

Examining the association between discrimination and risky social networks  
among illicit drug users

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## ABSTRACT

### Examining the association between discrimination and risky social networks among illicit drug users

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Discrimination is a predictor of increased drug use initiation. Thus, discrimination may systematically marginalize stigmatized individuals into risky social networks (e.g., networks with high burden of disease) that facilitate HIV transmission. Therefore, even when individual risk behaviors are low, membership in high risk network may perpetuate disease transmission. Studies have shown that black and Hispanic drug users' exhibit lower drug and sexual risk behaviors, yet they are most affected by HIV. Since blacks and Hispanics experience discrimination more often than whites, this relationship may explain their increased likelihood of HIV prevalence. In order to assess whether an association between discrimination and risky social networks existed and whether this relationship was modified among blacks and Hispanics, we used data from the Social Ties Associated with Risk of Transition (START) study. START (n=652) is a prospective cohort study among non-injection drug users (never injected and used non-injection heroin/crack/cocaine  $\geq 1$  year at least 2-3 times/ week) and a cross-sectional sample of newly initiated injection drug users (heroin/crack/cocaine injectors  $\leq 3$  years) recruited through respondent driven sampling and targeted street outreach in ethnographically mapped high drug activity NYC neighborhoods. We also combined START data with 2000 US Census data to examine whether neighborhood structural factors (e.g., poverty, education, minority composition and social cohesion) exacerbated the relationship between discrimination and risky social networks. Using log-binomial regression and population average modeling for neighborhood analyses, discrimination was shown to be significantly associated with more drug and sexual risk networks. Among blacks, discrimination due to race and drug use were important for having more embedded sex networks. Among whites and Hispanics, discrimination due to incarceration and drug use was significantly associated with embedded heroin and injection networks. Finally, the

relationship between drug use discrimination and more embedded heroin and injecting networks was also magnified among illicit drug users that are members of neighborhoods characterized by lower minority composition, less education and poorer social cohesion. More research is needed to better understand the how race/ ethnicity and neighborhood influence the socio-contextual process between discrimination and risky social networks.

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## DEDICATION

To my parents, Dennis Crawford and Patricia Vann-Crawford, because you stood on the shoulders of Mary Elizabeth Horn and Aunt Susie Anna Vaughn, I am here today. In every step of your lives you have shown me what it means to have success, to overcome failure, to work hard, be passionate, compassionate, willing to sacrifice and have faith. You are my heroes.

Chapter 1: Introduction

Illicit drug use is a widespread practice that drastically impacts the psychological and physical health of millions of Americans<sup>1</sup>. National data has consistently estimated that 20.1 million Americans use illicit drugs<sup>1</sup>. Of those, roughly 1.2 million inject drugs, which accounts for 11% of HIV infections<sup>1,2</sup>. Among injection drug users (IDUs) in the U.S., the HIV rate has been estimated to be as high as 28%<sup>3</sup>. For non-injection drug users, (NIDUs) the prevalence of HIV is not as clear because of the variability associated with various types of substance use. However, high risk sexual practices (unprotected sex, multiple partners, and survival sex) associated with NIDU puts them at increased risk of HIV transmission and acquisition<sup>4-7</sup>. In addition to being classified as a DSM-IV mental disease, drug use is also a social problem. For decades grand theorist have argued that in order to truly grasp social phenomenon, one must carefully examine the expectations and standards that have been set within their social structure which influence how networks of individuals act and react with one another<sup>8</sup>. Recently, epidemiologic research examining the role of social networks on the exchange of health risks to understand infectious disease transmission among drug users has been vital since it is the interaction between individuals (e.g., social relationships) that spreads infectious diseases such as HIV. Social network theory posits that the structure of one's social network determines their "behavior and attitudes by shaping the flow of resources which determine access to opportunities and constraints on behavior"<sup>9</sup>. Therefore, the make-up of one's social network confines ones available resources and their ability to act and react with one another in terms of safe behaviors that influence health, such as condom use and safe injection practices.

### Social networks

In social network analyses, a person is referred to as an ego and their networks are referred to as a group of nodes and the connections that link nodes to each other<sup>10</sup>. Networks can be measured egocentrically or sociometrically. Egocentric networks are considered the nodes that are reported by the ego only, whereas, sociometric networks are continuous chains of networks that include the ego, the nodes of an ego, the nodes of those nodes and so on. To understand the influence of nodes' network characteristics on an ego's behaviors, an egocentric network

analysis can be used to assess the risk potential of the reported network. Characteristics of one's network that are important to determine disease risk potential of the network include 1) total network size, 2) network density or the proportion of people with a specific characteristic in contrast to the total number of people in their network, 3) boundedness or the extent of their relationship (i.e., family, co-worker, friend) and 4) homogeneity or the similarity of the ego with respect to other persons in the network.

#### Social networks and health risk behaviors

Several studies have examined social network relationships on sexually transmitted infections<sup>11</sup>, sexual behaviors<sup>12,13</sup> and injection drug use behaviors<sup>14-17</sup> finding that network characteristics are highly linked to positive and negative individual risk behaviors (i.e. sexual and drug use practices). For example in a study examining the relationship between network characteristics and sexual risk behaviors, Latkin and colleagues found that increased network size increased odds of exchanging money or drugs for sex and having multiple male partners<sup>12</sup>. Network density defined as networks with more connected relationships, was inversely associated with exchanging money or drugs for sex<sup>12</sup>. In another study assessing the association between network characteristics and frequency of injection drug use, absence of a partner, size of drug network and network density were significantly associated with injecting at least once a day in the adjusted analysis<sup>16</sup>. Larger drug networks that are unsupportive (2 or more drug networks) has also been shown to influence the likelihood of injecting in shooting galleries and larger supportive drug networks is associated with a higher likelihood of sharing needles<sup>17</sup>. This has also been shown in other studies where an increased number of networks is associated with frequent needle sharing<sup>15,18</sup>, and being more central (or linked with more people) in a network is associated with needle sharing<sup>10</sup>.

Types of drug users in ones networks also have an important influence on individual risk behaviors. For example, it has been shown that increased numbers of crack users in ones networks confers higher odds of participation in transactional sex<sup>15</sup>. Social network drug use

patterns have also been shown to have an important influence on individual behaviors over time<sup>13</sup>. Specifically, individuals who had social networks with higher alcohol consumption were more likely to have casual sex partners, multiple partners and daily consume alcohol over time. Similarly those reporting networks with higher crack use were more likely to have multiple partners over time.

Likewise, positive network characteristics confer some positive health behaviors<sup>14</sup>. For example, networks of people that can provide health advice and financial support is associated with condom use and networks with positive peer norms about condom use are less likely to inject drugs<sup>14</sup>. Similarly, friends' attitudes towards drug use have also been shown to strongly predict behavioral change over time for HIV risk behaviors<sup>10</sup> and needle sharing<sup>19</sup>.

As explained above, there is a preponderance of evidence that social networks and specific social network characteristics are important for understanding individual sexual and drug using risk behaviors<sup>20</sup>. Therefore, understanding the social circumstances that shape social network development is pertinent to explaining the continued perpetuation and transmission of HIV. This dissertation will provide a framework for understanding the development of social networks through individual experiences of social discrimination. With this framework, this dissertation will examine the role of discrimination on social networks and attempt to explain how specific groups (e.g., racial/ ethnic minorities and those in neighborhoods of poor access) are disproportionately affected by HIV through development of larger risk network relationships.

#### Evidence of the influence of discrimination on health

A rapidly growing body of literature has examined the influence of various forms of discrimination, particularly racial discrimination on health behaviors<sup>21-24</sup> and health outcomes<sup>25-27</sup> in attempts to understand persistent racial/ ethnic disparities in a host of health outcomes in the US.

Discrimination is a social process that assigns differential treatment and opportunities to people because they exemplify a characteristic that is viewed negatively<sup>28-30</sup>. Discrimination can act on

multiple levels including individual and institutional levels to influence opportunities through personal relationships, employment, housing, health care, education and income.

Although it is well accepted that illicit drug users are treated poorly<sup>31</sup>, few studies have assessed the experience of discrimination among substance users. Earlier work examining the role of stigma in the health of drug users has brought to light the marginalizing experiences that many drug users encounter<sup>32,33</sup>. More recent work directly assessing discrimination among drug users has shown that most drug users experience some form of discrimination (drug use, jail time, poverty, race, age, sex, sexual orientation) in their lifetime<sup>34</sup>. And many drug users experience multiple forms of discrimination. The most common type of discrimination experienced is drug use discrimination (75.3%) followed by jail time discrimination (40.3%), poverty discrimination (32.7%) and racial discrimination (31.3%). Interestingly, while this study shows that drug use, poverty and racial discrimination were significantly associated with lower mental health scores, they also show that these same types of discrimination were significantly associated with higher depression scores. Models including demographics, social support/networks and only discrimination due to drug use found similar results, but interestingly compared to white drug users, black drug users had significantly higher mental health scores and lower depression scores signifying better mental health statuses. Using the same sample of drug users, Ahern and colleagues independently and jointly assessed the roles of discrimination, alienation and perceived devaluation on mental health, depression and physical health<sup>35</sup>. This analysis used questions about rejection from friends and family to proxy discrimination. A large proportion of persons reported rejection from family (75.2%) and friends (65.8%). Fewer persons were prevented from medical care (23.5%) or refused housing (33.5%) because of their drug use. Reports of alienation and perceived devaluation were high in the population. After adjusting for demographics, social support/ risk networks and drug use frequency, discrimination and alienation significantly influenced lower mental health scores ( $R^2=0.21$ ) and higher depression scores ( $R^2=0.27$ ) explaining a considerable amount of the relationship.

Most studies have focused on the influence of discrimination on mental health outcomes, particularly depression<sup>27,36</sup> since discrimination is believed to act through psychological stressors such as depression and poor self esteem to influence health behaviors, health seeking behaviors and physical health outcomes<sup>27,37</sup>. Studies have consistently shown that discrimination is associated with depression among drug users<sup>34,35</sup> and non-drug users<sup>38,39</sup>. However, as previously highlighted, this relationship has not been consistent for blacks who on average experience up to about 13 times more day-to-day discrimination than whites, but have a better mental health profile in terms of depression<sup>40,41</sup>. There has been a long-standing controversy on depression among racial/ ethnic groups, particularly for blacks who have been shown to have lower rates of depression despite the preponderance of evidence that blacks disproportionately experience poor access to healthcare and lower education, which are predictors of depression<sup>41-43</sup>. Other limited evidence suggests that the prevalence of depression among minority drug users is also lower than that of white drug users<sup>44,45</sup>. Researchers have argued that depression is experienced differently across cultures<sup>46,47</sup>, which the DSM-IV classification fails to measure and therefore lower rates of reported depression are spurious findings. Others have argued that mental health problems are stigmatizing among racial/ ethnic minorities which results in under report and lack of diagnosis for depression and other mental health symptoms<sup>47</sup>. Contrary to this argument, Givens and colleagues found that there were no differences between whites, blacks and Hispanics regarding stigma related to mental health treatment using an internet survey of depression treatment preference<sup>48</sup>. Therefore, mental health may be important, but may not explain the magnitude of the how discrimination influences health.

#### Understanding the impact of discrimination on formation of social networks

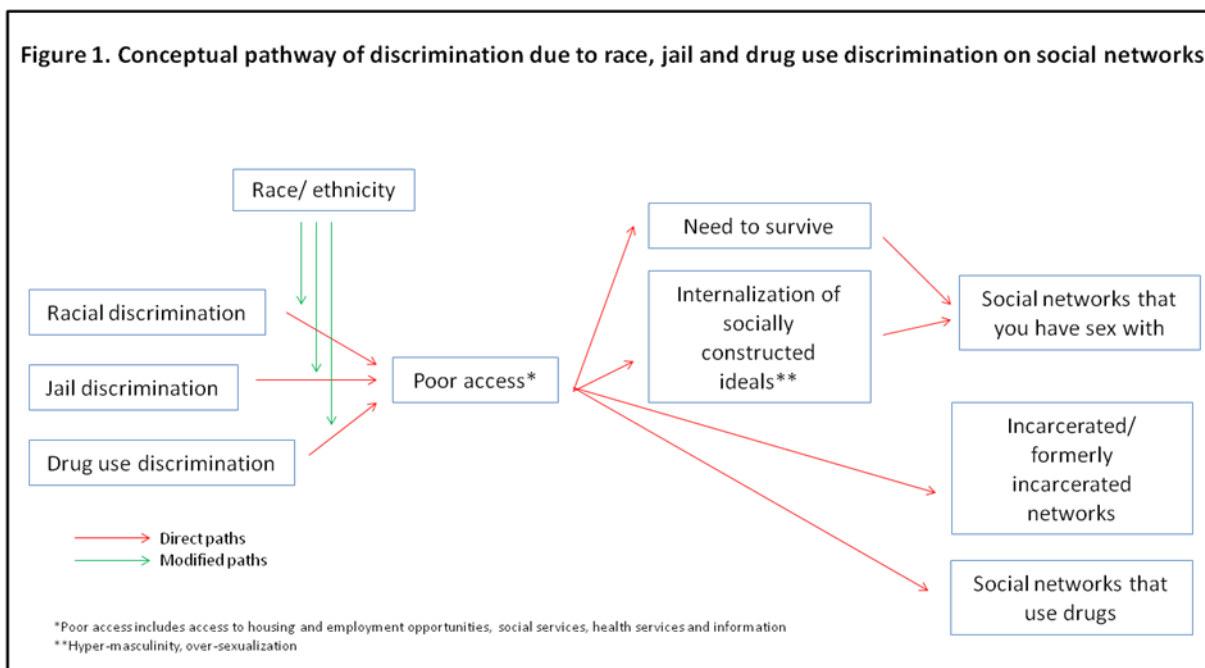
It is likely that other salient social factors such as social networks which have yet to be examined are more important than mental health for understanding the continued perpetuation of HIV outcomes in marginalized, highly stigmatized populations<sup>10,14,15,19,36,49</sup>. The current pathway of understanding discrimination on health outcomes through mental health may be insufficient since it 1) requires that an individual recognize when they are being discriminated against in order for it



to affect their health, which is not always the case, and 2) fails to take into account extraneous factors (e.g., historical perspective and coping) that may influence how discrimination affects one's mental state. It is plausible that discrimination influences one's social position and physical health without strained mental consequence. For example, discrimination due to race could encourage one to develop relationships with people of the same race to avoid further experiences of discrimination. This is problematic to health if members of the same race are more likely to have a disease such as SARS or HIV because development of a relationship with them increases one's chances of exposure and acquisition of disease. At the same time, development of such relationships may buffer against some health risks such as mental health risks since relationships with people that are like them provides comfort or increases coping responses for negative interpersonal treatment. Related to race, Brondolo and colleagues describes this as a "well-developed racial identity" where persons who experience negative interpersonal treatment have the ability to de-personalize this treatment and relate it to negative treatment of a group of people rather than a personal attack which buffers psychological distress and lowered self-esteem<sup>50</sup>. The resultant increased group identification could increase an individuals' propensity to establish network relationships with other individuals within their stigmatized group (e.g., drug use group, racial/ ethnic minority group) who understand and can identify with the negative experiences of discrimination. These relationships may be therapeutic and act as a buffer against other negative consequences of discrimination such as mental health problems, particularly depression. At the same time, these social networks can heighten other risks of disease (e.g., HIV, STI's, etc) depending on the risk characteristics (prevalence of disease, risk behaviors) of their network members and as such, the role that social network risk and support relationships may play in the process between discrimination and health needs to be accounted for.

Most of literature on discrimination theory has focused solely on racial discrimination. But, there are a number of people that experience discrimination because they are members of other stigmatized groups (i.e. drug users, formerly incarcerated), not just racial/ ethnic minorities; and frequently, stigmatized persons are members of multiple groups that are stigmatized (e.g., racial

minority and drug user). For the purposes of this dissertation, we propose one central conceptual model (Figure 1) to explain how various types of discrimination may influence risky social network relationships. That is, that an experience of discrimination systematically limits one from certain social and health services, health information and housing and employment opportunities, which results in direct formation of networks that also have poor access (e.g., formerly incarcerated, illicit drug users).



For example, as Link describes, when individuals are stigmatized they are isolated and rejected by their stigmatizers<sup>32</sup>. Thus, the potential for them to establish a relationship with a stigmatizer (i.e., non-drug user, non-minority, health professional, counselor, etc...) is prevented. Conversely, there remains an opportunity to establish relationships with other stigmatized persons (i.e. drug users, minorities, formerly incarcerated persons) who may be risky to their health. Individuals may also intentionally establish more risky relationships because of a need to survive and tap into the few resources a risk network can provide. Likewise, the internalization of the social constructions associated with being a member of a stigmatized group (i.e. worthlessness, powerless, inferior, etc...) may influence development of risk relationships. While Courtwright believes that this internalization results in an “adaptive” behavior<sup>51</sup>, this dissertation argues that

ideals of hyper-masculinity and over-sexualization challenge notions of powerlessness, worthlessness and bring a sense of control that stigmatized persons are told they lack. However, these ideals lead to increased risk sex networks<sup>52,53</sup> and increased risk of exposure to disease. This conceptual pathway is presented with the caveat that several other conceptual pathways have also been explicated to explain the relationship between discrimination and risky social networks and the degree to which each type of discrimination acts cannot be gauged by statistical techniques since some types of discrimination may have greater or smaller impact on individuals based on their socio-political history (Appendix 1). For simplicity we will draw upon the central pathway described since it is most closely aligned with explicating how discrimination systematically disadvantages stigmatized groups to tangible resources that could prevent negative consequences to their health. The argument contending that discrimination results in poorer access and utilization of services<sup>32,51,54</sup> has been consistently supported by the literature and provides a plausible explanation for how disparities persist among those that experience discrimination the most, despite empirical evidence showing riskier sexual and drug using practices among these populations<sup>55-58</sup>.

Thus, this dissertation proposes and examines how the isolating process of discrimination can filter individuals into groups that are riskier to their health and have a higher likelihood of transmitting disease. Specifically, discrimination marginalizes individuals resulting in an increased risk of developing social network relationships with other marginalized persons which collectively create a marginalized, high-risk network - not because they engage in more individual risk behaviors but because 1) they have a higher baseline HIV prevalence (e.g., drug users and incarcerated persons); 2) have fewer access to health resources; or 3) a discriminatory experience influences a risky sexual or drug user encounter. All of which results in continued perpetuation and transmission of HIV. Given the importance of understanding how discrimination influences the formation of social networks with risky characteristics, which thereby determines the nature or level of risk for HIV transmission and acquisition, this dissertation will examine the

role of individual-level discrimination on the formation of risky sex and drug using social network members which may contribute to racial/ ethnic disparities in HIV.

#### Racial/ ethnic disparities in HIV

In 2007, national statistics of HIV rates by race/ ethnicity show that blacks have an HIV rate approximately nine times that of whites (10.8/100,000) and three times that of Hispanics (36.9/100,000)<sup>59</sup>. For drug users, similar disparities exist. Surveillance statistics from 1994-2000 among injection drug users (IDUs) who account for 11% of HIV infections show that 23% of white IDUs had HIV compared to 65% of blacks and only 10% of Hispanics<sup>2,60</sup>. Counter intuitively, higher HIV rates among black drug users do not translate to higher drug use. In fact, blacks are less likely to use drugs and initiate injection drug use – a key form of HIV transmission<sup>56,57</sup>.

Prevalence data on lifetime drug abuse from the 2001-2002 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) show that blacks are 30% less likely (OR:0.7; 95%CI: 0.6-0.8) and Hispanics are 60% less likely (OR: 0.4; 95%CI 0.3-0.5) to report lifetime drug abuse compared to whites. Statistics from the National Household Survey on Drug Abuse from 2000-2002 show that only 0.8% of blacks have ever injected drugs compared to 1.7% of whites and 1.1% of Hispanics<sup>55</sup>. In the adjusted analysis of this study, whites remained more likely to ever inject and older whites were more likely to recently inject. Other studies also support lower drug use among blacks and Hispanics compared to whites in adolescence. A study among high school seniors over a 25 year period found lower annual and 30-day prevalence of drug use for all types of illicit drugs for blacks compared with whites<sup>58</sup>. For example, annual prevalence of cocaine, crack and heroin use among whites was 5.9, 2.4 and 1.2 respectively compared to 0.9, 0.4 and 0.4, respectively among blacks. Fuller and colleagues also found that whites initiated drug use at an earlier age compared with blacks<sup>57</sup>. After adjustment for injection drug use duration, sexual practices and other drug use, blacks were 0.19 (95%CI: 0.07-0.33) times less likely to initiate injection drug use during adolescence compared to whites. Among injection drug users, national statistics also show fewer risky injection practices among blacks and Hispanics compared with

whites. For example, although syringe sharing practices are still high, fewer blacks (29.1%) and Hispanics (28.9%) compared with whites (40.2%) shared syringes<sup>59</sup>.

With respect to high risk sexual practices that may also facilitate HIV transmission, there have been no race-specific analyses of sexual risk behaviors among drug users to attempt to understand whether riskier sexual practices among racial/ ethnic groups attempt to explain HIV disparities. But, national data of the general population also supports safer sexual practices of blacks compared to whites<sup>61</sup>. Given that current statistics fail to show higher risky sexual behaviors or risky injection practices among blacks and Hispanics, we continue to lack a clear understanding of the etiology of racial/ethnic disparities in HIV among drug users.

#### Social Networks, discrimination and race/ ethnicity

Black and Hispanic drug users tend to encounter discrimination more than whites<sup>34</sup>, thus it is possible that black and Hispanic drug users who are discriminated against develop bonds with other people who are discriminated against and these relationships develop into risk networks that have a higher likelihood of HIV transmission as described above. Since population studies have not shown that black and Hispanic drug users engage in riskier individual sexual and injection behaviors this mechanism would explain why black and Hispanic drug users are still contracting HIV at a higher rate than their white drug using counterparts. Namely, black and Hispanic drug users are through discriminatory experiences (e.g., police, race/ ethnicity drug use) filtered into social networks that are more likely to have HIV. Given the higher prevalence of HIV among blacks and Hispanics noted above, by chance alone blacks and Hispanics are more likely to establish a relationship with a high-risk person (i.e. someone with HIV).

Some investigators have argued that racial inequalities have an impact on drug using behaviors at critical points across the life course<sup>62</sup>. Throughout this trajectory, the isolation of blacks and Hispanics through discrimination may also exacerbate the chance of establishing a risky network. Once a risky network is established black and Hispanic drug users may be at a double

disadvantage in terms of HIV risk because studies have shown that network characteristics also influence an individuals' preventive/ risk behaviors <sup>14</sup>. Therefore, as shown in Figure 2, experiences of discrimination are higher among racial/ ethnic minorities which results in the development of riskier network relationships which results in disproportionate rates of HIV in these populations even without increases in individual risk behaviors. Thus, it is not necessarily "what one does", but "who it is done with", under "what social circumstances" and "within what social setting" that is driving infectious disease transmission and racial/ ethnic disparities in HIV among illicit drug users.

#### Social Networks, discrimination and neighborhood

Neighborhoods are geographic areas in which people reside that signify social position, cultural norms (e.g., ethnicity) <sup>63</sup> and provide immediate access to a host of factors (e.g., food sources, health facilities, crime, etc...) that affect health. Neighborhood characteristics have been shown to influence health outcomes ranging from low birth weight <sup>64</sup>, to adult obesity <sup>65</sup>, myocardial infarction survival <sup>66</sup>, injection cessation <sup>67</sup>, injection drug use initiation <sup>68</sup> injection drug use <sup>69</sup>, and perception of stress <sup>70</sup>. Given this, conditions of the neighborhood environment may also be of particular importance in the relationship between discrimination and social networks because specific neighborhood features may have the potential to diffuse or exacerbate one's experience of discrimination if 1) neighborhood characteristics (e.g., education, socioeconomic status, crime) are present that incite or normalize negative behaviors and relationships or if 2) neighborhood members provide a level of social support that acts against the internalization of discrimination <sup>71</sup>.

Using data from the Healthy Environments Partnership from Detroit and Michigan, a study found that higher minority neighborhood racial/ ethnic composition (e.g., percent African American) was significantly associated with perceived social stress which included neighborhood problems such as gang activity, drug dealing, gun shooting, prostitution, loitering and theft, vandalism or arson <sup>70</sup>. It is possible that persons who are members of disadvantaged neighborhoods (e.g., high minority composition and plagued with drug use and distribution) are also more likely to experience

discrimination, specifically discrimination due to drug use which is systematically targeted towards neighborhoods that are perceived to harbor drug exchange and high crime activity<sup>70,72</sup>. Higher crime rates and drug activity in these neighborhoods have also been argued to incite higher levels of police surveillance and harassment which could influence reports of discrimination due to incarceration or arrest<sup>73</sup>. Given this and evidence that neighborhood factors including minority composition (i.e. segregation)<sup>68,69</sup>, poverty<sup>67</sup> and education<sup>68</sup> influence drug use patterns (injection onset, injection cessation and injection incidence), it is likely that these neighborhood characteristics increase the likelihood of discrimination and therefore increases the opportunities for riskier relationships to be established (e.g., those that are more likely to inject drugs, inject drugs at an earlier age). Thus, their likelihood of acquisition of disease is also more likely.

A recent study by Dailey and colleagues assessed whether neighborhood socioeconomic position (SEP) (e.g., measured by percent working class, unemployed, below poverty line, less than high school education, expensive homes and median household income and racial composition) influenced reports of racial discrimination. This study reported conflicting evidence with the hypothesis that persons in disadvantaged neighborhoods are more likely to experience racial discrimination<sup>74</sup>, but because this study only assessed racial discrimination, several explanations are possible. Individuals in neighborhoods of higher minority composition and homogeneity in general may have a smaller chance of experiencing racial discrimination compared to neighborhoods that have lower levels of minority composition. A second explanation could be that more homogenous neighborhoods may also be characterized by higher levels of neighborhood social cohesion which has been shown to influence lower drug use<sup>75</sup>. This dissertation also examined the role of social cohesion in order to provide evidence to support or refute the role of neighborhood factors exacerbating experiences of discrimination. Neighborhoods with high scores of social cohesion may show a buffering or protective effect in relation to various forms of discrimination. A socially cohesive neighborhood may lend to a more tightly knit community that is more respectful and less judgmental of its members, even in more racially heterogeneous neighborhoods (i.e. neighborhoods with lower minority composition) where minorities are more

likely to come in contact with racist experiences; and therefore, these neighborhoods may lend safer or lower risk social network relationships. Given the importance of neighborhood factors, it is important to examine a host of neighborhood level factors (e.g., minority concentration, poverty level, education level, and social cohesion) that may put some populations at an increased risk of the negative effects of discrimination from police and within other structural contexts.

This dissertation will attempt to answer three questions based on the proposed causal pathway (Figure 1): 1) do experiences of discrimination influence risky social network relationships (Aim 1), 2) are the experiences of discrimination higher among blacks and Hispanics compared to whites resulting in the establishment of more risky social network relationships (Aim 2) and 3) are the experiences of discrimination different in certain neighborhoods resulting in differences in the establishment of risky social network relationships (Aim 3)? We hypothesize that, 1) those that experience discrimination will be more likely to have more risky social network members, 2) blacks and Hispanics will be more likely to experience discrimination and therefore have more risky social network members compared to whites and 3) persons that are members of neighborhoods characterized by poverty, low education, high minority composition and poor social cohesion are more likely to experience discrimination and therefore have more risky social network members.



## Chapter 2: Methods

## Parent Study Overview

This study utilized data from illicit drug users enrolled in the Social Ties Associated with Risk of Transition (START) study. START employed two study designs: 1) a bi-annual 18-month prospective study design among heavy non-injection drug users (NIDUs) who never injected and used heroin, crack or cocaine and 2) a cross-sectional assessment among recently initiated injection drug users (IDUs). The primary aims of START were to 1) understand social network and support characteristics associated with transition from non injection drug use to injection drug use applying a case-control design, 2) understand social network and support characteristics associated with adolescent transition into injection drug use and 3) determine the incidence of transition into injection drug use as well as related predictors of transition. For this dissertation, baseline data from NIDUs and cross-sectional data from IDUs will be utilized to understand the role of discrimination on risky drug and sex social network relationships.

## Recruitment

From August 2005 to January 2009, 652 IDUs and NIDUs were recruited using two recruitment strategies given the difficulty in reaching the target population: 1) targeted sampling strategies (TSS) and 2) respondent driven sampling (RDS). A description of the TSS employed for this study has been described elsewhere<sup>76</sup>, but in brief TSS was completed in ethnographically mapped high drug activity neighborhoods in New York City (NYC) using a time varied approach where different neighborhoods were visited at different times and days to obtain a more representative sample of each area. Specifically, targeted locations such as shooting galleries and sex-trading sites that were located in Harlem, Lower East Side, South Bronx, Jamaica-Queens and Bedford-Stuyvesant-Brooklyn were visited to recruit drug users by trained outreach workers, some of which were former drug users and all of which were members of the communities recruited in.

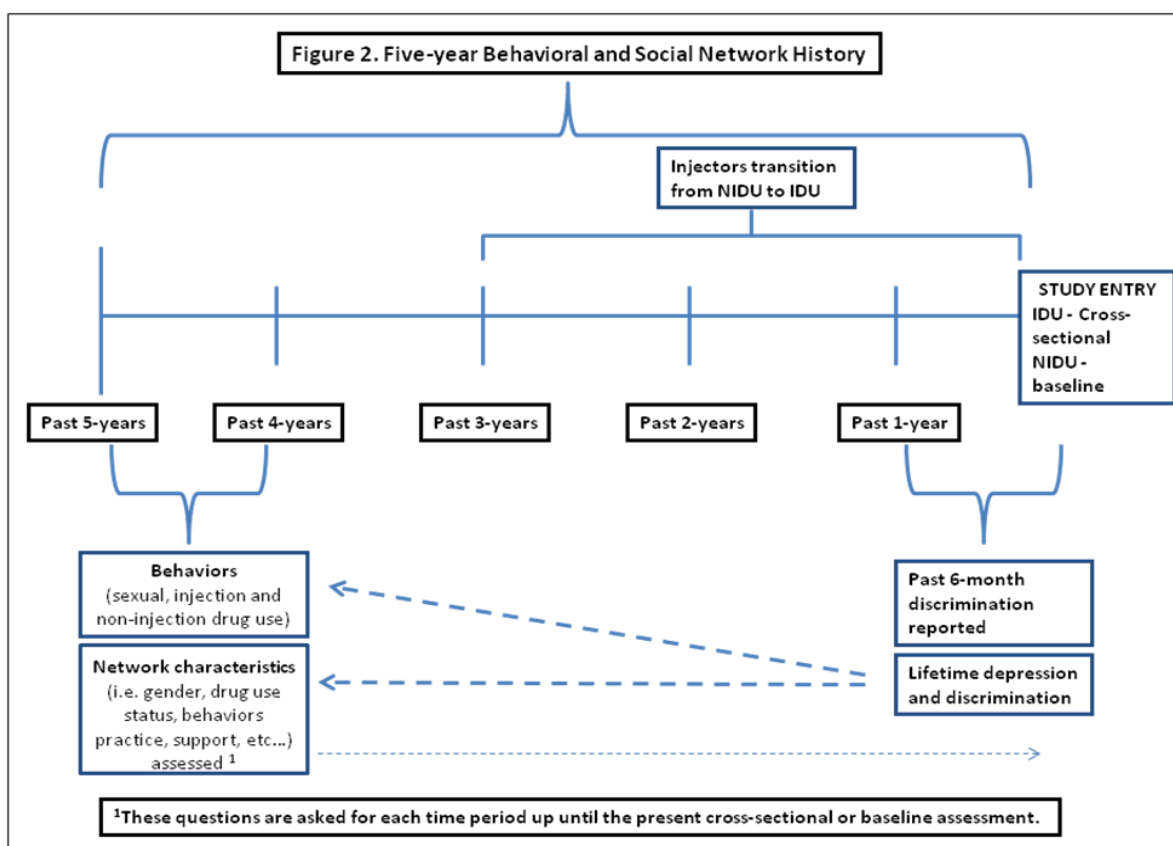
In conjunction with targeted recruitment, RDS was employed to enhance generalizability of the final sample and reach drug users who are harder to reach<sup>77,78</sup>. RDS is a chain referral sampling strategy that provides incentives to participants who recruit members of their social network. Thus, through the use of RDS, this study potentially has the ability to reach a wider range of drug users who are harder to reach (i.e., homeless drug users) and otherwise would not have been reached without the referral of their network member. In order to conduct RDS, forty-eight eligible drug users or “seeds” who met study eligibility criteria and reported having at least three drug-using network members were evenly recruited from the same neighborhoods sampled in TSS to ensure impartial sampling. Seed participants were chosen based on their drug use status and sex. Specifically, for each neighborhood, twelve seeds were recruited: eight were NIDUs (six males and two females) and four were IDUs (two males and two females). Seeds were given three RDS coupons to give their drug using network members who are between ages 18 and 40. Seeds were also offered an individual and group facilitated training (RDS Training – RDST) to aid in the recruitment of the seeds network members. Seeds were given additional RDS coupons until all three eligible network members were enrolled into the study. Each eligible network member also received three RDS coupons to refer at least one of their drug-using network members into the study. Network members were given a maximum of five RDS coupons regardless of whether they reached three recruited networks.

#### Eligibility

To be eligible for START, IDUs had to report injecting heroin, crack or cocaine for four years or less and at least once in the past 6 months; heavy NIDUs had to report non-injection use of heroin, crack or cocaine for 1 year or more at least 2-3 times a week in the past 3 months. Drug use was verified with a rapid drug test which detected opiate and cocaine metabolites in the urine and track marks (i.e. stigmata) were verified among those who reported injecting. All participants were required to provide valid identification including a photograph and birth date as well as informed consent for participation in survey instruments which was approved by the Institutional Review Boards of Columbia University and New York Academy of Medicine.

### Data Collection and Survey Instruments

IDUs and NIDUs completed face-to-face interviewer-administered survey instruments. Survey instruments included questions on demographic characteristics, injection and non-injection drug use practices, arrest patterns, sexual practices, traumatic events, drug treatment, mental health and discrimination experiences as well as a behavioral risk and social network history spanning five years prior to study entry and their transition into injection drug use. NIDUs were additionally followed-up every 6 months over an 18-month follow up period as shown in Figure 2 to re-assess patterns in drug use, sexual practices, mental health and discrimination experiences<sup>79</sup>.



At study entry, participants were asked to complete a behavioral risk and social network history spanning five years prior to study entry. Recalling behavioral histories has been shown to yield

valid responses (using construct validity techniques) among IDUs using a ten-year reconstruction of behavioral histories<sup>80,81</sup>. This study utilized a shorter period of recall (five as opposed to the validated ten-year behavioral history) which should provide more confidence in the recall of social network history provided over the past five years. Additionally, this study provided several prompts to re-focus individuals to each year of question by jogging memory for several important events that occurred during that year of their life (e.g., birth of a child, marriage, loss of home, national disaster, etc...). During each period, persons were asked general questions about who was a part of their social network that they used drugs with, had sex with, who they could talk to, who they could borrow money from and who could they stay with. Then, for each person listed in their social network, specific questions about that person's demographic characteristics and sexual/ drug using behaviors were asked. Since this is an egocentric social network analysis, individual network participation with specific drug using networks and sexual networks will be assessed rather than the network relationship itself.

#### Supplementary Data Sources - US Census Neighborhood Data

Data from the 2000 US Census on neighborhood characteristics will be utilized to ascertain information on neighborhood poverty, education level and minority composition. The Census is a decennial survey which provides a count of the entire US population and housing units. For the entire population, a short form which provides information on household members' age, race/ ethnicity, sex, household relationship and ownership status is collected. Among a sample (about 1 in 6) of persons and housing units, a longer form detailing information on ancestry, income, disability, marital status, occupation, work history and a host of other demographic and structural characteristics are obtained.

Publicly available neighborhood Census data is delineated on the county-level, Census tract and Census block group. A detailed description of the Census tract and block group can be found elsewhere (<http://www.census.gov/geo/www/GARM/Ch10GARM.pdf>). In brief, a Census tract is a small geographic area within a county that has between 2,500 and 8,000 residents. Census

tracts are chosen to be homogenous based on population characteristics such as economic status and living conditions. Census blocks (also called a Block numbering areas (BNAs)) are smaller geographic areas located within Census tracts. We used aggregated neighborhood data on the Census tract level from the 2000 US Census Summary Tape Files 2 and 3. Neighborhood characteristics including minority composition (percent black and percent Latino), poverty (percent living below 100% of the poverty threshold) and education (percent with less than a high school degree) of which START participants were recruited were the neighborhood characteristics of interest in the conceptual model of this dissertation.

START participants were asked what neighborhood and the cross streets in which they were recruited to participate in the study either through TSS or RDS. These neighborhoods were chosen as opposed to home addresses because most participants spent at least half of their time or more (84.28%) in these neighborhoods. Other studies have identified recruitment neighborhoods as those within which they frequently hang out, cop drugs, and develop relationships with other people<sup>68</sup>. Participant hangouts were mapped to the neighborhood they hung out in using ArcGIS software. Complete cross street addresses were given from 525 participants, 119 participant addresses were imputed to the mobile van location of their recruitment and eight participants had no recruitment information at all and will therefore be excluded from the neighborhood analyses. Participant cross streets were geo-coded on a New York City map and then spatially joined to a NYC census tract map in order to determine their appropriate census tracts. Geo-coded data was then merged with the complete data set which included detail information on Census characteristics analyzed in this dissertation.

#### Other data sources - Social Cohesion/ Collective Efficacy Neighborhood Data

Social cohesion data, which has been previously utilized and described elsewhere in more detail<sup>82</sup>, was taken from an anonymous random-digit-dialing telephone survey which was conducted in 2000 among 979 community residents in Harlem, Bronx, and Brooklyn. The target population consisted of all adult residents over the age of 18. The overall effective completion

rate of the survey was 67%. This survey was conducted as part of a separate community-based structural intervention at the New York Academy of Medicine using a private research firm to conduct phone interviews, in which community residents were asked about their attitudes and opinions towards drug use, perception of and dangerousness of drug users, crime, HIV, and HIV prevention through the implementation of the Expanded Syringe Access Program which legalized the sale of clean syringes in pharmacies. The survey instrument was conducted by bilingual interviewers in English and Spanish and administered in the language of the respondents' choice. The survey instrument took about 25 minutes to complete and all Spanish surveys were back-translated for accuracy and consistency. To ascertain neighborhood social cohesion/ collective efficacy, community residents were asked how strongly they agreed on 10 items assessing perceptions of neighborhood trust, shared values and safety. Available responses were on a five-point scale. Scores were averaged where low scores indicate low levels of cohesion and high scores indicate high levels of cohesion. Scores were aggregated to the zip code of corresponding participant hang outs. START participant hangouts were mapped to the corresponding zip code to ascertain levels of neighborhood social cohesion/ collective efficacy in which the participant belonged.

#### Measures - Outcomes

Utilizing the social network information, a network embeddedness risk score was created by pooling social network information over the past five years to gain an overall picture of the network characteristics<sup>83</sup>. Network embeddedness is defined as the total amount of risk an individual could potentially be exposed to within their network. Thus, the network embeddedness risk score captures the total number of high risk persons (e.g., any person who held sexual or drug use risk for disease transmission) within one's social network that could potentially expose the individual to some form of risk. Based on the type of risk imposed by the network member (i.e. sexual, drug and injecting), the score was created by tallying the total numbers of networks for each risk group. The specific outcomes examined were embedded 1) sex networks (sexual network members who are male and female sex partners, and those who participate in

transactional sex); 2) drug networks (network members who use crack, heroin, inject and networks drugs are used with); 3) injecting networks (network members who use heroin and inject drugs); and a total risk network variable was created which included all sex and drug networks identified above as well as networks that had ever spent time in jail. Since the sum of the score for each variable was right skewed and the median for the injecting networks was zero, we chose to dichotomize on the 75<sup>th</sup> percent cutoff for all outcome variables. Therefore, embedded sex networks were defined as having four or more vs. less than four, embedded drug networks were defined as having seven or more vs. less than seven, embedded heroin and injecting networks were defined as having two or more vs. less than two and the total embedded risk network variable was assessed as having 13 or more vs. less than 13<sup>80,81</sup>.

In order to create appropriate categorizations of the network embeddedness score described, analyses were performed assessing embeddedness of each drug and sex network individually. Individual network variables were dichotomized for those that have two or more (large networks) versus less than two (small networks) of the specified network characteristic with the exception of number of injecting networks which was dichotomized as presence vs. absence of an injecting network. These categorizations were based on the distribution of the reported networks and consistent with categorizations performed in other studies<sup>17</sup>. Specific to drug using networks, dichotomized network variables that were assessed as independent outcomes include 1) total networks that use drugs, 2) networks the participant uses drugs with, 3) networks that use crack, 4) use heroin and 5) inject drugs. Specific to risky sex networks, dichotomized network variables that were assessed as independent outcomes include 1) total sexual partners, 2) number of female partners, 3) number of male partners and 4) number of transactional sex networks. Finally, other risk networks that were assessed independently include 1) number of jail networks and 2) number of networks with less than a high school education. The latter analysis is presented in Appendix 2 to show the consistency of the results when the data are combined versus assessed individually.



## Measures - Exposures

Discrimination is the main independent variable of interest. Discrimination was collected using one item modified from previous discrimination studies<sup>84,85</sup> for drug using populations<sup>34</sup>: “In your lifetime, have you ever been discriminated against, prevented from doing something, or been hassled or made to feel inferior because of any of the following?” Available response categories included, age, race, sex (gender), sexual orientation, poverty, drug use, having been in jail or prison, religion, mental illness, physical illness, other and I have never been discriminated against. Participants could respond in the affirmative or non-affirmative to each type of discrimination.

Given that several types of discrimination were asked using only one question, an exploratory factor analysis (EFA) for the categorical measures of discrimination (age, race, sex (gender), sexual orientation, poverty, drug use, having been in jail or prison, religion, mental illness, physical illness, other) was performed in MPLUS to determine whether the underlying structure of each measure of discrimination captured unique or overlapping constructs. Detailed results of the EFA are attached in Appendix 3. In short, the EFA found five patterns across the eleven types of discrimination that were assessed. Using the Promax factor loadings, all of the discrimination measures loaded on two factors of which, discrimination due to incarceration and due to drug use was closely correlated but racial discrimination was an independent construct.

For this analysis, the three most prevalent types of discrimination in the illicit drug using population<sup>37</sup> were assessed: lifetime discrimination due to drug use, having been in jail or prison (hereafter referred to as incarceration), and race. For discrimination due to incarceration, we only included persons who reported spending time in jail or prison in their lifetime (80.98%), but it should be noted that 90.73% of the population had ever been arrested and had some interaction with the correctional system. It should also be noted that most people who did not spend time in jail or prison (99.30%) did not report experiencing discrimination due to incarceration.

#### Effect Modifiers – Individual level

To ascertain race/ ethnicity, participants were asked, “How do you describe your racial/ethnic background?” Available responses included Hispanic or Latino, Black, White, Asian or Pacific Islander, Native American, Eskimo, or Aleutian, Black and Hispanic, Mixed and Other. Racial/ ethnic groups were categorized as Hispanic, non-Hispanic black and all other racial/ ethnic groups. Whites (n=64) were combined with Asians/ Pacific Islanders (n=2), Native Americans/ Eskimos/ Aleutians (n=1), Mixed (n=18) and other (n=7) persons, due to their small sample sizes. Additionally, Hispanics who identified as black (n=5) were combined with Hispanics rather than non-Hispanic blacks since being of Hispanic ethnicity may confer different interpretations, meanings and experiences of discrimination<sup>86</sup>. To ensure that no differences in reports of discrimination among Hispanics that identified as black and Hispanics existed, we stratified reports of discrimination by these racial/ ethnic categories (Appendix 4). Hispanics who identified as black reported experiences discrimination that most closely resembled the reports of Hispanics. Hereafter, Hispanics, non-Hispanic blacks and all other racial/ ethnic groups will be referred to as Hispanics, blacks and whites, respectively.

#### Effect Modifiers – Neighborhood level

Neighborhood characteristics were taken from 2000 U.S. Census data and Social cohesion data. Participants were asked what neighborhood and the cross streets in which they were recruited to participate in the study either through TSS or RDS. These neighborhoods were chosen as opposed to home addresses because most participants spent at least half of their time or more (84.28%) in these neighborhoods. Other studies have identified recruitment neighborhoods as those within which they frequently hang out, cop drugs, and develop relationships with other people<sup>68</sup>. Participant recruitment neighborhoods were geo-coded to the census tract (US Census data) and zip code (Social cohesion data).

Using Summary Tape Files 2 and 3 from the 2000 US Census, we obtained data on neighborhood minority composition (percent black and percent Latino), poverty (percent living

below 100% of the poverty threshold) and education (percent with less than a high school degree) from census tracts represented in the data. Participant hangouts were mapped to the US census tract and corresponding neighborhood characteristics (e.g., minority composition, poverty and education) were ascertained. Tracts with missing observations were excluded from the analysis (n=9).

Neighborhood social cohesion data collected from a RDD telephone survey among NYC residents (described above), were assessed using two items on Sampson's measure of social cohesion and trust: "People around here are willing to help their neighbors" and "People in this neighborhood can be trusted." Respondents indicated whether they strongly agreed, agreed somewhat, disagreed somewhat, or disagreed strongly with these statements. The social cohesion/ collective efficacy score was calculated by averaging and aggregating individual responses to the zip code of corresponding participant hang outs as described by Sampson et al<sup>87</sup>. Zip codes with missing observations were excluded from this analysis (n=2).

All neighborhood variables (percent black, percent Latino, percent poverty, percent <high school education and social cohesion) were categorized into tertiles based on the distribution of the variable. Cut-points for neighborhood variables were, <44.04%, 44.04 – 75.78% and >75.78% for percent black, <20.09%, 20.09 – 49.77% and >49.77% for percent Latino, <31.46%, 31.46 – 49.12% and >49.12% for percent poverty, <70.61%, 70.61 – 78.41%, and >78.41% for percent high school education, and <3.37, 3.37 – 3.61 and >3.61 for social cohesion/ collective efficacy. Hereafter, tertile cut-points specifying the percent of residents in the neighborhood by the specified characteristic will be denoted as low, medium and high.

#### Covariates of Interest

Variables previously identified in the literature as potential confounders to social network characteristics were assessed<sup>12,14,18,20</sup>. Age was included as a continuous variable. Gender included those who self-identified as male and female. Transgendered persons were excluded

due to small sample sizes ( $n=5$ ). Education categories included those with less than a high school education, high school or general equivalency degree (GED) attainment, and some college or more. Legal income categories included those with no income, less than \$5,000 income, and income of \$5,000 or more. Number of female and male sex partners and age at sexual debut were included as continuous variables. Condom use with females and males were dichotomized into those who always used condoms vs. sometimes and never used condoms with sexual partners in the past two months. HIV testing frequency was dichotomized into those who had ever been tested  $\leq 3$  times vs.  $\geq 4$  times. Mental health status was measured as lifetime depression which was assessed using the question from the Composite International Diagnostic Interview (CIDI) which asked "In your lifetime, have you ever had a period of at least two weeks when nearly every day you felt, sad, depressed, or empty most of the time," with available responses as yes and no<sup>88</sup>. Injection status was dichotomized (yes/no) and categories for primary type of drug used included primarily cocaine, primarily crack cocaine, primarily heroin, and polytomous drug use of all three drug types equally. Sampling strategy was dichotomized as RDS and TSS.

#### General Statistical Plan

Basic descriptive statistics of the population were performed for each aim of the dissertation. The sample size frequency and percentages of categorical variables were calculated. Measures of location (median) and measures of spread (inter-quartile range) for continuous variables and frequencies were calculated for categorical variables. To determine whether significant differences existed by potential confounders, effect modifiers and embedded network outcomes, Mann Whitney tests for continuous variables and chi-square tests for categorical variables were performed.

Appropriate adjusted log-binomial regression models were performed to take into account the small sample sizes, estimate the prevalence ratios given the high prevalence of the embedded risk network outcomes and clustering of variables on multiple levels when appropriate. Variables

that showed a statistically significant effect on an embedded network outcome at the 0.10 level were included in the adjusted logistic regression model. Each type of discrimination including drug use discrimination, discrimination due to incarceration, and racial discrimination, was assessed independently without other types of discrimination. For adjusted models where multiple types of discrimination remained important to the outcome, discrimination types were controlled for simultaneously with other types of discrimination to tease out the effect of the specific form of discrimination of interest. All analyses were repeated using number of networks continuously as the dependent variable to determine if similar patterns existed.

#### Statistical power and sample size

The first study aim focused on detecting significant differences by number of risky network characteristics among those who experience discrimination compared to those who do not. Using Power Analysis and Sample Size (PASS) software to determine the minimum sample to detect an effect with 80% power and an alpha of 0.05 while taking into account five confounding variables, it was determined that a minimal sample of 136 would be needed given that the main independent form of discrimination explained at least 5% of the variance the specified individual network characteristic<sup>89</sup>. The second study aim assessed whether the relationship between discrimination and risky social networks is modified by race/ ethnicity. Therefore, power was calculated for the additional variance explained by the interaction term (race/ethnicity X discrimination), which was estimated to be 10%. To achieve 80% power, an additional 169 observations (total n = 305) were needed<sup>90</sup>. Finally, the last study aim assessed whether the relationship between discrimination and risky social network relationships is modified by neighborhood characteristics. Assuming an alpha level of 0.05 and that the interaction between discrimination and neighborhood accounts for 10% of the variation in individual risk networks; we used Optimal design software to determine that a minimum sample of 19 observations per census tract would be needed<sup>91</sup>.

The ability to detect an effect for final study aim (Aim 3) may be problematic since there were

several census tracts that did not have at least 19 observations. However in an article by Witte it was suggested that with small sample sizes it may still be possible to obtain precise estimates by using a semi-Bayes approach to specify a range of plausible values for the variance of the random effects<sup>92</sup>. The GLIMMIX default restricts one to empirical Bayes where a single common variance for the random effects is estimated from the data. Witte et al found that use of the GLIMMIX default generally led to the variance being estimated at 0 which led to overly precise estimates. Therefore, specification of the variance of the random effects may still provide valid estimates. In order to confirm that the findings of the neighborhood analysis are stable, we dropped census tracts with less than 19 observations and found that the association between neighborhood characteristics, although of different magnitude, was in the same direction (Appendix 11). Therefore, we retained all observations to improve the power of the analysis.

Chapter 3: Examining the role of discrimination on high risk social networks among illicit drug users

## Introduction

Despite the preponderance of data supporting the relationship between social networks, HIV risk behavior, and HIV transmission among drug users<sup>10-18,83,93-99</sup>, to our knowledge no studies have examined the role of discrimination as it pertains to being a member of a high risk social network among illicit drug users. Discrimination is a social process that can act on the individual and/or structural level to assign differential treatment and opportunities to people because they exemplify a characteristic that is viewed negatively<sup>28-30</sup>. Since discrimination has been found to be associated with several health behaviors including drug use and health seeking behaviors<sup>24,27,100-103</sup>, it is plausible that discrimination may also influence formation of specific social network relationships that increase the likelihood of HIV transmission, particularly among drug users who are highly marginalized and criminalized by society<sup>31</sup>.

Extant work has shown that drug users experience substantial discrimination<sup>32-35</sup> and that they also experience multiple types of discrimination with the most common forms of discrimination being due to drug use, jail time (incarceration), poverty and race<sup>34</sup>. Thus, experiences of discrimination could potentially influence one's social position thereby restraining the types of social network risk relationships that they develop with others<sup>49,104,105</sup>. If these relationships are with people who negatively influence their health risks, availability of health information and access it will increase their opportunity to come in contact with an infectious disease. For example, having increased numbers of crack users in ones networks confers a higher odds of participation in transactional sex<sup>15</sup>. Similarly, having an increased number of total networks and being more central (or linked with more people) is associated with needle sharing<sup>15,18 10</sup>. Therefore, an understanding of how individuals establish these relationships is needed.

The relation between experiences of discrimination and formation of high risk social networks may differ by type of discrimination. Drug users who are discriminated against because of their drug use may be more prone to develop relationships with other drug users thereby enhancing the opportunity to engage in behavior (e.g., transactional sex, needle sharing) that increase their



likelihood of HIV acquisition. Likewise, those who experience discrimination due to incarceration may be limited in the friendships, jobs and housing opportunities available to them because of being incarcerated or formerly incarcerated. As such, they may be exposed to higher risk social network relationships. While experiences of discrimination may encourage one to develop relationships with people that are like them in terms of their drug use status, incarceration history or race, this is associated with health risk behavior only if the baseline prevalence of risk in that subgroup is higher (thereby increasing ones chances of exposure and acquisition of disease). At the same time, development of relationships with people who are similar may buffer against mental health risks since relationships with people who are alike potentially provide comfort and encourage self-esteem which increases coping responses for negative interpersonal treatment<sup>50</sup>.

The purpose of this analysis was to examine the effect of individual-level discrimination due to drug use, incarceration and race on membership in high risk sex and drug-using social networks. We hypothesized that those who reported experiencing some type of discrimination (e.g., drug use, race, incarceration) will have significantly more high risk social network relationships compared to those who do not experience discrimination.

## Methods

Detailed explanations of the methods are described in the general methods section (Chapter 2).

## Study Overview

This study used data from illicit drug users enrolled in the Social Ties Associated with Risk of Transition (START) study. START employed two study designs: 1) a prospective study design among heavy non-injection drug users (NIDUs) who never injected and use heroin, crack or cocaine and 2) a cross-sectional assessment among recently initiated injection drug users (IDUs). For this study, baseline data from NIDUs and cross-sectional data from IDUs was used to understand the role of discrimination on high risk drug and sex social network relationships.

## Recruitment

From August 2005 to January 2009, 652 IDUs and NIDUs were recruited using two recruitment strategies: 1) targeted sampling strategies (TSS) and 2) respondent driven sampling (RDS). A description of the TSS employed for this study has been described elsewhere<sup>76</sup>. Briefly, TSS was completed in ethnographically mapped high drug activity neighborhoods in Harlem, Lower East Side, South Bronx, Jamaica-Queens and Bedford-Stuyvesant-Brooklyn. RDS, a chain sampling referral strategy, was employed to enhance generalizability of the final sample and reach drug users who are harder to reach<sup>77,78</sup>.

## Eligibility

To be eligible for START, IDUs had to report injecting heroin, crack or cocaine for four years or less and at least once in the past 6 months; heavy NIDUs had to report non-injection use of heroin, crack or cocaine for 1 year or more at least 2-3 times a week in the past 3 months. Drug use was verified with a rapid drug test which detected opiate and cocaine metabolites in the urine and injection status was verified by visual track marks (i.e. stigmata). IDUs and NIDUs completed 90 minute face-to-face interviewer-administered survey instruments. All participants were required to provide informed consent for participation in survey instruments which was approved by the Institutional Review Boards of Columbia University and New York Academy of Medicine.

## Outcomes

Participants were asked to complete a behavioral risk and social network history spanning five years prior to study entry. Recalling behavioral histories has been shown to yield valid responses (using construct validity techniques) among IDUs using a ten-year reconstruction of behavioral histories<sup>80,81</sup>. This study utilizes a shorter period of recall (five as opposed to the validated ten-year behavioral history) which should provide more confidence in the recall of social network history provided over the past five years. From the social network history, a network embeddedness risk score was created by pooling social network information over the past five years to gain an overall picture of the network characteristics<sup>83</sup>. The network embeddedness risk

score captures the total number of high risk persons (e.g., any person who held sexual or drug use risk for disease transmission) within ones social network that could potentially expose the individual to some form of risk. Based on the type of risk imposed by the network member (i.e. sexual, drug and injecting), the score was created by tallying the total numbers of networks for each risk group. The specific outcomes examined were embedded 1) sex networks (sexual network members who are male and female sex partners, and those who participate in transactional sex); 2) drug networks (network members who use crack, heroin, inject and networks drugs are used with); 3) injecting networks (network members who use heroin and inject drugs); and a total risk network variable was created which included all sex and drug networks identified above as well as networks that had ever spent time in jail. Since the sum of the score for each variable was right skewed and the median for the injecting networks was zero, we chose to dichotomize on the 75<sup>th</sup> percentile cutoff for all outcome variables. Therefore, embedded sex networks were defined as having four or more vs. less than four, embedded drug networks were defined as having seven or more vs. less than seven, embedded heroin and injecting networks were defined as having two or more vs. less than two and the total embedded risk network variable was assessed as having 13 or more vs. less than 13.

## Exposures

Discrimination is the main independent variable of interest. Discrimination was collected using one item modified from previous discrimination studies<sup>84,85</sup> for use with drug using populations<sup>34</sup>: “In your lifetime, have you ever been discriminated against, prevented from doing something, or been hassled or made to feel inferior because of any of the following?” Available response categories included, age, race, sex (gender), sexual orientation, poverty, drug use, having been in jail or prison, religion, mental illness, physical illness, other and I have never been discriminated against. Participants could respond in the affirmative or non-affirmative to each type of discrimination. For this analysis, three of the most prevalent types of discrimination in the illicit drug using population<sup>37</sup> were assessed: lifetime discrimination due to drug use, having been in jail or prison (hereafter referred to as incarceration), and race were assessed. For discrimination due

to incarceration, only persons who reported spending time in jail or prison in their lifetime were included (n=468).

#### Covariates of Interest

Variables previously identified in the literature as characteristics associated with social network characteristics were assessed<sup>12,14,18,20</sup>. Age was assessed continuously. Race/ ethnicity was categorized as Hispanic, non-Hispanic black and non-Hispanic whites were combined with all Other racial/ ethnic groups (Asian or Pacific Islander, Native American, Eskimo, or Aleutian, Black and Hispanic, Mixed and Other). Hispanics who identified as black (n=5) were combined with Hispanics rather than non-Hispanic blacks since being of Hispanic ethnicity may confer different interpretations, meanings and experiences of discrimination<sup>86</sup>. Gender included those who self-identified as male and female. Transgendered persons were excluded due to small sample sizes (n=5). Education categories were less than a high school education, high school or general equivalency degree (GED) attainment, and some college or more. Legal income categories included those with no income, less than \$5,000 income, and income of \$5,000 or more. Number of female and male sex partners and age at sexual debut were assessed continuously. Condom use with females and males were dichotomized into those who always used condoms with sexual partners in the past two months vs. not. HIV testing frequency was dichotomized into those who had been tested  $\leq 3$  times vs.  $\geq 4$  times. Mental health status was measured as lifetime depression which was derived from the Composite International Diagnostic Interview (CIDI), "In your lifetime, have you ever had a period of at least two weeks when nearly every day you felt, sad, depressed, or empty most of the time," with available responses as yes and no<sup>88</sup>. Injection status was dichotomized (yes/ no) and categories for primary type of drug used included primarily cocaine, primarily crack cocaine, primarily heroin, and polytomous drug use of all three drug types equally. Sampling strategy was dichotomized as RDS and TSS.

#### Statistical Analysis

First, measures of location (median) and measures of spread (inter-quartile range) for continuous variables and calculation of frequencies for categorical variables were created.

To determine which variables to include in the final model, bivariate associations between each separate type of discrimination (e.g., race, incarceration and drug use) and covariates of interest were examined with respect to high risk sex and drug using network characteristics. For categorical variables, chi-square statistics were used to determine statistically significant associations. For continuous variables, Mann-Whitney tests were calculated to determine whether statistically significant differences exist between the medians. Variables that showed a statistically significant effect on an outcome at the 0.10 level in the bivariate analysis were included in an adjusted log-binomial regression model to determine the independent relationship between each type of discrimination (e.g., drug use, incarceration, and race) and drug and sex risk networks, after taking into account individual sexual risk behaviors (e.g., lack of condom use, infrequent HIV testing and multiple sex partners). Log-binomial regression was used to estimate the prevalence ratio, given the high prevalence of drug and sex risk networks. Each type of discrimination including drug use discrimination, discrimination due to incarceration, and racial discrimination, was assessed independently without other types of discrimination (Models 1 -3). For adjusted models where multiple types of discrimination remained important to the outcome, discrimination types were controlled for simultaneously with other types of discrimination (Model 4) to tease out the effect of the specific form of discrimination of interest. All analyses were repeated using linear regression to determine if similar patterns existed when analyzing the networks continuously. Analyses were performed using SAS version 9.2<sup>106</sup>.

## Results

### Demographics and Risk Characteristics

Descriptive characteristics of population demographics including exposures, outcomes and covariates of interest are described in Table 2. Of 647 injection and non-injection drug users, the median age was 33, 70.5% were male and most were Black (48.8%) followed by Hispanic

(37.1%). About half (50.5%) had at least a high school education or general equivalency diploma (GED), 82.7% made \$5,000 or less/ year, 84.8% were un-married which includes single and divorced. In terms of drug use characteristics, most of the population (78.1%) did not inject drugs; 51.8% reported crack cocaine as the drug used most frequently, 27.3% primarily used heroin, 10.2% primarily used powder cocaine and 10.7% used powder cocaine, crack cocaine and heroin in equal frequency. In terms of sexual practices, the sample reported a median of one female sex partner and zero male sex partners in the past two months. Of those who reported female sex partners (n=369; 57.3%) in the past two months, only 28.1% always used condoms. Of those who reported male sex partners (n=208; 32.4%) in the past two months, only 31.4% always used condoms. The median age of sexual debut was 14 and more than half the sample (54.7%) had 4 or more HIV tests in their lifetime.

#### Discrimination Experiences

Almost half (47.8%) of the population reported experiencing at least one type of discrimination (age, race, sex, sexual orientation, poverty, drug use, incarceration, religion, mental illness, physical illness or other) in their lifetime. Of the types of discrimination focused on in this dissertation, 32.8% reported experiencing drug use discrimination, 33.9% experienced discrimination due to incarceration and 25.9% experienced racial discrimination (Table 2).

#### Social Network Characteristics

About one-third of the sample reported having largely embedded sex (30.8%), drug (29.8%), heroin and injecting (30.0%) and total risk networks (27.2%) over the past 5 years (Table 2). In the analysis stratified by specific type of risk network (Appendix 2) 30.5% had 2 or more persons who spent time in jail or prison, over half of the population (54.4%) had 2 or more sexual partners in the 5 past years, 33.9% had 2 or more female sex partners and only 21.5% had 2 or more male sex partners. Similarly, 21.8% reported having 2 or more transactional sex networks. Most participants (63.0%) had 2 or more persons in their network who used drugs; 40.8% reported 2 or more network members who used crack, 20.7% reported 2 or more network members who used

heroin and 24.6% reported 1 or more persons who injected drugs. Although many people had drug users in their network, fewer (50.5%) participants used drugs with 2 or more people.

#### Discrimination and Drug and Sex Risk Networks – Bivariate analysis

Bivariate relationships between discrimination and drug and sexual embedded risk networks are shown in Table 3. Those who reported experiencing discrimination due to drug use ( $p=0.0001$ ), incarceration ( $p=0.0451$ ) or race ( $p=0.0077$ ) were significantly more likely to have more embedded drug and sex risk networks. When the drug and sex networks were separated, only those who experienced discrimination due to drug use and racial discrimination were more likely to have embedded sex and drug networks. When looking at heroin and injecting networks only, those who experienced discrimination due to incarceration and drug use were more likely to have embedded heroin and injecting networks.

#### Discrimination and Drug and Sex Risk Networks – Adjusted Analysis

Results from the adjusted analysis are shown in Table 4. Those who experienced discrimination due to incarceration were marginally (OR: 1.07; 95% CI: 1.00 – 1.15) more likely to have embedded drug and sex risk networks after adjusting for marital status, number of male sex partners, age at sexual debut and primary drug used. Those who experienced racial discrimination (OR: 1.06; 95% CI: 0.99 – 1.14) and discrimination due to drug use (OR: 1.08; 95% CI: 1.03 – 1.14) also demonstrated a marginal association with embedded drug and sex risk networks after adjustment. After adjusting for all types of discrimination simultaneously, no forms of discrimination were associated with embedded drug and sex risk networks.

When embedded sex networks were investigated separately, discrimination due to drug use and race remained significant after adjustment, including taking into account each type of discrimination simultaneously. Specifically, after adjusting for race, marital status, primary drug used, injection status, recruitment strategy and discrimination due to drug use, those who experienced racial discrimination were 1.29 (95% CI: 1.00-1.66) times more likely to have

embedded sex networks. Similarly, after adjusting for race, marital status, primary drug used, injection status, recruitment strategy and racial discrimination, those who experienced discrimination due to drug use were 1.31 (95% CI: 1.02-1.67) times more likely to have embedded sex networks.

When embedded drug networks were looked at separately, discrimination due to drug use remained significant in the final model, but racial discrimination did not. Specifically, after adjusting for marital status and number of male sex partners, those who experienced racial discrimination were marginally more likely to have embedded drug networks (OR: 1.13; 95%CI: 0.99 – 1.28). But, this borderline association became insignificant after adjusting for discrimination due to drug use (OR: 1.04; 95%CI: 0.96 – 1.14). However, after adjusting for marital status, number of male sex partners and racial discrimination, those who experienced discrimination due to their drug use remained significantly more likely to have embedded drug networks (OR: 1.09; 95% CI: 1.00 – 1.19).

For heroin and injecting networks, an effect with discrimination due to incarceration did not persist after adjusting for race, age, age at sexual debut, primary drug used, injection status and recruitment strategy. However, drug use discrimination did remain important where those who experienced discrimination due to drug use were 1.45 (CI: 1.16 – 1.80) times more likely to have embedded heroin and injecting risk networks after adjusting for race, age, age at sexual debut, primary drug used, injection status and recruitment strategy.

The same patterns of significant associations were evident in the continuous analysis with two exceptions (data not shown). Racial discrimination ( $\beta=0.20$ ;  $p=0.02$ ) remained important with discrimination due to drug use ( $\beta=0.37$ ;  $p<0.01$ ) after adjusting for all forms of discrimination simultaneously for embedded total risk networks. Additionally, with respect to the embedded heroin and injecting network outcome, discrimination due to incarceration ( $\beta=0.21$ ;  $p=0.03$ )



demonstrated an independent association in the adjusted linear model which persisted after adjusting for discrimination due to drug use.

## Discussion

We found that discrimination due to drug use was significantly associated with embeddedness (e.g., number risk network relationships) of drug and sex risk social networks among illicit drug users. To our knowledge, this is the first study to examine the relationship between individual-level discrimination and high risk social networks. The findings of this study highlight the importance of the potential impact of various forms of social discrimination on high risk networks and understanding the heightened opportunity for infectious disease transmission that results among those marginalized by various forms of discrimination.

Several studies have shown that drug users with larger networks have riskier drug using and sexual risk behaviors<sup>12,16,17</sup>. Riskier behaviors within networks may be a result of increased opportunity for drug use and sex, which hampers the ability to access clean needles and condoms prior to drug use and/ or sexual act. A heightened level of camaraderie established among drug users with larger networks may also increase comfort levels thereby reducing inhibitions, and thus, safe drug and sex behaviors. This study shows that persons who experience discrimination are more likely to establish more embedded networks of people who hold some drug or sexual risk. Therefore, these networks may potentially heighten ones' likelihood of infectious disease transmission<sup>49</sup>.

There are several pathways that may explain the observed association between discrimination due to drug use and embedded drug and risk social networks. Most studies examining the role of discrimination on health have examined the role of discrimination on psychological stressors (e.g., depression and self-esteem) which influences health behaviors, health seeking behaviors and physical health outcomes<sup>27,37</sup>. However, subgroups (e.g., blacks) that are known to have disproportionately higher HIV prevalence<sup>2,59,60</sup>, do not have higher rates of depression<sup>34,44,45</sup> nor

higher sexual<sup>61</sup> and drug using<sup>55,57</sup> risk behaviors compared to whites. This study suggests an alternative pathway explicating the role of discrimination on physical health that aligns with our current knowledge about depression and risk behaviors among racial/ ethnic minorities. Namely that, discrimination acts to influence the social environment within which risk occurs. We assessed the role of depression in the pathway between discrimination and embedded risk networks and found no differences in the results suggesting that depression may not be the driving factor for this relationship (Appendix 5). Thus, it is not necessarily “what one does”, but “who it is done with”, under “what social circumstances” and “within what social setting” that is driving infectious disease transmission.

Related to the findings of this study, discrimination, specifically due to drug use, may restrict relationships available for drug users to develop thereby isolating them within networks of people who are more like them in terms of drug use status. This is problematic since within drug using networks, drug using behaviors are normalized, even encouraged, and the opportunity to come in contact with someone who has an infectious disease is increased because of the networks’ drug use status. More generally, this pathway of examining discrimination could also be understood by examining the development of other social networks that have been shown to be homogenous such as obese networks<sup>107</sup> and happy networks<sup>108</sup>. It is possible that these networks become homogenous because relationships with non-obese and un-happy persons are marginalizing for these groups of people. The implications of this are important since certain networks that persons are filtered into may lack agency (e.g., ability to access and navigate health care system) and knowledge for promoting healthy behaviors such as eating healthy and exercising. Thus, reinforcement or acceptance of risk behaviors (e.g., unhealthy eating and drug use) continues.

This study is limited by self-reporting and selection biases. Specifically, due to the sensitive nature of the questions asked during this study, social desirability may have biased participant responses. However, there is no evidence to support bias more or less among those with increased risk networks and therefore any bias in this case would be non-differential and tend

towards the null. Future studies could use Audio Computer Assisted Self Interview (ACASI) to prevent the possibility of bias due to interviewer collected data on sensitive subjects that may influence social desirability. Self-selection bias may have affected the sample we were able to obtain through TSS and RDS which may limit external generalizability to illicit drug users who do not self-select into research studies. Given the potential possibility of differences between sampling methods, we examined differences in total drug and sex risk networks by recruitment and found no significant differences. Additionally, due to the cross-sectional nature of the data, we are unable to establish temporality and therefore the results of this analysis do not imply causality. Temporality could be achieved if at the onset of drug use, drug users were prospectively followed to determine risk of developing a risk network after a discriminatory experience. Measurement bias may have also been present due to the one item measure of discrimination that may not suitably capture the construct of discrimination among drug users which could be over or under-estimated. Future studies on discrimination among drug users could benefit from discrimination assessments using vignettes to hone in on the specific construct of discrimination of interest (e.g., discrimination due to incarceration, race, drug use, poverty). Moreover, the measure of social networks in this study serves as an average risk of one's network over a five-year period so networks that conferred more risk were counted based on the number of categories of risk they held. This overlap in networks may lack qualitative data on the nature or degree of risk and therefore, future studies should specifically assess the degree of risk different types of networks hold on individual risk of disease acquisition. Given that there is no literature assessing the degrees of risk by networks, this study ascertained a complete average of risk based on every risk that an individual within a network held. Finally, related to the embedded sex network outcome, varying types of sexual risk networks with different levels of risk were combined which may have attenuated the effect between discrimination and high risk sex networks. When male, female and transactional sex networks were examined independently, the directionality of the associations was similar, but the magnitude of effect was strongest for transactional sex networks (Appendix 2). Therefore, the results for embedded sex networks may be an underestimate of the true effect.

This study also benefited from several strengths. First and foremost, it benefited from the unique availability of data on discrimination and a five year behavioral history of social networks that has been validated for use among drug users. The availability of this type of data is rare and it allows for unique examination of social network relationships. Moreover, this study was conducted among a high-risk drug using population, which allows understanding of HIV risk based on their social network drug use and sexual relationship status. The implications of these results for HIV prevention among drug users are substantial since HIV risk social network relationships are considerable. Finally, this is the first study to examine the relationship between discrimination and social network risk characteristics. The findings from this study suggest that there may be an alternate pathway outside of the stress and depression model to explain how discrimination influences health outcomes. This is particularly important since the pathway through social network relationships may explain lower levels of depression among racial/ ethnic minorities. For example, it is possible that racial/ ethnic minorities are more likely to experience discrimination<sup>40,41</sup>, and in turn, develop social network relationships with others who have similar racial/ ethnic backgrounds to avoid future experiences of discrimination<sup>50</sup>. These types of relationships may buffer against poor mental health outcomes. While our study does not examine how risk networks may also be supportive, further investigation of the role of supportive social networks on mental and physical health outcomes could be achieved using a prospective analysis to determine how mental and physical health changes after the development of supportive networks.

Future studies should be conducted to confirm the findings of this study and further explicate the process between discrimination and social network development. Given consistent results, HIV prevention and reduction interventions can be designed to focus on reducing development of risk networks by reducing the negative experiences of discrimination among illicit drug users. Specifically, interventions can attempt to build rapport and relationships among positive networks (e.g., social service providers) that may counteract negative influences of discrimination and

additionally provide resources that promote safe behaviors and can be shared with HIV risk networks. Social service providers who are already linked with many drug users may incorporate discrimination assessments to provide harm reduction for those who have experienced discrimination. These harm reduction trainings may be expanded and implemented as an intervention strategy targeted at the network level, so that drug users are trained on how to disseminate information on healthy drug and sex practices within their networks<sup>109-111</sup>. On a structural level, the creation of safe havens for drug users to access services (e.g., health care) and information may be needed to reduce the potential for discriminatory experiences, and thus, high risk networks. Finally, understanding how risk networks are developed through discrimination has important implications for understanding racial/ ethnic disparities in HIV. Examination of other social factors (i.e., race/ethnicity, neighborhood environment) that discrimination filters individuals into may also be salient for understanding the role of discrimination on health and ultimately disparities in health across racial/ ethnic minorities and other marginalized populations. Therefore, future examination of the role of discrimination on social network relationships among racial/ ethnic minorities is needed.

Chapter 4: Racial/ ethnic differences in discrimination and high risk social networks among illicit drug users

## Introduction

The HIV rate among blacks is approximately nine times that of whites (10.8/100,000) and three times that of Hispanics (36.9/100,000) in 2007<sup>59</sup>. For drug users, similar disparities exist. Surveillance statistics from 2001-2005 among injection drug users (IDUs) who account for 11% of HIV infections show that 21% of white IDUs had HIV/AIDS compared to 54% of blacks and 23% of Hispanics<sup>60,112</sup>. Counterintuitively, higher HIV rates among black drug users are not a result of higher drug use or sexual risk behaviors. Blacks are less likely to use drugs<sup>55,58</sup>, initiate injection drug use – a key form of HIV transmission<sup>56,57</sup> and engage in risky drug using<sup>59</sup> and sexual behaviors<sup>61</sup>. Yet, they disproportionately experience adverse social and other consequences of drug use such as arrest<sup>62,113</sup>. This paradoxical relationship has made HIV prevention arduous among racial/ ethnic minorities since the pathway of heightened HIV transmission is unclear. To understand the etiology of racial/ ethnic disparities in HIV, some studies have examined the social processes such as discrimination on health behaviors (e.g., HIV testing, depression) that may influence risk behaviors associated with HIV<sup>21,35,114</sup>.

Discrimination is defined as a process that systematically assigns differential treatment and opportunities for people because they have socially stigmatized characteristics (e.g., race, sex, religion, drug use, time in jail)<sup>28-30</sup>. Given its ability to shape opportunity it is also possible that discrimination shapes the level of risk within one's social network<sup>10,14,15,19,36,49</sup>. So that even if someone does not engage in more HIV risk behaviors, their opportunity to be exposed to disease is higher due to the level of risk within their network<sup>49</sup>. Thus, is not necessarily “what one does”, but “who it is done with”, under “what social circumstances” and “within what social setting” that is driving disparities in HIV transmission by race/ ethnicity.

Most of the literature examining discrimination on health has focused solely on racial discrimination. But, there are a number of people who experience discrimination because they are members of other stigmatized groups (i.e. drug users, formerly incarcerated), not just racial/ ethnic minorities. And frequently, stigmatized persons are at a double or triple disadvantage

because they are members of multiple groups that are stigmatized (e.g., racial minority and drug user). While various types of discrimination may act uniquely to influence health, we suggest that one central conceptual model can explain how various types of discrimination may influence high risk social network relationships. That is, that an experience of discrimination due to race, time in jail and drug use, systematically limits one from social and health services, health information and housing and employment opportunities, which could result in positive social network formation, but instead results in direct formation of networks that also have poor access (e.g., formerly incarcerated, illicit drug users) (Figure 1). Also, because discrimination systematically results in poorer access, the need to survive and the internalization of disadvantage could also lead to increased risk sex networks<sup>32,51,54</sup>. Given that blacks and Hispanics are significantly more likely to experience discrimination due to their drug use, race, and incarceration history, it is plausible that blacks and Hispanics are at a higher risk of developing more high risk social network relationships<sup>34,35</sup>. Thus, the goal of this study is to investigate whether the relationship between discrimination and high risk social networks is higher among blacks and Hispanics which will help explain how they are most affected by HIV and other infectious diseases. We hypothesize that the relationship between discrimination and high risk social networks is higher among blacks and Hispanics compared to whites. And that, multiple types of discrimination (e.g., racial, jail and drug use) will have an independent association with discrimination after adjusting for other types of discrimination.

## Methods

Detailed explanations of the methods are described in the general methods section (Chapter 2).

A general description of the methods follows.

## Study Overview

This study used data from illicit drug users enrolled in the Social Ties Associated with Risk of Transition (START) study. START employed two study designs: 1) a prospective study design among heavy non-injection drug users (NIDUs) who never injected and use heroin, crack or



cocaine and 2) a cross-sectional assessment among recently initiated IDUs. For this study, baseline data from NIDUs and cross-sectional data from IDUs was utilized to understand the role of race/ ethnicity in the relationship between discrimination and high risk social networks.

### Recruitment

From August 2005 to January 2009, 652 IDUs and NIDUs were recruited using two recruitment strategies given the difficulty in reaching the target population: 1) targeted sampling strategies (TSS) and 2) respondent driven sampling (RDS). A description of the TSS employed for this study has been described elsewhere<sup>76</sup>, but in brief TSS was completed in ethnographically mapped high drug activity neighborhoods in Harlem, Lower East Side, South Bronx, Jamaica-Queens and Bedford-Stuyvesant-Brooklyn. RDS, a chain sampling referral strategy, was employed to reach drug users who were harder to reach<sup>77,78</sup>.

### Eligibility

To be eligible for START, IDUs had to report injecting heroin, crack or cocaine for four years or less and at least once in the past 6 months; heavy NIDUs had to report non-injection use of heroin, crack or cocaine for at least 1 year and use at least 2-3 times a week in the past 3 months. Drug use was verified with a rapid drug test that detected opiate and cocaine metabolites in the urine. Visible track marks (i.e. stigmata) were verified among those who reported injecting. IDUs and NIDUs completed 90 minute face-to-face interviewer-administered survey instruments. All participants were required to provide informed consent for participation in survey instruments that was approved by the Institutional Review Boards of Columbia University and New York Academy of Medicine.

### Outcomes

Participants were asked to complete a behavioral risk and social network history spanning five years prior to study entry. Recalling behavioral histories has been shown to yield valid responses (using construct validity techniques) among IDUs using a ten-year reconstruction of behavioral

histories<sup>80,81</sup>. This study utilizes a shorter period of recall (five as opposed to the validated ten-year behavioral history) that should provide more confidence in the recall of social network history provided over the past five years. From the social network history, a network embeddedness risk score was created by pooling social network information over the past five years to gain an overall picture of the network characteristics<sup>83</sup>. Network embeddedness was defined as the total amount of risk an individual could potentially be exposed to within their network. The network embeddedness risk score captures the total number of high risk persons (e.g., any person who held sexual or drug use risk for disease transmission) within ones social network that could potentially expose the individual to some form of risk. A score was created by tallying the total numbers of networks for each risk group (i.e., sexual, drug and/ or injecting group members). There were four embeddedness outcomes examined, 1) sex networks (male and female sexual networks and networks who participate in transactional sex); 2) drug networks (networks that use crack, heroin, inject and networks drugs are used with); 3) injecting networks (networks that use heroin and inject drugs); and 4) a total risk network variable was created which included all sex and drug networks identified above as well as networks that had ever spent time in jail. Since the sum of the score for each variable was right skewed and the median for the injecting networks was zero, we chose to dichotomize on the 75<sup>th</sup> percent cutoff for all outcome variables. Therefore, embedded sex networks were assessed as having four or more vs. less than four, embedded drug networks were assessed as having seven or more vs. less than seven, embedded heroin and injecting networks were assessed as having two or more vs. less than two and the total embedded risk network variable was assessed as having 13 or more vs. less than 13.

## Exposures

Discrimination was the main independent variable of interest. Discrimination was collected using one item modified from previous discrimination studies<sup>84,85</sup> for drug using populations<sup>34</sup>: "In your lifetime, have you ever been discriminated against, prevented from doing something, or been hassled or made to feel inferior because of any of the following?" Available response categories

included, age, race, sex (gender), sexual orientation, poverty, drug use, having been in jail or prison, religion, mental illness, physical illness, other and I have never been discriminated against. Participants could respond in the yes or no to each type of discrimination. For this analysis, the three most prevalent types of discrimination in the population <sup>37</sup> were examined: lifetime discrimination due to race, drug use and having been in jail or prison (hereafter referred to as incarceration) were assessed. For discrimination due to incarceration, only persons who reported spending time in jail or prison in their lifetime were included (n=468).

#### Effect Modifiers

To ascertain race/ ethnicity, participants were asked, "How do you describe your racial/ethnic background?" Available responses included Hispanic or Latino, Black, White, Asian or Pacific Islander, Native American, Eskimo, or Aleutian, Black and Hispanic, Mixed and Other. Racial/ ethnic groups were categorized as Hispanic, non-Hispanic black and all other racial/ ethnic groups. Whites (n=64) were combined with Asians/ Pacific Islanders (n=2), Native Americans/ Eskimos/ Aleutians (n=1), Mixed (n=18) and other (n=7) persons, due to their small sample sizes. Additionally, Hispanics who identified as black (n=5) were combined with Hispanics rather than non-Hispanic blacks since being of Hispanic ethnicity may confer different interpretations, meanings and experiences of discrimination <sup>86</sup>. Hereafter, Hispanics, non-Hispanic blacks and all other racial/ ethnic groups will be referred to as Hispanics, blacks and whites, respectively.

#### Covariates of Interest

Variables previously identified in the literature as potential confounders to social network characteristics were assessed <sup>12,14,18,20</sup>. Age was included as a continuous variable. Gender included those who self-identified as male and female. Transgendered persons were excluded due to small sample sizes (n=5). Education categories included those with less than a high school education, high school or general equivalency degree (GED) attainment, and some college or more. Legal income categories included those with no income, less than \$5,000

income, and income of \$5,000 or more. Number of female and male sex partners and age at sexual debut were included as continuous variables. Condom use with females and males were dichotomized into those who always used condoms vs. sometimes and never used condoms with sexual partners in the past two months. HIV testing frequency was dichotomized into those who had been tested  $\leq 3$  times vs.  $\geq 4$  times. Mental health status was measured as lifetime depression which was assessed using the question from the Composite International Diagnostic Interview (CIDI) which asked "In your lifetime, have you ever had a period of at least two weeks when nearly every day you felt, sad, depressed, or empty most of the time," with available responses as yes and no<sup>88</sup>. Injection status was dichotomized (yes/no) and categories for primary type of drug used included primarily cocaine, primarily crack cocaine, primarily heroin, and polytomous drug use of all three drug types equally. Sampling strategy was dichotomized as RDS and TSS.

#### Statistical Plan

Descriptive statistics of the sample were conducted by race/ ethnicity. First we calculated measures of location (median) and measures of spread (inter-quartile range) for continuous variables and frequencies were calculated for categorical variables. To determine whether significant differences existed by racial/ ethnic groups and embedded network outcomes, Mann Whitney tests for continuous variables and chi-square tests for categorical variables were performed. Variables that showed a statistically significant effect on an embedded network outcome at the 0.10 level were included in an adjusted log-binomial regression model fitting a Poisson distribution to determine whether the relationship of discrimination with sex and, drug and injecting risk networks was modified by race/ ethnicity, after taking into account potential confounders. Log-binomial regression with a robust error variance was used to estimate the prevalence ratio because of the high prevalence of drug and sex risk networks, sparse cells of data and to account for overestimation of the variance<sup>115</sup>. Robust error variances were calculated to ensure direct estimation of the standard error. Interactions between race/ ethnicity and discrimination due to incarceration, race/ ethnicity and discrimination due to race, and race/ ethnicity and discrimination due to drug use were tested. All analyses were repeated using linear

regression to determine if similar patterns existed using when analyzing the networks continuously. Analyses were performed using SAS version 9.2<sup>106</sup>.

## Results

Descriptive characteristics of the population by race/ ethnicity are described in Table 5.

Hispanics were more likely than blacks and whites to be male, have less than a high school education, use powder cocaine and poly drugs, have four or more HIV tests in their lifetime, and report discrimination due to drug use. Blacks were more likely than Hispanics and whites to be older, have younger age at sexual debut, use crack cocaine, always use condoms with men and have four or more sex risk network members. Blacks were less likely than Hispanics and whites to report discrimination due to drug use and have two or more heroin and injecting networks.

Whites were more likely than Hispanics and blacks to be younger, female, high school educated, use heroin, inject drugs, always use condoms with females in the past two months, have three or fewer HIV tests in their lifetime, be recruited using RDS, and have two or more heroin and injecting networks.

Bivariate associations between demographic and embedded risk network outcomes are shown in Table 6. For embedded total risk networks, increased number of male sex partners, higher age at sexual debut, being un-married, primarily using crack cocaine and having depression in lifetime were significantly associated at the bivariate level. There were no differences in embedded total risk networks by race/ ethnicity. Differences did exist by race for embedded sex networks.

Specifically, blacks (37.7%) were significantly more likely to have more embedded sex networks than Whites (30.8%) and Hispanics (21.7%). Increased age, increased number of female sex partners, increased number of male sex partners, being single, using powder or crack cocaine, being a non-injector, having lifetime depression and being recruited using RDS were significantly associated with embedded sex networks. Specific to drug networks, increased number of male sex partners and being single were the only demographic characteristics important on the bivariate level. Racial/ ethnic differences were seen for embedded heroin and injecting networks

where Whites (47.2%) and Hispanics (40.4%) were significantly more likely to have embedded heroin and injecting networks compared to blacks (17.1%). Increased age, increased age at sexual debut, heroin and poly drug use, being an injector, lifetime depression and recruitment through TSS were also significantly associated with having more embedded heroin and injecting networks.

As described in Chapter 3, those who reported experiencing discrimination due to incarceration ( $p=0.0451$ ), race ( $p=0.0077$ ) or drug use ( $p=0.0001$ ) were significantly more likely to have embedded total risk networks. When the drug and sex networks were separated, only those who experience racial discrimination and discrimination due to drug use were more likely to have more embedded sex and drug networks. When looking at heroin and injecting networks only, participants who experienced discrimination due to incarceration and drug use were more likely to have more embedded heroin and injecting networks.

Table 7 shows the adjusted prevalence ratios for the relationship between discrimination due to race and drug use with embedded sex networks and embedded heroin/ injecting networks modified by race/ ethnicity. Heterogeneity of the association of discrimination due to race with sex networks ( $p=0.2542$ ), discrimination due to drug use and sex networks ( $p=0.7353$ ), discrimination due to incarceration and heroin and injecting networks ( $p=0.6335$ ) and discrimination due to drug use and heroin and injecting networks ( $p=0.5318$ ) was not observed according to race/ ethnicity. However, when stratifying the analysis by race/ ethnicity, important differences by racial/ ethnicity were observed. Blacks who experienced discrimination due to race were 1.45 (95% CI: 1.06 – 1.97) times more likely to have more embedded sex networks after adjusting for age, number of female sex partners, number of male sex partners, primary drug used, injection status, lifetime depression and recruitment strategy compared to those who did not experience discrimination. There was no association between racial discrimination and embedded sex networks among Hispanics and whites in the adjusted analysis. Similar, findings were seen the relationship between discrimination due to drug use and embedded sex networks. Specifically, blacks who

reported discrimination due to drug use compared to those who did not were 1.50 (95% CI: 1.10 – 2.03) times more likely were to more embedded sex risk networks. On the other hand, whites who experienced discrimination due to incarceration were significantly more likely to have embedded heroin and injecting risk networks while no relationship existed for blacks and Hispanics. When adjusting for discrimination due to race and drug use, simultaneously, no association was present for either type of discrimination.

Whites who experienced discrimination due to incarceration were 2.02 (95% CI: 1.09 – 3.74) times more likely to have more embedded heroin and injecting networks than those who did not experience drug use discrimination after adjusting for age, sex, age at sexual debut, primary drug used, injection status, lifetime depression and recruitment strategy. Whites who experienced discrimination due to drug use compared to those who did not were also significantly more likely (PR: 1.59; 95% CI: 1.07 – 2.37) to have embedded heroin and injecting networks after adjusting for age, sex, age at sexual debut, primary drug used, injection status, lifetime depression and recruitment strategy. Having more embedded heroin and injecting networks was consistent for Hispanics who experienced discrimination due to drug use (PR: 1.42; 95% CI: 1.05 – 1.92) compared to those who did not after adjusting for age, sex, age at sexual debut, primary drug used, injection status, lifetime depression and recruitment strategy. But this relationship was not important among blacks. When adjusting for discrimination due to incarceration and drug use simultaneously, no association was present for either type of discrimination.

The results of the analysis assessing networks continuously showed similar patterns except for the relationship between discrimination due to incarceration and embedded heroin and injecting networks (data not shown). Discrimination due to incarceration was significant among Hispanics ( $\beta=0.34$ ;  $p=0.0174$ ) but not among whites ( $\beta=0.35$ ;  $p=0.1283$ ). No relationship between discrimination due to incarceration and embedded heroin and injecting networks existed among blacks when networks were assessed continuously or categorically.

## Discussion

This study found that the relationship between discrimination and high risk networks was not modified by race/ ethnicity. However, important differences by race/ ethnicity were noted in the relationship between discrimination and embedded risk networks. Specifically, the relationship between discrimination due to race and drug use with embedded sex networks was significant for blacks but not for Hispanics or whites. Additionally, the relationship between discrimination due to incarceration with embedded heroin and injection networks was only significant among whites and the relationship between drug use discrimination and embedded heroin and injection networks was only significant among Hispanics and whites.

Although it was not of significant magnitude, we did expect that blacks and Hispanics who experienced discrimination would have more embedded risk networks. However, we did not posit that the association between discrimination and high risk social networks would be modified among whites. Nevertheless, these results may still help explain how racial/ ethnic disparities in HIV persist among black substance users compared to white substance users. For example, a host of interventions (disinfection of syringes with bleach<sup>116,117</sup>, syringe exchange<sup>118</sup>, and syringe access in pharmacies<sup>82,119</sup>) within a harm reduction framework have been implemented for injection drug users to prevent the transmission of HIV. And due to the success of such programs, racial/ ethnic groups (e.g., whites) that are more likely to inject drugs have had a reduced chance of contracting disease because their opportunity for exposure through syringe sharing has been decreased. On the contrary, behavioral interventions have made little, if any headway for non-IDUs who transmit HIV through sexual contact<sup>4-6</sup>. Thus, racial/ ethnic groups (e.g., blacks) that are more likely to engage in non-injection drug use continue to be at high risk for HIV through sexual transmission because interventions have been less successful at promoting healthy sex behaviors in this population. This study adds to current literature showing that blacks are at a higher risk for sexual transmission<sup>61</sup>, because this study shows that blacks who experience discrimination due to their race and drug use are even more likely to have embedded sexual networks compared to blacks who don't experience discrimination.



Our findings that show a higher likelihood of embedded heroin and injecting networks among Hispanics and whites that experience discrimination can also be explained by the fact that Hispanics and whites are more likely to use heroin and inject drugs compared to blacks in this study and previous reports<sup>55,57</sup>. Since heroin users and IDUs are more prone to visual designation as a drug user because of the physical manifestations of heroin use (i.e. track marks, droopy eyes, drowsiness, etc...) and paraphernalia for heroin injection (i.e. syringes, tourniquet, cotton, etc...) their likelihood of experiencing discrimination due to drug use may have been increased thereby increasing their likelihood of having more embedded high risk networks. Physical manifestations of heroin use and possession of drug paraphernalia may also result in unfair police harassment which would explain more embedded high risk networks among whites who have experienced discrimination due to incarceration. It is also possible that Hispanic and white heroin users and IDUs have increased numbers of relationships with other heroin users and IDUs as a function of their drug use. So, they may share drugs or injection equipment and these relationships are established through this pathway instead of discrimination. In order to tease out any effect of network development due to similar patterns of drug use we controlled for primary type of drug used and the association between discrimination due to incarceration and drug use with embedded heroin and injecting networks persisted. Therefore, it is likely that the high risk relationships seen among those who experienced discrimination are not the result of individual drug use practices and experiences of discrimination are independently important to understanding how high risk networks that may facilitate HIV transmission are formed.

The results of this study have several limitations. Self-reporting bias may have biased results if social desirability influenced responses in one racial group more than another. However, there is no evidence to support differential reports by race/ ethnicity, therefore any bias present would be towards the null. Differences in the samples recruited by TSS and RDS were different which may have introduced selection bias into the study. However, we adjusted for differences in sampling strategy in the analysis. Measurement bias may have also been present due to the one item measure of discrimination which may not suitably capture the construct of discrimination. But, any

biases in measurement by race/ ethnicity would be non-differential and therefore bias the results towards the null. However, future studies on discrimination among drug users could benefit from more refined discrimination assessments that utilize vignettes to hone in on the specific construct of discrimination of interest (e.g., discrimination due to incarceration, race, drug use, poverty). Categorization of racial/ ethnic groups may also be a limitation since Hispanics who identified as blacks were combined with all Hispanics in this study since Hispanic ethnicity may confer different interpretations, meanings and experiences of discrimination<sup>86</sup>. However, given that reports of discrimination among Hispanics who identified as black were more similar to Hispanics than blacks, we do not expect that this categorization would affect the results of our study. The measurement of social networks may also present measurement bias. Since all networks were pooled over the past five years and then categorized based on the number of categories of risk they held, networks may have had overlapping risks that were not accounted for. Additionally, differences in networks in each year existed (Appendix 7), but because we assessed lifetime discrimination and could not identify when over the lifetime discrimination occurred, we used a complete picture of risk networks that participants have encountered with the rationale that despite outward network turnover, the network posed some form of risk to the participant during their relationship. Future studies should assess changes in network structure over time and whether a gradient in risk network exists among those who report discrimination. Finally, since this analysis utilizes cross-sectional data, we are unable to establish temporality which could be achieved if at the onset of drug use, drug users were prospectively followed to determine risk of developing a risk network after a discriminatory experience.

This study is benefited by the rare availability of data on discrimination and a five year behavioral history of social networks that has been validated for use among drug users. This provides us with a unique opportunity to investigate the social network relationships among those who experience discrimination to understand racial/ ethnic disparities in HIV. Investigating this pathway to understand racial/ ethnic disparities in HIV has never been done and given the

positive results of this study, there are several implications for future research on racial/ ethnic disparities in HIV and discrimination.

Future studies should be conducted to confirm the findings of this study and further explicate the process between discrimination and social network development. Given consistent results, several HIV prevention/ reduction interventions can be implemented to reduce and buffer the negative effects of high risk social network formation. For example, social service providers and other service providers can screen for experiences of discrimination and among those who are discriminated against, harm reduction strategies can be implemented to prevent and reduce unhealthy behavior within network relationships. Additionally, training can be provided to drug users that teach them how to share safe health behavior information within their network<sup>109-111</sup>. Structural interventions that alter the view of and treatment towards drug users can also be performed. Such interventions can include educational campaigns in high-drug use communities that 1) educate about drug use as a disease rather than a behavior that is criminalized<sup>31</sup> and 2) increase awareness that negative treatment towards drug users may increase transmission of disease in particular communities (e.g., black and Hispanic) that are disproportionately affected by HIV. Increases in educational awareness may encourage community members to be more sensitive towards drug users and thus reduce isolation of the drug using population into riskier network structures. Safe spaces or safe havens can also be created on a structural level that provide drug users with opportunities to establish positive networks and create places where drug users will not receive negative treatment because of their drug use. Lobbying with organizations that are powerful in these communities (e.g., churches) may also help to structurally change treatment towards drug users which will reduce their potential of developing high risk networks and facilitating HIV transmission. In the face of a host of unsuccessful interventions aimed at reducing racial/ ethnic disparities in HIV<sup>4-6</sup>, it is imperative that alternate pathways that cause racial/ ethnic disparities be examined so that alternate interventions and strategies to reduce and ameliorate disparities can be implemented. Moreover, the influence of other salient social factors such as neighborhood characteristics, that may influence experiences of discrimination due to

processes of residential segregation, should also be examined as an important structural component for how racial/ ethnic disparities persist.

Chapter 5: Neighborhood differences in the relationship between discrimination and high risk social networks among illicit drug users

## Introduction

While a large body of research has shown that social network characteristics are highly linked to HIV risk behaviors, particularly among injection drug users (IDUs), little is known about the social factors associated with belonging to high risk social networks among illicit drug users. Studies have shown that increased numbers of crack users in ones' network confers higher odds of participation in transactional sex<sup>15</sup>, large network size is associated with frequent needle sharing<sup>15,18</sup>, and network centrality ( i.e., number of network ties) is associated with needle sharing<sup>10</sup>. While these findings are fairly well established, there is a paucity of empirical evidence on the social processes associated with high risk drug and sexual networks. This information can further strengthen social network based interventions aimed at prevention of infectious disease transmission, particularly HIV.

Neighborhood characteristics are one set of factors that may influence the formation of social networks. Neighborhood characteristics including minority composition<sup>68-70</sup>, poverty<sup>67</sup>, education level<sup>68</sup> and social cohesion<sup>75</sup> are associated with perceived social stress (e.g., drug dealing, loitering and theft) and drug use patterns including injection onset, injection cessation and injection incidence. It is plausible that conditions of the neighborhood environment may also be important in high risk social network development since neighborhood characteristics have the potential to 1) incite and normalize negative behaviors and relationships<sup>71</sup> and/ or 2) provide a level of social support and cohesion that acts against negative neighborhood characteristics that are potentially deleterious to health<sup>71</sup>. Moreover, neighborhood factors associated with drug use and drug dealing may also influence the chances of developing drug-using risk relationships that pose risk to health.

While neighborhood factors likely increase the potential for high risk relationships, experiences of social discrimination within such neighborhood conditions may be the mechanism through which high risk relationships are developed.<sup>28-30</sup> For example, studies have shown that neighborhood characteristics such as minority composition are associated with higher levels of crime and drug

activity. And as such, these neighborhood problems may incite higher levels of police surveillance and the potential for police harassment and discrimination due to incarceration or arrest<sup>73</sup>. As a result of the incarceration process and its negative consequences (e.g., employment, housing), the chances of entering into a relationship with someone with a history of incarceration or arrest, within a neighborhood of high drug activity is increased. Similarly, given that drug use is criminalized, the potential for experiencing discrimination due to drug use may also be exacerbated in such neighborhoods<sup>31</sup>, resulting in drug users becoming further isolated from the general population and more highly concentrated in drug-using networks.

Contrary to this argument, a recent study by Dailey and colleagues found that reports of racial discrimination were not associated with neighborhood racial composition and socioeconomic position<sup>74</sup>. Because this study only assessed racial discrimination, it is possible that individuals in neighborhoods of higher minority composition and homogeneity have a smaller chance of experiencing racial discrimination or identifying experiences of racial discrimination compared to neighborhoods that have lower levels of minority composition. Alternatively, racially homogenous neighborhoods may have higher levels of social cohesion which could influence lower levels of drug use<sup>75</sup>. Since socially cohesive neighborhoods provide a more tightly knit community that is more respectful and less judgmental of its members, they may buffer against discrimination and the development of risk relationships, even in more racially heterogeneous neighborhoods where minorities are more likely to come in contact with racist experiences.

Given the importance of neighborhood characteristics on drug use behaviors, this study will examine whether neighborhood minority composition, poverty level, education level, and social cohesion influence the relationship between various types of discrimination and high risk social networks. We hypothesize that persons that are members of neighborhoods characterized by either high minority composition, poverty, low education or poor social cohesion are more likely to experience discrimination due to incarceration, race and drug use, and therefore more likely to have a high risk sex and drug-using networks.

## Methods

Detailed explanations of the methods are described in the general methods section (Chapter 2).

### Study Population

Between August 2005 to January 2009, 652 injection drug users (IDUs) and non-IDUs (NIDUs) were recruited into the Social Ties Associated with Transition into injection drug use (START) study. START employed a 1) prospective study design among heavy NIDUs who never injected and use heroin, crack or cocaine and 2) a cross-sectional assessment among recently initiated IDUs. Participants were recruited into START using targeted sampling strategies (TSS) and respondent driven sampling (RDS) given the difficulty in reaching the target population. A description of the TSS employed for this study has been described elsewhere<sup>76</sup>, but in brief TSS was completed in ethnographically mapped high drug activity neighborhoods in Harlem, Lower East Side, South Bronx, Jamaica-Queens and Bedford-Stuyvesant-Brooklyn. RDS, a chain sampling referral strategy, was employed to enhance generalizability of the final sample and reach drug users who are harder to reach<sup>77,78</sup>.

To be eligible for the study individuals had to be between the ages of 18 and 40. IDUs had to report injecting heroin, crack or cocaine for four years or less and at least once in the past 6 months; heavy NIDUs had to report non-injection use of heroin, crack or cocaine for 1 year or more at least 2-3 times a week in the past 3 months. Participant age was verified with a form of photo identification (e.g., driver's license, state identification). Drug use was verified with a rapid drug test which detected opiate and cocaine metabolites in the urine and injection status was verified by visual track marks (i.e. stigmata). All participants were required to provide informed consent for participation in survey instruments which was approved by the Institutional Review Boards of Columbia University and New York Academy of Medicine. Participants were compensated \$30 and travel costs for each interview.

### Data collection



Eligible and consenting IDUs and NIDUs completed face-to-face interviewer-administered survey instruments. This study also included 6-month, 12-month and 18-month follow-up interviewer-administered surveys among NIDUs only. Only baseline data collected from NIDUs and cross sectional data collected among IDUs were included in the analyses.

Survey instruments included questions on demographic characteristics, injection and non-injection drug use practices, arrest patterns, sexual practices, traumatic events, drug treatment, mental health, discrimination experiences as well as a behavioral risk and social network history spanning five years prior to study entry. Participants were asked to retrospectively recall behaviors and individuals that were a part of their social network year-by-year. Recalling behavioral histories has been shown to yield valid responses (using construct validity techniques) among IDUs using a ten-year reconstruction of behavioral histories<sup>80,81</sup>. This study uses a shorter period of recall (five as opposed to the validated ten-year behavioral history) which should provide more confidence in the recall of social network history provided over the past five years.

#### Individual-Level Variables

Using the social network and behavioral history, a network embeddedness risk score was used to define the outcome was created by pooling social network information over the past five years to gain an overall picture of the network characteristics<sup>83</sup>. Network embeddedness is defined as the total amount of risk an individual could potentially be exposed to within their network. The network embeddedness risk score captures the total number of high risk persons (e.g., any person that held sexual or drug use risk for disease transmission) within ones social network that could potentially expose the individual to some form of risk. A score was created by tallying the total numbers of networks for each risk group (i.e. sexual, drug and/or injecting group members). There were four embeddedness outcomes examined 1) sex networks (sexual networks and networks who participate in transactional sex); 2) drug networks (networks that use crack, heroin, inject and networks drugs are used with); 3) injecting networks (networks that use heroin and inject drugs); and 4) a total risk network variable was created which included all sex and drug

networks identified above as well as networks that had ever spent time in jail. Since the sum of networks for each variable was right skewed and the median for the injecting networks was zero, we chose to dichotomize on the 75<sup>th</sup> percent cutoff for all outcome variables for consistency. Therefore, total sex networks were assessed as having four or more vs. less than four, total drug networks were assessed as having seven or more vs. less than seven, heroin and injecting networks were assessed as having two or more vs. less than two and the total risk network variable was assessed as having 13 or more vs. less than 13.

Discrimination due to incarceration, race and drug use were the main exposures of interest. Discrimination was collected using one item modified from previous discrimination studies<sup>84,85</sup> for drug using populations<sup>34</sup>: "In your lifetime, have you ever been discriminated against, prevented from doing something, or been hassled or made to feel inferior because of any of the following?" Available response categories included, age, race, sex (gender), sexual orientation, poverty, drug use, having been in jail or prison, religion, mental illness, physical illness, other and I have never been discriminated against. Participants could respond in the affirmative or non-affirmative to each type of discrimination. For this analysis, the three most prevalent types of discrimination in the population<sup>37</sup> were assessed: lifetime discrimination due to race, drug use and having been in jail or prison (hereafter referred to as incarceration) were assessed. For discrimination due to incarceration, only persons that reported spending time in jail or prison in their lifetime were included (n=468).

Variables previously identified in the literature as potential confounders were also assessed<sup>12,14,18,20</sup>. Age was assessed continuously. Race/ ethnicity was categorized as Hispanic, non-Hispanic black and non-Hispanic whites were combined with all Other racial/ ethnic groups (Asian or Pacific Islander, Native American, Eskimo, or Aleutian, Black and Hispanic, Mixed and Other). Hispanics who identified as black (n=5) were combined with Hispanics rather than non-Hispanic blacks since being of Hispanic ethnicity may confer different interpretations, meanings and experiences of discrimination<sup>86</sup>. Gender included those who self-identified as male and female.

Transgendered persons were excluded due to small sample sizes (n=5). Education categories were less than a high school education and a high school or general equivalency degree (GED) or more. Income categories included those with less than \$5,000 income, and income of \$5,000 or more. Number of female and male sex partners as well as age at sexual debut was assessed continuously. Condom use with females and males were dichotomized into those that always used condoms vs. sometimes and never used condoms with sexual partners in the past two months. HIV testing frequency was dichotomized into those that had been tested  $\leq 3$  times vs.  $\geq 4$  times. Mental health status was measured as lifetime depression which was assessed using the question from the Composite International Diagnostic Interview (CIDI) which asked "In your lifetime, have you ever had a period of at least two weeks when nearly every day you felt, sad, depressed, or empty most of the time," with available responses as yes and no<sup>88</sup>. Injection status was dichotomized (yes/ no) and categories for primary type of drug used included primarily cocaine, primarily crack cocaine, primarily heroin, and polytomous drug use of all three drug types equally. We also assessed sampling strategy (RDS vs. TSS) to ensure that no differences existed by recruitment.

#### Neighborhood-Level Variables

Participants were asked what neighborhood and the cross streets in which they were recruited to participate in the study either through TSS or RDS. These neighborhoods were chosen as opposed to home addresses because most participants spent at least half of their time or more (84.28%) in these neighborhoods. Other studies have identified recruitment neighborhoods as those within which they frequently hang out, cop drugs, and develop relationships with other people<sup>68</sup>. Participant recruitment neighborhoods were geo-coded to the census tract and zip code.

Using Summary Tape Files 2 and 3 from the 2000 US Census, we obtained data on neighborhood minority composition (percent black and percent Latino), poverty (percent living below 100% of the poverty threshold) and education (percent with less than a high school

degree) from census tracts represented in the data. Tracts with missing observations were excluded from the analysis (n=9).

Data on neighborhood social cohesion was taken from an anonymous random-digit-dial (RDD) telephone survey of 979 community residents in Harlem, Bronx, and Brooklyn<sup>82</sup>. This survey was conducted as part of a separate community-based structural intervention at the New York Academy of Medicine where community residents were asked about their attitudes and opinions towards drug use, crime, HIV, and HIV prevention through the implementation of a pharmacy syringe access program which legalized the sale of syringes. Surveys were administered in both English and Spanish and took about 25 minutes to complete. All Spanish surveys were back-translated for accuracy and consistency. The social cohesion/ collective efficacy score was calculated using the likert scale described by Sampson et al<sup>87</sup>. In brief, community residents were asked how strongly they agreed on 10 items assessing perceptions of neighborhood trust, shared values and safety. Available responses were on a five-point scale. Scores were averaged and aggregated to the zip code of corresponding participant hang outs. Zip codes with missing observations were excluded from this analysis (n=2).

All neighborhood variables (percent black, percent Latino, percent poverty, percent <high school education and social cohesion) were categorized into tertiles based on the distribution of the variable. Cut-points for neighborhood variables were, <44.04%, 44.04 – 75.78% and >75.78% for percent black, <20.09%, 20.09 – 49.77% and >49.77% for percent Latino, <31.46%, 31.46 – 49.12% and >49.12% for percent poverty, <70.61%, 70.61 – 78.41%, and >78.41% for percent high school education, and <3.37, 3.37 – 3.61 and >3.61 for social cohesion/ collective efficacy. Hereafter, tertile cut-points specifying the percent of residents in the neighborhood by the specified characteristic will be denoted as low, medium and high.

## Statistical Analysis

Descriptive statistics of the sample were conducted and included calculating measures of location (median) and measures of spread (inter-quartile range) for continuous variables and calculation of frequencies for categorical variables.

To determine which variables to include in the final model, bivariate associations between types of discrimination (e.g., race, incarceration and drug use), neighborhood characteristics and covariates of interest were assessed with respect to high risk sex and drug using network characteristics. For categorical variables, chi-square statistics were used to assess whether statistically significant associations were present. For continuous variables, Mann-Whitney tests were calculated to determine whether statistically significant differences exist between the medians. Variables that showed a statistically significant effect on an outcome at the 0.05 level in the bivariate analysis were included in an adjusted log-binomial regression model to determine the independent relationship between each type of discrimination (e.g., race, drug use, and incarceration) and drug and sex risk networks, after taking into account individual sexual risk behaviors (e.g., lack of condom use, infrequent HIV testing and multiple sex partners). The SAS GENMOD procedure was used to take into account clustering of variables on the tract level of Census variables and the zip code level for the social cohesion/ collective efficacy variable. We used log-binomial regression specifying a Poisson distribution to estimate the prevalence ratio given the high prevalence of the embedded network outcomes and take into account sparse cells of data. Two-way interactions between discrimination and neighborhood characteristics identified as important in the bivariate analysis ( $p < 0.05$ ) were tested and the data were also analyzed by stratifying the results by the important neighborhood characteristics. Multi-level analyses were also performed using mixed models to determine whether results were consistent (Appendix 8). Given that the results were almost identical, the population average models only are presented here to avoid failure in meeting assumptions of independence between and within individual and hierarchical level observations<sup>120</sup>. All analyses were performed using SAS version 9.2<sup>106</sup>.

## Results

### Population characteristics

Descriptive characteristics of the sample are described in Table 8. The median age was 33 (IQR: 23- 37). Participants were more likely to be black, male, have less than a high school education, make  $\leq$ \$5,000 annually and be divorced or single. In terms of sexual behaviors, the median number of female sex partners was 1 (IQR: 0 – 2) and of those who had sex with females, most used condoms sometimes and never. The median number of male sex partners was 0 (IQR: 0 -1) and of those with male partners, most used condoms sometimes and never. The median age at sexual debut was 14 (IQR: 12 – 16) and most participants received four or more HIV tests in their lifetime. Almost 60% experienced depression in their lifetime. Most participants were recruited through RDS.

Participants were more likely to hang out in neighborhoods characterized with medium percentages of blacks, Latinos and residents living below the poverty threshold. Neighborhoods that participants hung out had low percentages of people with a high school education and low social cohesion/ collective efficacy scores. About 25% of participants reported discrimination due to incarceration, 25.9% reported racial discrimination and 32.8% reported discrimination due to drug use. Embedded sex and drug networks were prevalent; 27.4% had embedded total sex and drug risk networks. When sex and drug embedded networks were assessed separately, 30.8% had embedded sex networks, 30.0% had embedded drug networks and 30.0% had embedded heroin and injecting networks.

### Bivariate analysis

Few neighborhood characteristics were significantly associated with embedded risk networks in the bivariate analysis (Table 9). Specifically, only participants who hung out in neighborhoods characterized by low percentages of black residents, low social cohesion/ collective efficacy, and high percentages of residents with less education were significantly more likely to have highly embedded heroin and injecting networks. In the bivariate analysis, all types of discrimination were

associated with embedded total sex and drug risk networks. When sex and drug networks were assessed separately, only discrimination due to race and drug use were important. Specific to heroin and injecting networks, discrimination due to incarceration and drug use were the only types of discrimination important for having more embedded heroin and injecting networks.

#### Adjusted analysis

In the adjusted analysis, heterogeneity of the association of discrimination due to incarceration and drug use with embedded heroin and injecting networks with neighborhood characteristics (percent black, percent < high school education, social cohesion) was not observed. However, when stratified by neighborhood characteristics, some differences were noted among those who reported experiencing discrimination due to race and drug use (Table 10). Specifically, those who experienced discrimination due to drug use in neighborhoods with low percentages of blacks (PR: 1.79; 95%CI: 1.29 – 2.48), medium percentages of people with less education (PR: 1.63; 95%CI: 1.10 – 2.41) and low levels of social cohesion/ collective efficacy (PR: 1.57; 95%CI: 1.17 – 2.12) were more likely to have had more embedded heroin and injecting networks after adjustment. Among neighborhoods with high percentages of people with less than a high school education, those who experienced discrimination due to drug use (PR: 1.45; 95%CI: 0.98 – 2.15; p=0.06) were marginally more likely to have more embedded sex and drug risk networks.

#### Discussion

The major finding in this study is that neighborhood social characteristics including minority composition, education and social cohesion are important in the relationship between discrimination and high risk social networks. While these neighborhood factors were not significant modifiers in the relationship between discrimination and embedded risk networks, members of neighborhoods with fewer black residents, less education and poorer social cohesion who experienced discrimination due to drug use had more embedded heroin and injecting networks.

To our knowledge, this is the first study to investigate the influence of neighborhood on the relationship between discrimination and high risk social networks. These findings and those from Dailey et al who examined the importance of neighborhood on perceptions of discrimination suggest that further examination of experiences of discrimination should take neighborhood characteristics into account. Our findings were consistent and support our explanation for the contrary findings by Dailey and colleagues, namely that members of neighborhoods with more minorities were less likely to report racial discrimination (Appendix 9). Our study goes further in that we found that among neighborhoods with fewer black residents, those who experienced discrimination were significantly more likely to have more embedded heroin and injecting networks. Since being a member of a more racially integrated (i.e. fewer minorities) neighborhood may increase the chances of a racial/ ethnic minority person encountering a racist or other discriminatory event, we also examined the role of social cohesion in the relationship between discrimination and embedded risk networks independently and while adjusting for minority composition simultaneously. Neighborhoods with low social cohesion were found to have a significant independent relationship between discrimination due to drug use and embedded heroin and injecting risk networks. And when adjusting for social cohesion and minority composition simultaneously, the effect of discrimination on embedded heroin and injecting networks among low percent black neighborhoods disappeared (Appendix 10). This suggests that it is not the racial make-up of the neighborhood, but an underlying level of cohesion within neighborhoods with more black residents that buffers against the negative effects of discrimination. Social cohesion may buffer against risk relationships because residents of close knit communities are less judgmental and more accepting of its neighborhood residents. Alternatively, neighborhoods with high social cohesion may also inherently have fewer risk relationships available because of lower drug use, drug dealing and other neighborhood problems. Further examination of the role of social cohesion on neighborhood characteristics (e.g., high minority composition)<sup>75</sup> that have historically disadvantaged neighborhood communities should be explored to support or challenge this plausible explanation<sup>63</sup>.



While our findings were consistent with Dailey et al in regards to discrimination reports among neighborhoods with high minority composition, we did not find differences in reports of discrimination in neighborhoods with lower education levels (Appendix 9) whereas Dailey et al showed that members of disadvantaged neighborhoods were less likely to report racial discrimination. These differences may exist because Dailey et al examined disadvantage using the Socioeconomic Position Index, which includes many predictors of financial neighborhood disadvantage and our study assessed neighborhood education individually. Although we did not find differences in reports of discrimination by neighborhood education, we did find that persons who experience discrimination due to drug use who are members of neighborhoods characterized by lower education have different social consequences in that they have more embedded heroin and injecting risk networks. We examined the role of social cohesion in the relationship between discrimination and embedded heroin and injecting networks among lower educated neighborhoods, but the effect of discrimination on heroin and injecting risk networks persisted and was stronger for neighborhoods with fewer residents with higher education. This may be a result of differences in drug activity in lower educated neighborhoods which inherently increase the likelihood of experiencing discrimination due to drug use as well as developing high risk drug using relationships. In a study assessing the social and environmental factors important in the drug use system, having low educational attainment followed by being black and having low income were important indicators of living in a neighborhood where one could see drugs being sold, see people “high” frequently and marijuana could be easily obtained<sup>121</sup>. Therefore, given potential differences in exposure to drug activity by education level, the role of discrimination in neighborhoods where residents have lower education warrants further investigation.

The results of this study have several limitations. Self-reporting bias may be present due to the sensitive nature of the study which asked questions about drug use, sexual practices and experiences of discrimination. It is likely that participants’ under-reported high risk practices, but there is no evidence to suggest that this occurs differentially by neighborhood, therefore any bias would likely be in the direction of the null. Since participants were recruited using RDS and TSS,

participants were likely to be different in terms of risk networks by recruitment strategy<sup>122</sup>. In order to isolate any effect based on differences in recruitment, we adjusted for sampling strategy in the adjusted analysis. Measurement bias may have also been present due to poor measurement of discrimination and social networks. Specifically, discrimination was asked using one question which may not have been suitable to accurately capture experiences of discrimination. Further, this measure of discrimination has not been validated among illicit drug users. As a result, reports of discrimination may be over or under-estimated. However, we do not expect error in measurement to be differential by neighborhood characteristics and therefore any bias present would be towards the null. Additional studies validating the use of the discrimination measure used in this study, as well as detailed vignettes that capture types, levels and appraisal of the various types of discrimination among illicit drug users is needed. Measurement error in social networks may also be over or under-estimated. For example, individuals may be unsure of their networks drug using practices so reports of networks risk behaviors may not be accurately described. Additionally, individuals may not recall all individuals that were a part of their network. The instrument used to measure social networks has been validated among IDUs over a ten year period. This study assessed social networks among IDUs and NIDUs over a five year period, therefore we expect recall to be more accurate. Further, we do not expect differences in recall by neighborhood characteristics and thus, any bias present in this analysis would be towards the null. Since this study measured embeddedness of risk within one's network over a five year period, risk networks, particularly those in the total risk network group, may overlap. Additionally, networks that also conferred support may be a part of the risk network. Future analyses should parse out the effects of networks that hold multiple risks as well as assets. Finally, related to the embedded sex network outcome, varying types of sexual risk networks with different levels of risk were combined which may have attenuated the effect between discrimination and high risk sex networks. When male, female and transactional sex networks were examined independently, the directionality of the associations was similar, but the magnitude of effect was strongest for transactional sex networks (Appendix 2). Therefore, the results for embedded sex networks may be an underestimate of the true effect.

Also, related to measurement error, this study utilizes data from the 2000 US Census which was collected on neighborhoods between 1990 and 2000. Therefore, the neighborhood characteristics representing neighborhoods in this study, where participants were recruited between 2005 and 2010, may not accurately reflect the current composition of neighborhoods especially given rapid neighborhood changes due to gentrification. A study by Geronimus and Bound found that bias related to changes in neighborhood socioeconomic predictors including education over a 10-year period is minimal at best<sup>123</sup>. Therefore, minimal changes would likely not affect the results of this study. Future analyses should utilize 2010 Census data once they become available to ensure that there are no changes in the results. Other neighborhood limitations include the use of neighborhood tracts and zip codes to delineate neighborhood boundaries that may not be accurate and congruency in parallel neighborhoods may have resulted in dependency and shared risk between neighborhoods<sup>63</sup>. Further, because participants were recruited in homogenous high drug activity neighborhoods, it may have limited our ability to detect important contextual effects. In such cases, we would expect our data to underestimate the true effect given that tracts and zip codes are relatively small areas compared to larger neighborhood areas which cut-off and likely mask parallel neighborhoods characteristics. Also, the use of participant hangout rather than home address may be a limitation, but because these neighborhoods were such that participants spent most of their time and felt more connected to, they are likely the most appropriate for a highly transient drug using population. Lastly, since this analysis was performed on cross-sectional data, we are unable to determine temporality. Investigation of drug users risk network development over time (which is underway with these data) and the life course would provide temporality and strengthen the investigation of this study.

With the limitations acknowledged, this study is also benefited by several strengths. This study was able to assess the relationship between various forms of social discrimination and high risk social networks among disadvantaged neighborhoods with a relatively sizable sample of heavy, illicit drug users. The availability of data on experiences of discrimination, social network

relationships and neighborhood data are unique and provide us with an inimitable opportunity to address an important question for understanding how relationships that facilitate HIV transmission are developed. To our knowledge, this question has not been addressed and its results have important implications for conduct of future social and infectious disease epidemiologic research. This study has highlighted that differences in the process of discrimination may exist in neighborhoods characterized by different levels of disadvantage, education and social cohesion. This is important to understand when assessing how the process of discrimination may impact health behaviors and health outcomes. Further, the results of this study suggest that underlying neighborhood constructs such as social cohesion may be important to consider when assessing neighborhood disadvantage. Such constructs are rarely assessed in neighborhood studies that mostly proxy neighborhood disadvantage based on neighborhood characteristics taken from US Census data<sup>63</sup>. Future research should address whether neighborhood characteristics, particularly social cohesion, influence the relationship between discrimination and high risk social network relationships over time to understand whether neighborhood factors are sustaining in their influence of buffering against the negative impact of discrimination. Consistency of these findings may highlight an important and feasible intervention point for improving health outcomes among populations that are more likely to experience discrimination. Neighborhood interventions that increase neighborhood social support and camaraderie through social events, neighborhood beautification projects and campaigns that increase knowledge and promote healthy behaviors around shared neighborhood values and concerns such as drug dealing, drug use and violence may be useful and should be explored. Finally, given the potential importance of discrimination on the development of high risk networks independent of negative neighborhood characteristics, further examination of the processes that facilitate the development of negative social relationships after an experience of discrimination is needed. An understanding of whether discrimination results in individual isolation of one's self or systematically isolates people into high risk networks and excludes them from beneficial social relationships will help in the development of tailored of interventions that counteract the negative effects of social discrimination and ultimately disparities in HIV.

## Chapter 6: Conclusion

As a means to explain pervasive racial/ ethnic disparities in HIV among illicit drug users, this dissertation examined the association between various forms of social discrimination and risky social networks that potentially facilitate transmission of HIV. Using cross-sectional data from injection and non-injection drug users, this dissertation found that various forms of discrimination are significantly associated with more drug and sexual risk networks. Specifically, discrimination due to incarceration, race and drug use were significantly associated with more embedded drug and sexual risk networks. And when accounting for experiencing multiple types of discrimination, discrimination due to drug use remained independently important for the relationship with embedded drug and sexual risk networks.

Related to understanding how these associations may perpetuate and exacerbate racial/ ethnic disparities in HIV is the finding that the relationship between discrimination and risk networks was modified by race/ ethnicity. Specifically, the association between racial and drug use discrimination and having more embedded sex networks was significant for blacks but not for Hispanics or whites. Additionally, the relationship between discrimination due to incarceration with embedded heroin and injection networks was only significant among whites and the relationship between drug use discrimination and embedded heroin and injection networks was only significant among Hispanics and whites.

Given that neighborhood characteristics may be an important factor for exposure to discrimination as well as an important factor for the types of social networks that we are exposed to, we also examined the role of neighborhood. We found that the relationship between drug use discrimination and more embedded heroin and injecting networks was magnified among illicit drug users that are members of neighborhoods characterized by lower minority composition, less education and poorer social cohesion.

These findings are important because they provide empirical evidence for how social processes can directly influence one's HIV risk by influencing the types of risk relationships that a person

can form. To our knowledge, this is the first body of work that has empirically examined how discrimination acts to directly disadvantage and influence disease risk through social network structures. Other studies have shown the influence that risky social networks have on individual disease risk and risk behaviors<sup>20</sup>, but to push the envelope to examine social processes that could influence how risky social networks are developed is important for understanding how HIV transmission has most affected blacks and Hispanics despite their lower sexual and drug use risk behaviors. In a recent article, Friedman discusses the importance of empirically examining structural forces including discrimination, neighborhood segregation and policing and socio-political movements that influence the conditional probability of infection among blacks who are spreading and contracting HIV faster than any other US population. As we progress into the fourth decade of the HIV epidemic, it is critical that the examination of these structural forces not only follows the traditional physiological trajectory that has informed much of our understanding of social determinants on health, but we also consider how structural factors socially expose individuals to material goods, services and relationships (or lack thereof) that are detrimental to our health, health behaviors and health literacy.

Fullilove and colleagues have described familial relationships as forms of social capital that may enhance or mitigate an individuals' ability to navigate and perform in difficult situations (e.g. drug use) that could influence their health outcomes and behaviors<sup>124</sup>. Aligned with this framework as well as that proposed by Friedman, the findings of this dissertation are supportive of the proposed theory (Figure 1) that discrimination influences ones access to vital resources and as a result they develop relationships with others who lack resources or they develop risky relationships as a mode of survival and negation of stereotypical ideals. But, these findings may also be supportive of another important pathway which the vast majority of the social network literature has followed<sup>107,108</sup>. Namely, that we develop relationships with people that we are similar to in terms of weight, happiness, goals, resources, etc... In this study, we adjusted for individual drug use to attempt to parcel out the influence of developing relationships with people because of drug use similarities. But it is possible that residual effects of this pathway persisted. However, since the relationship

between discrimination and risky social networks persisted, the overall findings of this study still suggest that this mechanism may be important in future examinations of social network development – related to risky drug using relationships as well as relationships established among the general population.

This theory may be examined in the general population by examining whether people who report discrimination (due to race) have more drug and sex risk networks. Alternatively, an examination of fewer non-risk/ support networks could also be examined among those who encounter discrimination compared to those who do not. For example, people who experience discrimination may be less likely to have individuals in their network with higher educational attainment, people that they can get accurate health information from, and/ or people they can network with to find a job; all of which are social problems associated with poorer health outcomes. Examination of the process of how we develop social networks that provide these material advantages and disadvantages is important and critical for understanding infectious disease transmission, health information dissemination and could also shed light on how social problems including poverty, poor education and lack of employment cluster to produce inequalities in health.

Future research that examines how social network relationships are developed should examine the temporal relationship between discrimination and risky network development, which this dissertation was unable to determine. Also, the hypotheses tested were not the primary objectives of the parent study. Thus, better measures of social discrimination were not included in the survey instrument. Future studies would benefit from discrimination measures with proven validity<sup>125</sup> as well as those capturing a host of independent constructs of discrimination which we attempted to do using EFA. Finally, a sample recruited using only one sampling strategy rather than two which were used in this study, may also reduce potential biases from dependent observations and potential differences in the samples obtained by each recruitment strategy.



Despite the limitations of this dissertation, the findings of this dissertation provide empirical evidence that support a new way of thinking about the influence of discrimination on health that pushes the envelope in our discussion of social determinants on health. Specifically, instead or in combination with assessing the mental sequelae and stress associated with discrimination, it may also be critical to develop measures that assess the level of material advantage and disadvantage experiences of discrimination may influence, particularly among social networks. These instruments could include measures that assess the number of people in an individuals' network with any medical training and the level of medical training, as these people are generally informal sources of health information. Additionally, assessing other network characteristics (i.e., financial stability, educational attainment, employment mobility) that could provide an individual with opportunities that would improve their livelihood and overall health may also be important to assess.

The results of this research are also important because they may help explain how racial/ ethnic disparities in HIV persist despite lower risk taking behaviors among these racial/ ethnic minorities. Examination of the processes of HIV transmission that are unique to minorities and create and perpetuate racial/ ethnic disparities is pertinent to reducing and ultimately ameliorating HIV. Future studies that use a longitudinal approach to establish a temporal relationship are still needed to confirm these findings and provide strong evidence for a causal relationship. Given similar findings using a longitudinal approach, additional points of intervention that are tailored to either preventing development of risk relationships or providing buffering effects for negative relationships that are established may be useful. Since it is impossible to randomize experiences of discrimination to determine true causality, observational studies of social exposures that do establish temporality but also have some grounding in previously established theories are needed to further support development of interventions on these social exposures that could be detrimental to health.

Finally, the findings of this dissertation are able to extend beyond understanding racial/ ethnic disparities among illicit drug users to examining how disease is transmitted in other marginalized populations. Understanding the social factors that influence how social networks are developed could shed light on how health information and health mis-information reaches marginalized populations and how other risk behaviors (e.g., eating habits, health-seeking behaviors) are spread. This is critical as our world becomes interconnected through social media outlets as clusters of disadvantaged groups have the potential to be further marginalized and have chronic negative exposures to their health.

Table 1. Minimum sample needed for each aim to achieve 80% power

Aim	Power	Alpha	Confounders accounted for	Estimated R <sup>2</sup>	Required N
1	80%	0.05	5	0.05	136
2	80%	0.05	0	0.15 (0.10 due to interaction)	305
3	80%	0.05	0	0.10	19/ census tract

Table 2. Sample population characteristics, START 2006-2009 (n=647)

Demographics		
	n	Median (IQR)
Age	647	33 (28 – 37)
Female sex partners	644	1.0 (0 – 2)
Male sex partners	641	0 (0 – 1)
Age at sexual debut	641	14 (12 – 16)
	n	%
Race/ ethnicity		
Hispanic	240	37.09
Black	316	48.84
White/ Other	91	14.06
Sex		
Male	456	70.48
Female	191	29.52
Education		
< High school	320	49.54
≥High school	326	50.46
Income		
≤\$5,000	507	82.71
>\$5,000	106	17.29
Marital status		
Married	98	15.24
Un-married (single, divorced)	545	84.76
Primary Drug used		
Powder cocaine	62	10.20
Crack cocaine	315	51.81
Heroin	166	27.30
Poly drug use	65	10.69
Injection Status		
Injector	141	21.89
Non-injector	503	78.11
Condom use with females (past two months)		
Always	104	28.11
Sometimes and Never	266	71.89
Condom use with males (past two months)		
Always	66	31.43
Sometimes and Never	144	68.57
HIV testing frequency (lifetime)		
≤3	271	45.32
≥4	327	54.68
Lifetime depression	375	57.96
Sampling		
RDS	421	65.07
TSS	226	34.93

Discrimination measures		
Incarceration <sup>‡</sup>		
Yes	159	33.97
No	309	66.03
Race		
Yes	165	25.94
No	471	74.06
Drug use		
Yes	209	32.86
No	427	67.14
Social risk networks		
Total risk networks		
≥13	176	27.20
<13	471	72.80
Sex risk networks		
≥4	199	30.76
<4	448	69.24
Drug risk networks		
≥7	193	29.83
<7	454	70.17
Heroin and injecting networks		
≥2	194	29.98
<2	453	70.02

<sup>‡</sup>Only includes those who reported spending time in jail or prison in their lifetime (n=468)

Table 3. Bivariate associations between types of discrimination and total, sex, drug and heroin and injecting risk networks over the past 5 years, START 2006-2009

	Total risk networks		Sex risk networks		Drug risk networks		Heroin and Injecting networks	
	High ( $\geq 13$ )		High ( $\geq 4$ )		High ( $\geq 7$ )		High ( $\geq 2$ )	
	%	p-value	%	p-value	%	p-value	%	p-value
<b>Discrimination measures</b>								
<b>Incarceration<sup>*</sup></b>								
Yes	33.33	0.0451	33.96	0.1098	33.33	0.3126	37.74	0.0285
No	24.60		26.82		28.80		27.83	
<b>Race</b>								
Yes	35.15	0.0077	40.00	0.0025	37.58	0.0120	32.12	0.5298
No	24.42		27.39		27.18		29.51	
<b>Drug use</b>								
Yes	36.84	0.0001	36.84	0.0180	39.71	0.0001	43.06	<0.0001
No	22.48		27.63		25.06		23.89	

<sup>\*</sup>Only includes those who reported spending time in jail or prison in their lifetime (n=468)

Table 4. Adjusted prevalence ratios (95% confidence intervals) between various forms of discrimination and total, sex, drug and heroin and injecting risk social networks over the past 5 years, START 2006-2009

Total risk networks				
Discrimination measures	Model 1	Model 2	Model 3	Model 4
Incarceration <sup>‡</sup>	1.07 (1.00 – 1.15)	-	-	1.05 (0.96 – 1.15)
Race	-	1.06 (0.99 – 1.14)	-	1.09 (0.93 – 1.09)
Drug use	-	-	1.08 (1.03 – 1.14)	1.03 (0.95 – 1.12)
Sex networks <sup>**</sup>				
Incarceration <sup>‡</sup>	-	-	-	-
Race	-	1.44 (1.14 – 1.81)	-	1.29 (1.00 – 1.66)
Drug use	-	-	1.44 (1.15 – 1.80)	1.31 (1.02 – 1.67)
Drug networks <sup>***</sup>				
Incarceration <sup>‡</sup>	-	-	-	-
Race	-	1.13 (0.99 – 1.28)	-	1.04 (0.96 – 1.14)
Drug use	-	-	1.09 (1.02 – 1.16)	1.09 (1.00 – 1.19)
Heroin and injecting networks <sup>****</sup>				
Incarceration <sup>‡</sup>	1.17 (0.93 – 1.47)	-	-	-
Race	-	-	-	-
Drug use	-	-	1.45 (1.16 – 1.80)	-

\*Adjusted for marital status, number of male sex partners, age at sexual debut, and primary drug used.

\*\*Adjusted for race, marital status, primary drug used, injection status and recruitment strategy.

\*\*\*Adjusted for marital status and number of male sex partners.

\*\*\*\*Adjusted for race, age, age at sexual debut, primary drug used, injection status and recruitment strategy.

<sup>‡</sup>Only includes those who reported spending time in jail or prison in their lifetime (n=468)

Table 5. Distribution of selected population characteristics by race/ ethnicity, START 2006-2009

Demographics	Total (n=647)	Hispanic (n=240)	Non- Hispanic Black (n=316)	Non- Hispanic White (n=91)	p-value
Median (IQR)					
Age	33 (28 – 37)	31 (27 – 36)	36 (31 – 39)	28 (23 – 34)	<0.0001
Female sex partners	1.0 (0 – 2)	1.0 (0 – 2)	1.0 (0 – 2)	0 (0 – 1)	0.0072
Male sex partners	0 (0 – 1)	0 (0 – 0)	0 (0 – 1)	0 (0 – 1)	<0.0001
Age at sexual debut	14 (12 – 16)	14 (13 – 15)	13 (12 – 15)	14 (13 – 16)	0.0048
%					
Sex					
Male	70.48	82.08	64.87	59.34	<0.0001
Female	29.52	17.92	35.13	40.66	
Education					
< High school	49.54	55.65	49.68	32.97	0.0011
≥High school	50.46	44.35	50.32	67.03	
Income					
≤\$5,000	82.71	80.80	84.90	80.22	0.3748
>\$5,000	17.29	19.20	15.10	19.78	
Marital status					
Married	15.24	15.42	14.70	16.67	0.8962
Un-married	84.76	84.58	85.30	83.33	
Primary Drug used					
Powder cocaine	10.20	11.79	9.86	7.06	<0.0001
Crack cocaine	51.81	33.62	72.11	30.59	
Heroin	27.30	39.74	10.20	52.94	
Poly drug use	10.69	14.85	7.82	9.41	
Injection Status					
Injector	21.89	35.42	2.87	52.22	<0.0001
Non-injector	78.11	64.58	97.13	47.78	
Female Condom use					
Always	28.11	24.68	30.29	31.71	0.4558
Sometimes and Never	71.89	75.32	69.71	68.29	
Male Condom use					
Always	31.43	33.33	35.25	16.22	0.0870
Sometimes and Never	68.57	66.67	64.75	82.78	
HIV testing frequency					
≤3	45.32	42.73	44.78	54.32	0.1940
≥4	54.68	57.27	55.22	45.68	
Lifetime depression	57.96	65.42	53.80	52.75	0.0127
Sampling strategy					
RDS	65.07	32.92	31.33	52.75	0.0006
TSS	34.93	67.08	68.67	47.25	



Discrimination measures					
Incarceration <sup>‡</sup>					
Yes	25.43	29.54	22.26	25.56	0.1532
No	74.57	70.46	77.74	74.44	
Race					
Yes	25.94	22.03	27.42	31.11	0.1755
No	74.06	77.97	72.58	68.89	
Drug use					
Yes	32.86	41.10	25.16	37.78	0.0003
No	67.14	58.90	74.84	62.22	
Social risk networks					
Total risk networks					
≥13	27.20	22.92	30.38	27.47	0.1466
<13	72.80	77.08	69.62	72.53	
Sex risk networks					
≥4	30.76	21.67	37.66	30.77	0.0003
<4	69.24	78.33	62.34	69.23	
Drug risk networks					
≥7	29.83	30.00	29.11	31.87	0.8775
<7	70.17	70.00	70.89	68.13	
Heroin and injecting networks					
≥2	29.98	40.42	17.09	47.25	<0.0001
<2	70.02	59.58	82.91	52.75	

<sup>‡</sup>Only includes those that reported spending time in jail or prison in their lifetime (n=468)

Table 6. Bivariate associations between selected demographics and total, sex, drug and heroin and injecting risk networks over the past 5 years, START 2006-2009

	Total risk networks		Sex risk networks		Drug risk networks		Heroin and Injecting networks	
	High ( $\geq 13$ )		High ( $\geq 4$ )		High ( $\geq 7$ )		High ( $\geq 2$ )	
	Median (IQR)	p-value	Median (IQR)	p-value	Median (IQR)	p-value	Median (IQR)	p-value
Age	33 (28-37)	0.6325	32 (28-37)	0.0698	34 (29-37)	0.7682	32 (27-37)	0.0137
Female sex partners	1 (0-2)	0.6098	1 (0-3)	0.0068	1 (0-2)	0.6837	1 (0-1)	0.2338
Male sex partners	0 (0-3)	<0.0001	0 (0-3)	<0.0001	0 (0-1.5)	0.0049	0 (0-1)	0.3523
Age at sexual debut	14 (12-15)	0.0528	14 (12-16)	0.1296	14 (12-16)	0.6793	14 (12-16)	0.0659
	%	p-value	%	p-value	%	p-value	%	p-value
Sex								
Male	25.88	0.2418	30.26	0.6739	29.17	0.5688	28.95	0.3736
Female	30.37		31.94		31.41		32.46	
Race								
Hispanic	22.92	0.1466	21.67	0.0003	30.00	0.8755	40.42	<0.0001
Black	30.38		37.66		29.11		17.09	
White	27.47		30.77		31.87		47.25	
Education								
< High school	26.88	0.8344	30.00	0.6606	28.75	0.5355	30.94	0.6185
$\geq$ High school	27.61		31.60		30.98		29.14	
Income								
$\leq$ \$5,000	27.61	0.3951	30.37	0.7298	29.78	0.9399	29.39	0.2612
$>$ \$5,000	23.58		32.08		30.19		34.91	
Marital status								
Married	13.27	0.0007	18.37	0.0038	18.37	0.0063	28.47	0.7079
Un-married	29.91		33.03		32.11		30.46	
Primary Drug used								
Powder cocaine	25.81	0.0843	35.48	0.0002	19.35	0.2073	16.13	<0.0001
Crack cocaine	31.75		37.78		31.43		19.05	
Heroin	21.08		18.67		29.52		49.40	
Poly drug use	24.62		26.15		35.38		46.15	
Injection Status								
Injector	22.70	0.1624	17.73	0.0001	32.62	0.4361	58.87	<0.0001
Non-injector	28.63		34.59		29.22		22.07	
Female Condom use								
Always	23.08	0.5682	29.81	0.9036	28.85	0.6758	25.96	0.5657

Sometimes/ Never Male Condom use	25.94		30.45		26.69		28.95	
Always	36.36	0.9508	43.94	0.6170	34.85	0.8593	24.24	0.1068
Sometimes/ Never HIV testing frequency	36.81		40.28		36.11		35.42	
≤3	29.15	0.4889	33.21	0.2735	30.26	0.7477	31.73	0.3379
≥4	26.61		29.05		29.05		28.13	
Lifetime depression								
Yes	31.20	0.0073	33.60	0.0658	31.47	0.2853	33.07	0.0445
No	21.69		26.84		27.57		25.74	
Sampling strategy								
RDS	29.22	0.1162	33.25	0.0603	31.35	0.2475	25.89	0.0019
TSS	23.45		26.11		26.99		37.61	
<b>Discrimination measures</b>								
<b>Incarceration*</b>								
Yes	33.33	0.0451	33.96	0.1098	33.33	0.3126	37.74	0.0285
No	24.60		26.82		28.80		27.83	
<b>Race</b>								
Yes	35.15	0.0077	40.00	0.0025	37.58	0.0120	32.12	0.5298
No	24.42		27.39		27.18		29.51	
<b>Drug use</b>								
Yes	36.84	0.0001	36.84	0.0180	39.71	0.0001	43.06	<0.0001
No	22.48		27.63		25.06		23.89	

\*Only includes those who reported spending time in jail or prison in their lifetime (n=468)

Table 7. Adjusted prevalence ratios (95% confidence intervals) between racial and drug use discrimination with sex and heroin and injecting networks by race/ ethnicity, START 2006 -2009

Sex networks*			
	Hispanic	Non-Hispanic black	Non-Hispanic white
Race discrimination			
Yes	1.40 (0.79 – 2.45)	1.45 (1.06 – 1.97)	0.86 (0.45 – 1.65)
No	1.00	1.00	1.00
Drug use discrimination			
Yes	1.21 (0.74 – 1.98)	1.50 (1.10 - 2.03)	1.54 (0.81 – 2.92)
No	1.00	1.00	1.00
Heroin and injecting networks**			
Incarceration discrimination <sup>‡</sup>			
Yes	1.17 (0.83 – 1.66)	1.08 (0.58 – 2.00)	2.02 (1.09 – 3.74)
No	1.00	1.00	1.00
Drug use discrimination			
Yes	1.42 (1.05 – 1.92)	1.57 (0.96 – 2.58)	1.59 (1.07 – 2.37)
No	1.00	1.00	1.00

\*Adjusted for age, number of female sex partners, number of male sex partners, marital status, primary drug used, injection status, lifetime depression and recruitment strategy.

\*\*Adjusted for age, age at sexual debut, primary drug used, injection status, lifetime depression and recruitment strategy.

<sup>‡</sup>Only includes those who reported spending time in jail or prison in their lifetime (n=468)

Table 8. Sample population characteristics, START 2006-2009 (n=636)

Demographics		
	n	Median (IQR)
Age	636	33 (28 – 37)
Female sex partners	633	1 (0 – 2)
Male sex partners	630	0 (0 – 1)
Age at sexual debut	631	14 (12 – 16)
	n	%
Race/ ethnicity		
Hispanic	231	36.32
Black	314	49.37
White/ Other	91	14.31
Sex		
Male	446	70.13
Female	190	29.87
Education		
< High school	316	49.76
≥High school	319	50.24
Income		
≤\$5,000	498	82.72
>\$5,000	104	17.28
Marital status		
Married	95	15.03
Single or divorced	537	84.97
Primary Drug used		
Powder cocaine	61	10.20
Crack cocaine	311	52.01
Heroin	161	26.92
Poly drug use	65	10.87
Injection Status		
Injector	496	78.36
Non-injector	137	21.64
Condom use with females (past two months)		
Always	103	28.45
Sometimes and Never	259	71.55
Condom use with males (past two months)		
Always	65	31.10
Sometimes and Never	144	68.90
HIV testing frequency (lifetime)		
≤3	264	44.97
≥4	323	55.03
Lifetime depression	367	57.70
Sampling		
RDS	417	65.57
TSS	219	34.43
Neighborhood characteristics		
% Black		
Low	211	33.18

Medium	237	37.26
High	188	29.56
% Latino		
Low	187	29.40
Medium	238	37.42
High	211	33.18
% Poverty		
Low	213	33.49
Medium	242	38.05
High	181	28.46
%< High School Education		
Low	276	43.40
Medium	217	34.12
High	143	22.48
Social Cohesion		
Low	279	43.87
Medium	187	29.40
High	170	26.73
<b>Discrimination measures</b>		
Incarceration		
Yes	159	25.40
No	467	74.60
Race		
Yes	162	25.92
No	463	74.08
Drug use		
Yes	205	32.80
No	420	67.20
<b>Social risk networks</b>		
Total risk networks		
≥13	174	27.36
<13	462	72.64
Sex risk networks		
≥4	196	30.82
<4	440	69.18
Drug risk networks		
≥7	191	30.03
<7	445	69.97
Heroin and injecting networks		
≥2	191	30.03
<2	445	69.97

Table 9. Bivariate associations between neighborhood, types of discrimination and total, sex, drug and heroin and injecting risk networks over the past 5 years, START 2006-2009

	Total risk networks		Sex risk networks		Drug risk networks		Heroin and Injecting networks	
	High ( $\geq 13$ )		High ( $\geq 4$ )		High ( $\geq 7$ )		High ( $\geq 2$ )	
	%	p-value	%	p-value	%	p-value	%	p-value
<b>Neighborhood characteristics</b>								
% Black <sup>Y</sup>								
Low	28.91	0.7514	27.49	0.4294	32.23	0.5346	38.86	0.0004
Medium	27.43		32.91		30.38		29.54	
High	25.53		31.91		27.13		20.74	
% Latino <sup>Y</sup>								
Low	28.34	0.9371	30.48	0.7880	31.55	0.7961	29.41	0.2426
Medium	26.89		32.35		28.57		26.89	
High	27.01		29.38		30.33		34.12	
% Poverty <sup>Y</sup>								
Low	26.29	0.4384	29.58	0.8203	31.46	0.0838	29.58	0.1098
Medium	30.17		32.23		33.47		34.30	
High	24.86		30.39		23.76		24.86	
% High School Education								
Low	24.28	0.1727	30.80	0.1154	25.36	0.0797	23.55	0.0039
Medium	27.65		26.73		33.64		32.72	
High	32.87		37.06		33.57		38.46	
Social Cohesion <sup>*</sup>								
Low	27.60	0.9538	26.52	0.1038	32.62	0.2565	37.63	0.0002
Medium	27.81		35.29		30.48		28.34	
High	26.47		32.94		25.29		19.41	
<b>Discrimination measures</b>								
Incarceration								
Yes	34.59	0.0171	35.22	0.1498	34.59	0.1465	38.36	0.0093
No	24.84		29.12		28.48		27.41	
Race								
Yes	35.80	0.0051	40.74	0.0013	38.27	0.0083	32.72	0.4253
No	24.41		27.21		27.21		29.37	
Drug use								
Yes	37.07	0.0001	37.07	0.0162	40.00	0.0002	43.41	<0.0001
No	22.62		27.62		25.24		23.81	

<sup>Y</sup>Census tracts = 143<sup>\*</sup>Zip codes = 60

Table 10. Adjusted prevalence ratios (95% confidence intervals) between discrimination and embedded heroin and injecting networks by select neighborhood characteristics, START 2006-2009

Heroin and injecting networks*									
Discrimination	% Black <sup>Y</sup>			% High School Education <sup>Y</sup>			Social Cohesion/ collective efficacy <sup>*</sup>		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Incarceration									
Yes	1.23 (0.83 – 1.83)	1.12 (0.71 – 1.76)	1.09 (0.48 – 2.46)	1.27 (0.73 – 2.20)	1.40 (0.88 – 2.21)	1.01 (0.58 – 1.75)	1.22 (0.86 – 1.76)	1.11 (0.67 – 1.83)	1.21 (0.49 – 2.95)
No	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Drug use									
Yes	1.79 (1.29 – 1.48)	1.16 (0.76 – 1.77)	1.52 (0.82 – 2.82)	1.18 (0.75 – 1.85)	1.63 (1.10 – 2.41)	1.45 (0.98 – 2.15)	1.57 (1.17 – 2.12)	1.19 (0.74 – 1.91)	1.59 (0.83 – 2.82)
No	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

\*adjusted for age, race, primary drug used, injection status, depression and recruitment.

<sup>Y</sup>Census tracts = 143

<sup>\*</sup>Zip codes = 60



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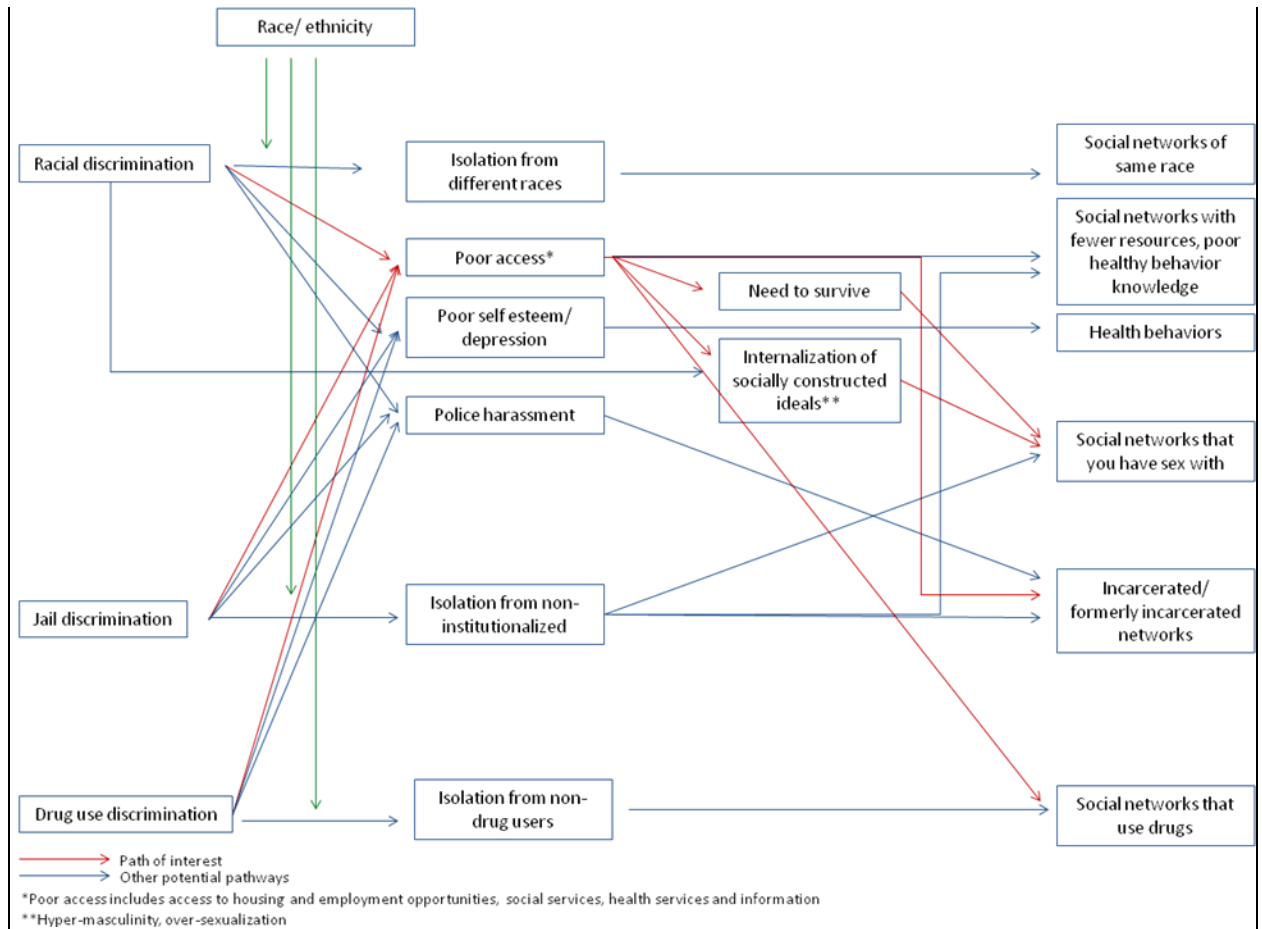
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Appendices

Appendix 1: Complete conceptual pathway between discrimination and risky social networks



## Appendix 2: Secondary Analysis – Embeddedness of individual drug and sex risk networks

### Demographics and Risk Characteristics

Descriptive characteristics of population demographics including exposures, outcomes and covariates of interest are described in Table 1. Of 652 injection and non-injection drug users, the median age was 33, 70.48% were male and most were Hispanic (48.77%) followed by Black (36.96%). About half (50.69%) had at least a high school education or general equivalency diploma (GED), 82.69% made \$5,000 or less/ year, 84.88% were un-married which includes single and divorced. In terms of drug use characteristics, most of the population (71.12%) did not inject drugs; 51.71% used crack cocaine as the primary drug of choice (or drug used most frequently), 27.24% primarily used heroin, 10.44% primarily used powder cocaine and 10.60% used powder cocaine, crack cocaine and heroin in equal frequency. In terms of sexual practices, the sample reported a median of one female sex partners and zero male sex partners in the past two months. Of those who reported female sex partners (n=370; 56.75%) in the past two months, only 28.11% always used condoms. Of those who reported male sex partners (n=214; 36.96%) in the past two months, only 32.24% always used condoms. The median age of sexual debut was 14 and in over half (55.06%) had 4 or more HIV tests in their lifetime.

### Discrimination Experiences

Almost half (47.67%) of the population reported experiencing at least one form of discrimination (age, race, sex, sexual orientation, poverty, drug use, incarceration, religion, mental illness, physical illness or other) in their lifetime. This analysis will independently assess the three most prevalent forms of discrimination in the population supported by the literature<sup>37</sup>: discrimination due race, drug use and incarceration. Twenty-five percent reported experiencing discrimination due to incarceration, 25.74% experienced racial discrimination and 32.61% experienced drug use discrimination.

### Social Network Characteristics

This analysis will assess sexual and drug using social networks over the past 5 years. More than half (59.82%) of the sample reported having 3 or more people in their social network over the past 5 years; 30.52% had 2 or more persons who spent time in jail or prison and 76.07% had 2 or more persons who had at least a high school education in their network. Over half of the population (54.45%) had 2 or more sexual partners in the 5 past years, 33.90% had 2 or more female sex partners and only 21.47% had 2 or more male sex partners. Only 21.78% reported having 2 or more transactional sex networks.

Most participants (63.04%) had 2 or more persons in their network who used drugs; 40.8% reported 2 or more network members who used crack, 20.71% reported 2 or more network members who used heroin and 24.65% reported 1 or more persons who injected drugs. Fewer (50.46%) participants used drugs with 2 or more people.

#### Discrimination and General Network Characteristics

##### Total network size

While most participants had at least one network member (86.34%), those who experienced discrimination because of their drug use were significantly more likely to have 3 or more network members ( $p=0.0021$ ) in the bivariate analysis. Specifically, 93.78% of those who experience discrimination because of their drug use had 3 or more total network members compared to 85.42% of those who did not experience discrimination. The median number of female sex partners was significantly higher among those who had 3 or more total network members ( $p=0.0203$ ). Race/ ethnicity and age were also borderline related to total network size where Hispanics and younger drug users were more likely to have 3 or more network. After adjusting for important confounders, drug discrimination was independently associated with total network size. Those who experienced drug discrimination were 2.48 (95% CI: 1.33 – 4.63) times more likely to have a total network of 3 or more persons.

##### Jail network

Drug discrimination was also significantly associated with having 2 or more jail networks ( $p<0.0001$ ) in the bivariate analysis. Forty-one percent of those who experienced drug discrimination had 2 or more jail networks compared to 25% of those who did not experience drug discrimination. Similarly, 40.12% of those who experienced discrimination due to incarceration compared to 26.88% who did not had 2 or more jail networks. Racial discrimination was borderline significant ( $p=0.0747$ ) where 35.76% of those who experienced racial discrimination compared to 28.36% who did not had 2 or more jail networks. Some sexual risk practices were borderline significant with having 2 or more jail networks. Specifically, female condom use, number of male sex partners and age at sexual debut were associated with having 2 or more jail networks.

In the adjusted analysis, drug discrimination remained independently associated with number of jail networks. Three separate models assessing the independent influence of drug discrimination, discrimination due to incarceration and racial discrimination independently taking into account important confounders were performed and a final model taking into account all important forms

of discrimination were performed. In the model assessing drug discrimination, we found that those who experienced drug discrimination were 2.13 (95% CI: 1.49 – 3.05) times more likely to have 2 or more jail networks. Racial discrimination was not significant in the adjusted model, however, discrimination due to incarceration was; those who experienced discrimination due to incarceration were 87% (95% CI: 1.28 – 2.74) more likely to have 2 or more jail networks compared to those who did not experience discrimination due to incarceration. After taking into account discrimination due to drug use and incarceration simultaneously, discrimination due to incarceration became negligible and the association between drug discrimination remained significant suggesting that discrimination due to incarceration is driving the association. Those who experienced drug discrimination were 1.84 (95% CI: 1.22 – 2.80) times more likely to have 2 or more jail networks after adjusting for discrimination due to incarceration and important sexual risk practices.

#### Education network

The proportion of participants with networks that had a high school education was higher than the proportion with jail networks, but among those who experienced drug use discrimination, 81.82% had 2 or more high school educated networks compared to 73.15% of those who did not experience discrimination ( $p=0.0160$ ). Racial discrimination was slightly associated with more high school educated networks ( $p=0.0677$ ). As expected, those who had a high school education were significantly more likely to have a network with a high school education ( $p=0.0031$ ). Characteristics associated with having 2 or more high school educated networks were assessed in two separate models, one for drug discrimination and another for racial discrimination. Those who reported were experiencing drug discrimination were 60% (95% CI: 1.06 – 2.42) more likely to have 2 or more networks with at least a high school education after adjusting for number of female sex partners and high school education level, which also remained associated with having 2 or more high school educated networks (OR: 1.67; 95% CI: 1.15 – 2.42). Similarly, those who experienced racial discrimination were 36% (95% CI: 1.15 – 2.42) more likely to have 2 or more networks with at least a high school education after adjusting for number of female sex partners and high school education level, which also remained associated with having 2 or more high school educated networks (OR: 1.70; 95% CI: 1.17 – 2.48) in this model. After adjusting for drug and racial discrimination simultaneously, education level (OR: 1.68; 95% CI: 1.15 – 2.45) was the only important characteristic that influenced having 2 or more networks with a high school education.

#### Discrimination and Sexual Network Characteristics

### Total sex network size

Discrimination was not associated with having 2 or more sex networks, although drug discrimination was borderline significant ( $p=0.0955$ ). More whites and others (67.74%), followed by blacks (54.40%) and Hispanics (49.38%) had 2 or more sex partners ( $p=0.0104$ ). Those with a high school education (58.48%) were more likely to have 2 or more partners compared to those without a high school education (50.47%;  $p=0.04$ ). Un-married persons (57.09%) were significantly more likely to have 2 or more sex partners compared to married persons (40.82;  $p=0.0029$ ). Younger persons ( $p<0.0001$ ), those with more female ( $p=0.0026$ ) and male sex partners ( $p<0.0001$ ) were also more likely to have 2 or more sex partners.

### Female sex network

Although discrimination was not important for the number of sexual networks over the past 4 years, it was important for the types of sexual networks one had over the past 4 years. Those who experienced drug discrimination were significantly more likely to have 2 or more female sex networks (39.71%) compared to those who did not experience drug discrimination (31.02%;  $p=0.0292$ ). Those who experienced discrimination due to incarceration were also significantly more likely to have 2 or more female sex networks (41.36%) compared to those who did not experience drug discrimination (31.25%;  $p=0.0187$ ). Males (46.49%) compared to females (4.71%;  $p<0.0001$ ), un-married (36.55%) compared to married (20.41%;  $p=0.0019$ ) and persons whose drug of choice was cocaine (46.88%) as opposed to crack (28.71%), heroin (34.13%) or poly drug use (38.46%;  $p=0.0271$ ) were more likely to have 2 or more female sex partners. Younger age, more female and male sex partners in the past two months are also significantly associated with 2 or more female sex networks. Drug discrimination, discrimination due to incarceration nor racial discrimination were important in the adjusted analysis with three separate models assessing the independent influence each on having 2 or more sexual partners while taking into account important confounders.

### Male sex network

Juxtaposed to the results on characteristics associated with female sex networks, those who experienced discrimination due to incarceration were significantly less likely to have 2 or more male partners ( $p=0.0383$ ). Fifteen percent who experienced discrimination due to incarceration had 2 or more male sex partners compared to 23.13% of those who did not experience discrimination due to incarceration. Racial and drug discrimination were not important for having 2 or more male networks. Whites and others (32.26%) compared to blacks (26.42%) and Hispanics (10.79%;  $p<0.0001$ ), females (53.40%) compared to males (7.68%;  $p<0.0001$ ), crack users (26.81%) compared to cocaine (20.31%), heroin (17.37%) and poly drug users (12.31%;

$p=0.0183$ ) were more likely to have 2 or more male sex networks. Those that had fewer female sex partners ( $p<0.0001$ ) and more male sex partners ( $p<0.0001$ ) were also more likely to have 2 or more male sex partners. Persons with high school education and those that always use condoms with males were borderline associated with having 2 or more male sex partners. In the adjusted analysis, discrimination due to incarceration was not important, but male sex partners in the past two months (OR: 1.48; 95% CI: 1.27 – 1.71), Hispanic ethnicity (OR: 0.35; 95% CI: 0.16 – 0.74) and female sex (OR: 6.53; 95% CI: 3.64 – 11.71) were significantly associated with having 2 or more male sex partners over the past five years.

#### Transactional sex network

In terms of characteristics associated with having 2 or more transactional sex networks in the past 5 years, those that encountered racial ( $p=0.0294$ ) and drug ( $p=0.0348$ ) discrimination were significantly more likely to have 2 or more transactional sex networks. Almost 30% of those who experienced racial discrimination had 2 or more transactional sex networks, compared to 19.75% who did not experience racial discrimination. Further, 26.79% who experienced drug discrimination compared to 19.44% who did not had 2 or more transactional sex networks. Blacks (29.25%) were more likely than whites/ others (16.13%) and Hispanics (14.11%;  $p<0.0001$ ) to have 2 or more transactional sex networks. Females (27.75%) compared to males (19.30%;  $p=0.0176$ ), un-married (23.45%) compared to married (12.24%;  $p=0.0132$ ), crack users (31.23%) compared to cocaine (17.19%), heroin (9.58%) and poly drug users (15.38%;  $p<0.0001$ ), non-injectors (25.25%) compared to injectors (9.86%;  $p<0.0001$ ) and those with more male sex partners ( $p<0.0001$ ) were also more likely to have 2 or more transactional sex networks. Two separate models were performed to assess the independent role of racial discrimination and drug discrimination after adjusting for important confounders. In the racial discrimination model, those who experienced racial discrimination were 71% (95% CI: 1.08 – 2.69) more likely to have 2 or more transactional sex networks. In this model more male sex partners (OR: 1.10; 95% CI: 1.04 – 1.17), being un-married (OR: 2.00; 95% CI: 1.03 – 3.91) and crack cocaine (OR: 2.09; 95% CI: 1.14 – 3.82) as the primary drug of choice was also associated with 2 or more transactional sex network. In the model assessing drug discrimination, those that experienced drug discrimination were 84% (95% CI: 1.19 – 2.84) more likely to have 2 or more transactional sex networks. In this model, more male sex partners (OR: 1.10; 95% CI: 1.04 – 1.17) and crack cocaine (OR: 2.05; 95% CI: 1.12 – 3.76) as the primary drug of choice were also significantly associated with having 2 or more sex networks. When adjusting for racial and drug discrimination simultaneously, racial discrimination became insignificant (OR: 1.45; 95% CI: 0.90 – 2.35) and those that experienced drug discrimination were 65% (95% CI: 1.04 – 2.61) more likely to have 2 or more transactional sex networks. More male sex partners (OR: 1.10; 95% CI: 1.04 – 1.17) and crack cocaine (OR:

2.07; 95% CI: 1.13 – 3.80) as the primary drug of choice were consistently associated with having 2 or more male sex partners.

#### Discrimination and Drug Network Characteristics

##### Total drug using network size

Both racial and drug discrimination were associated with having 2 or more drug users within your network in the past 4 years. Those that reported experiencing racial discrimination were significantly more likely to have 2 or more drug users within their network (72.12% vs. 59.45%;  $p=0.0037$ ). Likewise, those that reported experiencing drug discrimination were significantly more likely to have 2 or more drug users within their network (73.68% vs. 57.41%;  $p<0.0001$ ). Younger age ( $p=0.0465$ ), more male sex partners ( $p=0.0040$ ) and powder cocaine ( $p=0.0319$ ) as the primary drug of choice were also significantly associated with having 2 or more drug users within their network. In the adjusted analysis assessing the independent role of racial discrimination (without drug discrimination) after adjusting for confounders, those that experienced racial discrimination were 1.86 (95% CI: 1.25 – 2.77) times more likely to have 2 or more drug using networks. Younger persons (OR: 0.96; 95% CI: 0.93 – 0.99) and those with more male sex partners (OR: 1.11; 95% CI: 1.02 – 1.20) were also significantly more likely to have 2 or more drug using networks in the adjusted analysis. Heroin users compared to cocaine users were 60% (95% CI: 0.23 – 0.69) less likely to have 2 or more drug users within their network. In the adjusted analysis assessing the independent role of drug discrimination (without racial discrimination) after adjusting for confounders, those that experienced drug discrimination were 2.34 (95% CI: 1.60 – 3.42) times more likely to have 2 or more drug users within their network. Analogous to the model assessing racial discrimination, in this model, younger age (OR: 0.96; 95% CI: 0.93 – 0.99) and more male sex partners (OR: 1.10; 95% CI: 1.02 – 1.20) were associated with 2 or more drug users within their network and significantly fewer heroin users (OR: 0.34; 95% CI: 0.20 – 0.60) compared to cocaine users had 2 or more drug users within their network. In the final adjusted model, which assessed racial and drug discrimination concurrently, racial discrimination (OR: 1.49; 95% CI: 0.98 – 2.26) was no longer significantly important in having 2 or more drug users within their network. However those that experienced drug discrimination were 2.10 (95% CI: 1.41 – 3.12) times more likely to have 2 or more drug users within their network. Age, number of male sex partners and primary drug of choice remained significantly associated with number of drug users within network, where age (OR: 0.96; 95% CI: 0.93 – 0.99) was negatively associated, male sex partners (OR: 1.10; 95% CI: 1.02 – 1.20) was positively associated and heroin users (OR: 0.35; 95% CI: 0.20 – 0.61) were less likely than cocaine users to have 2 or more drug users within their network.



#### Network of people to use drugs with

Racial discrimination and drug discrimination were also associated with increased number of people that drugs were used with. About 60% of those who experienced racial discrimination compared to 47.9% of those that did not had 2 or more persons to use drugs with ( $p=0.0228$ ). Similarly, 58.37% of those that experience drug discrimination compared to 46.76% of those that did not had 2 or more persons to use drugs with ( $p=0.0058$ ). Un-married persons, those that primarily used cocaine, infrequent condom users with males and those with more male sex partners were also more likely than married persons, crack, heroin and poly drug users, always condom users with males and fewer male sex partners to have 2 or more persons to used drugs with. In the adjusted model which independently assessed racial discrimination (without drug discrimination), those that experienced racial were discrimination were 3.19 (95% CI: 1.44 – 7.04) times more likely to have 2 or more persons to use drugs with compared to those that did not experience racial discrimination. More male sex partners (OR: 1.11; 95% CI: 1.01 – 1.21) and infrequent condom use with males (OR: 2.42; 95% CI: 1.23 – 4.76) were also associated with 2 or more persons to use drugs with. In the model independently assessing drug discrimination after adjusting for confounders, drug discrimination was not significantly associated with networks to use drugs with. However, in this model, male sex partners and infrequent condom use with males remained important.

#### Crack using network

Discrimination influenced the types of drug users that were a part of one's network. Racial discrimination and drug discrimination were significantly associated with having 2 or more crack using networks; 49.09% of those that experienced racial discrimination compared to 37.18% that did not had 2 or more crack using networks and 47.85% of those that experienced drug discrimination compared to 36.57% that did not had 2 or more crack using networks. Blacks compared to Hispanics and whites/ others, older persons, females compared to males, those that used crack primarily compared to cocaine, heroin or poly drug use, non-injectors compared to injectors, and those with more male sex partners were also more likely to have 2 or more crack using networks. In the adjusted analysis assessing racial discrimination independently after adjusting for confounders, those that experienced racial discrimination were 1.96 (95% CI: 1.32 – 2.89) times more likely to have 2 or more crack using networks. The number of male sex partners (OR: 1.09; 95% CI: 1.02 – 1.17) and being a crack user (OR: 2.40; 95% CI: 1.44 – 4.02) or poly drug user (OR: 2.61; 95% CI: 1.31 – 5.20) compared to cocaine user were also significantly associated with having 2 or more crack using networks. In the model assessing drug discrimination independently adjusting confounders, those that experienced drug discrimination

were 2.06 (95% CI: 1.41 – 2.99) times more likely to have 2 or more crack using networks. Number of male sex partners and drug of choice were consistently associated with the outcome. For each additional male sex partner there was a 9% (95% CI: 1.02 – 1.17) increase in the odds of having 2 or more crack using networks. Crack users were 2.37 (95% CI: 1.42 – 3.96) times and poly drug users were 2.51 (95% CI: 1.26 – 5.01) times more likely to have 2 or more crack using networks. In the model adjusting for racial and drug discrimination concurrently, both racial and drug discrimination remained important for having 2 or more crack networks. Persons experiencing racial discrimination were 63% (95% CI: 1.08 – 2.46) more likely to have 2 or more crack using networks. Additionally, those that experienced drug discrimination were 1.79 (95% CI: 1.21 – 2.66) times more likely to have 2 or more crack using networks. After accounting for racial and drug discrimination more male sex partners (OR: 1.09; 95% CI: 1.02 – 1.17), crack users (OR: 2.42; 95% CI: 1.44 – 4.06) and poly drug users (OR: 2.34; 95% CI: 1.10 – 4.98) were more likely to have 2 or more crack using networks.

#### Heroin using network

Racial discrimination was not associated with having more heroin using networks, but discrimination due to incarceration and drug discrimination were significantly associated. Twenty-nine percent of those that experienced discrimination due to incarceration compared to 17.92% that did not had 2 or more heroin using networks. Similarly, 33.01% of those that experience discrimination due to incarceration compared to 15.05% that did not had 2 or more heroin using networks. Whites/ others followed by Hispanics then blacks were more likely to have 2 or more heroin using networks. Intuitively, heroin and poly drug users compared to cocaine and crack users and injectors compared to non-injectors were significantly more likely to have 2 or more heroin using networks. In the model adjusting for discrimination due to incarceration and taking confounders (race/ ethnicity, drug of choice and injection status) into account, those that experienced discrimination due to incarceration were 69% (95% CI: 1.10 – 2.60) more likely to have 2 or more heroin using networks. Race/ ethnicity and drug of choice were important in this model where blacks (OR: 0.41; 95% CI: 0.22 – 0.77) compared to whites/ others were significantly less likely to have more heroin networks and poly drug users (OR: 2.34; 95% CI: 1.10 – 4.98) compared to cocaine users were significantly more likely to have more heroin networks. In the model adjusting for drug discrimination, those that experienced drug discrimination were 2.37 (95% CI: 1.57 – 3.56) times more likely to have 2 or more heroin networks after adjusting for race/ ethnicity, drug of choice and injection status. In this model, blacks compared to whites/ others were 57% (95% CI: 0.23 – 0.83) less likely to have 2 or more heroin networks and poly drug users compared to cocaine users were 2.48 (95% CI: 1.16 – 5.31) times more likely to have 2 or more heroin networks. When adjusting for discrimination due to drug use and incarceration

simultaneously, discrimination due to incarceration becomes insignificant (OR: 1.13; 95% CI: 0.69 – 1.85) but drug discrimination remains important as those that experience drug discrimination are 2.24 (95% CI: 1.41 – 3.58) times more likely to have 2 or more heroin networks after adjusting for race/ ethnicity, drug of choice and injection status. Blacks compared to whites/ others were 0.43 (95% CI: 0.23 – 0.82) times less likely to have 2 or more heroin networks and poly drug users compared to cocaine users were 2.45 (95% CI: 1.14 – 5.25) times more likely to have 2 or more heroin networks. Injection status was not important in the final model.

#### Injection drug using network

Finally, discrimination was also important for having at least one injection drug using network. Those that experienced drug discrimination were significantly more likely to have 1 or more injection drug using networks (34.78% vs. 19.86%;  $p < 0.0001$ ). More whites/ others followed by Hispanics and very few blacks had 1 or more injection drug using networks ( $p < 0.0001$ ). Younger persons had significantly more heroin using networks. Heroin users had significantly more injection drug using networks than poly drug users, cocaine or crack users. Injectors compared to non-injectors and infrequent condom users with males were significantly more likely to have 1 or more injection drug using networks. In the adjusted model, the only characteristic that remained important was infrequent condom use with men. Infrequent condom users with men were 6.94 (95% CI: 2.33 – 20.67) times more likely to have an injection drug using network.

Table 1. Selected socio-demographic and social network characteristics, START 2006-2009

Covariates of Interest		
	n	Median (IQR)
Age	652	33 (28 – 37)
Female sex partners	649	1.0 (0 – 2)
Male sex partners	646	0 (0 – 1)
Age at sexual debut	646	14 (12 – 16)
	n	%
Race/ ethnicity		
Black	241	36.96
Hispanic	318	48.77
White/ Other	93	14.26
Sex		
Male	456	70.48
Female	191	29.52
Education		
< High school	321	49.31
≥High school	330	50.69
Income		
≤\$5,000	511	82.69
>\$5,000	107	17.31
Marital status		
Married	98	15.12
Un-married (single, divorced)	550	84.88
Primary Drug used		
Powder cocaine	64	10.44
Crack cocaine	317	51.71
Heroin	167	27.24
Poly drug use	65	10.60
Injection Status		
Injector	142	21.88
Non-injector	507	78.12
Condom use with females (past two months)		
Always	104	28.11
Sometimes and Never	266	71.89
Condom use with males (past two months)		
Always	69	32.24
Sometimes and Never	145	67.76
HIV testing frequency (lifetime)		
≤3	271	44.94
≥4	332	55.06
Exposures of Interest - Discrimination		
Incarceration		
Yes	162	25.23
No	480	74.77
Race		
Yes	165	25.74
No	476	74.26
Drug use		
Yes	209	32.61
No	432	67.39
Outcomes of Interest – Network characteristic past 5 years		
Total Social Network (past year)		

≥3	390	59.82
< 3	262	40.18
Jail Network		
≥2	199	30.52
<2	453	69.48
High School Educated Network		
≥2	496	76.07
<2	156	23.93
Total Sex Partner Network		
≥2	355	54.45
<2	297	45.55
Female Sex Partner		
≥2	221	33.90
<2	431	66.10
Male Sex Partner		
≥2	140	21.47
<2	512	78.53
Transactional Sex Network		
≥2	142	21.78
<2	510	78.22
Total Drug Network		
≥2	411	63.04
<2	241	36.96
Drug use network		
≥2	329	50.46
<2	323	49.54
Crack Network		
≥2	266	40.80
<2	386	59.20
Heroin Network		
≥2	135	20.71
<2	517	79.29
Injecting Network		
≥1	158	75.35
0	483	24.65

Table 2. Bivariate associates between selected demographics and social network characteristics over the past 5 years, START 2006-2009

	Total social network	p-value	Jail network	p-value	Network education level	p-value
	Yes (≥3)		Yes (≥2)		Yes (≥2)	
Race/ ethnicity		0.0551*		0.4623		0.3287
Black	84.91		32.70		78.62	
Hispanic	91.29		29.05		73.86	
White/ Other	90.32		26.88		73.12	
Sex		0.2218		0.1131		0.1271
Male	89.25		28.29		77.85	
Female	85.86		34.55		72.25	
Education		0.8964		0.7496		0.0031
< High school	87.85		31.15		71.03	
≥High school	88.18		30.00		80.91	
Income		0.4008*		0.6340		0.8323
≤\$5,000	88.06		31.31		75.73	
>\$5,000	91.59		28.97		74.77	
Marital status		0.7345*		0.6508		0.8858
Married	89.80		32.65		75.51	
Un-married (single, divorced)	87.82		30.36		76.18	
Primary Drug used		0.2217*		0.2177		0.9447
Powder cocaine	95.31		31.25		78.13	
Crack cocaine	86.75		33.75		75.08	
Heroin	86.23		25.15		74.85	
Poly drug use	89.23		26.15		76.92	
Injection Status		0.4031		0.1780		0.1146
Injector	90.14		26.06		71.13	
Non-injector	87.57		31.95		77.51	
Condom use with females (past two months)		0.8454*		0.0642		0.4989
Always	91.35		20.19		81.73	
Sometimes and Never	89.85		29.70		78.57	
Condom use with males (past two months)		0.3535*		0.5233		0.3763
Always	85.51		34.78		73.91	
Sometimes and Never	90.34		39.31		79.31	
HIV testing frequency (lifetime)		0.8351		0.5458		0.4033

≤3	87.08			32.10			76.75		
≥4	87.65			29.82			73.80		
Any Discrimination			0.0421			<0.0001			0.0148
Yes	85.19			21.89			71.38		
No	90.49			36.50			79.75		
Discrimination due to incarceration			0.1289			0.0015			0.3826
Yes	91.36			40.12			78.40		
No	86.88			26.88			75.00		
Racial Discrimination			0.1200			0.0747			0.0677
Yes	91.52			35.76			81.21		
No	86.97			28.36			74.16		
Drug use Discrimination			0.0021			<0.0001			0.0160
Yes	93.78			41.15			81.82		
No	85.42			25.00			73.15		
	Median			Median			Median		
	Yes (≥3)	No (<3)	p-value	Yes (≥2)	No (<2)	p-value	Yes (≥2)	No (<2)	p-value
Age	33	35	0.0596	34	32	0.1234	33	33	0.9870
Female sex partners	1	0	0.0203	1	1	0.2296	0	1	0.0059
Male sex partners	0	0	0.4301	0	0	0.0012	0	0	0.5056
Age at sexual debut	14	14	0.8699	14	14	0.0605	14	14	0.1636

Table 3. Adjusted odds ratio and 95% confidence interval between selected demographics and social network characteristics over the past 5 years, START 2006-2009

	Total Social Network (≥3)	Jail network (≥2)	Jail network (≥2)	Jail network (≥2)	Jail network (≥2)	Education network (≥2)	Education network (≥2)	Education network (≥2)
	Past 4 years OR (95% CI)							
Jail Discrimination	-	1.87 (1.28 – 2.74)	-	-	1.35 (0.86 – 2.11)	-	-	-
Racial Discrimination	-	-	1.41 (0.96 – 2.07)	-	-	1.36 (1.15 – 2.42)	-	1.53 (0.99 – 2.35)
Drug use Discrimination	2.48 (1.33 – 4.63)	-	-	2.13 (1.49 – 3.05)	1.84 (1.22 – 2.80)	-	1.60 (1.06 – 2.42)	1.19 (0.75 – 1.91)
Age	-	-	-	-	-	-	-	-
Female sex partners	1.14 (0.97 – 1.35)	-	-	-	-	1.09 (0.99 – 1.21)	1.10 (0.99 – 1.21)	1.09 (0.99 – 1.21)
Male sex partners	-	1.08 (1.03 – 1.13)	1.07 (1.03 – 1.12)	1.08 (1.03 – 1.13)	1.08 (1.03 – 1.13)	-	-	-
Age at sexual debut	-	-	-	-	-	-	-	-
Race/ ethnicity								
Black	-	-	-	-	-	-	-	-
Hispanic	-	-	-	-	-	-	-	-
White/ Other	-	-	-	-	-	-	-	-
Sex								
Male	-	-	-	-	-	-	-	-
Female	-	-	-	-	-	-	-	-
Education								
< High school	-	-	-	-	-	ref	ref	ref
≥High school	-	-	-	-	-	1.67 (1.15 – 2.42)	1.70 (1.17 – 2.48)	1.68 (1.16 – 2.45)
Income								
≤\$5,000	-	-	-	-	-	-	-	-
>\$5,000	-	-	-	-	-	-	-	-
Marital status								
Married	-	-	-	-	-	-	-	-
Un-married (single, divorced)	-	-	-	-	-	-	-	-
Primary Drug used								
Powder cocaine	-	-	-	-	-	-	-	-
Crack cocaine	-	-	-	-	-	-	-	-
Heroin	-	-	-	-	-	-	-	-
Poly drug use	-	-	-	-	-	-	-	-
Injection Status								
Injector	-	-	-	-	-	-	-	-
Non-injector	-	-	-	-	-	-	-	-
Condom use with females (past two months)								
Always	-	-	-	-	-	-	-	-
Sometimes and Never	-	-	-	-	-	-	-	-
Condom use with males (past two months)								
Always	-	-	-	-	-	-	-	-
Sometimes and Never	-	-	-	-	-	-	-	-
HIV testing frequency (lifetime)								
≤3	-	-	-	-	-	-	-	-
≥4	-	-	-	-	-	-	-	-



Table 4. Bivariate associates between selected demographics and social network drug using characteristics over past 5 years, START 2006-2009

	Drug using network	p-value	Use drugs with network	p-value	Crack using network	p-value	Heroin using network	p-value	Injection drug using networks	p-value
	Yes (≥2)		Yes (≥2)		Yes (≥2)		Yes (≥2)		Yes (≥1)	
Race/ ethnicity		0.6692		0.3943		0.0028		<0.0001		<0.0001
Black	63.21		50.94		47.48		12.26		11.22	
Hispanic	61.41		47.72		35.27		27.80		35.02	
White/ Other	66.67		55.91		32.26		31.18		43.48	
Sex		0.0979		0.5501		0.0344		0.6035		0.7868
Male	61.18		49.78		38.16		20.18		24.38	
Female	68.06		52.36		47.12		21.99		25.40	
Education		0.5872		0.6636		0.5404		0.2135		0.5790
< High school	64.17		51.40		42.06		22.74		23.72	
≥ High school	62.12		49.70		39.70		18.79		25.61	
Income		0.1243		0.1694		0.6896		0.1384		0.3174
≤\$5,000	62.23		49.71		40.90		19.77		23.71	
>\$5,000	70.09		57.01		42.99		26.17		28.30	
Marital status		0.1032		<0.0001		0.1071		0.1436		0.4528
Married	56.12		32.65	1	33.67		15.31		27.84	
Un-married (Divorced, single)	64.73		54.00		42.36		21.82		24.26	
Primary Drug used		0.0319		0.0044		<0.0001		<0.0001*		<0.0001*
Powder cocaine	73.44		67.19		20.31		12.50		15.63	
Crack cocaine	63.72		51.74		52.37		12.62		15.53	
Heroin	53.89		41.32		21.56		32.34		45.45	
Poly drug use	64.62		47.69		50.77		35.38		26.15	
Injection Status		0.1867		0.0960		0.0010		<0.0001		<0.0001
Injector	58.45		44.37		28.87		33.10		58.87	
Non-injector	64.50		52.27		44.18		17.36		15.09	
Condom use with females (past two months)		0.2598		0.1672		0.5729		0.6589		0.3212
Always	65.38		53.85		40.38		18.27		19.80	
Sometimes and Never	59.02		45.86		37.22		20.30		24.71	
Condom use with males (past two months)		0.0547		0.0486		0.7231		0.5143		0.0101*

Always	60.87			46.38			53.62			18.84			13.04		
Sometimes and Never	73.79			60.69			51.03			22.76			29.17		
HIV testing frequency (lifetime)		0.3856			0.2242			0.7903			0.7967			0.0891	
≤3	63.10			51.66			40.22			21.03			27.82		
≥4	59.64			46.69			39.16			20.18			21.78		
Any Discrimination		<0.0001			0.0001			0.0002			<0.0001			0.0005	
Yes	53.54			42.09			33.00			13.80			17.99		
No	70.25			57.36			47.85			26.99			30.03		
Discrimination due to incarceration		0.1556			0.5556			0.7251			0.0015			0.1144	
Yes	67.28			52.47			41.36			29.63			29.38		
No	61.04			49.79			39.79			17.92			23.14		
Racial Discrimination		0.0037			0.0228			0.0072			0.9103			0.2139	
Yes	72.12			58.18			49.09			21.21			28.40		
No	59.45			47.90			37.18			20.80			23.50		
Drug use Discrimination		<0.0001			0.0058			0.0064			<0.0001			<0.0001	
Yes	73.68			58.37			47.85			33.01			34.78		
No	57.41			46.76			36.57			15.05			19.86		
	Median			Median			Median			Median			Median		
	Yes (≥2)	No (<2)	p-value	Yes (≥2)	No (<2)	p-value	Yes (≥2)	No (<2)	p-value	Yes (≥2)	No (<2)	p-value	Yes (≥1)	No (0)	p-value
Age	33	34	0.0465	33	34	0.0798	34	32	0.0069	32	33	0.2184	31	34	<0.0001
Female sex partners	1	1	0.7208	1	1	0.6941	1	1	0.5170	1	1	0.9442	1	1	0.1488
Male sex partners	0	0	0.0040	0	0	0.0077	0	0	<0.0001	0	0	0.4659	0	0	0.9398
Age at sexual debut	14	14	0.6311	14	14	0.7498	14	14	0.4907	14	14	0.8750	14	14	0.0793

Table 5. Adjusted odds ratio and 95% confidence interval between selected demographics and drug using social network characteristics over the past 5 years, START 2006-2009

	Drug use Network (≥2)	Drug use Network (≥2)	Drug use Network (≥2)	Use drugs with Network (≥2)	Use drugs with Network (≥2)	Crack Network (≥2)	Crac Network (≥2)	Crack Network (≥2)	Heroin Network (≥2)	Heroin Network (≥2)	Heroin Network (≥2)
Past 4 years											
OR (95% CI)											
Discrimination due to incarceration	-	-	-	-	-	-	-	-	1.69 (1.10 – 2.60)	-	1.13 (0.69 – 1.85)
Racial Discrimination	1.86 (1.25 – 2.77)	-	1.49 (0.98 – 2.26)	3.19 (1.44 – 7.04)	-	1.96 (1.32 – 2.89)	-	1.63 (1.08 – 2.46)	-	-	-
Drug use Discrimination	-	2.34 (1.60 – 3.42)	2.10 (1.41 – 3.12)	-	1.41 (0.74 – 2.71)	-	2.06 (1.41 – 2.99)	1.79 (1.21 – 2.66)	-	2.37 (1.57 – 3.56)	2.24 (1.41 – 3.58)
Age	0.96 (0.93 – 0.99)	0.96 (0.93 – 0.99)	0.96 (0.93 – 0.99)	-	-	1.01 (0.98 – 1.05)	1.01 (0.98 – 1.05)	1.01 (0.98 – 1.05)	-	-	-
Female sex partners	-	-	-	-	-	-	-	-	-	-	-
Male sex partners	1.11 (1.02 – 1.20)	1.10 (1.02 – 1.20)	1.11 (1.02 – 1.20)	1.11 (1.01 – 1.21)	1.10 (1.01 – 1.19)	1.09 (1.02 – 1.17)	1.09 (1.02 – 1.17)	1.09 (1.02 – 1.17)	-	-	-
Age at sexual debut	-	-	-	-	-	-	-	-	-	-	-
Race/ ethnicity											
Black	-	-	-	-	-	1.08 (0.59 – 1.96)	1.10 (0.60 – 2.00)	1.12 (0.61 – 2.04)	0.41 (0.22 – 0.77)	0.43 (0.23 – 0.83)	0.43 (0.23 – 0.82)
Hispanic	-	-	-	-	-	1.06 (0.59 – 1.88)	0.95 (0.54 – 1.68)	1.01 (0.57 – 1.81)	0.83 (0.48 – 1.44)	0.82 (0.47 – 1.42)	0.82 (0.47 – 1.42)
White/ Other	-	-	-	-	-	ref	ref	ref	ref	ref	ref
Sex											
Male	-	-	-	-	-	ref	ref	ref	-	-	-
Female	-	-	-	-	-	1.26 (0.84 – 1.90)	1.20 (0.80 – 1.81)	1.27 (0.84 – 1.91)	-	-	-
Education											
< High school	-	-	-	-	-	-	-	-	-	-	-
≥High school	-	-	-	-	-	-	-	-	-	-	-
Income											
≤\$5,000	-	-	-	-	-	-	-	-	-	-	-
>\$5,000	-	-	-	-	-	-	-	-	-	-	-
Marital status											
Married	-	-	-	ref	ref	-	-	-	-	-	-
Un-married (single, divorced)	-	-	-	1.97 (0.88 – 4.41)	1.73 (0.79 – 3.79)	-	-	-	-	-	-
Primary Drug used											
Powder cocaine	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Crack cocaine	0.65 (0.39 – 1.10)	0.65 (0.38 – 1.09)	0.65 (0.39 – 1.11)	0.90 (0.36 – 2.24)	0.91 (0.37 – 2.24)	2.40 (1.44 – 4.02)	2.37 (1.42 – 3.96)	2.42 (1.44 – 4.06)	0.79 (0.42 – 1.49)	0.80 (0.42 – 1.51)	0.79 (0.42 – 1.50)
Heroin	0.40 (0.23 – 0.69)	0.34 (0.20 – 0.60)	0.35 (0.20 – 0.61)	0.43 (0.15 – 1.25)	0.50 (0.18 – 1.41)	0.66 (0.35 – 1.25)	0.62 (0.33 – 1.19)	0.62 (0.32 – 1.18)	1.64 (0.83 – 3.22)	1.68 (0.85 – 3.32)	1.65 (0.83 – 3.28)
Poly drug use	0.75 (0.37 – 1.49)	0.69 (0.34 – 1.39)	0.72 (0.36 – 1.44)	0.93 (0.26 – 3.28)	0.78 (0.22 – 2.72)	2.61 (1.31 – 5.20)	2.51 (1.26 – 5.01)	2.59 (1.30 – 5.18)	2.34 (1.10 – 4.98)	2.48 (1.16 – 5.31)	2.45 (1.14 – 5.25)
Injection Status											
Injector	-	-	-	-	-	ref	ref	ref	ref	ref	ref
Non-injector	-	-	-	-	-	0.95 (0.55 – 1.63)	0.89 (0.51 – 1.52)	0.92 (0.53 – 1.58)	1.09 (0.64 – 1.86)	1.03 (0.60 – 1.77)	1.03 (0.60 – 1.78)
Condom use with females (past two months)											
Always	-	-	-	-	-	-	-	-	-	-	-
Sometimes and Never	-	-	-	-	-	-	-	-	-	-	-
Condom use with males (past two months)											
Always	-	-	-	ref	ref	-	-	-	-	-	-

Sometimes and Never	-	-	-	2.42 (1.23 – 4.76)	2.22 (1.16 – 4.28)	-	-	-	-	-	-
HIV testing frequency (lifetime)											
≤3	-	-	-	-	-	-	-	-	-	-	-
≥4	-	-	-	-	-	-	-	-	-	-	-

Table 6. Bivariate associates between selected demographics and social network **sexual** characteristics over the past 5 years, START 2006-2009

	Sex network	p-value	Female sex network	p-value	Male sex network	p-value	Transactional sex network	p-value
	Yes (≥2)		Yes (≥2)		Yes (≥2)		Yes (≥2)	
Race/ ethnicity		0.0104		0.0614		<0.0001		<0.0001
Black	54.40		29.56		26.42		29.25	
Hispanic	49.38		39.00		10.79		14.11	
White/ Other	67.74		35.48		32.26		16.13	
Sex		0.3787		<0.0001*		<0.0001		0.0176
Male	53.29		46.49		7.68		19.30	
Female	57.07		4.71		53.40		27.75	
Education		0.0400		0.6227		0.0556		0.8467
< High school	50.47		33.02		18.38		21.50	
≥ High school	58.48		34.85		24.55		22.12	
Income		0.5712		0.2055		0.2079		0.8246
≤\$5,000	54.01		32.88		22.31		21.53	
>\$5,000	57.01		39.25		16.82		20.56	
Marital status		0.0029		0.0019		0.9954		0.0132
Married	40.82		20.41		21.43		12.24	
Un-married (Divorced, single)	57.09		36.55		21.45		23.45	
Primary Drug used		0.3038		0.0271		0.0183*		<0.0001*
Powder cocaine	64.06		46.88		20.31		17.19	
Crack cocaine	54.26		28.71		26.81		31.23	
Heroin	51.50		34.13		17.37		9.58	
Poly drug use	49.23		38.46		12.31		15.38	
Injection Status		0.8842		0.8278		0.7064		<0.0001
Injector	54.93		34.51		20.42		9.86	
Non-injector	54.24		33.53		21.89		25.25	
Condom use with females (past two months)		0.9007		0.8395		0.8070*		0.8419
Always	56.73		51.92		6.73		18.27	
Sometimes and Never	56.02		50.75		5.64		19.17	
Condom use with males (past two months)		0.6518		0.1403*		0.0945		0.5105
Always	63.77		14.49		50.72		37.68	
Sometimes and Never	66.90		7.59		62.76		33.10	
HIV testing frequency (lifetime)		0.6294		0.6316		0.6203		0.6730
≤3	54.98		34.69		22.14		22.51	
≥4	53.01		32.83		20.48		21.08	
Any Discrimination		0.0345		0.1041		0.6379		0.0072

Yes	49.83			30.64			20.54			17.17		
No	58.28			36.81			22.09			26.07		
Discrimination due to incarceration		0.4183			0.0187			0.0383				0.3038
Yes	56.79			41.36			15.43			24.69		
No	53.13			31.25			23.13			20.83		
Racial Discrimination		0.1156			0.0809			0.8238				0.0294
Yes	59.39			39.39			20.61			27.88		
No	52.31			31.93			21.43			19.75		
Drug use Discrimination		0.0955			0.0292			0.7819				0.0348
Yes	58.85			39.71			20.57			26.79		
No	51.85			31.02			21.53			19.44		
	Median			Median			Median			Median		
	Yes (≥2)	No (<2)	p-value	Yes (≥2)	No (<2)	p-value	Yes (≥2)	No (<2)	p-value	Yes (≥2)	No (<2)	p-value
Age	32	34	<0.0001	31	34	<0.0001	33	33	0.7862	34	33	0.1316
Female sex partners	1	1	0.0026	2	0	<0.0001	0	1	<0.0001	0	1	0.8808
Male sex partners	0	0	<0.0001	0	0	<0.0001	2	0	<0.0001	1	0	<0.0001
Age at sexual debut	14	14	0.2304	14	14	0.0961	14	14	0.4500	14	14	0.6186

Table 7. Adjusted odds ratios and 95% confidence intervals between selected demographics and social network **sexual** characteristics over the past 5 years, START 2006-2009

	Total Sex Network (≥2)	Female Sex Network (≥2)	Female Sex Network (≥2)	Female Sex Network (≥2)	Male Sex Network (≥2)	Transactional Sex Network (≥2)	Transactional Sex Network (≥2)	Transactional Sex Network (≥2)
	Past 4 years							
	OR (95% CI)							
Discrimination due to incarceration	-	1.30 (0.84 – 2.01)	-	-	1.00 (0.53 – 1.89)	-	-	-
Racial Discrimination	-	-	1.14 (0.74 – 1.75)	-	-	1.71 (1.08 – 2.69)	-	1.45 (0.90 – 2.35)
Drug use Discrimination	1.36 (0.95 – 1.96)	-	-	1.42 (0.94 – 2.14)	-	-	1.84 (1.19 – 2.84)	1.65 (1.04 – 2.61)
Age	0.94 (0.91 – 0.97)	0.93 (0.89 – 0.97)	0.93 (0.90 – 0.97)	0.93 (0.90 – 0.97)	-	-	-	-
Female sex partners	1.17 (1.06 – 1.28)	1.23 (1.10 – 1.37)	1.23 (1.10 – 1.38)	1.23 (1.10 – 1.37)	0.76 (0.58 – 0.98)	-	-	-
Male sex partners	1.18 (1.07 – 1.30)	0.86 (0.73 – 1.02)	0.86 (0.73 – 1.01)	0.86 (0.73 – 1.01)	1.48 (1.27 – 1.71)	1.10 (1.04 – 1.17)	1.10 (1.04 – 1.17)	1.10 (1.04 – 1.17)
Age at sexual debut	-	-	-	-	-	-	-	-
Race/ ethnicity								
Black	0.76 (0.43 – 1.34)	0.80 (0.41 – 1.57)	0.79 (0.40 – 1.54)	0.82 (0.42 – 1.60)	0.58 (0.28 – 1.17)	1.26 (0.62 – 2.56)	1.26 (0.62 – 2.56)	1.29 (0.63 – 2.62)
Hispanic	0.55 (0.32 – 0.95)	0.71 (0.38 – 1.33)	0.72 (0.39 – 1.34)	0.71 (0.38 – 1.33)	0.35 (0.16 – 0.74)	0.87 (0.42 – 1.82)	0.79 (0.38 – 1.65)	0.83 (0.40 – 1.75)
White/ Other	ref	ref	ref	ref	ref	ref	ref	ref
Sex								
Male	-	ref	ref	ref	ref	ref	ref	ref
Female	-	0.09 (0.04 – 0.19)	0.09 (0.04 – 0.19)	0.09 (0.04 – 0.19)	6.53 (3.64 – 11.71)	1.23 (0.76 – 1.99)	1.17 (0.73 – 1.89)	1.24 (0.76 – 2.00)
Education								
< High school	ref	-	-	-	-	-	-	-
≥High school	1.56 (1.11 – 2.20)	-	-	-	-	-	-	-
Income								
≤\$5,000	-	-	-	-	-	-	-	-
>\$5,000	-	-	-	-	-	-	-	-
Marital status								
Married	ref	ref	ref	ref	-	ref	ref	ref
Un-married (single, divorced)	1.76 (1.11 – 2.78)	1.93 (1.08 – 3.45)	1.96 (1.10 – 3.52)	1.95 (1.09 – 3.50)	-	2.00 (1.03 – 3.91)	1.91 (0.98 – 3.73)	1.94 (0.99 – 3.79)
Primary Drug used								

Powder cocaine	-	ref	ref	ref	ref	ref	ref	ref
Crack cocaine	-	0.61 (0.34 – 1.09)	0.62 (0.34 – 1.10)	0.62 (0.34 – 1.10)	1.30 (0.61 – 2.79)	2.09 (1.14 – 3.82)	2.05 (1.12 – 3.76)	2.07 (1.13 – 3.80)
Heroin	-	0.59 (0.31 – 1.11)	0.63 (0.33 – 1.18)	0.60 (0.32 – 1.13)	1.06 (0.44 – 2.54)	0.69 (0.30 – 1.60)	0.66 (0.28 – 1.52)	0.65 (0.28 – 1.51)
Poly drug use	-	0.72 (0.33 – 1.54)	0.73 (0.34 – 1.57)	0.73 (0.34 – 1.57)	0.83 (0.27 – 2.50)	1.03 (0.41 – 2.56)	0.99 (0.40 – 2.46)	1.01 (0.40 – 2.52)
Injection Status								
Injector	-	-	-	-	-	ref	ref	ref
Non-injector	-	-	-	-	-	0.64 (0.30 – 1.36)	0.62 (0.29 – 1.32)	0.63 (0.29 – 1.35)
Condom use with females (past two months)								
Always	-	-	-	-	-	-	-	-
Sometimes and Never	-	-	-	-	-	-	-	-
Condom use with males (past two months)								
Always	-	-	-	-	-	-	-	-
Sometimes and Never	-	-	-	-	-	-	-	-
HIV testing frequency (lifetime)								
≤3	-	-	-	-	-	-	-	-
≥4	-	-	-	-	-	-	-	-



### Appendix 3: Exploratory factor analysis of discrimination measures

Exploratory factor analysis (EFA) for the categorical measures of discrimination (age, race, sex (gender), sexual orientation, poverty, drug use, having been in jail or prison, religion, mental illness, physical illness, other) was performed in MPLUS to determine whether the underlying structure of each measure of discrimination captured unique or overlapping constructs. The results of the EFA are shown below.

The MPLUS code was written to examine whether the data fit one to two factors. This analysis found five patterns across the eleven types of discrimination that were entered into the EFA. As shown from the one factor result output, the data is not satisfactorily fit with one factor. However, the EFA with two factors shows that the data are fit well signified by the p-value (0.2297) and root mean square error of approximation (0.018) which were non-significant and fell below the cut-point of 0.06 recommended by Hu and Bentler (1999). Contrary to these results, the root mean square residual of 0.1234 is not below the recommended cut-point of 0.08 which therefore encourages us to interpret these findings with caution.

Since the two factors identified in the data were correlated at 0.657, this analysis will interpret the Promax rotated factor loadings which are calculated for correlated factors. The Promax rotated factor loadings show that variables A, B (racial discrimination), C, D and E load on one factor whereas variables F (discrimination due to drug use), G (discrimination due to incarceration), H, I, J, and K load on a different factor. Of these variables, the variables in this dissertation load on two different factors where discrimination due to drug use and discrimination due to incarceration represent the closest construct.

## MPLUS SYNTAX:

Mplus VERSION 3.12  
MUTHEN & MUTHEN  
08/23/2010 9:24 AM

## INPUT INSTRUCTIONS

TITLE: EFA DISCRIMINATION VARIABLES 081910

DATA: FILE IS "C:\Users\Natalie\Documents\Factor analysis\factor.csv";

## VARIABLE:

## NAMES ARE

L\_1\_A\_A  
L\_1\_A\_B  
L\_1\_A\_C  
L\_1\_A\_D  
L\_1\_A\_E  
L\_1\_A\_F  
L\_1\_A\_G  
L\_1\_A\_H  
L\_1\_A\_I  
L\_1\_A\_J  
L\_1\_A\_K;

## USEVARIABLES ARE

L\_1\_A\_A  
L\_1\_A\_B  
L\_1\_A\_C  
L\_1\_A\_D  
L\_1\_A\_E  
L\_1\_A\_F  
L\_1\_A\_G  
L\_1\_A\_H  
L\_1\_A\_I  
L\_1\_A\_J  
L\_1\_A\_K;

## CATEGORICAL ARE

L\_1\_A\_A  
L\_1\_A\_B  
L\_1\_A\_C  
L\_1\_A\_D  
L\_1\_A\_E  
L\_1\_A\_F  
L\_1\_A\_G  
L\_1\_A\_H

```
L_1_A_I  
L_1_A_J  
L_1_A_K;
```

```
MISSING ARE ALL (-9);
```

```
ANALYSIS:
```

```
TYPE = EFA 1 2 MISSING;  
ESTIMATOR = WLSMV;
```

```
output: sampstat;
```

## MPLUS OUTPUT

\*\*\* WARNING in Output command

SAMPSTAT option for analysis types MISSING and MCOHORT requires H1.

Analysis type H1 is turned on automatically.

\*\*\* WARNING

Data set contains cases with missing on all variables.

These cases were not included in the analysis.

Number of cases with missing on all variables: 10

2 WARNING(S) FOUND IN THE INPUT INSTRUCTIONS

## EFA DISCRIMINATION VARIABLES 081910

## SUMMARY OF ANALYSIS

Number of groups	1
Number of observations	642
Number of dependent variables	11
Number of independent variables	0
Number of continuous latent variables	0

## Observed dependent variables

Binary and ordered categorical (ordinal)

L\_1\_A\_A L\_1\_A\_B L\_1\_A\_C L\_1\_A\_D L\_1\_A\_E L\_1\_A\_F  
L\_1\_A\_G L\_1\_A\_H L\_1\_A\_I L\_1\_A\_J L\_1\_A\_K

Estimator	WLSMV
Maximum number of iterations	1000
Convergence criterion	0.500D-04
Maximum number of steepest descent iterations	20
Maximum number of iterations for H1	2000
Convergence criterion for H1	0.100D-03

## Input data file(s)

C:\Users\Natalie\Documents\Factor analysis\factor.csv

Input data format FREE

## SUMMARY OF DATA

Number of patterns 5

## COVARIANCE COVERAGE OF DATA

Minimum covariance coverage value 0.100

## PROPORTION OF DATA PRESENT

Covariance Coverage					
	<u>L_1_A_A</u>	<u>L_1_A_B</u>	<u>L_1_A_C</u>	<u>L_1_A_D</u>	<u>L_1_A_E</u>
L_1_A_A	0.995				
L_1_A_B	0.995	0.998			
L_1_A_C	0.995	0.998	0.998		
L_1_A_D	0.995	0.998	0.998	0.998	
L_1_A_E	0.995	0.998	0.998	0.998	0.998
L_1_A_F	0.995	0.998	0.998	0.998	0.998
L_1_A_G	0.995	0.998	0.998	0.998	0.998
L_1_A_H	0.992	0.995	0.995	0.995	0.995
L_1_A_I	0.995	0.998	0.998	0.998	0.998
L_1_A_J	0.995	0.998	0.998	0.998	0.998
L_1_A_K	0.994	0.997	0.997	0.997	0.997

Covariance Coverage					
	<u>L_1_A_F</u>	<u>L_1_A_G</u>	<u>L_1_A_H</u>	<u>L_1_A_I</u>	<u>L_1_A_J</u>
L_1_A_F	0.998				
L_1_A_G	0.998	1.000			
L_1_A_H	0.995	0.995	0.995		
L_1_A_I	0.998	0.998	0.995	0.998	
L_1_A_J	0.998	0.998	0.995	0.998	0.998
L_1_A_K	0.997	0.997	0.994	0.997	0.997

Covariance Coverage	
	<u>L_1_A_K</u>
L_1_A_K	0.997

## SUMMARY OF CATEGORICAL DATA PROPORTIONS

L_1_A_A	
Category 1	0.895
Category 2	0.105
L_1_A_B	
Category 1	0.743
Category 2	0.257
L_1_A_C	
Category 1	0.897
Category 2	0.103
L_1_A_D	
Category 1	0.934
Category 2	0.066
L_1_A_E	
Category 1	0.846

Category 2 0.154  
 L\_1\_A\_F  
 Category 1 0.674  
 Category 2 0.326  
 L\_1\_A\_G  
 Category 1 0.748  
 Category 2 0.252  
 L\_1\_A\_H  
 Category 1 0.947  
 Category 2 0.053  
 L\_1\_A\_I  
 Category 1 0.939  
 Category 2 0.061  
 L\_1\_A\_J  
 Category 1 0.978  
 Category 2 0.022  
 L\_1\_A\_K  
 Category 1 0.967  
 Category 2 0.033

#### SAMPLE STATISTICS

##### ESTIMATED SAMPLE STATISTICS

###### MEANS/INTERCEPTS/THRESHOLDS

	L_1_A_A\$	L_1_A_B\$	L_1_A_C\$	L_1_A_D\$	L_1_A_E\$
1	1.254	0.651	1.265	1.510	1.018

###### MEANS/INTERCEPTS/THRESHOLDS

	L_1_A_F\$	L_1_A_G\$	L_1_A_H\$	L_1_A_I\$	L_1_A_J\$
1	0.451	0.667	1.615	1.548	2.017

###### MEANS/INTERCEPTS/THRESHOLDS

	L_1_A_K\$
1	1.841

###### CORRELATION MATRIX (WITH VARIANCES ON THE DIAGONAL)

	L_1_A_A	L_1_A_B	L_1_A_C	L_1_A_D	L_1_A_E
L_1_A_A					
L_1_A_B	0.745				
L_1_A_C	0.698	0.671			
L_1_A_D	0.443	0.364	0.653		
L_1_A_E	0.704	0.653	0.780	0.524	

L_1_A_F	0.641	0.489	0.501	0.406	0.760
L_1_A_G	0.518	0.523	0.446	0.255	0.639
L_1_A_H	0.554	0.643	0.592	0.462	0.649
L_1_A_I	0.504	0.282	0.541	0.320	0.530
L_1_A_J	0.200	0.344	0.204	0.019	0.278
L_1_A_K	0.320	0.212	0.256	0.207	0.269

## CORRELATION MATRIX (WITH VARIANCES ON THE DIAGONAL)

	L_1_A_F	L_1_A_G	L_1_A_H	L_1_A_I	L_1_A_J
L_1_A_G	0.753				
L_1_A_H	0.637	0.591			
L_1_A_I	0.518	0.501	0.493		
L_1_A_J	0.189	0.352	0.365	0.432	
L_1_A_K	0.066	0.166	0.142	0.225	-0.698

## CORRELATION MATRIX (WITH VARIANCES ON THE DIAGONAL)

L\_1\_A\_K

## RESULTS FOR EXPLORATORY FACTOR ANALYSIS

## EIGENVALUES FOR SAMPLE CORRELATION MATRIX

	1	2	3	4	5
1	5.691	1.785	0.893	0.754	0.649

## EIGENVALUES FOR SAMPLE CORRELATION MATRIX

	6	7	8	9	10
1	0.442	0.312	0.277	0.156	0.112

## EIGENVALUES FOR SAMPLE CORRELATION MATRIX

	11
1	-0.071

## EXPLORATORY ANALYSIS WITH 1 FACTOR(S) :

CHI-SQUARE VALUE           66.123  
DEGREES OF FREEDOM        28  
PROBABILITY VALUE         0.0001

RMSEA (ROOT MEAN SQUARE ERROR OF APPROXIMATION) :  
ESTIMATE IS 0.046

ROOT MEAN SQUARE RESIDUAL IS 0.1397

ESTIMATED FACTOR LOADINGS

1

L_1_A_A	0.824
L_1_A_B	0.753
L_1_A_C	0.822
L_1_A_D	0.569
L_1_A_E	0.893
L_1_A_F	0.826
L_1_A_G	0.759
L_1_A_H	0.761
L_1_A_I	0.608
L_1_A_J	0.362
L_1_A_K	0.266

ESTIMATED RESIDUAL VARIANCES

	L_1_A_A	L_1_A_B	L_1_A_C	L_1_A_D	L_1_A_E
1	0.320	0.433	0.324	0.676	0.203

ESTIMATED RESIDUAL VARIANCES

	L_1_A_F	L_1_A_G	L_1_A_H	L_1_A_I	L_1_A_J
1	0.317	0.425	0.422	0.630	0.869

ESTIMATED RESIDUAL VARIANCES

	L_1_A_K
1	0.929

EXPLORATORY ANALYSIS WITH 2 FACTOR(S) :

CHI-SQUARE VALUE	26.529
DEGREES OF FREEDOM	22
PROBABILITY VALUE	0.2297

RMSEA (ROOT MEAN SQUARE ERROR OF APPROXIMATION) :  
ESTIMATE IS 0.018

ROOT MEAN SQUARE RESIDUAL IS 0.1234



## VARIMAX ROTATED LOADINGS

	1	2
L_1_A_A	0.663	0.513
L_1_A_B	0.642	0.443
L_1_A_C	0.864	0.343
L_1_A_D	0.592	0.226
L_1_A_E	0.603	0.662
L_1_A_F	0.247	0.881
L_1_A_G	0.203	0.801
L_1_A_H	0.471	0.601
L_1_A_I	0.342	0.511
L_1_A_J	0.157	0.342
L_1_A_K	0.323	0.071

## PROMAX ROTATED LOADINGS

	1	2
L_1_A_A	0.628	0.279
L_1_A_B	0.631	0.204
L_1_A_C	0.951	-0.034
L_1_A_D	0.656	-0.034
L_1_A_E	0.493	0.492
L_1_A_F	-0.046	0.945
L_1_A_G	-0.069	0.870
L_1_A_H	0.350	0.487
L_1_A_I	0.224	0.444
L_1_A_J	0.059	0.335
L_1_A_K	0.379	-0.083

## PROMAX FACTOR CORRELATIONS

	1	2
1	1.000	
2	0.657	1.000

## ESTIMATED RESIDUAL VARIANCES

	L_1_A_A	L_1_A_B	L_1_A_C	L_1_A_D	L_1_A_E
1	0.298	0.391	0.137	0.598	0.198

## ESTIMATED RESIDUAL VARIANCES

	L_1_A_F	L_1_A_G	L_1_A_H	L_1_A_I	L_1_A_J
1	0.163	0.316	0.417	0.622	0.858

## ESTIMATED RESIDUAL VARIANCES

L\_1\_A\_K

1      0.891

Beginning Time: 09:24:50  
Ending Time: 09:24:50  
Elapsed Time: 00:00:00

MUTHEN & MUTHEN  
3463 Stoner Ave.  
Los Angeles, CA 90066

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Web: [www.StatModel.com](http://www.StatModel.com)  
Support: [Support@StatModel.com](mailto:Support@StatModel.com)

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## Appendix 4: Reports of discrimination by extended race and ethnicity categories

Demographics	Total (n=647)	Hispanic (n=235)	Non- Hispanic Black (n=316)	Non- Hispanic White (n=91)	Hispanic/ Black (n=5)	p- value
<b>Discrimination measures</b>						
Incarceration*						
Yes	33.97	38.67	29.65	37.93	0.00	0.1317
No	66.03	61.33	70.35	62.07	100.00	
Race						
Yes	25.94	22.27	27.24	31.87	0.00	0.1758
No	74.06	77.73	72.76	68.13	100.00	
Drug use						
Yes	32.86	41.05	25.00	38.46	50.00	0.0006
No	67.14	58.95	75.00	61.54	50.00	

Appendix 5: Mediating role of depression on the relationship between various forms of discrimination and high risk networks

	Total risk networks		Sex risk networks		Drug risk networks		Heroin and Injecting networks	
	High ( $\geq 13$ )		High ( $\geq 4$ )		High ( $\geq 7$ )		High ( $\geq 2$ )	
	%	p-value	%	p-value	%	p-value	%	p-value
Depression								
Yes	31.20	0.0073	33.60	0.0658	31.47	0.2853	33.07	0.0445
No	21.69		26.84		27.57		25.74	

Total risk networks*		
	Model 1	Model 2 (adjusted for depression)
Discrimination		
‡ Incarceration	1.07 (1.00 – 1.15)	1.06 (0.98 – 1.13)
‡ Race	1.06 (0.99 – 1.14)	1.04 (0.98 – 1.10)
‡ Drug use	1.08 (1.03 – 1.14)	1.06 (1.01 – 1.11)
Sex networks**		
	Model 1	Model 2 (adjusted for depression)
Race	1.44 (1.14 -1.81)	1.39 (1.10 – 1.76)
Drug use	1.44 (1.15 – 1.80)	1.38 (1.10 – 1.74)
Heroin and injecting networks***		
	Model 1	Model 2 (adjusted for depression)
‡ Incarceration	1.17 (0.93 – 1.47)	1.13 (0.90 – 1.43)
‡ Drug use	1.45 (1.16 – 1.80)	1.46 (1.18 – 1.82)

\*Adjusted for marital status, number of male sex partners, age at sexual debut, and primary drug used.

\*\*Adjusted for race, marital status, primary drug used, injection status and recruitment strategy.

\*\*\*Adjusted for marital status and number of male sex partners.

\*\*\*\*Adjusted for race, age, age at sexual debut, primary drug used, injection status and recruitment strategy.

Appendix 6. Adjusted associations at a glance: Presence of relationship between discrimination and risk network

	Discrimination		
	Drug use	Race	Incarceration
<b>Overall Network</b>			
Total	+		
Jail	+		+
High School Educated	+	+	
<b>Sex Networks</b>			
Total			
Female			
Male			
Transactional	+	+	
<b>Drug Network</b>			
Total	+	+	
Use drugs with		+	
Crack	+	+	
Heroin	+		+
IDU			

Appendix 7: Analysis of social networks pooled over the past five years versus social networks in the past year

Table 1. Sample population characteristics, START 2006-2009 (n=647)

Demographics		
	n	Median (IQR)
Age	647	33 (28 – 37)
Female sex partners	644	1.0 (0 – 2)
Male sex partners	641	0 (0 – 1)
Age at sexual debut	641	14 (12 – 16)
	n	%
Race/ ethnicity		
Hispanic	240	37.09
Black	316	48.84
White/ Other	91	14.06
Sex		
Male	456	70.48
Female	191	29.52
Education		
< High school	320	49.54
≥High school	326	50.46
Income		
≤\$5,000	507	82.71
>\$5,000	106	17.29
Marital status		
Married	98	15.24
Un-married (single, divorced)	545	84.76
Primary Drug used		
Powder cocaine	62	10.20
Crack cocaine	315	51.81
Heroin	166	27.30
Poly drug use	65	10.69
Injection Status		
Injector	141	21.89
Non-injector	503	78.11
Condom use with females (past two months)		
Always	104	28.11
Sometimes and Never	266	71.89
Condom use with males (past two months)		
Always	66	31.43
Sometimes and Never	144	68.57
HIV testing frequency (lifetime)		
≤3	271	45.32
≥4	327	54.68
Lifetime depression	375	57.96
Sampling		

RDS	421	65.07		
TSS	226	34.93		
<b>Discrimination measures</b>				
Incarceration*				
Yes	159	33.97		
No	309	66.03		
Race				
Yes	165	25.94		
No	471	74.06		
Drug use				
Yes	209	32.86		
No	427	67.14		
<b>Social risk networks (5 years ago)</b>			<b>Social risk networks(1 year ago)</b>	
Total risk networks			Total risk networks	
≥7	164	25.35	≥5	367 56.72
<7	483	74.65	<5	280 43.28
Sex risk networks			Sex risk networks	
≥2	187	28.90	≥3	321 49.61
<2	460	71.10	<3	326 50.39
Drug risk networks			Drug risk networks	
≥4	182	28.13	≥2	293 53.96
<4	465	71.87	<2	250 46.04
Heroin and injecting networks			Heroin and injecting networks	
≥1	211	32.61	≥1	205 31.68
<1	436	67.39	<1	442 68.32

\*Only includes those that reported spending time in jail or prison in their lifetime (n=468)

Table 2. Bivariate associates between types of discrimination and total, sex, drug and heroin and injecting risk social network characteristics

	Total risk networks		Sex risk networks		Drug risk networks		Heroin and Injecting networks		Total risk networks		Sex risk networks		Drug risk networks		Heroin and Injecting networks	
	5 YEARS AGO								1 YEAR AGO							
	High ( $\geq 7$ )		High ( $\geq 2$ )		High ( $\geq 4$ )		High ( $\geq 1$ )		High ( $\geq 5$ )		High ( $\geq 3$ )		High ( $\geq 2$ )		High ( $\geq 1$ )	
	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value
<b>Incarceration<sup>‡</sup></b>																
Yes	28.30	0.1789	25.79	0.6908	59.75	0.2391	49.06	0.8638	59.75	0.2391	49.06	0.8638	27.67	0.7975	34.59	0.7315
No	22.65		27.51		54.05		48.22		54.05		48.22		28.80		33.01	
<b>Race</b>																
Yes	32.73	0.0109	32.12	0.2471	63.03	0.0589	55.76	0.0699	63.03	0.0589	55.76	0.0699	35.15	0.0200	36.97	0.1441
No	22.72		27.39		54.56		47.56		54.56		47.56		25.69		30.79	
<b>Drug use</b>																
Yes	31.10	0.0189	30.14	0.5511	65.55	0.0017	55.98	0.0263	65.55	0.0017	55.98	0.0263	33.97	0.0223	42.58	0.0001
No	22.28		27.87		52.46		46.60		52.46		46.60		25.29		27.40	

<sup>‡</sup>Only includes those that reported spending time in jail or prison in their lifetime (n=468)



Table 3. Adjusted prevalence ratios (95% confidence intervals) between various forms of discrimination and total, sex, drug and heroin and injecting risk social network characteristics, START 2006-2009

5 YEARS AGO					1 YEAR AGO			
Total risk networks					Total risk networks			
Discrimination measures	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Incarceration <sup>‡</sup>	-	-	-	-	-	-	-	-
Race	-	1.35 (1.03 – 1.76)	-	1.27 (0.94 – 1.72)	-	1.04 (0.97 – 1.11)	-	-
Drug use	-	-	1.21 (0.98 – 1.49)	1.24 (0.93 – 1.66)	-	-	1.05 (0.99 – 1.10)	-
Sex networks <sup>**</sup>					Sex networks <sup>**</sup>			
Incarceration <sup>‡</sup>	-	-	-	-	-	-	-	-
Race	-	-	-	-	-	-	-	-
Drug use	-	-	-	-	-	-	1.03 (0.98 – 1.08)	-
Drug networks <sup>***</sup>					Drug networks <sup>***</sup>			
Incarceration <sup>‡</sup>	-	-	-	-	-	-	-	-
Race	-	1.38 (1.07 – 1.78)	-	1.29 (0.98 – 1.69)	-	-	-	-
Drug use	-	-	1.33 (1.03 – 1.70)	1.23 (0.94 – 1.60)	-	-	1.03 (0.97 – 1.10)	-
Heroin and injecting networks <sup>****</sup>					Heroin and injecting networks <sup>****</sup>			
Incarceration <sup>‡</sup>	-	-	-	-	-	-	-	-
Race	-	-	-	-	-	-	-	-
Drug use	-	-	1.56 (1.25 – 1.95)	-	-	-	1.13 (0.96 – 1.35)	-

5 YEAR AGO ANALYSIS:

\*Adjusted for marital status, number of male sex partners, and recruitment strategy.

\*\*\*Adjusted for marital status and number of male sex partners.

\*\*\*\*Adjusted for race, age, age at sexual debut, male condom use, primary drug used, and injection status.

‡Only includes those that reported spending time in jail or prison in their lifetime (n=468)

1 YEAR AGO ANALYSIS:

\*Adjusted for age, sex, education, marital status, number of male sex partners, age at sexual debut and recruitment strategy.

\*\* Adjusted for age, primary drug used, injection status, number of female sex partners, number of male sex partners and recruitment strategy.

\*\*\*Adjusted for gender, primary drug used, age at sexual debut and number of male sex partners.

\*\*\*\*Adjusted for race, age, age at sexual debut, number of male sex partners, primary drug used, injection status and recruitment.

Appendix 8: Results of neighborhood analysis (AIM 3) using mixed models (PROC GLIMMIX)

Heroin and injecting networks*	
Discrimination	
Incarceration	
Yes	1.24 (0.93 – 1.64)
No	1.00
Drug use	
Yes	1.50 (1.19 – 1.90)
No	1.00

\*adjusted for age, race, primary drug used, injection status, depression and recruitment.

Heroin and injecting networks*									
	% Black p=0.8070			% High School Education p=0.2963			Social Cohesion/ collective efficacy p=0.9457		
Discrimination due to Incarceration									
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Yes	1.23 (0.71 – 2.13)	1.12 (0.63 – 1.98)	1.09 (0.43 – 2.80)	1.27 (0.66 – 2.44)	1.40 (0.78 – 2.53)	1.01 (0.49 – 2.09)	1.23 (0.75 – 2.01)	1.11 (0.58 – 2.10)	1.21 (0.47 – 3.15)
No	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	% Black p=0.6654			% High School Education p=0.9064			Social Cohesion/ collective efficacy p=0.6393		
Discrimination due to Drug use									
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Yes	1.79 (1.12 – 2.84)	1.16 (0.70 – 1.93)	1.52 (0.72 – 3.22)	1.18 (0.69 – 2.04)	1.63 (0.99 – 2.70)	1.45 (0.83 – 2.54)	1.58 (1.05 – 2.37)	1.19 (0.66 – 2.16)	1.59 (0.73 – 3.45)
No	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

\*adjusted for age, race, primary drug used, injection status, depression and recruitment.

APPENDIX 9: Frequency of experiences of discrimination by select neighborhood characteristics

	Percent Black				Percent Latino				Percent High School Education				Percent Poverty				Percent Social Cohesion			
	Low	Medium	High	p-value	Low	Medium	High	p-value	Low	Medium	High	p-value	Low	Medium	High	p-value	Low	Medium	High	p-value
Discrimination measures																				
Incarceration	37.74	40.25	22.01	0.0504	23.90	32.70	43.40	0.0065	47.80	32.08	20.13	0.2802	35.85	40.25	23.90	0.3617	42.14	33.96	23.90	0.3646
Race	37.65	37.04	25.31	0.2427	29.63	32.72	37.65	0.2640	48.15	31.48	20.37	0.2438	40.12	32.72	27.16	0.0890	41.36	33.33	25.31	0.5127
Drug use	39.51	37.56	22.93	0.0138	25.85	35.61	38.54	0.1160	45.37	34.63	20.00	0.4080	37.07	37.56	25.37	0.3489	46.83	28.78	24.39	0.4758

P<0.10, p<0.05

APPENDIX 10: Adjusted prevalence ratios (95% confidence intervals) between discrimination due to drug use and embedded heroin and injecting networks among those in neighborhoods with medium levels of education, START 2006-2009

Heroin and injecting networks		
	Medium% Less than High School Education	
	Model 1*	Model 2**
Drug use discrimination		
Yes	1.63 (1.10 – 2.41)	1.85 (1.04 – 3.29)
No	1.00	1.00
	Low % Black	
Drug use discrimination	Model 1*	Model 2**
Yes	1.79 (1.12 – 2.84)	1.56 (0.85 – 2.88)
No	1.00	1.00

\*adjusted for age, race, primary drug used, injection status, depression and recruitment.

\*\*adjusted for age, race, primary drug used, injection status, depression, recruitment and neighborhood social cohesion.

Appendix 11: Bivariate associations between social networks and neighborhood characteristics for census tracts with >19 observations (n=311)

	Total risk networks		Sex risk networks		Drug risk networks		Heroin and Injecting networks	
	High ( $\geq 13$ )		High ( $\geq 4$ )		High ( $\geq 7$ )		High ( $\geq 2$ )	
	%	p-value	%	p-value	%	p-value	%	p-value
<b>Neighborhood characteristics</b>								
% Black <sup>Y</sup>								
Low	26.67	0.9980	23.33	0.5039	36.67	0.4843	40.00	0.0540
Medium	26.85		34.23		28.19		26.85	
High	26.52		31.82		25.76		19.70	
% Latino <sup>Y</sup>								
Low	28.57	0.8323	29.76	0.8545	28.57	0.2378	22.62	0.2138
Medium	25.00		33.33		23.48		21.97	
High	31.33		32.63		33.68		31.58	
% Poverty <sup>Y</sup>								
Low	24.42	0.5018	23.26	0.0806	27.91	0.1987	24.42	0.3771
Medium	31.18		38.71		34.41		30.11	
High	25.00		33.33		23.48		21.97	
High school education								
Low	28.86	0.3866	34.90	0.2790	32.21	0.1690	31.54	0.0392
Medium	26.52		31.82		25.76		19.70	
High	16.67		20.00		16.67		16.67	
Social Cohesion*								
Low	28.13	0.9814	25.00	0.6094	37.50	0.4141	40.63	0.0425
Medium	26.53		34.01		27.89		26.53	
High	26.52		31.82		25.76		19.70	
<b>Incarceration</b>								
Yes	37.33	0.0150	38.67	0.1371	37.33	0.0423	34.67	0.0309
No	23.08		29.49		25.21		22.22	
<b>Race</b>								
Yes	39.02	0.0028	47.56	0.0003	40.24	0.0045	28.05	0.4949
No	22.03		25.99		23.79		24.23	
<b>Drug use</b>								
Yes	37.11	0.0044	41.24	0.0150	38.14	0.0083	38.14	0.0004
No	21.70		27.36		23.58		19.34	