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## A Comparison of Substance Use Patterns Among Lifetime Heroin-Injecting Individuals By Racial Groups

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### Abstract

**Background**—Studies have identified differential substance use patterns by racial groups. One of the most commonly reported differences is a higher rate of injection drug use (IDU) among Non-Hispanic Whites compared to African Americans, but this is complicated by factors related to IDU (e.g., earlier drug-use initiation) that overlap with being White.

**Objective**—We explored differential substance use-patterns by racial groups within a sample of injection heroin users.

**Methods**—Substance-use data were collected from 373 not-in-treatment heroin users who endorsed any lifetime injection use (69.4% male). We examined differences in substance-use patterns (e.g., age of initiation, gateway adherence) by racial groups. Multiple t-tests with Bonferroni correction were conducted to understand which demographic and substance-use characteristics varied by racial groups.

**Results**—Relative to Non-Hispanic Whites, African Americans (45.8% of sample) were more likely to start using heroin earlier in their life, but also more likely to experience a longer delay between starting and regularly using heroin. We also identified differences in the degree of (injection) heroin-use consequences by racial groups. After correcting for multiple comparisons and controlling for age and gender, we observed differences for six substance-use and demographic characteristics by racial group. White participants were younger, started cocaine use earlier, and experienced more heroin-use consequences across two separate domains.

**Conclusions**—After controlling for injection use, we observed differential substance-use characteristics by racial groups. The findings could be used to develop targeted prevention and harm-reduction strategies.

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#### Author contributions

TEHM was responsible for conceptualizing and analyzing the data, and drafting the manuscript. JJJ and MKG assisted with conceptualizing the analyses, interpreting the findings, and editing the manuscript. All authors have read and approved of this manuscript.

#### Disclosure of interest

All authors declare no conflict of interest with respect to the conduct or content of this work.

## Keywords

Heroin; Injection; Consequences; Race

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## Introduction

Serious health and social problems associated with heroin use (Hser et al. 2001; Godfrey et al. 2004; Degenhardt & Hall 2012) make it important to improve our understanding of factors intertwined with injection heroin use. Among persons age 18 years and older, Non-Hispanic Whites now have significantly higher rates of heroin use than African Americans (Martins et al. 2017). However, when these rates are examined by age groups this pattern changes. In the older age group (56–78 years), African Americans have a higher prevalence of Opioid Use Disorder (OUD) (Vasilenko et al. 2017). Studies have found differential substance-use characteristics by racial groups, including age of initiation and progression (Whites typically initiate substance use earlier) (Fuller et al. 2005; Stoltman et al. 2015), route of administration (Whites more likely to inject) (Fuller et al. 2005), consequences of heroin use (overall, Whites tend to have more consequences) (Zapolski et al. 2014; Stoltman et al. 2015), and treatment outcomes (worse outcomes among African Americans) (Lê Cook & Alegría 2011; Saloner & Cook 2013; Guerrero et al. 2013; Lister et al. 2017).

Many studies examining race in heroin use focus on treatment outcomes. Those findings identified African Americans as more likely to enter substance use disorder (SUD) treatment than Non-Hispanic Whites (Lê Cook & Alegría 2011), but less likely to complete treatment (Saloner & Cook 2013; Guerrero et al. 2013). Findings also suggest Whites seeking SUD treatment have higher rates of psychiatric comorbidities, more severe alcohol use, and more family and social difficulties than African Americans (Petry 2003). Yet, African American substance users have more legal and employment problems (Petry 2003; Racz et al. 2016) and, despite higher overall rates of opioid use among Whites, African Americans are 6–10 times more likely to be incarcerated for drug offenses than their White counterparts (Netherland & Hansen 2017). Injection drug use (IDU), which is more common among Whites (Fuller et al. 2005), is linked to greater addiction severity and worse treatment outcomes (Gossop et al. 1992; Fuller et al. 2005; Trenz et al. 2012; Black et al. 2013; Bonar & Bohnert 2016). Given the confounding role of injection use and the differential substance-use characteristics demonstrated for African American and White heroin users, it is critical to disentangle injection status from race in these investigations.

To explain different race-related patterns in trajectory of use, research often cites the “gateway hypothesis,” involving two substance-use transition points: (1) legal substance use (alcohol and tobacco) precedes marijuana use, and (2) marijuana use precedes use of more problematic illegal substances (e.g., cocaine and heroin) (Kandel 1975). Notably, African Americans’ substance-use progression appears to follow a different trajectory from the theorized gateway path (White et al. 2007; Woodcock et al. 2015). Research suggests that trajectories that vary from theorized gateway transitions are associated with poor physical environment, greater access to drugs, and psychiatric dysfunction (Mackesy-Amity et al. 1997; Degenhardt & Hall 2012; Tarter et al. 2012). Although the gateway hypothesis is a

frequently-discussed theoretical model, evidence is mixed as to whether gateway adherence is associated with risk of SUD and other consequences of substance use (Wells & McGee 2008; Degenhardt et al. 2009; Sartor et al. 2014).

Most individuals meeting criteria for a SUD (including OUD) are *not* currently in treatment (Democratic Staff of the Senate Committee on Finance 2016; Quality 2016), and this treatment gap is greater for racial/ethnic minorities (Office of the Surgeon General 2016). Thus, our understanding from prior studies of SUD patients about relationships among race, IDU and their associated substance-use trajectories, consequences and outcomes, may be biased. This highlights the importance of conducting focused racial comparisons among non-treatment seeking, heroin-injecting individuals to shed light on how these differences manifest and to inform tailored approaches for clinical subgroups. Most prior investigations of differences by racial groups included heroin-using participants with mixed routes of administration (i.e. both injection and non-injection users). In those studies, Non-Hispanic Whites exhibited higher rates of IDU (Fuller et al. 2005; Cooper et al. 2005; Armstrong 2007; Broz & Ouellet 2008; Stoltman et al. 2015). Given the confounding role of race with IDU in those studies, it is difficult to interpret past findings regarding differences in substance-use characteristics by racial groups unless one controls for route of use. The present study addressed this problem.

Aims of this study were to investigate within a non-treatment, heroin IDU sample differences by racial groups in: (1) substance-initiation and use patterns, and (2) heroin-use consequences and quit attempts, to improve understanding of which substance-use characteristics are specific to IDU rather than race in this sample. Based on our earlier findings in a sample of heroin users with mixed routes of use (Woodcock et al. 2015), we hypothesized that African Americans would endorse later onset of any substance use but earlier heroin initiation than Non-Hispanic Whites. Consistent with epidemiological data (Martins et al. 2017), we hypothesized that Non-Hispanic White heroin injection users would be younger. Having removed non-injection drug use as a confound, we predicted that health consequences from heroin use would not vary by racial groups because these consequences are strongly correlated with IDU (Gossop et al. 1992; Lawrinson et al. 2008; Hines et al. 2017); however, for other factors—such as non-health consequences (e.g., social, occupational), gateway adherence, and heroin latency—an exploratory analysis comparing characteristic differences by racial groups is necessary.

## Methods

### Participant selection

Data were collected from participants screened for several IRB-approved laboratory-based studies conducted between 2005 and 2015 in the Detroit, MI metropolitan region. The study sample was primarily urban; the catchment area included Wayne County (which encompasses the City of Detroit) and two neighboring counties (Oakland, Macomb). Potential participants responded to newspaper and community advertisements and completed an initial telephone screening interview. Participants 18 to 55 years old who denied current major medical or psychiatric disorders (e.g., mood and psychotic disorders) during phone screening were invited for in-person screening, which included informed

consent and biosamples, and completing questionnaires. Participants were compensated \$25 for this visit.

This analysis included 373 non-treatment seeking, current heroin users who endorsed injecting heroin at least once. Lifetime injection status was chosen (over recent injection or injection preference) because *any* injection heroin use has been associated with significantly greater health risks and addiction severity/dependence (Gossop et al. 1992; Lawrinson et al. 2008; Hines et al. 2017). In addition, lifetime injection status is more relevant to the study variables because we primarily analyzed *lifetime* substance-use characteristics and consequences. Further, to support this approach, preliminary analysis of the larger dataset of injector and non-injectors found a strong correlation between lifetime use and current (past two weeks) injection heroin use ( $r=.847$ ;  $p<.001$ ). Only participants who endorsed Non-Hispanic White or Non-Hispanic African American were included. (None were excluded because all participants who endorsed injecting heroin were Non-Hispanic White or Non-Hispanic African American.) Participants' data were included in analyses if their urine sample tested positive for opioid use ( $> 300$  ng/ml), breath alcohol level was negative ( $<.02\%$ ; Alco Sensor III Breathalyzer) and they were cognitively intact, defined by IQ score  $\geq 80$  on the Shipley Institute of Living Scale (Zachary 1991).

### Group difference measures

**Substance-use patterns and progression**—Lifetime and current substance-use characteristics for tobacco, alcohol, marijuana, cocaine, and heroin were measured using a standardized self-report battery (Drug History and Use Questionnaire, available upon request). To define route of heroin use, this assessment instrument probed for different routes of administration, and whether these routes were used lifetime (ever/never) and currently (past two weeks). Given the health risks of any lifetime injection use noted above, this was used to categorize participants for group data analyses.

Participants were asked about age of initial use of each substance and age of first regular use (*at least weekly*). Progression was measured by examining age of first use of each measured substance. New variables were created to indicate which substance had been used first. “Gateway adherence” was measured by whether a legal substance (alcohol and tobacco) preceded marijuana use, and whether use of marijuana preceded use of cocaine or heroin. If either transition failed to occur, substance-use progression was coded as gateway non-adherent. If multiple substances were initiated in the same year this was coded as unclear/poly-substance use in our analysis of gateway adherence.

Frequency of substance use was asked in multiple ways: frequency of use over past day, past week, and days used in past month. As daily heroin use predominated in this sample, a past-month frequency of heroin-use variable was calculated using past-month days of heroin use multiplied by mean daily past-week heroin use. Duration of heroin use was defined as current age minus age of initial use. We relied on self-reported frequency-of-use data in combination with a positive urine screen for opioids to confirm recent heroin use. A subset of participants was asked about past-month heroin spending and purchasing habits, past-month income, and percentage of income spent on heroin. For methods see (Roddy & Greenwald 2009; Roddy et al. 2011)

**Heroin-use consequences and treatment seeking**—Lifetime heroin-use consequences were assessed using a drug-specific checklist of 21 items, the Heroin Use Consequences scale (Moses et al. 2018). Participants were asked to indicate (never [0] or ever [1]) if they had experienced each consequence as a *direct result of their heroin use*. The individual items were empirically sorted via principal component analysis into five domains in a previous study (Moses et al. 2018) and compared across these domains for additional analysis. We also asked participants whether they had ever sought treatment for heroin (yes [1] or no [0]) and how many times they tried to quit using heroin.

## Data analysis

We conducted independent *t*-tests and chi-square analyses to examine group differences (i.e. African American, Non-Hispanic Whites) in continuous (e.g., age of initiation) and categorical (e.g., gateway adherence) variables in bivariate analyses. We used Bonferroni correction for multiple comparisons ( $p < .003$ ) to explore the hypothesis-generating variables. To mitigate inter-correlation concerns, we chose age of initial cocaine use in our final analyses and eliminated other substance-use initiation variables that were highly correlated ( $p < .001$ ) with age of cocaine-use initiation in Table 3. We also eliminated heroin-use duration due to its correlation ( $p < .001$ ) with age. In some cases, we conducted exploratory analyses on smaller data subsets; as these groups were not part of the primary analyses, they were excluded from our multiple-comparison corrections. When there was a significant difference between demographic variables by racial groups, we conducted subsequent analyses to control for these variables. We used ANCOVA for continuous control variables (e.g., age), and regression analyses (linear, logistic) for categorical control variables (e.g., gender).

Descriptive data are presented as mean  $\pm$  one standard deviation. Continuous variables that were initially non-normally distributed were  $\log_{10}$  transformed for analyses unless otherwise noted. For ease of comprehension, tables and figures show non-transformed means. For *t*-tests, the Levene test for homogeneity of variance was used; if homogeneity was violated, results were corrected resulting in fewer degrees of freedom. Analyses were conducted with SPSS v.25 and when Bonferroni correction was not employed, a criterion of  $p < .05$  was used to reject the null hypothesis. Some variables were not used in our final comparison due to incomplete data (e.g., age of regular cocaine use, total heroin bags used). Incomplete data refer to questions that were not answered because they were not applicable (e.g., age of regular cocaine use for participants who never used regularly) or they were part of a questionnaire that was not presented to all participants (e.g., only some participants were asked about their heroin-purchasing habits).

## Results

### Demographic characteristics

The average participant was a 41.5 $\pm$ 9.9 year-old, Non-Hispanic White (54.2%), male (69.4%) with 12.4 $\pm$ 1.6 years education. Whites ( $n=202$ ; mean age=37.1 $\pm$ 10.0 years; 73.8% male) were younger than African Americans ( $n=171$ ; mean age=46.8 $\pm$ 6.5 years; 61.3% male) ( $t(347)=11.30$ ,  $p < .001$ ) and were more likely to be male ( $\chi^2=3.88$ ,  $p=.049$ ).

Educational level did not vary by racial groups. We also compared lifetime injection status to current (last two weeks injection status). Only 67.7% of the original sample answered the question about current injection status. History of injection heroin use did not significantly impact whether a person answered this question and for those with a history of injection heroin use there were no differences in gender, age, or race between those who answered and those who did not ( $p>.05$ ). We found that 88.9% ( $n=229$ ) of individuals who provided information about current injection heroin use ( $n=253$ ) had injected heroin during the past two weeks ( $r=0.179$ ,  $p=.004$ ). Although a high percentage of both Whites and African Americans had injected heroin during the past two weeks (94.5% and 82.0% respectively), more Whites reported current injection use ( $\chi^2=8.97$ ,  $p=.003$ ).

### Initiation and progression to heroin use

First substances used were similar by racial groups. Alcohol (African Americans=25.1%; Whites=25.2%), tobacco (15.8%; 19.3%), and marijuana (12.9%; 8.4%) were the most common first substances used. Relative to Whites, African American participants' substance-use progression was less likely to adhere to the gateway hypothesis (27.2% vs. 11.5%,  $\chi^2=13.66$ ,  $p<.001$ ). For example, African Americans were more likely than Whites to use heroin as their first substance (6.4% vs. 0.5%,  $\chi^2=10.49$ ;  $p=.001$ ), and they were more likely to use marijuana before legal substances (e.g., tobacco and alcohol) (17.7% vs. 9.4%,  $\chi^2=5.09$ ,  $p=.024$ ).

Progression from first substance used to first use of heroin followed different timelines for the two groups. Whites initiated use of any substance  $1.3\pm 0.4$  years earlier than African Americans ( $t(363)=4.42$ ,  $p<.001$ ) and began regularly using their first substance earlier ( $t(366)=6.46$ ,  $p<.001$ ). There were no differences by racial group between time from initial to regular drug use (latency) for any of the substances measured. Except for heroin, African Americans began using all substances later. Time between first using any substance to first using heroin was  $3.1\pm 0.8$  years shorter for African Americans ( $t(359)=-3.94$ ,  $p<.001$ ); participants who used heroin as their first substance were excluded from this analysis.

### Characteristics of heroin use

We observed differential patterns for heroin initiation and progression by racial groups. African Americans began using heroin earlier, but Whites had a shorter latency period, resulting in no significant differences in mean age of beginning regular heroin use (Table 1).

After initiating heroin, the two groups show different patterns of use. Whites used heroin more frequently. During the week prior to study screening, Whites reported using heroin an average of  $32.1\pm 30.3$  times whereas African Americans used  $24.1\pm 19.1$  times ( $t(359)=3.48$ ,  $p=.001$  [ $\log_{10}$ ]). Similarly, during the month prior to screening, Whites reported using heroin  $132.9\pm 115.5$  times whereas African Americans reported using  $103.3\pm 82.2$  times ( $t(356)=3.37$ ,  $p=.001$  [ $\log_{10}$ ]). African American participants had a longer duration of heroin use by  $10.9\pm 1.1$  years ( $t(338)=10.30$ ,  $p<.001$ ); this difference remained significant after controlling for age ( $F(1,370)=13.37$ ,  $p<.001$ ).

Consequences of heroin use also differed by racial groups (see Table 2). African Americans had  $2.2\pm 0.5$  fewer heroin consequences ( $t(341)=4.53$ ,  $p<.001$ ) than Non-Hispanic Whites.

Of the 21 heroin consequences (20 of which loaded onto five different domains/factors; (Moses et al. 2018)), Whites endorsed 10 items significantly more often: arrested/legal problems (from *Factor 1*); lost job, warning at work, missed work, high at work (from *Factor 2*); financial problems, family problems, drove under the influence, couldn't stop using (from *Factor 4*); and shakes and tremors (from *Factor 5*). Whites had more *Factor 2* ( $t(370)=5.66, p<.001$ ), and *Factor 4* ( $t(290)=5.57, p<.001$ ) consequences.

There were no differences by racial group in lifetime heroin quit-attempts or incidence of treatment seeking ( $ps>.05$ ). Despite being a currently non-treatment seeking sample, 74.8% (75.3% of African Americans; 74.4% of Whites) had previously sought treatment. Mean lifetime number of heroin quit-attempts was  $11.2\pm 18.0$  for African Americans and  $11.8\pm 21.4$  for Whites.

A subset of the sample had complete self-report data on heroin-purchasing habits ( $n=190$ ; 46.3% African American). Whites spent more money each time they purchased heroin:  $\$38.63\pm 24.70$  versus  $\$27.49\pm 19.74$  ( $t(186)=3.45, p<.001$ ) but purchased heroin  $2.70\pm 1.27$  fewer times weekly ( $t(188)=2.90, p=.004$ ). Nonetheless, Whites still used more heroin ( $\$10$  bag units) daily than African Americans:  $5.8\pm 4.0$  bags versus  $4.5\pm 3.2$  bags ( $t(191)=2.75, p=.007$ ). Despite differences in heroin purchasing and total weekly use, there were no significant differences in total monthly income amount, income sources, or percent of total income spent on heroin ( $ps>.05$ ).

### Differences in substance-use characteristics by racial groups

We conducted multiple  $t$ -tests with Bonferroni adjustment ( $p<.003$ ) to correct for Type 1 error. This approach allowed us to establish which variables were most robustly associated with differences by racial groups (Table 3). In these comparisons, we found African Americans were older and their substance-use progression was less likely to adhere to the gateway hypothesis. Non-Hispanic White participants had an earlier age of initial cocaine use and had a shorter latency period for heroin initiation.

Age significantly differed between the two groups. In age-controlled ANCOVAs, we found that gateway adherence likelihood, heroin latency, and heroin-use frequency no longer significantly differed by racial groups (all  $ps>.05$ ), whereas age of initial heroin use ( $F(1,370)=17.20, p<.001$ ) and *Factor 1* consequences ( $F(1,369)=9.75, p=.002$ ) were newly associated with racial group: Whites initiated heroin later and endorsed more *Factor 1* consequences. We then separately controlled for sex, which did not remove any of the significant relationships, but did result in age of initial heroin use becoming significant ( $F(1,370)=10.37, p=.001$ ), with African Americans initiating heroin use earlier.

### Differences in current injection use

We believe lifetime IDU is an appropriate marker for the types of lifetime risk characteristics measured here, but recognize there could be racial group differences between individuals who endorsed current injection heroin use versus not. Thus, we conducted a subset of the above analyses using the smaller sample of individuals who had answered the question about current IV heroin use ( $n=253$ , 42.3% African American). We re-ran all analyses shown in Tables 1, 2, and 3 with this smaller group and found no change in significance for most

variables. Supplemental Table 1 presents a subset of these results. The general substance use and demographic characteristics had four changes: percent of individuals currently using alcohol ( $\chi^2=3.44$ ,  $p=.064$ ), sex ( $\chi^2=2.17$ ,  $p=.141$ ), and age of initial heroin use ( $t(227)=1.80$ ,  $p=.073$ ) were no longer significant. Past-month heroin use became significant ( $t(219)=2.06$ ;  $p=.041$ ) with Whites using more than African Americans ( $128.1\pm 100.6$  vs.  $103.3\pm 63.2$ ). Four lifetime heroin-use consequences became significant: Whites had higher rates of consequences in all instances (visited emergency room, accident or injury, missed school, and high at school). As this additional exploratory analysis was conducted in a subset of the initial sample to compare our findings between current and lifetime injection status we did not correct for multiple comparisons; however, if we had used Bonferroni correction, there would be no difference in findings between the current and lifetime injection groups.

## Discussion

The present study of lifetime heroin injectors compared substance-use characteristics by racial groups—Non-Hispanic African Americans and Non-Hispanic Whites. Previous studies of heroin users found Whites were more likely to be injection users than African Americans (Fuller et al. 2005; Arreola et al. 2014). To date, the literature on substance-use characteristics among heroin-using samples has reported on racial group differences without controlling for confounds (e.g., injection drug use). This study aimed to disentangle these links by investigating behavioral differences among a sample of lifetime heroin-injection users. As any lifetime IDU is associated with worse health and treatment outcomes and the variables analyzed in this study were primarily lifetime outcomes, we selected the sample based on lifetime (rather than recent) IDU history to remove the race/IDU confound. To further support this approach we conducted analyses on our larger sample of injectors and non-injectors and found a strong correlation between lifetime and current injection status. This relationship remained significant with the majority of our sample endorsing past two-week IDU. One notable finding was that approximately 10% more Whites endorsed past two week IDU; however, most participants in both groups still endorsed current IDU. To test our hypothesis that lifetime IDU was an appropriate measure of any group differences, we re-ran analyses using current IDU data and found minimal changes in the results. This finding confirmed our approach of using lifetime IDU, a choice made in part because our other consequence measures were also lifetime; in short, lifetime history of injecting is most relevant to these results. Despite potential limitations in this approach, we believe these findings extend the literature and offer a more precise understanding of behavioral differences across two discrete race groups, African Americans and Non-Hispanic Whites.

Our findings demonstrate differential patterns of substance-use initiation by racial group and that these findings are consistent whether defining the sample by lifetime or current injection heroin use. Non-Hispanic Whites began using all substances earlier except heroin. These results agree with studies that found earlier cocaine initiation among White substance users (Fuller et al. 2005; Arreola et al. 2014), which may relate to variations in substance access across demographic groups (Stoltman et al. 2015); we previously identified racial differences in geographic (urban vs. suburban Detroit) segregation of opportunity for heroin purchasing and use (Draus et al. 2012). The most commonly used first substance was



alcohol, followed by tobacco and marijuana. This modal pattern is consistent with the gateway hypothesis and literature on substance-use progression (White et al. 2007; Vaughn et al. 2008; Woodcock et al. 2015). A subgroup (27.2%) of African American subjects reported substance-use progression that diverged from at least one premise of the gateway hypothesis, consistent with previous work (Ramchand et al. 2006; Keyes et al. 2012; Belcher et al. 2014; Witbrodt et al. 2014). About 6.4% of African American subjects used heroin first, inconsistent with the gateway path. The finding of gateway non-adherence being associated with African American race disappeared once we controlled for age, suggesting this relationship is better distinguished by age (rather than race) differences. This finding echoes a general concern that the gateway hypothesis is culturally biased toward drug-use progression patterns of Whites of certain ages (e.g., those in early adulthood) and may not generalize to other groups (Vanyukov et al. 2012). Other limitations of the gateway hypothesis include failing to specify mechanisms that link stages of progression, and not addressing how transition points predict risk of addiction (Ramchand et al. 2006; Keyes et al. 2012; Belcher et al. 2014; Witbrodt et al. 2014). Yet, this theory continues to generate research (Kandel & Kandel 2015). Our perspective is that observations of race and age differences in drug-use progression (gateway or otherwise) may offer opportunities for tailoring assessment, prevention, and treatment protocols; this is especially important for an IDU population due to the stigma and medical harms of heroin injection.

Our study also highlights differences by racial groups in heroin-use consequences, which may be clinically important for assessment and treatment. Non-Hispanic Whites reported significantly more heroin-use consequences and higher scores for three consequence domains. These findings remained when defining the sample by current (rather than lifetime) injection status. Although we did not observe differences by racial groups heroin-related overdose or emergency room visits, Whites were more likely to endorse consequences that reflect health, family, social, financial, and occupational problems. One potential explanation for these significant findings is that Whites had a shorter latency period between initial use and regular use, and used heroin more frequently and in larger amounts per day, than African Americans. These distinct patterns of use may partly explain why African Americans are at lower risk for heroin-specific consequences. Notably, our findings contrast with some data that African Americans are more vulnerable to substance-related consequences, including legal problems (Lê Cook & Alegría 2011; Guerrero et al. 2013). One explanation for resolving these seemingly contradictory findings is that most studies involved treatment-seeking populations. Also, our findings are specific to heroin-related problems, whereas other studies may ask the question more broadly and could elicit different responses. Finally, injection heroin users may be at a uniquely higher risk of legal problems due to paraphernalia associated with injecting and more visible marks of use. This might mean that legal risks unique to injection heroin use mediate the previously-observed greater legal risks associated with substance use among African Americans. It would be useful to understand whether specific social or economic conditions moderate heroin consequences differently by racial groups depending on their treatment-seeking status.

Our findings indicate that African American heroin-injection users were older and demonstrated a different progression of substance use than White heroin-injection users. This suggests a need for a different style of intervention for this population. While

traditional interventions may target “at-risk” youth who have already begun substance use, this may be less successful for African Americans who (compared to Whites) tend to have a different trajectory of using substances and may even use heroin first. Traditional programs may be more relevant to Non-Hispanic White communities where opioid-use problems have risen more dramatically among people aged 18–44 years compared with other racial groups (Lê Cook & Alegría 2011; Guerrero et al. 2013). Finally, African Americans report fewer consequences than Whites, suggesting they might interact less often with access points to treatment services. Thus, education and risk-reduction interventions for this population may need to be implemented in the community rather than waiting for those at risk to seek help. Pertinent interventions for this population may include brief motivational interviewing for harm reduction at contact points in the community (e.g., syringe exchange programs and clinics) (Baker et al. 1994; Bernstein et al. 2005; Lundahl et al. 2010) in addition to active peer outreach (Scott et al. 2018). Additionally, our findings support the potential value of brief cultural competency training for community health workers and clinic staff to ensure they are educated on different heroin-use patterns and trajectories and appropriate interventions by racial groups (Guerrero et al. 2017).

Contrary to expectations, there were no race differences in lifetime incidence of heroin treatment seeking or quit-attempts. Prior research suggests African Americans are more likely to enter treatment but less likely to complete (Lê Cook & Alegría 2011; Guerrero et al. 2013). We recommend some research strategies to address unanswered questions. First, future research could explore racial differences in how the factors assessed in this study affect treatment seeking. It is possible that previously-reported race differences in treatment seeking were confounded with, or predicated on, route-of-administration differences, rather than race. Given that route of administration was not reported in those earlier studies, we cannot say whether injection use is associated with lower or higher likelihood of treatment entry or completion (and we did not assess lifetime number of treatment episodes). Second, future research should examine the influence of sociodemographic characteristics in larger samples. We found that both gender and age influenced some substance-use characteristics by the racial groups. This information could improve assessment, prevention, and treatment protocols by targeting differences specific to race, gender, and age. Additionally, our finding that age underlies some of the initially observed differences by racial groups suggests age is an important factor to consider when describing substance-use characteristics across diverse heroin-using samples. Third, we suggest that future research should extend our findings by measuring additional factors (e.g., psychiatric symptoms, addiction severity levels, injection-use patterns) that may vary by race and influence substance-use characteristics.

Limitations of this study should be considered. First, self-report measures may introduce recall bias for our substance-use variables. Second, the data are cross-sectional, prohibiting causal inferences. Notably, we were not aiming to assess causality nor assert any inherent differences; rather, we sought to assess behavioral differences by race group while controlling for injection status. Third, because this study focuses on a sample of current non-treatment seeking injection heroin users, inferences regarding race differences may not generalize to non-injecting users or treatment-seeking individuals. Fourth, our assessment instrument did not query the subject’s current preferred route of administration, or frequency of injection use; therefore, these data do not address the specificity or severity of injection

use. Fifth, other socio-environmental (e.g., socio-economic status, social support) and psychiatric factors (co-occurring mental health problems) can impact substance-use progression and addiction severity; however, our study did not assess these constructs.

## Conclusion

This study highlights differences by race group in substance-use progression and heroin-use characteristics in an injection heroin-using sample. Recognizing and understanding race differences in substance-use progression may assist prevention and harm reduction efforts; this study further extends work demonstrating that treatment tailored to specific needs of patients results in better outcomes (Collins & Varmus 2015). Our study is valuable because the high proportion of White injection heroin users makes it hard to disentangle which differences in heroin use are more directly related to race versus injection use. By examining these differences within a sample of injection heroin-using individuals, we may improve understanding of how these differences manifest. Notably, we see that African American participants demonstrate a more gradual progression of use with later onset of regular use and fewer overall negative consequences associated with heroin. As a result, many of the current prevention and harm reduction efforts may not access this population underscoring the importance of more targeted outreach to this population.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1.** Differences in substance use characteristics among African American and White injection heroin users

	Tobacco			Alcohol			Marijuana			Cocaine		
	African Amer.	White	t value	African Amer.	White	t value	African Amer.	White	t value	African Amer.	White	t value
<b>Ever Used % (n)</b>	80.7% (138)	84.7% (171)	-1.00	88.9% (152)	93.6% (189)	-1.58	86.5% (148)	95.0% (192)	-2.80**	87.7% (150)	90.1% (182)	-0.73
<b>Regular Use % (n)</b>	75.4% (129)	83.2% (168)	0.11	63.2% (108)	67.8% (137)	-0.94	63.2% (108)	78.2% (158)	-3.20**	55.6% (95)	56.4% (114)	-0.17
<b>Current Use % (n)</b>	69.0% (118)	75.2% (152)	0.70	45.0% (77)	34.2% (69)	2.14*	28.1% (48)	35.1% (71)	-1.47	46.2% (79)	46.5% (94)	-0.07
<b>Age of First Use</b>	16.2±4.5	14.7±4.6	3.45**	16.1±6.3	13.5±4.3	4.66***	15.9±3.6	14.1±2.7	5.22***	28.5±8.1	21.0±6.5	9.01***
<b>Age of Regular Use</b>	18.4±4.9	16.4±4.9	4.25***	21.6±7.3	17.3±3.5	5.51***	17.4±4.1	15.3±2.8	4.86***	32.3±8.2	23.2±6.9	8.57***
<b>Latency</b>	2.2±3.0	1.7±2.4	1.79	5.8±5.9	4.5±3.8	0.34	1.9±3.0	1.4±2.4	0.88	2.9±4.3	2.8±4.5	0.09
<b>Quit Attempts</b>	4.1±10.1	3.3±8.6	0.81	1.0±2.3	1.4±3.1	0.32	1.1±2.6	1.4±7.5	0.64	4.2±7.6	4.5±13.7	1.62

Note. Means and standard deviations shown unless otherwise specified. Non-Hispanic White  $n = 202$  (54.2%) and African American  $n = 171$  (45.8%).

\*  $p < .05$

\*\*  $p < .01$ , and

\*\*\*  $p < .001$



**Table 2.**

Racial group comparisons of heroin consequences among injection heroin users

Factor loading	Consequence items	Sample endorsement <i>n</i> (%)		Chi-Square
		African American ( <i>n</i> = 171)	Non-Hispanic White ( <i>n</i> = 202)	
<b>Factor 1</b>	Visited emergency room	28 (28.3%)	59 (39.9%)	3.49
	Overdose	59 (34.7%)	87 (43.1%)	2.71
	Health problem	42 (24.9%)	51 (25.2%)	0.01
	Accident or injury	18 (10.7%)	35 (17.3%)	3.35
	Arrested/legal problems	68 (40.2%)	102 (50.5%)	3.90*
	Unexpected reaction	58 (34.7%)	75 (37.7%)	0.34
<b>Factor 2</b>	Lost job	56 (32.9%)	111 (55.2%)	18.48***
	Warning at work	43 (25.3%)	88 (43.6%)	13.51***
	Missed work	82 (48.8%)	137 (67.8%)	13.73***
	High at work	85 (50.0%)	164 (81.2%)	40.57***
<b>Factor 3</b>	Missed school	32 (18.9%)	42 (20.9%)	0.22
	High at school	29 (17.3%)	47 (23.3%)	2.03
	Suspended or expelled	13 ( 7.7%)	17 ( 8.4%)	0.07
<b>Factor 4</b>	Financial problems	140 (82.4%)	187 (92.6%)	9.07**
	Family problems	121 (70.8%)	169 (83.7%)	8.91**
	Drove under influence	110 (64.7%)	177 (87.6%)	27.50***
	Couldn't stop using	120 (70.6%)	190 (94.1%)	36.62***
<b>Factor 5</b>	Seizures and fits	9 ( 5.3%)	10 ( 5.0%)	0.03
	Shakes and tremors	32 (18.8%)	60 (30.3%)	6.43*
	Memory lapse or blackouts	59 (35.1%)	69 (34.3%)	0.03
<b>Did Not Load</b>	Fight or quarrel	62 (36.5%)	71 (35.1%)	0.07

\*  $p < .05$ \*\*  $p < .01$ , and\*\*\*  $p < .001$

**Table 3.**

Racial group comparisons for baseline demographic and substance use characteristics among injection heroin users

Factors	All Participants (N = 373)	African American (n = 171)	Non-Hispanic White (n = 202)	Test Statistic	p value
<i>Demographic Characteristics</i>					
Current Age	41.5±9.9	46.8±6.5	37.1±10.0	t=11.31	<.001
Sex (Male)	69.4% (259)	64.3% (110)	73.8% (149)	$\chi^2=3.88$	.049
Education	12.4±1.6	12.4±1.7	12.4±1.5	t=0.139	.889
<i>Substance Use Characteristics</i>					
Age of Initial Cocaine Use	24.3±8.2	28.5±5.1	21.0±6.5	t=9.01	<.001
Age of Initial Heroin Use	22.7±7.3	21.5±6.9	23.7±7.4	t=2.92	.004
Gateway Adherent	74.0% (276)	62.6% (107)	83.7% (169)	$\chi^2=13.66$	<.001
<i>Heroin Use Characteristics</i>					
Age of Regular Heroin Use	24.8±7.7	24.1±7.9	25.3±7.6	t=1.43	.155
Heroin Latency	2.1±4.3	2.7±4.7	1.6±3.9	t=3.75	<.001
Past-Month Heroin Frequency	119.4±102.6	103.3±82.2	132.9±115.5	t=3.52	<.001
Factor 1 Consequences	1.8±1.6	1.6±1.5	2.0±1.6	t=2.19	.029
Factor 2 Consequences	2.1±1.6	1.6±1.6	2.5±1.5	t=5.66	<.001
Factor 4 Consequences	3.2±1.2	2.9±1.3	3.5±0.9	t=5.57	<.001
Factor 5 Consequences	0.6±0.8	0.6±0.8	0.7±0.8	t=1.13	.260
Quit Attempts	11.5±19.9	11.2±18.0	11.8±21.4	t=0.45	.648
Ever Sought Treatment	71.6%	71.3%	71.8%	$\chi^2=0.042$	.837

Note. Means and standard deviations shown unless otherwise specified.