–12.37)***	11.58 (3.89–34.46)***
No	Ref.	Ref.	Ref.
Marijuana use, past year			
Yes	1.57 (1.22–2.02)***	1.43 (0.92–2.24)	1.09 (0.52–2.29)
No	Ref.	Ref.	Ref.
Alcohol use, past year			
Yes	0.60 (0.40–0.89)*	0.49 (0.24–1.00)	0.29 (0.12–0.72)**
No	Ref.	Ref.	Ref.
Use of non-medical opioid pain relievers, past year			
Yes	3.46 (2.70–4.43)***	9.24 (6.13–13.93)***	12.72 (6.56–24.65)***
No	Ref.	Ref.	Ref.
Illicit drug use, past year <sup>d</sup>			
Yes	3.06 (2.43–3.86)***	5.13 (3.58–7.35)***	3.75 (1.97–7.13)***
No	Ref.	Ref.	Ref.
Arrested and booked for breaking the law, lifetime			
Yes	2.58 (2.08–3.20)***	2.15 (1.58–2.92)***	1.95 (1.25–3.05)**
No	Ref.	Ref.	Ref.
Engagement in religious activities, past year			
Yes	Ref.	Ref.	Ref.
No	1.22 (0.99–1.49)	1.24 (0.90–1.71)	1.43 (0.93–2.21)
Major depressive episode, lifetime			
Yes	1.51 (1.17–1.96)**	1.38 (0.97–1.97)	1.60 (1.02–2.52)*
No	Ref.	Ref.	Ref.
Sexually transmitted disease in past year			
Yes	1.11 (0.69–1.79)	1.29 (0.70–2.40)	0.80 (0.29–2.23)
No	Ref.	Ref.	Ref.

aOR, adjusted odds ratio; CI, confidence interval.

<sup>a</sup> Unweighted N.<sup>b</sup> Non-Hispanic Native American/Alaska Native, Native Hawaiian/Other Pacific Islander, Asian, and multiple race.<sup>c</sup> Medicaid, Medicare, TRICARE, CHAMPUS, CHAMPVA, Veterans Affairs, and military health insurance.<sup>d</sup> Cocaine, stimulants and hallucinogens.\*  $p < 0.05$ , statistically significant finding.\*\*  $p < 0.01$ , statistically significant finding.\*\*\*  $p < 0.001$ , statistically significant finding.

study demonstrated a high level of variability in their ability and willingness to combine different routes of heroin use such as injecting and smoking of heroin. Of a worrying note, was the finding that majority of young adult heroin users reportedly found it fairly or very easy to obtain heroin. Data from the Drug Enforcement Administration's National Seizure System show a quadrupling in the amount of heroin seized at the southwest border of the US in 2013 (Drug Enforcement Administration, 2015). The increased availability of heroin highlights the need for increased cooperation between public health, law enforcement and regulatory agencies. However, it is encouraging to note that majority of young adult heroin users also perceived that use of heroin once or twice a week posed a great risk of harm to them. This is important as gaining insight into the problem of heroin use, abuse or dependence by young adult heroin users may be the first step towards seeking treatment.

Among young adults, cigarette smoking, use of non-prescribed opioid pain relievers and illicit drugs, and having been arrested and booked for breaking the law were statistically significant correlates of heroin use in the past month, past year and at some time during their lives. The odds of heroin use was greatest in young adults who used non-prescribed opioid pain relievers. Misuse of prescription opioids has been reported to be the "gateway" to heroin use (Muhuri et al., 2013; Rudd, Aleshire, Zibbell, & Gladden, 2016; Lankenau et al., 2012). As much as four out of five people who initiated heroin have previously abused prescription opioids (Muhuri et al., 2013; Lankenau et al., 2012; Jones, 2013). The transition from prescription opioids to heroin has been shown to occur predominantly in young individuals (Mars, Bourgois, Karandinos, Montero, & Ciccarone, 2014). Mars, et al., in a study conducted among users of opioid pain relievers in Philadelphia and San Francisco, reported that approximately 95% of young adult heroin users (20 to 29 years) in the study had progressed to heroin from opioid pills (Mars et al., 2014). In contrast, older adults (30 years and older) primarily transitioned to heroin from other drugs such as marijuana, cocaine or methamphetamine. Due to heroin being readily available and a cheaper alternative to prescription opioids, coupled with the recent tightening in prescribing practices of opioid pain relievers (Drug Enforcement Administration, Department of Justice, 2014) and production of abuse-deterrent opioid pain relievers (Cicero, Ellis, & Surratt, 2012; Cicero & Ellis, 2015), many young adult opioid abusers may switch over to heroin (Cicero et al., 2012).

A surprising finding of the present study was the decreased odds of heroin use in young adults who consumed alcohol. This finding was at variance to findings from other studies which reported that alcohol use was associated with increased odds of heroin use in the general population (Jones et al., 2015; Darke et al., 2015). A possible explanation for this finding among young adults may be the moderational effect of age on the association between alcohol and heroin use. Findings from a previous study (Odegard & Rossow, 2004) that examined alcohol drinking and heroin overdose, suggested that the association between alcohol drinking and heroin overdose was moderated by age. Odegard and Rossow reported that although alcohol intake increased the risk of heroin overdosing in the general population, alcohol was associated with a statistically significant lower risk of subsequent heroin overdose in young adults (less than 26 years), but was associated with a statistically significant higher risk in older adults (40 years and older) (Odegard & Rossow, 2004). Future studies are needed to further explore the moderational effect of age on the association between alcohol drinking and heroin use.

This study has a number of strengths such as the utilization of a nationally-representative sample of young adults and examining lifetime, past-year and past month use of heroin. Additionally, this study addressed the literature gap in improving the understanding of the correlates, patterns and attitudes of heroin use in young adults in the US. However, results should be viewed in the light of a few limitations. Heroin use was self-reported and was not validated with biological

samples. As a result, reported prevalence may have underestimated the true prevalence of heroin use among young adults. Second, NSDUH samples the population of noninstitutionalized, civilian individuals in the US. Therefore, results from this study are not generalizable to young adults who are homeless, incarcerated, in the military or residents of substance abuse treatment programs. Lastly, due to the cross-sectional nature of this study, causality cannot be inferred for correlates of heroin use that were examined.

## 5. Conclusion

This study demonstrates that fewer than 2% of young adults in the US reported ever using heroin, and 82% of those reported no use in the past month. It also shows a shift towards heroin use among young adults in higher SES groups. Young adults who used non-prescribed opioid pain relievers and other illicit drugs, smoked cigarettes and were arrested and booked for breaking the law, had the greatest odds of using heroin. In addition, young adult heroin users initiated heroin use at an early age and used other substances along with heroin. Of note was the high level of variability demonstrated by young adult heroin users in the routes through which they used heroin and the ease by which they reported obtaining heroin. Comprehensive programs that target young adult heroin users and also address important risk factors for heroin use are needed. In addition, holistic measures should be taken to particularly address the problem of abuse of non-prescribed opioid pain relievers and to prevent young adults from switching over to heroin.

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### Contributors

Drs. Ihongbe and Masho designed the study. Dr. Ihongbe conducted the statistical analysis and wrote the first draft of the manuscript. Dr. Masho conducted manuscript preparation and review. All authors contributed to and have approved the final manuscript.

### Conflict of interest

All authors declare that they have no conflict of interest.

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