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Associations of Nonmedical Pain Reliever Use and Initiation of Heroin Use in the United States

Authors

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Abstract

Recent increases in the annual number of persons in the United States who used heroin for the first time have raised concerns that prior nonmedical use of prescription pain relievers may have led to heroin use in many people. This study examines the recent trends in heroin initiation, including the role of nonmedical prescription pain reliever use in the heroin trend among persons aged 12 to 49. Pooling data from the National Survey on Drug Use and Health (NSDUH) conducted annually from 2002 through 2011, the study finds that the recent (12 months preceding interview) heroin incidence rate was 19 times higher among those who reported prior nonmedical pain reliever (NMPR) use than among those who did not (0.39 vs. 0.02 percent). In contrast, the recent NMPR incidence rate was almost 2 times higher among those who reported prior heroin use than who did not (2.8 vs. 1.6 percent). Four out of five recent heroin initiates (79.5 percent) previously used NMPR whereas only 1.0 percent of recent NMPR initiates had prior use of heroin. However, the vast majority of NMPR users have not progressed to heroin use. Only 3.6 percent of NMPR initiates had initiated heroin use within the 5-year period following first NMPR use. The study contributes important new data to improve understanding of the role of prior NMPR use in initiation of heroin use in the U.S. general population.

Introduction

In the United States, nonmedical prescription pain reliever (NMPR) use is a major public health problem[1] that has resulted in increasing numbers of emergency department visits,[2] treatment admissions,[3] and fatal overdoses.[4,5,6] Although there has been some decline in the prevalence of past month NMPR use among persons aged 12 or older (e.g., from 2.0 percent in 2002 to 1.7 percent in 2011), estimates of recent initiation and prevalence of past year NMPR use (e.g., 1.9 million past year initiates and 11.1 million past year users in 2011) remain second only to those of marijuana (e.g., 2.6 million past year initiates and 18.1 million past year users in 2011). Furthermore, over a 10-year period (2002 to 2011), there were an estimated 25 million Americans aged 12 or older who ever initiated NMPR use.[7] There is a concern among treatment providers, policymakers, and others that NMPR use can progress to heroin use. Anecdotal reports and localized small-scale studies have suggested that some individuals who had been abusing OxyContin® switched to heroin after the reformulation in late 2010 that made OxyContin more difficult to crush. Street price data from the Rocky Mountain Poison Control Center Drug Diversion Monitoring program indicate that the demand for the new formulation was much lower than that for the old formulation, which was more powerful and produced highs similar to those produced by heroin.[8] Data

showed that the street price of the new formulation was nearly 20 to 30 percent lower than that of the old formulation, indicating lower demand for the new formulation. However, the reformulation may have led potential abusers of OxyContin to switch to heroin.

This progression may result simply because heroin may be cheaper or easier for them to get in some locations. Studies on incidence, prevalence, dependence, or abuse of NMPR and their demographic, behavioral, and social correlates are available,[9,10] but the literature on transition from NMPR to heroin use is relatively sparse. Estimating the progression from NMPR use to heroin initiation and characterizing the individuals involved in this transition in the general population are important for informing substance use intervention strategies. Both prescribed opioids and heroin act on the same receptors, and individuals who use prescription opioids nonmedically sometimes alter the route of administration (e.g., snorting or injecting) to intensify the effect.[11] Concern persists because of increases in past year heroin initiation from 108,000 in 2005, 90,000 in 2006, and 106,000

in 2007 to 178,000 in 2011 (**Figure 1**).[7] Reasons for this increase are unclear, but one hypothesis is that the increase is caused by the transition to heroin use among the expanding population of people with NMPR experience. Using the combined data from the 2002-2004 and 2008-2010 National Survey on Drug Use and Health (NSDUH) public use files, a recent study has shown that 77 percent of those reporting both NMPR and heroin use in the past year were found to have initiated NMPR use prior to initiating heroin.[12] That study used the public use files, which did not include data on the date of first use and, therefore, could not determine whether NMPR or heroin was initiated first among respondents whose ages of first use for the two substances were the same. Using detailed data on age of first use of NMPR and heroin that are available in the restricted version of the NSDUH data files would allow us to refine the analysis that would involve the examination of incidence rates of heroin use in relation to prior NMPR use status or incidence rates of NMPR use in relation to prior heroin use status.

Figure 1. Past Year Heroin Users, Heroin Dependence, and Heroin Initiates among Persons Aged 12 or Older: 2002-2011
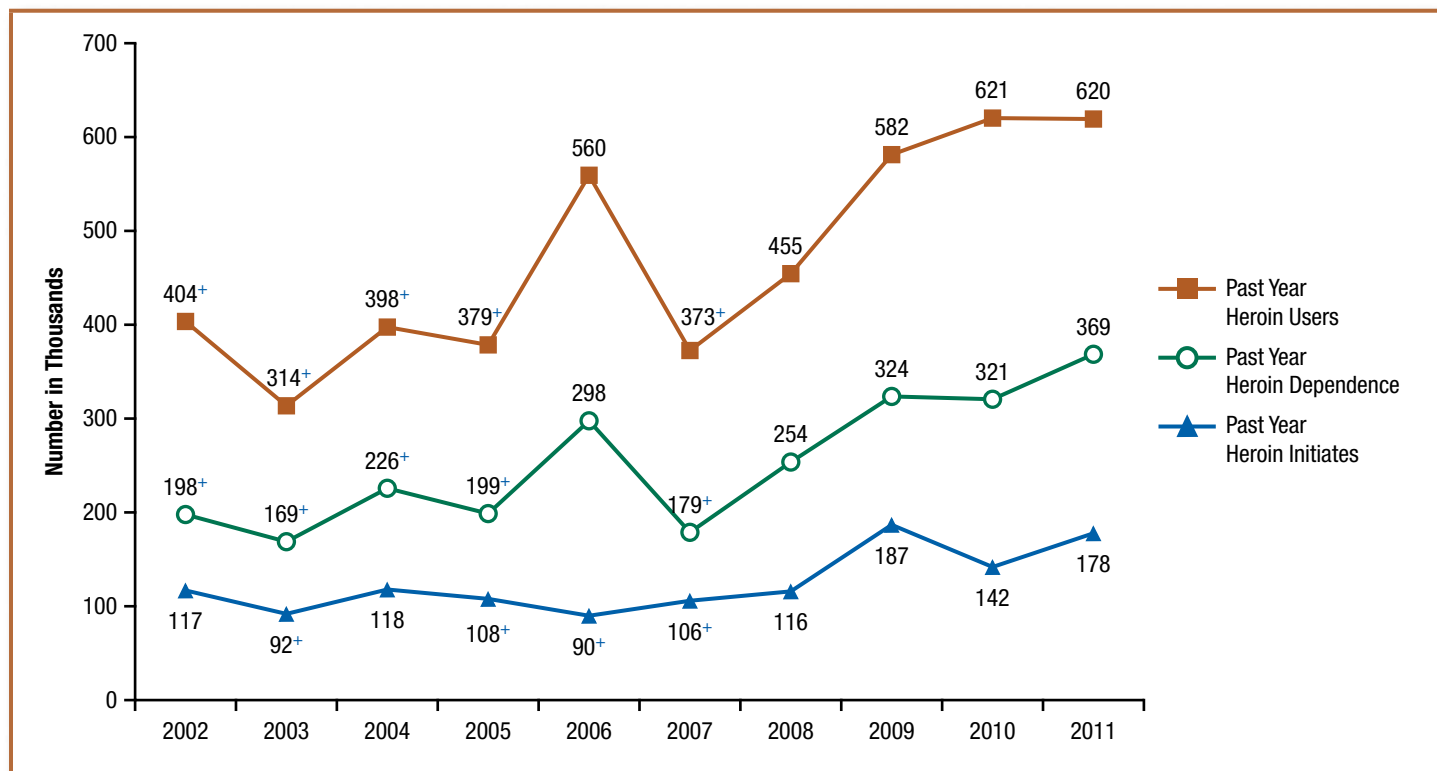
[+] Difference between this estimate and the 2011 estimate is statistically significant at the .05 level.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.

The evidence that NMPR use precedes heroin initiation comes mostly from studies that involved the drug-using population in localized areas. A 2009 study of heroin injectors in Kings County, Washington, indicated that 39 percent of individuals who had used heroin in the prior 4 months had dependence on prescription-type opioids beforehand.[13] An exploratory qualitative study, which collected data during the period between 2008 and 2009 from young injection drug users (aged 16 to 25) in New York and Los Angeles, suggested that prescription opioid use was the main factor for predicting injection drug use or heroin use.[14] A study of predominantly urban dwelling, male, Caucasian, and economically disadvantaged active nonmedical users of opioids (aged 16 or older) from Cumberland County, Maine, has shown that within first year of initiation, polyopioid use including OxyContin led to a quicker transition to heroin and injection drug use (IDU).[15] A study of individuals from the Vietnam Era Twin Registry found that the rate of transition to regular use of heroin was higher than the rate of transition to regular use of amphetamines, cocaine, sedatives, or psychedelics, with the highest conditional probability for the transition from regular cocaine use to abuse/dependence.[16]

In the field of substance abuse, there are also theories of common vulnerability, suggesting that drug use is part of a general repertoire of risky behavior.[17,18] This explanatory model presumes that there are no significant differences within the group of illicit drug users and that the selection of different drugs to consume is largely a function of environmental factors, such as opportunity to use a given drug. Some genetic studies also have shown that there are different genetic makeups that confer greater sensitivity to abuse certain classes of drugs that are similar in biochemical composition and are metabolized similarly in the body. Taken together, these theories highlight that there is likely to be a strong correlation in the usage patterns in the use of different drugs, particularly those that share a similar chemical composition.

As noted earlier, it is possible that the sequence of initiation may be driven by opportunity, and a few small-scale studies have revealed that heroin use may often precede NMPR use. For instance, a qualitative study of 25 street opioid injectors in Toronto revealed that their first injection experiences were followed by transition to prescription opioids.[19] An additional study used a retrospective chart review of 178 patients in a methadone maintenance treatment program found that 35 percent used heroin prior to initiating pain reliever use.[20] A study of clients attending substance use treatment programs from 2005 to 2008 found that women were more likely than men to report medical use as well as abuse of prescription opioids.[21,22] Most studies cited previously were based on samples within a small number of communities or from specific subpopulations.

The purpose of this study is to describe the trends in heroin initiation by demographic characteristics and to explore the relationship between prior NMPR use and heroin initiation in specific subgroups, using the large nationally representative sample from combined years of NSDUH. The survey captures data on the sequencing of drug use patterns retrospectively through questions on the timing (e.g., month/year), first use of a variety of substances, and prominent characteristics that have been linked to initiation of either NMPR or heroin. A primary objective is to examine heroin use incidence in relation to prior NMPR use as well as the reverse process that links NMPR incidence with prior use of heroin. Another objective is to determine the extent to which the recent increase in heroin initiation can be attributed to the persistently high rates of NMPR use in the United States.

Data and Methods

Conducted by the Federal Government since 1971, NSDUH is the Nation's primary source of statistical information on the use of illicit drugs, alcohol, and tobacco by the U.S. civilian noninstitutionalized population aged 12 or older. Data used in this study are derived from the 2002 to 2011 NSDUHs. Because of the focus on heroin initiation and the rarity of heroin initiation among those aged 50 or older, the analysis was restricted to respondents aged 12 to 49 who were at risk for heroin initiation, for a total combined sample size of approximately 609,000 (representing an annual average of approximately 155 million individuals).

In addition, the 2002 to 2011 NSDUHs included approximately 524,000 persons aged 12 to 49 at risk for NMPR initiation (representing an annual average of approximately 132 million persons. The survey employed a four-stage, stratified cluster sample design; oversampled individuals aged 12 to 17 and 18 to 25; and used computer-assisted interviewing methods for data collection. NSDUH asks questions that include lifetime, past year, and past month usage, as well as age and month at first use for the following drug classes: marijuana, cocaine (and crack), hallucinogens, heroin, inhalants, alcohol, and tobacco, as well as nonmedical use of prescription pain relievers, tranquilizers, stimulants, and sedatives. NSDUH defines nonmedical use of prescription drugs as use of drugs that were not prescribed for the respondent or used only for the experience of feeling they caused. The questions about age at first NMPR use and first heroin use were as follows: "How old were you the first time you used any prescription pain reliever that was not prescribed for you that or that you took only for the experience or feeling it caused?" and "How old were you the first time you used heroin?" Follow-up questions for recent initiates ascertained the month of first use, allowing the construction of various categories of users such as (1) initiated heroin use within 12 months preceding interview, (2) initiated NMPR use within 12 months preceding interview, (3) initiated NMPR use prior to 12 months before the interview, and (4) lag time between first NMPR use and subsequent heroin initiation. To assess heroin injection among initiators of the drug, data from the question, "Have you ever, even once, used a needle to inject heroin?" were used.

Outcome Measures

Past Year Initiation of Heroin Use

Past year heroin initiation rates were computed as the number who used heroin for the first time within the past 12 months, divided by the number who never used heroin prior to 12 months ago, multiplied by 100. The rate essentially represents the proportion of nonusers of heroin (as of 12 months ago) that initiate heroin use within a 12-month period. For assessing past year heroin use initiation by prior NMPR use status (defined

subsequently), heroin initiates whose NMPR initiation dates either coincided with or followed heroin initiation dates were considered nonusers of NMPR. A second measure of initiation of heroin use involved calculating the proportion of NMPR initiates (those who reported initiating NMPR use 12 to 23, 24 to 35, 36 to 47, 48 to 59, or 60 to 71 months before the survey interview, respectively) who progressed to heroin initiation in 0 to 11, 12 to 23, 24 to 35, 36 to 47, or 48 to 59 months before the survey interview, respectively. This measure only involves 5 years because of the substantial recall bias associated with initiation estimates based on retrospective reports for longer periods.[22]

Past Year Initiation of NMPR Use

Past year NMPR initiation rates were calculated as the number who used NMPR for the first time within the past 12 months, divided by the number who never used NMPR prior to 12 months ago, multiplied by 100.

Correlates of Past Year Initiation

Correlates of Initiation of Heroin or NMPR Use

As a correlate of past year heroin initiation, *prior NMPR use status* was defined as a two-category construct (i.e., no prior NMPR use vs. prior NMPR use), and each category was divided further into two subcategories (no prior illicit drugs vs. prior illicit drugs). The second correlate was the *frequency of use of NMPR in the past year among prior lifetime NMPR users*, based on two variables: (1) whether the person ever used NMPR in his/her lifetime and (2) how many times in the past year the person used NMPR. It is possible for someone to have been a NMPR user at some point in their lifetime but to have not used NMPR in the past year and thus 0 days of use in the past year. The third correlate of past year heroin initiation was a two-category construct of the disorder status of prior NMPR use (no dependence/abuse in past year vs. dependence/abuse in past year). The NMPR dependence or abuse was defined using the criteria specified in *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV), including symptoms such as withdrawal, tolerance, use in dangerous situations, trouble with the law, and interference in major obligations at work, school, or home during the past year.[23]

As demographic, family income, and geographic correlates of past year heroin initiation, the study included the following variables: age (12 to 17, 18 to 25, and 26 to 49), gender (male vs. female), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic others), annual household income (less than $20,000, $20,000 to 49,999, $50,000 to 74,999, and $75,000 or greater), county type (metropolitan vs. non-metropolitan), and region (Northeast, Midwest, South, and West). For assessing trends, data were pooled into 3- or 4-year time periods to improve precision.

As a correlate of past year NMPR initiation, prior heroin use status was defined as a two-category construct (no heroin use prior to NMPR initiation vs. heroin use prior to NMPR initiation), and each category was further divided into two subcategories (no other illicit drugs prior to NMPR initiation vs. other illicit drugs prior to NMPR initiation). However, for this outcome measure, no demographic, family income, or geographic correlates were considered.

SAS® (version 9.2) was used for data file preparation. SUDAAN® (version 10) was used to obtain estimates and their standard errors, reflecting the complex design features (i.e., stratum, replicate, and average analysis weight) of the NSDUH 2002 to 2011 combined sample. For individuals aged 12 to 49, we performed bivariable analyses to calculate the following weighted estimates: (1) prevalences of demographic, household income, and geographic characteristics of individuals who were at risk for past year initiation of heroin use by prior NMPR use status; (2) past year heroin incidence rates per 100 by those characteristics as well as prior NMPR use status, frequency of use of NMPR in past year, and disorder status of prior NMPR users for different survey year groupings; (3) average 12-month heroin incidence proportions among individuals who initiated NMPR use 12 to 23, 24 to 35, 36 to 47, 48 to 59, or 60 to 71 months before interview (only presented in the text); (4) percent distribution of past year heroin initiates in different categories of the correlates for different survey year groupings; (5) percentages of past year heroin initiates who used a needle to inject heroin by selected characteristics; (6) past year NMPR

incidence rates per 100 by prior drug use status for different survey year groupings; and (7) percentages of past year NMPR initiates in different categories of the correlates for different survey year groupings. Statistical tests were conducted, comparing between-year groupings or subgroups of the population. Estimates that did not meet the criteria for statistical reliability were not included in statistical tests of comparisons.

Results

Table 1 presents descriptive data on the population aged 12 to 49 at risk for heroin initiation, including comparisons of sociodemographic characteristics to discriminate between those with and those without prior NMPR use. Of the at-risk individuals, about 37 percent were aged 12 to 25, 50 percent were male, 63 percent were non-Hispanic whites, and 19 percent had household incomes less than $20,000. The majority (85 percent) resided in metropolitan areas. Relative to those with no prior NMPR use history, individuals with NMPR use were more likely to be male, be non-Hispanic white, be aged 18 or older, reside in the West, and have a household income of less than $50,000.

Heroin Initiation

Table 2 presents overall past year heroin incidence rates and the rates by age, gender, race/ethnicity, annual household income, county type, region, prior NMPR use status, frequency of use of NMPR in past year, and disorder status of prior NMPR users, for 3-year groupings as well as for all years combined. Some of the results from Table 2, namely the rates by age, gender, annual household income, and region for each year grouping are also presented in Figures 2-5.

The overall rate of heroin initiation increased from 0.07 percent during 2005-2008 to 0.11 percent during 2009-2011 (Table 2 and Figure 2). The rates significantly increased between 2002-2004 and 2009-2011 or between 2005-2008 and 2009-2011 for the following subgroups: females, non-Hispanic Whites, those in the 18 to 25 and 26 to 49 age groups, those in the less than $20,000 and $20,000 to $49,999 income categories, those in metropolitan areas and non-metropolitan areas, and those in the Northeast,

Table 1. Selected Characteristics of Persons Aged 12 to 49 at Risk for Initiation of Heroin Use in Past Year, by Prior Nonmedical Pain Reliever (NMPR) Use: Percentages and Standard Errors of Percentages, Annual Averages Based on 2002-2011

| Demographic and Geographic Characteristics | Prior NMPR Use Status | | At Risk for Initiation of Heroin Use in Past Year (N[1] = 154,961) | |
	Prior NMPR Use (N[1] = 25,599)		No Prior NMPR Use (N[1] = 129,362)	
Total	100.0	(0.00)	100.0	(0.00)	100.0 (0.00)
Age				
12 to 17	9.7[a]	(0.10)	17.4	(0.07)	16.1 (0.06)
18 to 25	29.3[a]	(0.21)	19.2	(0.10)	20.9 (0.10)
26 to 49	61.0[a]	(0.24)	63.5	(0.12)	63.1 (0.11)
Gender				
Male	54.7[a]	(0.25)	48.5	(0.11)	49.6 (0.10)
Female	45.3[a]	(0.25)	51.5	(0.11)	50.4 (0.10)
Race/Ethnicity				
Non-Hispanic White	74.0[a]	(0.26)	60.8	(0.20)	63.0 (0.19)
Non-Hispanic Black	8.8[a]	(0.17)	13.8	(0.14)	13.0 (0.13)
Hispanic	12.7[a]	(0.20)	17.8	(0.16)	17.0 (0.15)
Non-Hispanic Others	4.5[a]	(0.11)	7.6	(0.10)	7.1 (0.09)
Household Income				
< $20,000	20.8[a]	(0.23)	18.2	(0.14)	18.6 (0.14)
$20,000-$49,999	35.7[a]	(0.27)	33.1	(0.15)	33.5 (0.14)
$50,000-$74,999	17.6[a]	(0.21)	18.3	(0.11)	18.2 (0.10)
> $75,000	26.0[a]	(0.29)	30.5	(0.20)	29.7 (0.18)
County Type				
Metropolitan	84.6	(0.24)	84.8	(0.16)	84.7 (0.16)
Nonmetropolitan	15.4	(0.24)	15.2	(0.16)	15.3 (0.16)
Region				
Northeast	15.8[a]	(0.21)	18.6	(0.13)	18.1 (0.12)
Midwest	22.1	(0.23)	22.1	(0.13)	22.1 (0.13)
South	36.1	(0.30)	36.3	(0.20)	36.2 (0.18)
West	26.0[a]	(0.30)	23.1	(0.19)	23.6 (0.17)

*Low precision; no estimate reported.

NOTE: The percentages may not add to 100 percent due to rounding.

NOTE: Standard errors of estimates are displayed in parentheses.

NOTE: At Risk for Initiation of Heroin Use is defined as persons who did not use heroin in their lifetime or who initiated heroin within 12 months before the interview.

[a] Difference between no prior NMPR use and prior NMPR use estimate is statistically significant at the .05 level.

[1] N is an estimate in thousands.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2005, 2006-2010 (revised March 2012), and 2011.

Table 2. Past Year Heroin Use Incidence Rate of Persons Aged 12 to 49 at Risk for Initiation of Heroin Use, by Demographic and Geographic Characteristics and Prior Illicit Drug Use Status: Annual Averages Based on 2002-2004, 2005-2008, 2009-2011, and 2002-2011

Demographic and Geographic Characteristics and Prior Illicit Drug Use Status	Heroin Use Incidence Rate × 100			
	2002-2004	2005-2008	2009-2011	2002-2011
Total	**0.07[a] (0.009)**	**0.07[a] (0.006)**	**0.11 (0.010)**	**0.08 (0.005)**
Age				
12 to 17	0.13 (0.019)	0.09 (0.015)	0.11 (0.018)	0.11 (0.010)
18 to 25	0.17[b] (0.020)	0.19[a] (0.020)	0.26 (0.026)	0.20 (0.013)
26 to 49	0.03 (0.011)	0.02[a] (0.007)	0.06 (0.012)	0.03 (0.006)
Gender				
Male	0.09 (0.013)	0.09 (0.011)	0.12 (0.014)	0.10 (0.007)
Female	0.06[a] (0.011)	0.05[b] (0.006)	0.10 (0.014)	0.07 (0.006)
Race/Ethnicity				
Non-Hispanic White	0.08[b] (0.010)	0.09[b] (0.009)	0.14 (0.014)	0.10 (0.006)
Non-Hispanic Black	0.05 (0.033)	0.01 (0.006)	* (*)	0.02 (0.010)
Hispanic	0.05 (0.020)	0.04 (0.012)	0.08 (0.022)	0.06 (0.010)
Non-Hispanic Others	0.06 (0.034)	0.05 (0.021)	0.09 (0.039)	0.07 (0.018)
Household Income				
< $20,000	0.12 (0.035)	0.09[a] (0.017)	0.18 (0.032)	0.13 (0.016)
$20,000-$49,999	0.06[a] (0.009)	0.06[a] (0.009)	0.10 (0.016)	0.07 (0.007)
$50,000-$74,999	0.06 (0.012)	0.08 (0.018)	0.10 (0.026)	0.08 (0.011)
> $75,000	0.05 (0.014)	0.06 (0.011)	0.08 (0.014)	0.06 (0.007)
County Type				
Metropolitan	0.07[a] (0.010)	0.07[b] (0.007)	0.11 (0.011)	0.08 (0.005)
Nonmetropolitan	0.07[a] (0.014)	0.07[a] (0.012)	0.12 (0.024)	0.08 (0.010)
Region				
Northeast	0.09[a] (0.019)	0.09[a] (0.016)	0.17 (0.031)	0.11 (0.013)
Midwest	0.07 (0.017)	0.07[a] (0.011)	0.11 (0.018)	0.08 (0.008)
South	0.08 (0.017)	0.06 (0.011)	0.05 (0.009)	0.06 (0.007)
West	0.04[b] (0.009)	0.07[b] (0.015)	0.15 (0.028)	0.09 (0.011)
No Prior Nonmedical Pain Reliever (NMPR) Use	**0.02 (0.007)**	**0.02 (0.004)**	**0.02 (0.005)**	**0.02 (0.003)**
No Prior Illicit Drug Use[1]	* (*)	* (*)	* (*)	* (*)
Prior Illicit Drug Use[1]	0.05 (0.014)	0.04 (0.010)	0.04 (0.011)	0.04 (0.007)
Prior NMPR Use	**0.32[a] (0.041)**	**0.31[a] (0.032)**	**0.56 (0.053)**	**0.39 (0.024)**
No Prior Illicit Drug Use[1]	* (*)	* (*)	* (*)	* (*)
Prior Illicit Drug Use[1]	0.39[a] (0.050)	0.38[a] (0.039)	0.68 (0.065)	0.47 (0.029)

Table 2. Past Year Heroin Use Incidence Rate of Persons Aged 12 to 49 at Risk for Initiation of Heroin Use, by Demographic and Geographic Characteristics and Prior Illicit Drug Use Status: Annual Averages Based on 2002-2004, 2005-2008, 2009-2011, and 2002-2011 *(continued)*

Demographic and Geographic Characteristics and Prior Illicit Drug Use Status	Heroin Use Incidence Rate × 100			
	2002-2004	**2005-2008**	**2009-2011**	**2002-2011**
Frequency of Use of NMPR in Past Year among Prior Lifetime NMPR Users				
0 Days	0.09 (0.041)	0.07 (0.019)	0.11 (0.032)	0.09 (0.017)
1-29 Days	0.32[a] (0.060)	0.27[a] (0.045)	0.60 (0.115)	0.38 (0.042)
30-99 Days	1.13 (0.228)	1.02 (0.258)	1.60 (0.358)	1.22 (0.164)
100-199 Days	1.35 (0.379)	1.79 (0.406)	2.77 (0.618)	1.97 (0.270)
200-365 Days	3.01[a] (1.240)	2.73[a] (0.645)	6.68 (1.360)	4.10 (0.616)
Disorder Status of Prior NMPR Users				
No Dependence/Abuse in Past Year[2]	0.23[a] (0.034)	0.19[a] (0.023)	0.34 (0.044)	0.25 (0.019)
Dependence/Abuse in Past Year[2]	2.23[a] (0.525)	2.52[a] (0.446)	4.83 (0.715)	3.15 (0.324)

*Low precision; no estimate reported.
NOTE: Standard errors of incidence proportions are displayed in parentheses.
NOTE: At Risk for Initiation of Heroin Use is defined as persons who did not use heroin in their lifetime or who initiated heroin within 12 months before the interview.
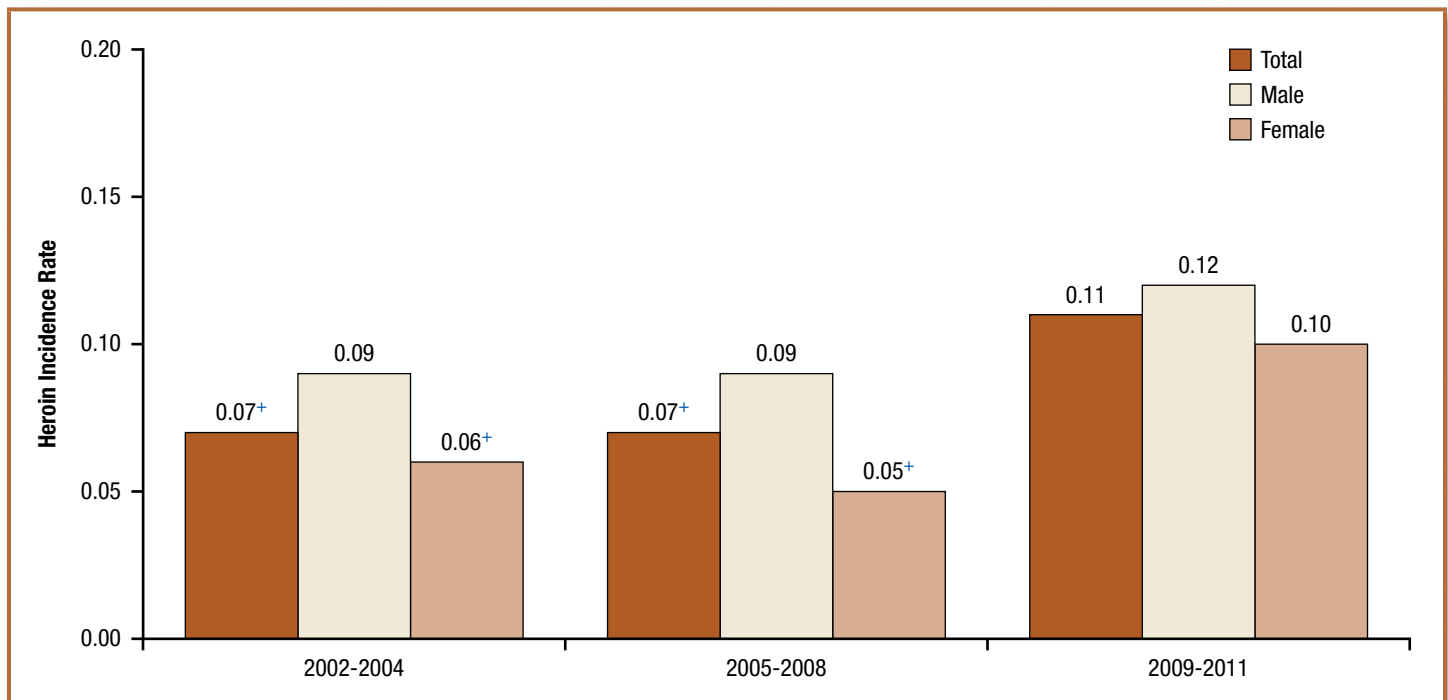[a] Difference between estimate and 2009-2011 estimate is statistically significant at the .05 level.
[b] Difference between estimate and 2005-2008 estimate is statistically significant at the .05 level.
[1] Illicit drugs include marijuana/hashish, cocaine (including crack), hallucinogens, and inhalants.
[2] Dependence or abuse is based on definitions found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).
Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2005, 2006-2010 (revised March 2012), and 2011.

Figure 2. Heroin Incidence Rates among Persons Aged 12 to 49, by Gender: 2002-2011

[+] Difference between this estimate and the 2011 estimate is statistically significant at the .05 level.
Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.

Figure 3. Heroin Incidence Rates among Persons Aged 12 to 49, by Age Group: 2002-2011
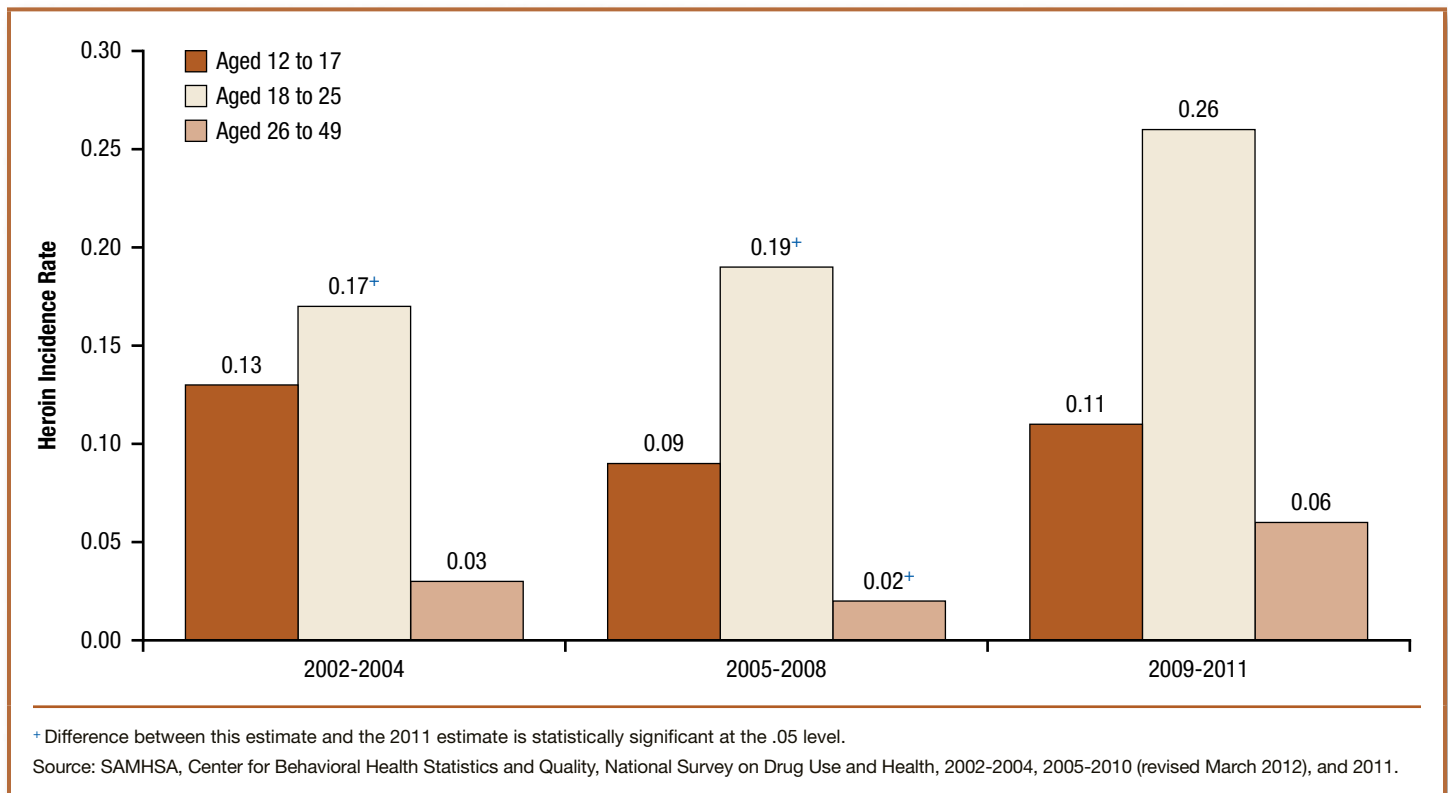

+ Difference between this estimate and the 2011 estimate is statistically significant at the .05 level.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.

Figure 4. Heroin Incidence Rates among Persons Aged 12 to 49, by Income: 2002-2011

+ Difference between this estimate and the 2011 estimate is statistically significant at the .05 level.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.
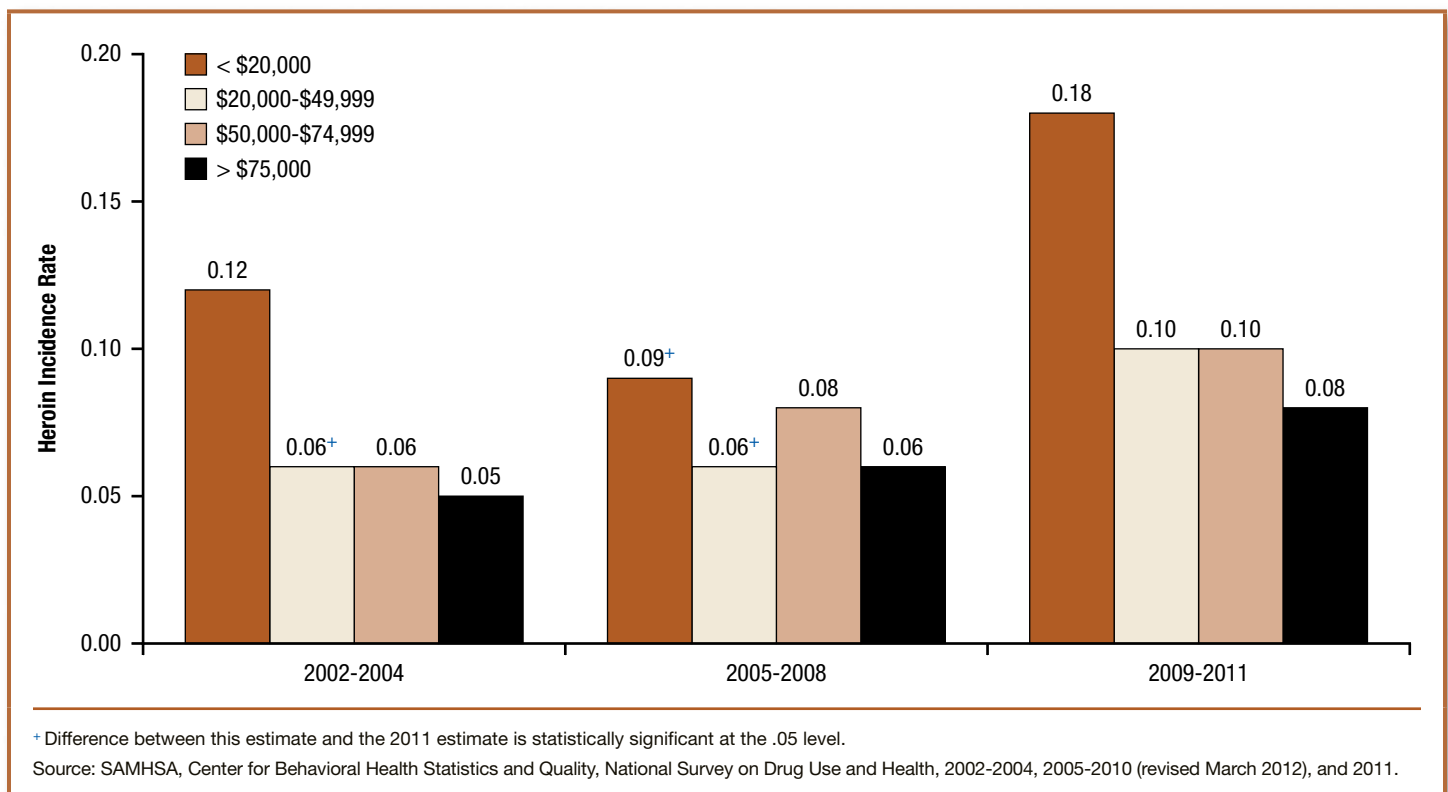
Midwest, and West (Table 2 and Figures 2-5). As Table 2 shows, in the NSDUH 2002 to 2011 combined sample, the past year heroin initiation rate was higher for males than females, higher for people aged 18 to 25 than for other age groups, and lower for blacks than for those in other racial/ethnic groups. The population with the highest rate of heroin initiation was those with prior NMPR use. The rate of heroin initiation among prior NMPR users was approximately 19 times greater than those who did not have NMPR use (0.39 vs. 0.02 percent). The rate of heroin initiation increased with increases in the frequency of past year NMPR use (0.09, 0.38, 1.22, 1.97, or 4.10 percent among those who were prior NMPR users for 0, 1 to 29, 30 to 99, 100 to 199, or 200 to 365 days, respectively). The rate of heroin use initiation among prior NMPR users was also higher among those classified with NMPR dependence or abuse than those without NMPR dependence or abuse (3.15 vs. 0.25 percent).

Table 3 shows the percentage distribution of past year heroin initiates classified by various correlates for the 3-year groupings and all years combined. In the

NSDUH 2002 to 2011 combined sample of heroin initiates aged 12 to 49, 79.5 percent reported prior NMPR use (31.3 percent with past year dependence/ abuse and 48.2 percent with no such disorders in the past year), and the remaining 20.5 percent did not (**Figure 6**). The majority of heroin initiates were aged 18 to 25 (52.7 percent), male (59 percent), non-Hispanic white (79.3 percent), and residents of the metropolitan areas (84.5 percent).

Past Year Use of Needles to Inject Heroin

As **Table 4** shows, from 2002 to 2011, the proportion of past year heroin initiates who had used needles to inject heroin was 26.6 percent. This proportion was higher for females (36.1 percent) than males (20.1 percent). The proportion of past year heroin initiates who ever used a needle to inject heroin did not vary significantly by age, race/ethnicity household income, county type, region, prior NMPR status, frequency of use of NMPR in past year, and disorder status of prior NMPR users. The relatively small sample size in these categories may be a reason why some of the numerical differences, although large, were not statistically

Figure 5. Heroin Incidence Rates among Persons Aged 12 to 49, by Region: 2002-2011
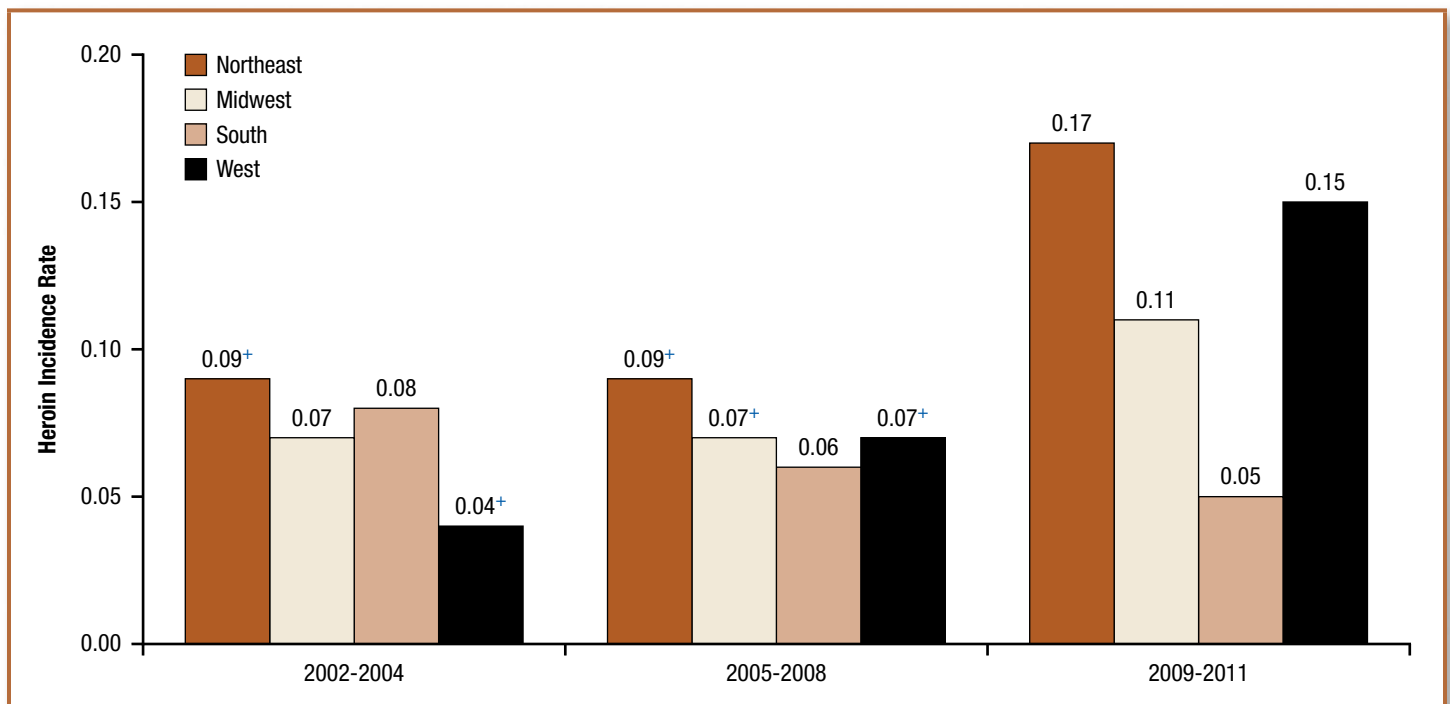
+ Difference between this estimate and the 2011 estimate is statistically significant at the .05 level.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.

Table 3. Percentage Distribution of Past Year Heroin Initiates Aged 12 to 49, by Demographic and Geographic Characteristics and Prior Illicit Drug Use Status: Annual Averages Based on 2002-2004, 2005-2008, 2009-2011, and 2002-2011

Demographic and Geographic Characteristics and Prior Illicit Drug Use Status	Percent Distribution			
	2002-2004 N[1] = 109	2005-2008 N[1] = 105	2009-2011 N[1] = 169	2002-2011 N[1] = 125
Total	100.0 (0.00)	100.0 (0.00)	100.0 (0.00)	100.0 (0.00)
Age				
12 to 17	29.0[b] (4.46)	21.1 (3.50)	15.7 (2.54)	21.0 (1.94)
18 to 25	47.2 (5.80)	57.4 (4.99)	52.4 (4.63)	52.7 (2.97)
26 to 49	* (*)	* (*)	31.8 (5.01)	26.3 (3.35)
Gender				
Male	60.5 (5.94)	63.1 (4.25)	54.6 (4.72)	59.0 (2.87)
Female	39.5 (5.94)	36.9 (4.25)	45.4 (4.72)	41.0 (2.87)
Race/Ethnicity				
Non-Hispanic White	* (*)	82.2 (3.69)	79.5 (4.13)	79.3 (2.71)
Non-Hispanic Black	* (*)	2.4 (1.13)	* (*)	3.1 (1.56)
Hispanic	* (*)	10.2 (2.85)	14.0 (3.42)	11.7 (1.99)
Non-Hispanic Others	* (*)	5.1 (2.13)	6.6 (2.66)	5.9 (1.53)
Household Income				
< $20,000	* (*)	23.1 (3.97)	30.9 (4.40)	29.0 (2.91)
$20,000-$49,999	30.5 (4.77)	28.9 (4.01)	30.1 (4.16)	29.8 (2.49)
$50,000-$74,999	16.3 (3.29)	21.3 (4.30)	15.3 (3.78)	17.6 (2.27)
> $75,000	19.6 (4.76)	26.7 (4.25)	23.7 (3.64)	23.6 (2.42)
County Type				
Metropolitan	85.5 (3.07)	84.9 (2.79)	83.5 (3.20)	84.5 (1.80)
Nonmetropolitan	14.5 (3.07)	15.1 (2.79)	16.5 (3.20)	15.5 (1.80)
Region				
Northeast	24.3 (4.64)	23.5 (3.78)	27.1 (4.36)	25.2 (2.50)
Midwest	21.7 (4.94)	21.4 (3.46)	21.4 (3.22)	21.5 (2.14)
South	* (*)	30.6[a] (4.67)	17.7 (2.98)	28.1 (2.70)
West	12.9[b] (3.06)	24.5 (4.52)	33.8 (4.75)	25.2 (2.67)
No Prior Nonmedical Pain Reliever (NMPR) Use	*** (*)**	**23.1 (4.55)**	**13.9 (3.15)**	**20.5 (2.63)**
No Prior Illicit Drug Use[2]	0.6 (0.32)	1.0 (0.64)	1.5 (0.75)	1.1 (0.38)
Prior Illicit Drug Use[2]	* (*)	22.1 (4.49)	12.4 (3.09)	19.4 (2.62)
Prior NMPR Use	*** (*)**	**76.9 (4.55)**	**86.1 (3.15)**	**79.5 (2.63)**
No Prior Illicit Drug Use[2]	* (*)	0.1 (0.07)	* (*)	0.0 (0.02)
Prior Illicit Drug Use[2]	* (*)	76.8 (4.55)	86.1 (3.15)	79.5 (2.63)

(continued)

Table 3. Percentage Distribution of Past Year Heroin Initiates Aged 12 to 49, by Demographic and Geographic Characteristics and Prior Illicit Drug Use Status: Annual Averages Based on 2002-2004, 2005-2008, 2009-2011, and 2002-2011 *(continued)*

Demographic and Geographic Characteristics and Prior Illicit Drug Use Status	Percent Distribution			
	2002-2004 N[1] = 109	2005-2008 N[1] = 105	2009-2011 N[1] = 169	2002-2011 N[1] = 125
Frequency of Use of NMPR in Past Year among Prior Lifetime NMPR Users				
0 Days	* (*)	14.8 (3.64)	12.8 (3.40)	14.5 (2.53)
1-29 Days	27.5 (4.93)	23.1 (3.77)	26.2 (4.35)	25.5 (2.56)
30-99 Days	25.2 (4.76)	25.6 (5.29)	19.9 (4.08)	23.0 (2.75)
100-199 Days	14.1 (3.80)	19.8 (4.02)	17.0 (3.47)	17.2 (2.19)
200-365 Days	* (*)	16.6 (3.67)	24.0 (4.50)	19.7 (2.70)
Disorder Status of Prior NMPR Users				
No Dependence/Abuse in Past Year[3]	48.9 (6.00)	46.0 (4.57)	49.7 (4.67)	48.2 (2.94)
Dependence/Abuse in Past Year[3]	23.8 (5.02)	30.9 (4.56)	36.4 (4.57)	31.3 (2.78)

*Low precision; no estimate reported.

NOTE: Standard errors of incidence proportions are displayed in parentheses.

NOTE: At Risk for Initiation of Heroin Use is defined as persons who did not use heroin in their lifetime or who initiated heroin within 12 months before the interview.

[a] Difference between estimate and 2009-2011 estimate is statistically significant at the .05 level.

[b] Difference between estimate and 2005-2008 estimate is statistically significant at the .05 level.

[1] N is an estimate in thousands.

[2] Illicit drugs include marijuana/hashish, cocaine (including crack), hallucinogens, and inhalants.

[3] Dependence or abuse is based on definitions found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2005, 2006-2010 (revised March 2012), and 2011.

Figure 6. Percentage of Heroin Initiates among Persons Aged 12 to 49, by Prior and Past Year Dependence/Abuse of Nonmedical Pain Relievers (NMPR): 2002-2011
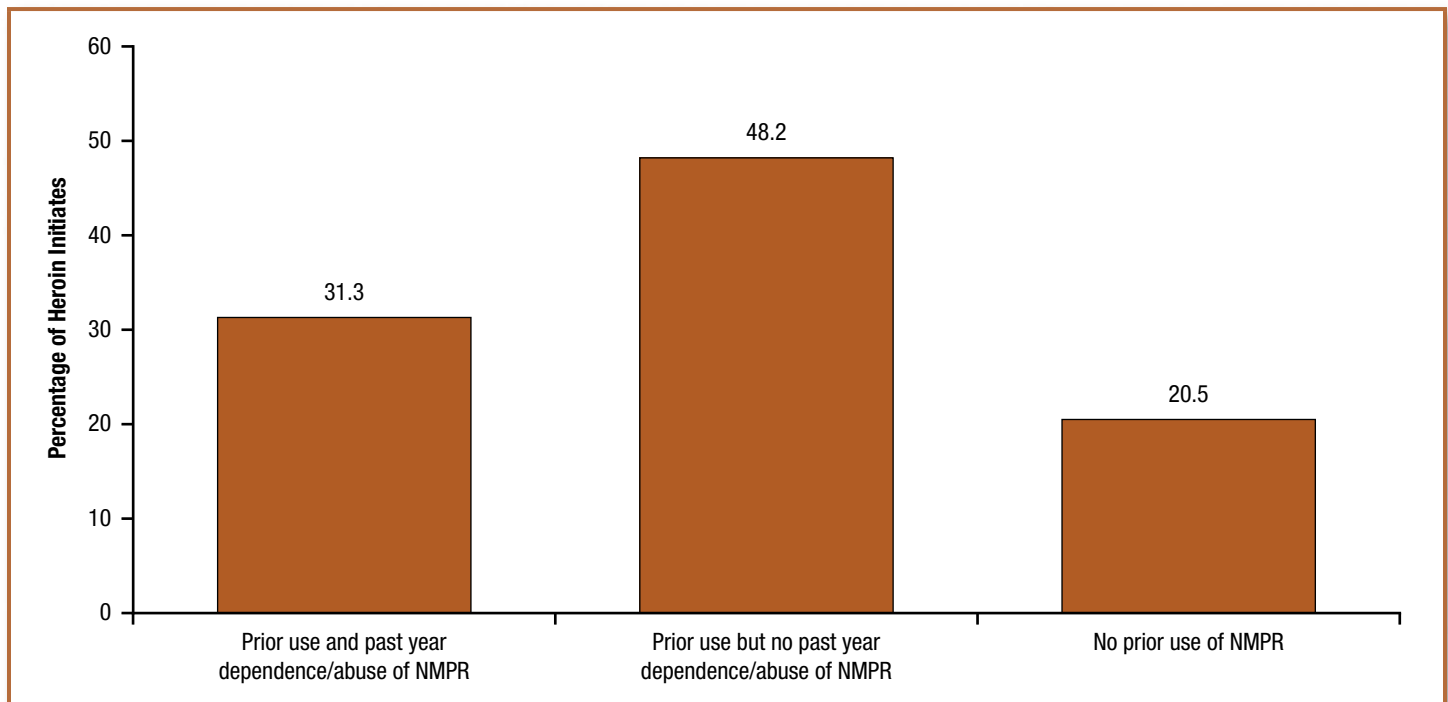
Note: Past year NMPR users are those who had initiated NMPR use prior to initiation of heroin use in the past 12 months. Past year NMPR users who initiated NMPR subsequent to initiation of heroin use in the past 12 months are not included. Dependence or abuse is based on definitions found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.

Table 4. Past Year Heroin Initiates Who Ever Used a Needle to Inject Heroin among Persons Aged 12 to 49, by Demographic, Geographic Characteristics, and Prior Drug Use Status: Percentages, Annual Averages Based on 2002-2011

Demographic/Geographic Characteristics/Prior Drug Use	Annual Average Percentage of Past Year Heroin Initiates Who Ever Used Needle to Inject Heroin
Total	**26.6 (2.40)**
Age	
12 to 17	32.5 (4.01)
18 to 25	25.6 (2.70)
26 to 49	* (*)
Gender	
Male	20.1 (2.54)
Female	36.1[b] (4.18)
Race/Ethnicity	
Non-Hispanic White	27.6 (2.58)
Non-Hispanic Black	* (*)
Hispanic	* (*)
Non-Hispanic Others	* (*)
Household Income	
< $20,000	29.0 (5.40)
$20,000-$49,999	30.2 (3.87)
$50,000-$74,999	* (*)
> $75,000	24.3 (4.13)
County Type	
Metropolitan	25.4 (2.61)
Nonmetropolitan	33.4 (5.41)
Region	
Northeast	28.2 (5.21)
Midwest	27.0 (4.05)
South	32.9 (5.02)
West	17.6 (3.69)
Prior NMPR Use	
No Prior Illicit Drug Use[1]	* (*)
Prior Illicit Drug Use[1]	24.4 (2.45)
Frequency of Use of NMPR in Past Year among Prior Lifetime NMPR Users	
0 Days	* (*)
1-29 Days	21.7 (3.91)
30-99 Days	22.7 (4.80)
100-199 Days	* (*)
200-365 Days	* (*)
Disorder Status of Prior NMPR Users	
No Dependence/Abuse in Past Year[2]	22.9 (2.78)
Dependence/Abuse in Past Year[2]	26.6 (4.20)

*Low precision; no estimate reported.

[a] Difference between male estimate and female estimate is statistically significant at the .05 level.

[b] Difference between estimate and Northeast estimate is statistically significant at the .05 level.

[1] Illicit drugs include marijuana/hashish, cocaine (including crack), hallucinogens, and inhalants.

[2] Dependence or abuse is based on definitions found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.

significant. There was also no significant change between 2002 and 2011 in the proportion of heroin initiates with needle use (data not shown).

Pattern of Heroin Initiation during the 5-Year Period after NMPR Initiation

From 2002 to 2011, the annual number of NMPR initiates aged 12 to 49 declined from 2.3 million in 2002 to 1.8 million in 2011, and over this 10-year period, there were more than 20 million NMPR initiates aged 12 to 49 (calculated from the data). Individuals who reported life time NMPR use can be grouped into cohorts by months before interview date when NMPR was initiated for examining the cumulative incidence proportion of heroin use among NMPR initiates. As noted in the data and methods section, using the reported age and month at first use data, a 5-year retrospective summary of the progression from NMPR initiation to heroin initiation was created. Results suggest that the proportion of NMPR initiates who progressed to heroin initiation, expressed per 100 has remained fairly steady: 0.71 (SE = 0.05), 0.87 (SE = 0.06), 0.76 (SE = 0.06), 0.89 (SE = 0.09), or 0.69 (SE = 0.14) during the first, second, third, fourth, or fifth year, respectively, following first NMPR use; these incidence estimates involve five cohorts of individuals who initiated NMPR use in 12 to 23, 24 to 35, 36 to 47, 48 to 59, and 60 to 71 months before interview, respectively. Accumulation of these estimates indicates that, only 3.6 percent of NMPR initiates [1 - (1 - 0.0071) × (1 - 0.0087) × (1 - 0.0076) × (1 - 0.0089) × (1 - 0.0069) = 0.036] had initiated heroin in 5 years following first NMPR use.

Past Year Nonmedical Pain Reliever Initiation Preceded by Heroin Use

Table 5 shows the past year NMPR incidence rate among individuals at risk for NMPR use initiation by prior heroin use status and demographic factors, stratified by year groupings. From 2002 to 2011, prior heroin users were more likely than their nonuser counterparts to initiate NMPR use in the past year (2.8 vs. 1.6 percent), and this progression varied little over time. Those who were prior users of heroin as well as other illicit drugs had the highest NMPR incidence rate

(4.1 percent). **Table 6** shows the percentage distribution of NMPR initiates in prior drug use categories. An overwhelming majority of NMPR initiates (99.0 percent) had not used heroin before using NMPR.

Discussion

This nationally representative study finds a strong association between prior nonmedical use of pain relievers and the subsequent past year initiation of heroin use. There are two key findings that were observed in this study. First, the recent (12 months preceding interview) heroin incidence rate was 19 times higher among those who reported prior NMPR use than among those who did not report NMPR use (0.39 vs. 0.02 percent; 0.39 ÷ 0.2 ≅ 19). There are many plausible explanations for this finding, including the gateway theory of drug use that posits that the use of some drugs may expose individuals to a repertoire of biological and behavioral factors that could influence their future use of other drugs. In this case, NMPR use may precondition one to engage in heroin use because prescription pain relievers have a similar pharmacological effect as that of heroin, given their similarities in chemical structure. Although the findings indicate that NMPR use is a common step on the pathway to heroin initiation, most NMPR users do not progress to heroin use. Second, heroin use appears to be neither a sufficient nor a necessary condition for the subsequent onset of NMPR use. Put differently, it appears that there are many unique pathways leading to NMPR use, and many of those do not involve heroin as a developmental precursor, or milestone, on the career trajectory of an illicit drug user.

Findings of this study can be generalized to the U.S. general population aged 12 to 49, although there are several noteworthy limitations. For example, the number of heroin initiates in the United States may have been underestimated because of the exclusion of institutionalized and homeless individuals, populations that may have disproportionately higher rates of heroin use.[24] However, to the extent that the influence of prior NMPR use on subsequent heroin initiation does not vary between noninstitutionalized and other populations, the magnitude of the association estimated

Table 5. Past Year Nonmedical Pain Reliever Use Incidence Rate and Corresponding Standard Errors among Persons Aged 12 to 49 at Risk for Initiation of Nonmedical Pain Reliever Use, by Prior Illicit Drug Use Status: Annual Averages Based on 2002-2004, 2005-2008, 2009-2011, and 2002-2011

Prior Drug Use Status	Nonmedical Pain Reliever Use Incidence Rate × 100			
	2002-2004	2005-2008	2009-2011	2002-2011
Total	1.7[b] (0.04)	1.6[a] (0.03)	1.5 (0.04)	1.6 (0.02)
Prior Heroin Use Status				
No Heroin Use Prior to NMPR Use	1.7[b] (0.04)	1.6[a] (0.03)	1.5 (0.04)	1.6 (0.02)
No Other Illicit Drugs[1] Use Prior to NMPR Use	0.8[b] (0.04)	0.8[b] (0.03)	0.7 (0.04)	0.8 (0.02)
Other Illicit Drugs[1] Use Prior to NMPR Use	2.8[a] (0.07)	2.6 (0.07)	2.5 (0.07)	2.6 (0.04)
Heroin Use Prior to NMPR Use	2.3 (0.62)	2.5 (0.56)	4.1 (1.63)	2.8 (0.51)
No Other Illicit Drugs[1] Prior to NMPR Use	* (*)	* (*)	* (*)	* (*)
Other Illicit Drugs[1] Use Prior to NMPR Use	2.3 (0.62)	2.5 (0.57)	4.0 (1.66)	2.8 (0.52)

*Low precision; no estimate reported.
NOTE: Standard errors of estimates are in parentheses.
NOTE: At Risk for Initiation of Nonmedical Pain Reliever Use is defined as persons who did not use nonmedical pain relievers in their lifetime or who initiated nonmedical pain relievers within 12 months before the interview.
[a] Difference between estimate and 2009-2011 estimate is statistically significant at the .05 level.
[b] Difference between estimate and 2005-2008 estimate is statistically significant at the .05 level.
[1] Other illicit drugs include marijuana/hashish, cocaine (including crack), hallucinogens, and inhalants.
Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.

Table 6. Percentage Distribution of Past Year Nonmedical Pain Reliever Use among Persons Aged 12 to 49 at Risk for Initiation of Nonmedical Pain Reliever Use, by Prior Illicit Drug Use Status: Annual Averages Based on 2002-2004, 2005-2008, 2009-2011, and 2002-2011

Prior Drug Use Status	Percent Distribution			
	2002-2004 N[1] = 2,278	2005-2008 N[1] = 2,080	2009-2011 N[1] = 1,927	2002-2011 N[1] = 2,094
Total	100.0 (0.00)	100.0 (0.00)	100.0 (0.00)	100.0 (0.00)
Prior Heroin Use Status				
No Heroin Use Prior to NMPR Use	99.1 (0.25)	99.2 (0.18)	98.7 (0.50)	99.0 (0.18)
No Other Illicit Drugs[2] Use Prior to NMPR Use	25.2[b] (1.04)	29.5[a] (0.97)	26.4 (1.17)	27.2 (0.61)
Other Illicit Drugs[2] Use Prior to NMPR Use	73.9[b] (1.05)	69.7 (0.98)	72.3 (1.21)	71.8 (0.62)
Heroin Use Prior to NMPR Use	0.9 (0.25)	0.8 (0.18)	1.3 (0.50)	1.0 (0.18)
No Other Illicit Drugs[2] Prior to NMPR Use	0.0 (0.01)	* (*)	0.1 (0.06)	0.0 (0.02)
Other Illicit Drugs[2] Use Prior to NMPR Use	0.9 (0.25)	0.8 (0.18)	1.2 (0.49)	1.0 (0.18)

*Low precision; no estimate reported.
NOTE: The percentages may not add to 100 percent due to rounding.
NOTE: Standard errors of estimates are in parentheses.
NOTE: At Risk for Initiation of Nonmedical Pain Reliever Use is defined as persons who did not use nonmedical pain relievers in their lifetime or who initiated nonmedical pain relievers within 12 months before the interview.
[a] Difference between estimate and 2009-2011 estimate is statistically significant at the .05 level.
[b] Difference between estimate and 2005-2008 estimate is statistically significant at the .05 level.
[1] N is an estimate in thousands.
[2] Other illicit drugs include marijuana/hashish, cocaine (including crack), hallucinogens, and inhalants.
Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002-2004, 2005-2010 (revised March 2012), and 2011.

here is unlikely to be affected. Besides, the relationship between prior NMPR use and subsequent heroin use may have been partially accounted for by factors such as availability of pain relievers or heroin supply, which we could not examine here. In addition, heroin initiation may have been underestimated to an unknown degree because some heroin users may not report their use in the survey interview, despite the NSDUH data collection procedures that provide privacy and confidentiality to respondents. Another limitation of this study is that it is based on the retrospective reports of age of onset of drug use. Many studies have shown age-related biases in the timing of recalling key events, such as illicit substance use.[25] The recall of these events may be faulty because they happened only one time, unlike other high-frequency events that would solidify in one's memory. However, for the most part, we focused on initiation within the past 12 months, to minimize the recall bias. Despite these limitations, this study contributes important new data to improve understanding of the role of NMPR use in initiation of heroin use in the U.S. general population.

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