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## Urban vs. rural differences in prescription opioid misuse among adults in the United States: Informing region specific drug policies and interventions

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### Abstract

**Background**—In the United States, prescription opioid misuse (POM) has increased dramatically over the past two decades. However, there are still questions regarding whether rural/urban differences in adult POM exist, and more important, which factors might be driving these differences.

**Methods**—Using data from the 2011 and 2012 National Survey on Drug Use and Health, we conducted unadjusted and adjusted binary logistic regression analyses to determine the association between metropolitan status and POM.

**Results**—We found that urban adults were more likely to engage in POM compared to rural adults because of their higher use of other substances, including alcohol, marijuana, and other illicit and prescription drugs, and because of their greater use of these substances as children.

**Conclusions**—This study fills an important gap in the literature by not only identifying urban/rural differences in POM, but by also pointing out factors that mediate those differences. Because patterns and predictors of POM can be unique to geographic region, this research is critical to informing tailored interventions and drug policy decisions. Specifically, these data suggest that interventions should be aimed at urban illicit drug users and adults in manual labor occupations.

### Keywords

prescription opioid misuse; prevention; rural and urban drug use; poly-drug use; interventions; drug policy

## INTRODUCTION

Over the last two decades, prescription opioid misuse (POM) has increased dramatically to become a serious behavioral health concern in the United States (Substance Abuse Mental Health Services Administration [SAMHSA], 2012). The morbidity, mortality, and economic burden caused by POM are substantial. A recent report estimated that in 2007, POM cost the U.S. over \$55 billion in healthcare, lost workplace productivity, and criminal justice costs (Birnbaum et al., 2011). Additionally, the rate of treatment admissions for POM has quadrupled from 1999-2009 (SAMHSA, 2010), and prescription opioids are now implicated in more deaths annually than cocaine and heroin combined (Centers for Disease Control and Promotion [CDC], 2011).

POM is particularly problematic in some rural areas (Wunsch et al., 2009). Places like rural Maine and areas of Appalachia, including eastern Kentucky, southern Ohio, and western Virginia all have longstanding struggles with POM (Inciardi & Goode, 2007). In fact, the origins of the POM epidemic can be traced back to rural America, where media reports of OxyContin® abuse first began to surface (Hays, 2004). Recent data from rural communities across the country show that POM is still active in these regions (Havens et al., 2011).

POM is also endemic to many large metropolitan centers. For example, New York City and South Florida have had well-documented problems with POM, such as high rates of overdose deaths, excessive opioid diversion, and surges in treatment admissions (Florida Office of Attorney General, 2012; NYC Mayor's Task Force on Prescription Painkiller Abuse, 2013). These and other urban locations have been at the center of the POM epidemic for many years now (Lankenau et al., 2012). Over the past decade, prescription opioids have become a prominent fixture in the urban black market for drugs (Rigg, Kurtz, & Surratt, 2012) because they are used in conjunction with other street and club drugs, and are a common substitute for heroin (Rigg & Ibañez, 2010; Davis & Johnson, 2008; Kurtz et al., 2006).

A number of studies have examined rural/urban differences in POM, with conflicting findings. On one hand, researchers using various restricted samples have found that rural adults have greater odds of POM than their urban peers. For example, in a sample of felony probationers, Havens et al. (2007) found that rural probationers were almost five times more likely than their urban counterparts to have misused prescription opioids. In a recent study of prescription drug users in Kentucky, Young et al. (2012) found that rural Kentuckians were more likely than urban Kentuckians to begin using oxycodone and hydrocodone at earlier ages and have significantly greater odds of lifetime and recent use of various prescription opioids. Similarly, in a sample of methadone maintenance patients, Rosenblum et al. (2007) found that the odds of POM increased as urbanicity decreased. On the other hand, using nationally representative data, Wang et al. (2013) found similar prevalence of POM in urban and rural counties, and using U.S. poison center surveillance data, Spiller et al. (2009) similarly found that population density was not associated with POM.

In addition to lack of agreement about whether there are indeed rural/urban differences in adult POM, these studies often present only fully adjusted models with no attempt to

identify the characteristics that might explain the rural/urban POM differences that exist. Understanding the demographic and psychosocial characteristics of individuals that might influence rural/urban differences in POM is important for tailoring interventions to the unique needs and differences of residents in these areas. There are a number of important compositional differences in human capital (embodied knowledge and skills that impact one's ability to work; Becker, 1962) and resource characteristics, perceptions of risk or prior experience with sanctions, health care experiences, and prior and recent substance use that may explain why residents in one type of area are more or less likely to engage in POM than residents in another type of area.

On the one hand, compared to urban residents, rural residents have been found to have lower human capital characteristics (e.g., income, educational attainment; Byun et al., 2012; Roscigno & Crowle, 2001), a higher proportion of manual labor occupations (McGranahan, 2003), less access to illicit street drugs (James et al., 2002), worse self-rated health (Monnat & Pickett, 2011), less psychological distress (Dhingra et al., 2009), greater frequency of emergency department (ED) use (Haggerty et al., 2014; Haggerty et al., 2007), and higher arrest rates for crimes like domestic violence and drunk driving (Logan, Walker, & Leukefeld; Olson, Weisheit, & Ellsworth). Each of these factors have been found to be associated with POM in various adult populations (Rigg & DeCamp, 2014; Dowling, Stor & Chilcoat, 2006; Becker et al., 2008; Harrell & Broman, 2009; Cicero et al., 2008). On the other hand, rural residents are more likely to attend religious services than their urban counterparts (Chalfant & Heller, 1991; Ellison & Sherkat, 1995) and are less likely to engage in illicit drug use (Gfroerer et al., 2008), both of which might reduce the likelihood that rural residents will engage in POM.

Given the ambiguity surrounding whether there are indeed rural/urban differences in adult POM, and given our lack of understanding about the characteristics of individuals that might influence these differences, this study builds on previous research in this area by using a nationally representative data set of US adults to identify rural vs. urban differences in POM and to identify the characteristics that mediate those differences.

## METHODS

### Data sources and respondents

We use data from the National Survey of Drug Use and Health (NSDUH), which is an annual survey of the U.S. population aged 12 and older that has been collected for over 30 years. The main focus of the NSDUH is prevalence and correlates of substance use in the U.S. The NSDUH uses a multi-stage area probability sample of all 50 states and the District of Columbia. The survey is administered using computer assisted in-person and audio self-interviewing (U.S. Department of Health and Human Services [DHHS], 2012). We aggregated data from the 2011 and 2012 survey years to enable a large enough sample for robust analysis of respondents aged 18 and older. Our analyses are restricted to non-Hispanic Whites, non-Hispanic Blacks, and Hispanics. Due to the importance of controlling for race/ethnicity in this analysis and the small NSDUH sample sizes for Asians, Native Americans, Native Hawaiians and Pacific Islanders, and multi-race groups living in rural counties, we excluded those groups from our analysis. In 2011 and 2012, the weighted

screening response rates were 87.0% and 86.1%, respectively, and the weighted interview response rates were 74.4% and 73.0%, respectively (DHHS, 2011; DHHS, 2012).

### Variables selected for analysis

Our outcome of interest was POM in the past year. Respondents were asked: “How long has it been since you last used any prescription pain reliever that was not prescribed for you or that you took only for the experience or feeling it caused?” We dichotomized respondents into those who reported POM in the past year vs. those who did not (including those who never engaged in POM). The survey asked respondents about several specific opioids, including codeine, hydrocodone, oxycodone, Demerol, Dilaudid, methadone, and morphine, among others.

Our main independent variable of interest was metropolitan status. The NSDUH categorizes respondents’ counties of residence into large metropolitan, small metropolitan, and nonmetropolitan. Nonmetropolitan counties are those that fall outside of a metropolitan statistical area (MSA) as defined by the Office of Management and Budget (OMB). We collapsed respondents living in large metropolitan and small metropolitan counties into one metropolitan category (Wang et al., 2013). Throughout the paper, we use the term “urban” in lieu of metropolitan and the term “rural” in lieu of nonmetropolitan. These terms have been used interchangeably in prior studies on drug use in rural and urban areas (Havens et al. 2011). As a sensitivity check, we also ran models using the all three metropolitan status categories instead of the dichotomous operationalization. The results from those models were the same, and there were no significant differences in POM between respondents in small metropolitan versus large metropolitan counties.

We examined a number of covariates as potential mediators in the association between metropolitan status and POM. These are characteristics that have been found to vary between urban and rural residents and are also likely to be associated with POM. First, *human capital characteristics* included family income, receipt of any public assistance in the past year, educational attainment, employment status, having health insurance, and working in a manual labor occupation (farming, fishing and forestry, installation, maintenance and repair work, and construction trades and extraction work). *Perceived risk and sanctions* variables included respondent’s perception that heroin is easy to obtain, perception that heroin use is risky, whether the respondent had ever been arrested for breaking the law, and number of religious services attended in the past year. *Clinical characteristics* included self-rated health, visiting an ED for medical treatment in the past year, and a psychological distress variable measured by a series of questions that comprise the K6 scale – a validated scale that measures respondents symptoms of distress: feeling nervous, hopeless, restless or fidgety, sad or depressed, everything is an effort, and no good or worthless. Respondents rated the severity of each symptom on a scale of 0 to 4 during the past year when they felt the worst. For each respondent, the NSDUH provides a summed K6 score, and this score was used to create a variable for past-year psychological distress, where a score greater than 13 indicates the presence of serious psychological distress (Kessler et al., 2003; Wang et al., 2013). *Substance use* variables included past year use of nicotine, alcohol, marijuana, other illicit drugs (cocaine, crack, heroin, methamphetamine, and hallucinogens), and non-medical

use of non-opioid prescription drugs (tranquilizers, sedatives, and stimulants). We also included age of first alcohol use, age of first cigarette use, and a composite variable for age of first illicit drug use (marijuana, cocaine, crack, heroin, hallucinogens, and methamphetamine).

Finally, we controlled for a number of demographic characteristics based upon results from previous studies that indicate higher odds of POM among certain demographic groups (Becker et al., 2008; Cicero, Inciardi & Muñoz, 2005). Control variables included race/ethnicity, age, gender, marital status, and presence of children in the household. To standardize the family income variable, we also control for total number of people living in the household.

### Statistical analysis

We first used difference of means and difference of proportion t-tests to compare characteristics between respondents who indicated past-year POM vs. those who indicated no past-year POM as well as between urban and rural respondents. We then conducted unadjusted and adjusted binary logistic regression analysis to determine the association between metropolitan status and POM as well as to determine whether human capital and resource characteristics, perceptions of risk and sanctions, clinical characteristics, or substance abuse characteristics explain the rural/urban differences that exist. Each group of variables is introduced in a sequential manner (Keith, 2006). To determine whether the changes in the magnitude of the coefficients are a function of true mediation vs. the addition of covariates, we use the KHB method in Stata – a method that allows researchers to statistically assess the influence of confounding relative to the influence of rescaling (Karlson, Holm & Breen, 2012). To assess for risk of multicollinearity, we examined correlations between all covariates and found no strong associations (i.e., greater than 0.6) that would suggest a problem with multicollinearity in our regression models. All analyses were performed using StataMP version 13. We used study-calculated weights and robust standard errors via the ‘cluster’ option in Stata to adjust for the complex sampling design and non-response bias.

## RESULTS

Our sample was composed of 47,440 respondents, with 5.7% of respondents reporting POM in the past year. Characteristics of respondents are presented in Table 1 for the sample as a whole, as well as by POM and by county type. There were a number of significant differences between respondents who reported POM vs. those who did not. Probability of POM was significantly higher among urban respondents, Whites, younger respondents, individuals who were never married, those with children living in the household, low income and low education respondents, those receiving public assistance, respondents who were either employed or unemployed, those working in manual labor occupations, respondents who perceive that heroin is easy to obtain, those who have been arrested, those who attended no religious services in the past year, individuals with serious psychological distress, individuals with at least one ED visit in the past year, respondents who used nicotine, alcohol, marijuana, other illicit drugs, or other prescription drugs (non-opioids)

non-medically in the past year, and those who first used alcohol, cigarettes, and illicit drugs under the age of 18. Probability of POM was significantly lower among females, married respondents, respondents with health insurance, retired individuals or those keeping house, individuals who perceive heroin use as risky, and individuals who attended religious services more than 24 times in the past year.

There are also a number of important differences between respondents living in urban vs. rural areas. Those living in rural areas are more likely to be White, older, married, have lower incomes and lower educational attainment, receive public assistance, be disabled, keeping house, or retired, and work in a manual labor occupation. Those in rural areas are also more likely than those in urban areas to have: been arrested, attended church more than 24 times in the past year, rate their health as fair or poor, visited the ED for medical care at least once in the past year, used nicotine in the past year, and started smoking under the age of 18. Those in rural areas are less likely than those in urban areas to: have children living in the household, be employed, have health insurance, perceive that heroin is easy to obtain, have used alcohol, marijuana, other illicit drugs, and non-opioid prescriptions within the past year, and have started using alcohol or illicit drugs as a child.

### Regression results

In an unadjusted binary logistic regression model, we found that rural respondents had about 18% lower odds of POM compared with urban respondents (OR 0.82, 95% CI 0.72-0.95,  $p < .008$ ). Results of adjusted binary logistic regression models predicting POM are presented in Table 2. Model 1 shows that, adjusting for demographic characteristics, respondents residing in rural areas have about 15% lower odds of POM compared with urban respondents (OR 0.85, CI 0.73-0.92,  $p < .019$ ). The addition of human capital and resource characteristics in Model 3 increased the magnitude of the urban/rural difference to 25% (OR 0.75, CI 0.64-0.86,  $p < .001$ ); not accounting for human capital and contextual characteristics in Model 1 masked the true magnitude of the association between metropolitan status and POM. Supplemental analysis (not shown but available upon request) indicated that the addition of the educational attainment variable led to the decrease in the odds ratio for 'rural'. This is because rural respondents have significantly lower educational attainment than urban respondents, and low educational attainment is associated with increased POM. Our results suggest that rural residents have lower POM than would be expected based on their educational attainment alone, and if rural residents had the same higher level of education as urban residents, their odds of POM would be 25% lower than their urban peers.

The addition of perceived risk and sanction variables in Model 3 and clinical characteristics in Model 4 did little to change the magnitude of the rural/urban difference in POM. Net of these controls, rural residents remained significantly less likely to report POM (OR 0.77, CI 0.66-0.89,  $p < .001$ ). However, the introduction of substance use variables in Model 5 resulted in a decrease in and elimination of significance for the rural/urban difference. Results of our KHB test for statistical mediation (not shown due to space constraints, but available upon request) found a significant difference in the coefficient for 'rural' between Model 4 and Model 5. In addition, the KHB test indicated that, net of the rescaling that occurs due to the introduction of new variables, illicit drug use before the age of 18

accounted for 15.4% of the change in the coefficient for 'rural' and use of alcohol, marijuana, other illicit drugs, and other prescriptions (non-opioids) in the last year collectively accounted for 36.6% of the change in the coefficient for 'rural.'

## DISCUSSION

The current study is important for a number of reasons. Whereas prior work in this area tends to rely on restricted samples, we used a nationally representative data set of US adults which allows for broader generalization. Additionally, our study fills an important gap in the literature by not only identifying urban/rural differences in POM, but by also pointing out factors that mediate those differences. Because the drivers of POM are often area specific, this research is critical to informing tailored prevention and policy decisions.

Results showed that the profile of U.S. adult prescription opioid misusers is largely consistent with those found in other studies, particularly with regards to demographics and psychosocial characteristics (Sigmon, 2006; Cicero, Inciardi & Muñoz, 2005). Interestingly, however, we found that residents living in urban areas were more likely to engage in POM than those in rural regions. This differs with the results of other studies that found rural adults more at risk for POM (Havens et al., 2007; Rosenblum et al., 2008; Young et al., 2012), but those studies were restricted to small samples of very specific populations (probationers, methadone maintenance patients, and residents of Kentucky). Our results are more in line with those of Wang et al. (2013), who using nationally representative data, also found POM prevalence to be slightly higher among urban residents than rural residents. It is worth noting that our estimate of POM is slightly higher than those found in the Wang et al. study. This may be partly explained by our sample being limited to White, Black, and Hispanic respondents. Respondents who were excluded due to small nonmetropolitan samples, particularly Asians, have very low rates of POM (Wu et al., 2013; Watkins & Ford, 2011). Accordingly, interpretation of our results should be considered in light of the racial/ethnic context of our sample. In addition, Wang et al. used data from the 2008 and 2009 versions of the NSDUH while our analysis uses more recent data from 2011 and 2012.

We also observed that religiosity was protective against POM. Few studies examine this association among adults. Prior work has shown that religiosity can protect against numerous types of drug abuse (Palamar, Kiang & Halkitis, 2014; Herman-Stahl et al., 2007); our study is among the first, however, to show that religiosity can specifically protect against adult POM. Additionally, results showed that adults in manual labor occupations were more likely to misuse opioids than adults who were not in these professions. This finding suggests that individuals in manual labor occupations are at increased risk for POM and should be monitored more closely for chronic pain and opioid use/misuse. Employers and labor unions in these professions would do well to develop POM prevention programs for their workers that aim to educate on the dangers of POM and also provide them with evidence-based alternatives to using opioids for pain management (e.g., cognitive behavioral therapy, massage treatment).

Our finding of lower odds of POM among rural adults is different from adolescent- focused studies that have found rural teenagers to be at greater risk for POM than their urban

counterparts (McCauley et al., 2010; Dew, Elison & Dozier, 2007). A recent population-based study (Havens, Young & Havens, 2011), for example, found that adolescents living in rural areas were significantly more likely to report lifetime POM than adolescents residing in urban areas. These previous studies suggest that rural adolescents are more likely to engage in POM probably because drugs such as heroin are less available to adolescents in rural regions (Draus & Carlson, 2006).

Our results suggest though that urban adults have a higher likelihood of POM compared to rural adults because of their higher use of other substances, including alcohol, marijuana, and other illicit and prescription drugs and because of their greater use of these substances as children. This finding suggests that, in urban areas, prescription opioids are more often used in conjunction with other drugs than they are in rural areas, and that this type of poly-drug use is contributing to elevated levels of urban POM. Additionally, our findings suggest that a reduction in illicit drug use among adolescents will lower rates of POM in urban areas. Policymakers and practitioners who are interested in reducing urban POM should take note of the close connection between POM and illicit drug use in these communities and therefore aim interventions at illicit drug users, particularly those under age 18 (Rigg & Murphy, 2013).

Our results should be interpreted in light of some methodological considerations. First, the NSDUH is a household sample of the non-institutionalized population of the US and therefore may not necessarily represent persons not permanently attached to one particular household. For example, it is unlikely for persons who experience excessive housing instability or are serious long-term substance users to appear in the NSDUH. Second, this study utilized cross-sectional data which prohibited us from being able to establish temporal order and ascribe causality. Third, the data used are based on self-reports of substance use and may be subject to under-reporting due to recall and/or social desirability bias. These effects are believed to have been mitigated, however, through the use of a trained interviewer. Last, we acknowledge as a limitation our inability to distinguish residents in large nonmetropolitan counties that are adjacent to metro counties from those living in small remote rural counties. Further, counties are heterogeneous geographic units where many outlying residents of an urban county (e.g., exurban or urban fringe) may experience a life that is more rural in character than residents living in the center city of an urban county. Unfortunately, the NSDUH do not allow for a more fine grained geographic analysis. These more nuanced definitions of rural vs. urban may lead to different findings.

Despite these limitations, this research begins to provide answers to the question of whether rural/urban differences in adult POM exist, and more important, which factors might be driving these differences. This study was among the first to demonstrate a significantly higher prevalence of POM among urban adults using a nationally representative sample. Moreover, we were able to specifically show that these differences are mediated, in large part, by the fact that urban adults tended to initiate illicit drug use prior to age 18 and were more likely to have used other drugs in the past year. Future research should attempt to determine if rural/urban differences are more pronounced among certain subgroups of users (e.g., racial/ethnic minorities) or different classes of controlled medications (e.g.,



benzodiazepines). Additional data on the unique POM onset patterns in these areas would also help facilitate the development of more region specific drug policies and interventions.

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Table 1

Descriptive Statistics and Difference of Proportions tests for Variables Included in Sample, 2011-2012

	Full Sample (N=47,440)	Past Year Nonmedical Opioid Use		County Type		p-value	Rural (N=9,854)	p-value
		No (N=43,169)	Yes (N=4,271)	Urban (N=37,586)	Rural (N=9,854)			
Non-medical use of prescription opioids	5.7	-----	-----	5.9	4.9	0.0002		
County Type								
Urban	84.0	83.9	86.3	-----	-----	-----		
Rural	16.0	16.1	13.7	-----	-----	-----		
<i>DEMOGRAPHIC CHARACTERISTICS</i>								
Race/Ethnicity								
non-Hispanic white	74.0	73.8	76.2	0.0005	71.5	87.0	<.0001	
non-Hispanic black	11.6	11.8	9.3	<.0001	12.5	7.1	<.0001	
Hispanic	14.4	14.4	14.5	0.812	16.0	5.9	<.0001	
Age								
18-25	15.1	14.0	34.1	<.0001	15.4	13.6	<.0001	
26-34	16.8	16.1	28.2	<.0001	17.0	15.6	0.0007	
35-49	27.3	27.3	24.1	<.0001	27.4	26.0	0.006	
50 and older	40.9	42.6	13.5	<.0001	40.2	44.8	<.0001	
Female	49.2	49.6	43.3	<.0001	49.2	49.3	0.873	
Marital status								
Married	52.0	53.3	29.6	<.0001	51.2	55.7	<.0001	
Divorced, separated, widowed	20.0	20.2	16.2	<.0001	19.6	22.1	<.0001	
Never married	28.1	26.5	54.2	<.0001	29.2	22.2	<.0001	
Number of people in household	3.00 (1.40)	2.99 (1.42)	3.28 (1.12)	<.0001	3.03 (1.44)	2.87 (1.20)	<.0001	
Any children in household	39.0	38.8	42.6	<.0001	39.4	37.0	<.0001	
<i>HUMAN CAPITAL &amp; RESOURCE CHARACTERISTICS</i>								
Family Income								
Less than \$20,000	18.4	18.1	24.1	<.0001	17.6	22.7	<.0001	
\$20,000-39,999	21.1	20.9	25.4	<.0001	20.1	26.7	<.0001	
\$40,000-74,999	28.0	28.1	27.1	0.177	27.7	29.9	<.0001	
\$75,000 or more	32.4	32.9	23.4	<.0001	34.6	20.6	<.0001	

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	Full Sample (N=47,440)	Past Year Nonmedical Opioid Use		County Type		p-value	Rural (N=9,854)	p-value
		No (N=43,169)	Yes (N=4,271)	Urban (N=37,586)	Rural (N=9,854)			
Any public assistance in past year	20.1	19.4	31.3	19.3	24.1	<.0001	<.0001	<.0001
Educational attainment								
Less than high school	13.0	12.8	17.4	12.3	16.7	<.0001	<.0001	<.0001
High school grad/some college	57.7	57.4	63.1	56.4	64.5	<.0001	<.0001	<.0001
College graduate	29.3	29.9	19.5	31.3	18.8	<.0001	<.0001	<.0001
Employment status								
Employed	67.0	66.8	71.0	68.0	62.0	<.0001	<.0001	<.0001
Unemployed	8.1	7.7	14.9	8.1	8.3	<.0001	0.524	<.0001
Disabled	5.6	5.6	4.8	5.0	8.5	0.015	<.0001	<.0001
In School	2.6	2.5	4.3	2.7	2.1	<.0001	0.0003	<.0001
Keeping house or retired	16.8	17.5	5.0	16.3	19.2	<.0001	<.0001	<.0001
Works in manual labor occupation	6.8	6.7	10.3	6.6	8.4	<.0001	<.0001	<.0001
Has health insurance	83.2	83.9	71.7	83.5	81.5	<.0001	<.0001	<.0001
<i>RISK/SANCTIONS</i>								
Perceives that heroin is easy to obtain	17.3	16.8	25.7	17.6	15.6	<.0001	<.0001	<.0001
Perceives heroin use as risky	84.3	85.0	73.3	84.3	84.5	<.0001	0.610	<.0001
Ever been arrested and booked for breaking law	22.8	21.6	43.4	22.5	24.6	<.0001	<.0001	<.0001
# of religious services attended in past year								
None	40.3	39.8	49.7	40.5	39.5	<.0001	0.061	<.0001
1-5	20.6	20.3	25.5	20.9	19.0	<.0001	<.0001	<.0001
6-24	13.4	13.6	11.0	13.6	12.9	<.0001	0.088	<.0001
more than 24	25.7	26.4	13.9	25.1	28.6	<.0001	<.0001	<.0001
<i>CLINICAL CHARACTERISTICS</i>								
Poor/fair self-rated health	13.2	13.1	14.1	12.4	17.1	0.071	<.0001	<.0001
Psychological distress	11.9	10.9	29.4	11.8	12.4	<.0001	0.130	<.0001
Had at least one emergency room visit in past year	29.0	28.3	41.7	28.4	32.3	<.0001	<.0001	<.0001
<i>SUBSTANCE USE</i>								
Nicotine use	40.9	38.9	73.2	40.1	44.8	<.0001	<.0001	<.0001
Alcohol use	76.1	75.2	91.6	77.5	68.8	<.0001	<.0001	<.0001
Marijuana use	16.4	13.9	57.7	17.1	12.9	<.0001	<.0001	<.0001

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	Full Sample (N=47,440)	Past Year Nonmedical Opioid Use		County Type		p-value	Rural (N=9,854)	p-value
		No (N=43,169)	Yes (N=4,271)	Urban (N=37,586)	Rural (N=9,854)			
Any illicit drug use (not incl. marijuana)	4.2	2.7	29.2	4.6	<.0001	2.6	<.0001	
Non-medical use of other non-opioids	4.2	2.1	38.1	4.3	<.0001	3.6	0.003	
Age of first cigarette use								
Never used	21.6	22.5	7.4	21.8	<.0001	20.2	0.0005	
under 18	57.3	56.2	75.1	56.7	<.0001	60.7	<.0001	
18-25	19.4	19.7	16.2	19.9	<.0001	17.3	<.0001	
older than 25	1.7	1.7	1.4	1.7	0.301	1.7	0.745	
Age of first alcohol use								
Never used	7.9	8.3	1.9	7.6	<.0001	9.8	<.0001	
under 18	58.7	57.3	81.9	59.1	<.0001	56.4	<.0001	
18-25	31.7	32.7	15.8	31.6	<.0001	31.9	0.576	
older than 25	1.7	1.8	0.5	1.7	<.0001	1.9	0.062	
Age of first illicit drug use								
Never used	36.4	38.1	8.5	35.4	<.0001	42.1	<.0001	
under 18	36.4	34.3	70.0	37.0	<.0001	32.8	<.0001	
18-25	23.3	23.6	20.0	23.8	0.019	20.7	<.0001	
older than 25	3.9	4.0	1.5	3.8	<.0001	4.3	0.016	

Notes: Two-tailed difference of proportions t-tests; weighted

**Table 2**  
Odds Ratios and 95% Confidence Intervals from Logistic Regression Models Predicting POM

	Model 1			Model 2			Model 3		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
County Type (urban=ref)									
Rural	0.845	0.734-0.972	0.019	0.745	0.644-0.861	<.001	0.770	0.664-0.892	<.001
<i>DEMOGRAPHIC CHARACTERISTICS</i>									
Race/Ethnicity (non-Hispanic white=ref)									
non-Hispanic black	0.575	0.475-0.696	<.001	0.479	0.392-0.584	<.001	0.494	0.404-0.603	<.001
Hispanic	0.661	0.557-0.786	<.001	0.573	0.480-0.684	<.001	0.631	0.528-0.754	<.001
Age (18-25=ref)									
26-34	0.920	0.803-1.054	0.229	0.908	0.790-1.043	0.173	0.795	0.691-0.914	0.001
35-49	0.518	0.437-0.613	<.001	0.512	0.433-0.606	<.001	0.458	0.387-0.542	<.001
50 and older	0.191	0.115-0.251	<.001	0.219	0.165-0.290	<.001	0.220	0.166-0.291	<.001
Female	0.802	0.716-0.897	<.001	0.882	0.782-0.995	0.041	1.081	0.958-1.220	0.206
Marital status (married=ref)									
Divorced, separated, widowed	1.892	1.547-2.315	<.001	1.515	1.227-1.870	<.001	1.372	1.108-1.697	0.004
Never married	1.999	1.681-2.378	<.001	1.682	1.413-2.002	<.001	1.477	1.243-1.756	<.001
Number of people in household	1.087	1.033-1.144	0.001	1.046	0.992-1.104	0.098	1.049	0.994-1.107	0.081
Any children in household	0.895	0.764-1.047	0.165	0.844	0.720-0.989	0.036	0.859	0.732-1.007	0.060
<i>HUMAN CAPITAL &amp; RESOURCE CHARACTERISTICS</i>									
Family Income (\$75,000 or more=ref)									
Less than \$20,000				1.011	0.833-1.227	0.913	1.012	0.832-1.231	0.904
\$20,000-39,999				1.142	0.944-1.381	0.172	1.131	0.934-1.369	0.207
\$40,000-74,999				1.116	0.939-1.327	0.214	1.115	0.936-1.328	0.221
Any public assistance in past year				1.595	1.374-1.852	<.001	1.456	1.248-1.699	<.001
Educational attainment (college=ref)									
Less than high school				1.499	1.202-1.870	<.001	1.288	1.032-1.609	0.026
High school graduate				1.318	1.109-1.566	0.002	1.200	1.008-1.428	0.040
Employment status (employed=ref)									
Unemployed				1.277	1.091-1.496	0.002	1.182	1.009-1.385	0.039

	Model 1			Model 2			Model 3		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Disabled				0.904	0.665-1.228	0.517	0.835	0.613-1.138	0.254
In School				0.838	0.682-1.029	0.091	0.894	0.728-1.098	0.286
Keeping house or retired				0.514	0.386-0.684	<.001	0.526	0.396-0.698	<.001
Manual labor occupation				1.268	1.028-1.565	0.027	1.225	0.990-1.515	0.062
Has health insurance				0.812	0.712-0.926	0.002	0.861	0.755-0.982	0.026
<i>RISK/SANCTIONS</i>									
Perceives that heroin is easy to obtain							1.536	1.347-1.752	<.001
Perceives heroin use as risky							0.554	0.486-0.631	<.001
Ever been arrested and booked for breaking law							2.118	1.880-2.387	<.001
# of religious services attended in past year (none=ref)									
1-5							1.125	0.981-1.290	0.092
6-24							0.822	0.680-0.993	0.042
more than 24							0.735	0.613-0.881	0.001
Pseudo R-square	0.083			0.099			0.126		

  

	Model 4			Model 5		
	OR	95% CI	p	OR	95% CI	p
County Type (urban=ref)						
Rural	0.768	0.662-0.892	0.001	0.886	0.746-1.052	0.167
<i>DEMOGRAPHIC CHARACTERISTICS</i>						
Race/Ethnicity (non-Hispanic white=ref)						
non-Hispanic black	0.514	0.421-0.628	<.001	0.799	0.641-0.998	0.048
Hispanic	0.667	0.558-0.798	<.001	0.941	0.778-1.139	0.534
Age (18-25=ref)						
26-34	0.814	0.707-0.938	0.004	1.017	0.859-1.203	0.846
35-49	0.490	0.413-0.582	<.001	0.777	0.636-0.948	0.013
50 and older	0.250	0.187-0.333	<.001	0.502	0.370-0.682	<.001
Female	0.983	0.869-1.112	0.789	1.058	0.917-1.220	0.442
Marital status (married=ref)						
Divorced, separated, widowed	1.294	1.041-1.607	0.020	1.150	0.909-1.454	0.245
Never married	1.471	1.235-1.751	<.001	1.103	0.901-1.349	0.342



	Model 4			Model 5		
	OR	95% CI	p	OR	95% CI	p
Number of people in household	1.044	0.989-1.101	0.121	1.029	0.965-1.097	0.388
Any children in household	0.875	0.747-1.025	0.098	0.989	0.826-1.185	0.907
<i>HUMAN CAPITAL &amp; RESOURCE CHARACTERISTICS</i>						
Family Income (\$75,000 or more=ref)						
Less than \$20,000	0.943	0.774-1.150	0.563	0.954	0.759-1.199	0.688
\$20,000-39,999	1.087	0.897-1.318	0.395	1.231	0.994-1.524	0.057
\$40,000-74,999	1.089	0.913-1.298	0.343	1.225	1.005-1.493	0.044
Any public assistance in past year	1.355	1.160-1.583	<.001	1.386	1.164-1.651	<.001
<i>Educational attainment (college=ref)</i>						
Less than high school	1.213	0.971-1.517	0.090	1.336	1.034-1.726	0.027
High school graduate	1.165	0.978-1.517	0.087	1.148	0.944-1.397	0.166
<i>Employment status (employed=ref)</i>						
Unemployed	1.113	0.949-1.306	0.118	0.962	0.801-1.155	0.679
Disabled	0.610	0.448-0.832	0.002	0.596	0.417-0.852	0.005
In School	0.895	0.726-1.103	0.298	0.820	0.638-1.054	0.121
Keeping house or retired	0.516	0.388-0.685	<.001	0.658	0.481-0.899	0.009
Manual labor occupation	1.248	1.006-1.548	0.044	1.387	1.104-1.743	0.005
Has health insurance	0.859	0.753-0.981	0.025	0.931	0.802-1.079	0.341
<i>RISK/SANCTIONS</i>						
Perceives that heroin is easy to obtain	1.436	1.255-1.642	<.001	1.213	1.034-1.422	0.018
Perceives heroin use as risky	0.550	0.482-0.628	<.001	0.582	0.499-0.678	<.001
Ever been arrested and booked for breaking law	2.003	1.776-2.258	<.001	1.206	1.051-1.384	0.008
<i># of religious services attended in past year (none=ref)</i>						
1-5	1.116	0.972-1.281	0.119	1.236	1.057-1.446	0.008
6-24	0.810	0.668-0.983	0.033	0.976	0.782-1.217	0.826
more than 24	0.751	0.626-0.902	0.002	1.191	0.975-1.454	0.087
<i>CLINICAL CHARACTERISTICS</i>						
Poor/fair self-rated health	1.136	0.946-1.364	0.172	1.148	0.931-1.417	0.197
Psychological distress	2.107	1.848-2.402	<.001	1.544	1.328-1.794	<.001
At least one visit to emergency room in past year	1.465	1.303-1.647	<.001	1.347	1.183-1.535	<.001
<i>SUBSTANCE USE</i>						

	Model 4			Model 5		
	OR	95% CI	p	OR	95% CI	p
Nicotine use				1.321	1.116-1.564	0.001
Alcohol use				1.485	1.124-1.963	0.005
Marijuana use				2.137	1.835-1.963	<.001
Any illicit drug use (not incl. marijuana)				2.128	1.779-2.545	<.001
Non-medical use of other non-opioids				10.378	8.672-12.420	<.001
Age of first cigarette use (never used=ref)						
under 18				1.015	0.754-1.365	0.924
18-25				0.937	0.689-1.274	0.676
older than 25				1.435	0.650-3.167	0.372
Age of first alcohol use (never used=ref)						
under 18				0.951	0.533-1.697	0.865
18-25				0.802	0.459-1.402	0.439
older than 25				0.883	0.345-2.256	0.795
Age of first illicit drug use (never used=ref)						
under 18				2.009	1.514-2.666	<.001
18-25				1.647	1.230-2.204	0.001
older than 25				1.207	0.665-2.191	0.536
Pseudo R-square						
				0.142		

Notes: two tailed tests, weighted

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