Heroin Initiation Among Unemployed or Uninsured Prescription Opioid Users

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Introduction

Prescription opioid use has begun to decline, however as prescription opioid use has declined, heroin use has increased in the US [1,2,4,6]. Recent studies show as much as 80% of new heroin users used a prescription opioid before using heroin for the first time indicating that a new pathway to illicit opioid use has developed [5].

New research shows that as much as 50% of men outside of the labor force take opioids at least once a day [18]. This would imply that as the number of men outside of the work force taking prescription pain medication has increased, the number of men at risk of heroin initiation has also increased. With labor force participation at a twenty-year low, this is a very disconcerting combination of factors.

This paper adds to the literature on heroin initiation in three ways. First it examines the impact of unemployment on heroin initiation among users of prescription pain relievers in the US. Second it examines how insurance use and unemployment may interact to encourage opioid use. Finally, this paper examines how education and unemployment may have interacted to diffuse ideas about heroin as an alternative to prescription pain relievers across various demographic and socioeconomic groups.

Literature Review and Framework

Since 2011, the number of opioid prescriptions has begun to decline in the United States [1]. Similar declines have also been observed not just in the general population, but also in the active duty military population who have a high rate of chronic pain that is frequently treated with opioid therapy [2]. Despite the reduction in opioid prescribing, heroin related deaths increased five-fold between 2010 and 2016 [4,6]. The relationship between prescription opioids and heroin appears to be connected; a 2014 study of 28 states found that increases in heroin death rates were positively correlated with prescription opioid death rates indicating that populations using prescription opioids are more likely to use illicit opioids like heroin [9]. Additionally, between 1970 and 2000, the first opioid used by most heroin users was heroin; however, more recent findings show that 80% of new initiates of heroin used a prescription opioid as their first opioid [5,7,8]. Other studies have shown that 39% of heroin users had dependence on prescription opioids before using heroin [13]. This evidence would indicate that the best population to study to understand the current trend in heroin use would be recipients of prescription pain relievers. The purpose of this analysis is to better understand the transition between pain relievers and heroin use.

During the last decade, there have been two factors that may have influenced the prescribing of opioids in the US. First, the Institute of Medicine put out pain treatment guidelines in 2011 for doctors to follow when prescribing prescription pain relievers [22]. This change affected the availability of prescription opioids after these guidelines were put forward. Second, the affordable care act (also known as Obamacare) may have given more people access to health insurance, which may have given them more opportunities to see doctors about chronic pain. The federal healthcare exchange (healthcare.gov) was implemented in 2013. When investigating opioid use, it may be beneficial to investigate these time periods more cautiously.

Sex, race, and age have all been shown to be key factors in heroin initiation [10,11]. Men have been shown to have more than twice the odds of heroin abuse or dependence than women and have higher overdose rates [10,6]. Although women have lower rates of heroin use than men, the use of heroin has been increasing faster for women than for men bringing women closer to convergence with men in terms of heroin use [11]. Between 2002 and 2013, non-Hispanic whites almost doubled their rates of heroin use, while other races appear to have either stayed steady or decreased [10]. In 2000 Non-Hispanic blacks aged 45-64 had the highest rate of poisoning related deaths involving heroin, by 2013 the highest rate of poisoning related deaths had shifted to non-Hispanic whites aged 18-44, strongly indicating a clear demographic shift in heroin use between those years [6]. Between 2002 and 2013, the 18-25 age group had the highest rate of heroin use of any age group; however the 25-44 age group during that same period had a higher rate of heroin related poisonings [10,11,6].

There is some evidence of concurrent use of illicit drugs and heroin use [10]. Binge drinking alcohol and marijuana use have a mild effect on increased heroin use [10]. Using cocaine or abusing prescription opioids has a much more pronounced effect [10]. It may be possible that being in regions with other illicit drugs makes finding heroin easier, or using other illicit drugs lowers inhibitions about using illicit drugs [10].

Typically, substance abuse begins with those at high socioeconomic status [16,17]. After a period, this behavior then transmits to individual at lowers socioeconomic standing [16,17] and may become stigmatized until the pattern diffuses. This pattern has been observed in patterns of cigarette use over the last several decades and may have implications to opioid use in the United States.

Income is shown to have a strong link to heroin use in the literature. Those at lower incomes are at higher risk for heroin use. Individuals at middle incomes have also seen an increasing amount of heroin use in the past decade [10,11]. If the new pathway to heroin use involves prior use of prescription opioids, it may be the case that many of these individuals are experiencing chronic pain. Chronic pain has been associated with increased amount of unemployment and functional limitation which may impact income more than other socioeconomic metrics [12].

Education is seldomly mentioned in the heroin initiation literature. Hence one focus of this analysis is to determine the impacts of education on the transition between prescription pain relievers and heroin use. Education and opioid related mortality however has been studied recently. Much of the educational gradient in mortality can be explained by opioid related poisonings [13]. The impact of opioid use on educational gradients has increased and is higher for non-Hispanic whites than for any other group [13]. Education has been considered a fundamental cause in mortality literature and may work in similar ways in high risk behaviors like heroin use [15]. Education is also important in that it may allow better access to employment and in turn better access to health insurance and health care. Additionally, education remains constant throughout the adult life course and may be a better choice for measuring socioeconomic status than income or other metrics [14,21].

Access to health insurance has been shown to have an impact on transitioning to heroin use [10]. Individuals using Medicaid however show comparable results to those without insurance [10]. The lack of health insurance may be linked to unemployment as many people may not be able to afford health insurance without assistance from their employer. Furthermore, individuals that have lost their health insurance may be more likely to seek opioids from

alternative sources if they are no longer able to afford to fill their prescriptions. The interaction between employment and health insurance is an important outcome in this analysis.

Unemployment can have a serious impact on psychological wellbeing [32]. Individuals experiencing unemployment can experience many mental health issues including depression, anxiety and distress [32]. When compared to employed groups, the rate of individuals with mental health problems is more than double among the unemployed [32]. This can lead individuals to other unhealthy behaviors including substance abuse [34] and can increase the likelihood of receiving opioids [33].

Unemployment may also be a crucial factor in the current trends in opioid abuse. A recent paper showed that as many as 50% of primary aged men out of the labor force use opioids daily [18]. Additionally, the proportion of the male population in the labor force hit a high of 67% in 2000 then dropped to near 62% in 2015 where it has remained [19]. This leaves a substantial proportion of the population at risk of using opioids, and at risk of using more dangerous substances like heroin. Understanding the impact of unemployment and its interaction with health insurance and education on heroin use is the primary objective of this paper.

Methods

To investigate heroin initiation among users of prescription pain relievers, data were collected from the Substance Abuse and Mental Health Services Administration's (SAMHSA) National Survey on Drug Use and Health (NSDUH) for the years spanning 2006-2014 [22-31]. The NSDUH dataset is a survey weighted nationally representative dataset that investigates current patterns of drug use in the United States. Only respondents that used a prescription pain

reliever in the previous twelve months were included in the analysis. Respondents less than 18 or over 65 were removed from the dataset. Only individuals receiving healthcare through Medicaid, private insurance, or lacking insurance were included (those with CHAMPUS or other healthcare were removed). Additionally, respondents reporting having used heroin more than 1 year before the year the survey was administered were removed to ensure that the population was heroin naïve during the reference frame of this analysis. Finally, the dataset was segmented into three datasets representing the years 2006-2008, 2009-2011, and 2012-2014.

Since the objective is to determine factors leading to the initiation of heroin among users of prescription pain relievers, the main outcome variable for this analysis is the use of heroin in the previous twelve months before participating in the NSDUH survey. This variable does not discriminate between different formulations of heroin or method of administration. Additionally, this variable only looks at heroin use and does not differentiate between heroin abuse or heroin dependence.

Our main independent variables include employment status and insurance coverage. A dummy variable was created to measure unemployment; this variable was coded as 1 for a respondent that did not have full time or part time employment and 0 otherwise during the time of their response. Those that have left the workforce and those that have employment other than full or part time employment were marked as unemployed as well. This grouping of the unemployed, and those that left the work force was created both to describe all individuals out of the workforce and for technical reasons to avoid small cell sizes between college education or high-income categories . The reference group for the variable are those individuals that have full or part time employment so that the effect of unemployment could be better understood. Health insurance was coded as one of three options: Uninsured, private insurance, or Medicaid. The

uninsured serve as the reference category to investigate if there are differences between Medicaid and private insurance plans.

Socioeconomic status in this analysis is measured by both income and education. Income is categorized as less than $20,000, $20,000-$49,999, $50,000 - $74,999, or $75,000 or more. The less than $20,000 group is the reference for this analysis which allows use to observe how higher income groups may have varying rates of heroin use compared to the lowest income group. Education is categorized as "Less than High School", "High School Graduate", "Some College", or "College Graduate". High school graduates are set as the reference group to better observe both how higher educational attainment may be initiating heroin use, but also to better understand how those with less than a high school education (who have historically used heroin more than other groups) may differentially initiate heroin use in comparison to those with a high school degree.

Demographic variables for race, sex, and age are also included in this analysis. Race is categorized as Non-Hispanic White, Non-Hispanic Black, Hispanic, and Other. The category for other includes Asian, Pacific Islander, and those identifying as two or more races. Sex was categorized as male (reference) or female. Men have historically used heroin more than women, setting men as the reference group makes the changes that women may be experiencing more obvious. Age was categorized as 18-25, 26-34, 35-49, and 50-64 years of age. The 18-25 years group, which has historically been the most likely to use heroin, is used as the reference group in this analysis. Respondents younger than 18 were likely to still be attending school and to not have joined the workforce yet, similarly respondents older than 65 were removed since they were likely to be retired.

To better understand how combinations of drugs might encourage or discourage the initiation of heroin use, variables for drug abuse for drugs other than heroin are also included in this analysis. These variables include markers for alcohol abuse, marijuana abuse, cocaine abuse, or abuse of prescription pain killers.

Statistical Analysis

All statistical analyses are performed using R v3.4.3. To use survey weighted data and survey weighted statistical methods, the survey library within R was used. This package includes the ability to use complex survey design within a wide variety of statistical tools.

Survey weighted proportions and unweighted counts of heroin initiation by each of the included variables are measured for each three year segment. The significance of the difference in heroin initiation between each category is measured by survey weighted chi-square tests. To better understand the changes over time, measurements for employment status, insurance type, and education are graphed across time.

To understand how the initiation of heroin use among users of prescription pain relievers has changed over time, survey weighted logistic regression models stratified by each of the three year time frames in the analysis were estimated. Creating three separate models will show how variables have changed over time. The first set of models includes variables for employment status, insurance, education, income, race, sex, age, and substance abuse. The second set includes the same variables as the first set of models with in the inclusion of interaction terms between health insurance and unemployment. The third set of models includes the same set of variables as the first set with the inclusion of interaction terms between unemployment and education.

Results

A total of 7,187 respondent were included between 2006 and 2014 with 2,294 between 2006 and 2008, 2,392 between 2009 and 2011, and finally 2,500 between 2012 and 2014. Between 2006 and 2008, 62 respondents used heroin in the previous year, a number that increased to 86 in the following three years and eventually 136 between 2012 and 2014. Survey weighted proportions showed 3.7% (3.2%, 4.0%) of the those prescribed a prescription pain reliever used heroin across all years. Between the earliest cohort and the most recent that value increased from 2.7% in 2006-2008 to 4.7% in 2012-2014. Overall there is a notable increase among prescription pain reliever initiating heroin use.

Table 1 shows increasing rates of heroin use between the 2006-2008 cohorts and the 2012-2014 variables. Notably, unemployed increased from 7.19% to 9.22%, the uninsured went from 5% to 10%, and pain reliever abuse increased from 3.88% to more than ten percent. Whites increased from 1.95% to 5.88%, while all other race ethnicity groups either decreased or stayed steady. The 18-24 age group increased the most dramatically from 3% to 8%, while the oldest age decreased slightly from 4.95% to 1.88%.

Table 1. Percent using heroin in the last year by key variables

	2006-2008		2009-2011		2012-2014	
Employment						
Employed	1.6	(0.88, 2.65)	2.89	(1.94, 4.14)	3.22	(2.32, 4.36)
Unemployed	7.19	(3.84, 12.08)	5.88	(3.37, 9.42)	9.22	(6.76, 12.2)
Insurance						
No Insurance	5.01	(2.74, 8.30)	4.98	(3.25, 7.28)	10.13	(7.67, 13.06)
Medicaid	7.29	(3.04, 14.27)	6.38	(3.60, 10.33)	7.11	(4.46, 10.65)
Private Insurance	1.11	(0.42, 2.36)	2.31	(1.27, 3.83)	1.29	(0.78, 2.02)
Education						
Less than High School	4.76	(2.19, 8.87)	4.85	(1.65, 10.75)	5.62	(3.58, 8.33)
High School Graduate	2.42	(1.23, 4.25)	5.27	(3.49, 7.59)	5.92	(4.06, 8.28)
Some College	2.51	(1.00, 5.16)	3.84	(2.11, 6.38)	6.32	(4.36, 8.81)
College Graduate	2.18	(0.42, 6.44)	1.13	(0.35, 2.7)	1.41	(0.67, 2.59)
Other Demographics						
<$20000	5.3	(2.52, 9.66)	6.28	(3.87, 9.53)	9.35	(6.67, 12.66)
$20000-$49999	2.92	(1.49, 5.10)	4.35	(2.41, 7.16)	4.7	(3.12, 6.77)
$50000-$74999	1.8	(0.28, 4.43)	1.8	(0.67, 3.85)	2.86	(1.50, 4.92)
> $75000	1.47	(0.44, 4.79)	2.03	(0.93, 3.83)	2.66	(1.36, 4.63)
White	1.95	(1.23, 2.93)	3.95	(2.82, 5.37)	5.88	(4.65, 7.31)
Black	3.69	(1.03, 9.11)	7.84	(3.33, 15.17)	2.59	(0.81, 6.09)
Hispanic	8.04	(2.90, 16.98)	1.05	(0.17, 3.33)	2.82	(1.30, 5.27)
Other	1.05	(0.13, 3.73)	1.07	(0.05, 5.06)	1.05	(0.07, 4.59)
Male	3.84	(2.33, 5.93)	4.93	(3.38, 6.92)	6.78	(5.30, 8.52)
Female	1.41	(0.65, 2.66)	2.09	(1.20, 3.38)	2.48	(1.66, 3.57)
18-24	3.03	(1.67, 5.02)	3.86	(2.66, 5.38)	8.27	(6.38, 10.5)
25-44	1.83	(0.90, 3.3)	3.22	(1.89, 5.08)	2.84	(1.69, 4.46)
45-64	4.95	(1.52, 11.57)	4.39	(1.49, 9.78)	1.88	(0.65, 4.17)
Concurrent Drug Use						
No Alcohol Abuse	2.86	(1.85, 4.23)	3.48	(2.54, 4.64)	5.11	(4.04, 6.36)
Alcohol Abuse	2.17	(0.41, 6.48)	5.65	(1.37, 14.67)	2.35	(1.10, 4.38)
No Pain Reliever Abuse	2.76	(1.79, 4.04)	3.58	(2.64, 4.74)	4.59	(3.62, 5.75)
Pain Reliever Abuse	3.88	(0.32, 14.99)	7.44	(0.77, 25.67)	10.2	(3.12, 23.12)
No Cocaine Abuse	2.5	(1.65, 3.63)	3.65	(2.71, 4.8)	4.59	(3.65, 5.70)
Cocaine Abuse	24.23	(0.01, 94.24)	10.62	(0.00, 99.99)	19.04	(0.19, 75.91)
No Marijuana Abuse	2.35	(1.52, 3.45)	3.62	(2.68, 4.77)	4.66	(3.66, 5.83)
Marijuana Abuse	23.28	(3.65, 59.15)	7.86	(0.36, 32.75)	10.92	(2.02, 30.10)

In the first set of multivariate regression models (Table 2), the only significant factor across all three cohorts was sex. Private insurance in the earliest cohort and the most recent

cohort showed a significant protective effect. Unemployment showed a significant impact in the 2006-2008 and the 2012-2014 cohorts. Race and age, which were not significant in the 2006-2008 cohort both became protective in comparison to their reference categories (white, 18-24). Marijuana abuse was a strong indicator of heroin use in the earliest cohort, however it was not found to be a significant factor in later years; alternatively, cocaine abuse showed the opposite shift over time. Income and education did not appear to have an impact in these models.

Table 2 Logistic regression models of heroin use by key factors for each cohort

	2006-2008		2009-2011		2012-2014	
Intercept	0.02 (0.01, 0.09)	***	0.08 (0.03, 0.27)	***	0.32 (0.18, 0.57)	***
Employment Status						
Unemployment	2.89 (1.06, 7.89)	*	1.48 (0.64, 3.44)		2.15 (1.31, 3.54)	**
Insurance						
Medicaid	1.47 (0.50, 4.35)		1.13 (0.53, 2.40)		0.92 (0.52, 1.61)	
Private	0.33 (0.13, 0.83)	*	0.77 (0.28, 2.14)		0.19 (0.11, 0.36)	***
Education						
Less than High School	1 (0.38, 2.64)		0.86 (0.29, 2.53)		0.72 (0.4, 1.27)	
Some College	1.2 (0.42, 3.39)		0.99 (0.50, 1.94)		1.23 (0.72, 2.11)	
College Graduate	1.31 (0.32, 5.37)		0.33 (0.10, 1.03)	.	0.5 (0.22, 1.14)	
Income						
20000-49999	1.41 (0.51, 3.92)		0.83 (0.41, 1.69)		0.61 (0.35, 1.05)	.
50000-75000	1.15 (0.28, 4.69)		0.43 (0.14, 1.30)		0.65 (0.31, 1.36)	
> 75000	1.05 (0.31, 3.53)		0.62 (0.22, 1.76)		0.89 (0.39, 2.03)	
Race						
Black	1.14 (0.36, 3.69)		1.5 (0.64, 3.52)		0.29 (0.11, 0.74)	*
Hispanic	2.76 (1.00, 7.62)	.	0.2 (0.05, 0.79)	*	0.46 (0.23, 0.93)	*
Other	0.56 (0.13, 2.48)		0.24 (0.04, 1.52)		0.16 (0.03, 0.95)	*
Sex						
Female	0.32 (0.14, 0.76)	*	0.42 (0.23, 0.77)	**	0.31 (0.21, 0.47)	***
Age						
25-44	0.79 (0.36, 1.76)		0.84 (0.43, 1.65)		0.37 (0.21, 0.63)	***
45-64	2.51 (0.87, 7.20)	.	1.21 (0.50, 2.97)		0.25 (0.09, 0.65)	**
Substance Abuse						
Alcohol Abuse	0.82 (0.23, 2.87)		1.6 (0.57, 4.48)		0.32 (0.15, 0.68)	**
Pain Reliever Abuse	0.84 (0.10, 7.15)		1.5 (0.28, 7.94)		1.85 (0.65, 5.26)	
Cocaine Abuse	3.28 (0.65, 16.62)		3.9 (0.70, 21.77)		3.66 (1.19, 11.31)	*
Marajuana Abuse	4.28 (1.45, 12.68)	**	1.69 (0.41, 6.97)		2.45 (0.9, 6.67)	.

*** 0.001 **0.01 *0.05 .0.1

The only significant interaction term included in Table 3 was the interaction between Medicaid and unemployment in 2006. With the interaction terms incorporated, the Medicaid variable became significant for that year indicating that Medicaid recipients were more at risk of

using heroin when they were employed, however this effect vanished in later cohorts. Hispanic also became positively significant in the 2006-2008 cohort, in the later two cohorts this factor becomes positively protective. The other variables in this model appear to show similar patterns to the first set of regression models.

Table 3 Logistic Regression Models including unemployment and insurance interactions

	2006-2008	2009-2011	2012-2014
Intercept	0.01 (0, 0.07) ***	0.1 (0.03, 0.27) ***	0.32 (0.16, 0.61) ***
Employment Status			
Unemployment	4.99 (1.57, 15.83) **	0.97 (0.4, 2.39)	2.17 (1.1, 4.28) *
Insurance			
Medicaid	5.49 (1.6, 18.84) **	1.25 (0.38, 4.05)	0.93 (0.38, 2.28)
Private	0.39 (0.11, 1.33)	0.51 (0.2, 1.3)	0.2 (0.09, 0.41) ***
Education			
Less than High School	1.24 (0.46, 3.32)	0.84 (0.31, 2.23)	0.72 (0.4, 1.28)
Some College	1.19 (0.44, 3.23)	1.02 (0.51, 2.01)	1.23 (0.71, 2.13)
College Graduate	1.26 (0.33, 4.81)	0.33 (0.11, 1.05) .	0.5 (0.22, 1.15)
Income			
20000-49999	1.38 (0.54, 3.58)	0.84 (0.42, 1.66)	0.61 (0.35, 1.06) .
50000-75000	1.22 (0.31, 4.81)	0.48 (0.16, 1.45)	0.65 (0.31, 1.37)
> 75000	1.18 (0.38, 3.64)	0.66 (0.24, 1.78)	0.89 (0.39, 2.04)
Race			
Black	1.24 (0.4, 3.91)	1.59 (0.68, 3.75)	0.29 (0.11, 0.75) *
Hispanic	2.66 (1.06, 6.67) *	0.21 (0.06, 0.79) *	0.46 (0.23, 0.93) *
Other	0.42 (0.08, 2.12)	0.22 (0.03, 1.51)	0.16 (0.03, 0.96) *
Sex			
Female	0.32 (0.14, 0.71) **	0.41 (0.23, 0.76) **	0.31 (0.21, 0.47) ***
Age			
25-44	0.82 (0.38, 1.79)	0.88 (0.45, 1.71)	0.37 (0.21, 0.64) ***
45-64	2.43 (0.88, 6.75) .	1.18 (0.5, 2.76)	0.25 (0.09, 0.65) **
Substance Abuse			
Alcohol Abuse	0.88 (0.23, 3.42)	1.51 (0.6, 3.78)	0.32 (0.15, 0.68) **
Pain Reliever Abuse	0.74 (0.07, 7.36)	1.47 (0.26, 8.19)	1.85 (0.65, 5.28)
Cocaine Abuse	2.81 (0.54, 14.73)	3.87 (0.69, 21.81)	3.67 (1.18, 11.44) *
Marajuana Abuse	4.59 (1.56, 13.44) **	1.7 (0.4, 7.23)	2.45 (0.9, 6.66) .
Insurance Uneployment Interaction			
Unemployment by Medicaid	0.11 (0.02, 0.65) *	1.06 (0.24, 4.63)	0.97 (0.28, 3.41)
Unemployment by Privates	1.06 (0.17, 6.68)	3.88 (0.72, 20.83)	0.98 (0.23, 4.19)

*** 0.001 **0.01 *0.05 .0.1

The interaction terms for education and unemployment shown in table 4 show significant effects in the earliest cohort. The 2006-2008 group showed strong effects for the unemployment by some college and the unemployment by college graduates. In the 2006-2008 cohort, the effect vanishes, while the unemployment by the less than high school group shows a significant effect. The 2012-2014 group does not show any significant interaction. The effect for Hispanics appears to show a similar trend with the inclusion of the education and unemployment variables as it does for the inclusion of the insurance and unemployment variables where Hispanics begin with a significant positive effect then shift to a significant protective effect. Other variables appear to show the same patterns as in the first set of multivariate logistic regression models.

Table 4 Logistic Regression Models with the inclusion education and unemployment interaction terms

	2006-2008	2009-2011	2012-2014
Intercept	0.04 (0.01, 0.14) ***	0.1 (0.04, 0.29) ***	0.36 (0.19, 0.70) **
Employment Status			
Unemployment	0.57 (0.17, 1.96)	1 (0.37, 2.69)	1.62 (0.64, 4.11)
Insurance			
Medicaid	1.56 (0.48, 5.08)	1.1 (0.51, 2.40)	0.93 (0.52, 1.67)
Private	0.34 (0.14, 0.85) *	0.69 (0.27, 1.78)	0.19 (0.11, 0.36) ***
Education			
Less than High School	0.59 (0.18, 1.9)	0.26 (0.07, 0.99) *	0.58 (0.24, 1.40)
Some College	0.47 (0.1, 2.18)	1.01 (0.46, 2.2)	0.99 (0.48, 2.06)
College Graduate	0.27 (0.06, 1.1) .	0.26 (0.08, 0.86) *	0.45 (0.16, 1.26)
Income			
20000-49999	1.26 (0.45, 3.54)	0.82 (0.41, 1.65)	0.61 (0.35, 1.06) .
50000-75000	1.02 (0.26, 4.01)	0.43 (0.14, 1.33)	0.64 (0.31, 1.34)
> 75000	0.98 (0.31, 3.12)	0.63 (0.22, 1.79)	0.88 (0.38, 2.04)
Race			
Black	1.15 (0.37, 3.57)	1.54 (0.67, 3.55)	0.29 (0.11, 0.74) *
Hispanic	2.71 (1.02, 7.2) *	0.19 (0.05, 0.77) *	0.47 (0.23, 0.96) *
Other	0.52 (0.11, 2.43)	0.24 (0.04, 1.57)	0.16 (0.03, 0.95) *
Sex			
Female	0.34 (0.14, 0.8) *	0.41 (0.23, 0.75) **	0.31 (0.21, 0.47) ***
Age			
25-44	0.87 (0.4, 1.91)	0.81 (0.42, 1.57)	0.36 (0.21, 0.63) ***
45-64	2.44 (0.82, 7.3)	1.21 (0.52, 2.8)	0.25 (0.10, 0.65) **
Substance Abuse			
Alcohol Abuse	0.8 (0.24, 2.68)	1.58 (0.58, 4.3)	0.32 (0.15, 0.68) **
Pain Reliever Abuse	0.93 (0.12, 7.39)	1.69 (0.34, 8.4)	1.87 (0.66, 5.36)
Cocaine Abuse	2.91 (0.55, 15.43)	4.53 (0.93, 22.19) .	3.43 (1.12, 10.51) *
Marajuana Abuse	3.83 (1.21, 12.09) *	1.71 (0.44, 6.55)	2.44 (0.88, 6.75) .
Education Uneployment Interaction			
Unemployment by less than high school	4.5 (0.62, 32.83)	6.42 (1.28, 32.28) *	1.53 (0.42, 5.60)
Unemployment by Some College	9.95 (1.56, 63.58) *	0.84 (0.21, 3.32)	1.56 (0.45, 5.37)
Unemployment by College Graduate	32.13 (4.94, 209.1) ***	2.27 (0.21, 24.13)	1.3 (0.23, 7.46)

Discussion

Like previous findings we found that respondents that had private healthcare were less likely to use heroin than respondents that had Medicaid or no health insurance. Additionally, whites shifted from being the least likely to use heroin to the most likely to use heroin and the 18-24 age group was the most likely age group to use heroin. In contrast to previous results, no link was found between income and heroin use in this analysis.

A significant protective effect by sex was found. Although other papers investigating heroin use had found that women increased heroin use at a faster rate than men, this analysis found that both men and women increased their rates of heroin use approximately 75%. Since this analysis only includes respondents that had used pain relievers in the past year, it may be the case that women are increasingly likely to use heroin because they are increasingly being prescribed opioids [20].

An unexpected finding was that after accounting for interactions between unemployment and insurance or education, Hispanics were more likely to use heroin than Whites in the earliest Cohort, but where less likely or the same in later cohorts. It is hard to explain what is happening here. Between 2008, more than 3 million undocumented immigrants, of which more than 75% are Hispanic, were removed from the United States [35, 36]. It could be that there may be a link between illicit opioid use and deportations in the US.

As expected, private insurance was protective against heroin use. Interestingly this was only the case in the first and last cohort. During the recession which began in 2008, many individuals lost their jobs, which may have temporarily changed the characteristics of the unemployed and the uninsured during this time. After including the interaction terms between

unemployment and Medicaid, Medicaid users were at an increased risk for transitioning to heroin, however unemployed Medicaid users were less likely to transition to heroin. This pattern did not continue in the two later cohorts. The effects of this will need further research to understand how employed Medicaid recipients are at greater risk.

Unemployment was a significant predictor during the 2006-2008 cohort and in the 2012-2014 cohorts. Once unemployment and education interactions were introduced the effect of unemployment was no longer significant on its own (see Table 4). This indicates that the effects of unemployment are somehow related to education. In the earliest cohort having education higher than high school and being unemployed was significantly related to transitioning. This effect was diminished in the two later cohorts. In the following cohort, having less than a high school education was a significant predictor. Finally, in the last cohort there is no significant difference between education and unemployment interactions. This implies a transition similar to the fundamental causes pattern described by Link and Phelan [15] which describes a pattern were the highest SES groups begin a trend which is later diffused to the lowest SES groups. After the negative effects are shown, the highest SES groups will then be the first to drop the unhealthy behaviors. Typically, the low SES individuals that maintain an unhealthy behavior are marginalized and criminalized for maintaining the behavior; hopefully this is a trend that can be reversed.

More research is needed to understand how unemployment leads to increased risk of heroin use among individuals using prescription pain relievers. Unemployment is a significant risk factor, if this is linked with a loss of insurance, the protective effects of private insurance may diminish and switching to Medicaid may not help. Since Medicaid recipients are as likely to use heroin as the uninsured after 2008, it may be that insurance gaps after losing private

insurance may temporarily leave someone at risk for heroin use, then not recover. Loss of employment may also decrease psychological well-being, leaving the unemployed at greater risk. Warning signs leading to heroin use should be monitored among those that have recently lost their jobs.

Limitations

Even though heroin use rates are increasing, it is still a rare occurrence. This led to small cell sizes in this analysis that may have skewed results. Without grouping together multiple years of data, it is very difficult to get a large enough sample of data to perform an adequate analysis. Additionally, the cross-sectional nature of the data makes it impossible to determine what came first, prescription opioids (or other drugs), or heroin.

Policy Implications

The demographics of heroin use have shifted from white to Hispanic, from male to increasingly female, and from older populations to younger populations. The idea of using heroin in place of prescription opioids has become widespread and now spans socioeconomic boundaries that were unaffected before. Policy designed to impact the initiation of heroin use among users of prescription pain medications should focus on white, unemployed individuals with Medicaid or lacking health insurance regardless of income or education level. Failure to address this shift in demographics may place resources in the wrong areas and fail to impact change where it is needed most.

Conclusion

This analysis verified that the demographics of prescription pain relievers that initiate heroin use have shifted from older minority groups to younger white groups. Unemployment appears to play a role, especially when linked to education; however over time this link has shifted from the highest educated and unemployed being the most at risk for heroin initiation to the least educated and unemployed being the most at risk.

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