DOES PLACE MATTER?: AN EXAMINATION OF NEIGHBORHOOD DISADVANTAGE AND HIV RISK

by

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Master of Arts
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DEDICATION

This dissertation is dedicated to my Uncle Danny and to my Aunt Sonny for their tireless, and at times ill-advised, support in the attainment of all of my professional and personal aspirations.

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ABSTRACT

DOES PLACE MATTER?: AN EXAMINATION OF NEIGHBORHOOD DISADVANTAGE AND HIV RISK

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A systematic review of neighborhood influences on HIV risk behaviors was conducted with a focus on 1) the various conceptualizations of neighborhood, 2) the net findings regarding neighborhood effects on HIV risk, and 3) an evaluation of the samples' generalizability. Neighborhood characteristics were associated with HIV risk, including drug and sex-related behaviors, independent of individual characteristics. However, these relationships varied by time. While early studies have most often found that greater neighborhood disadvantage was related to greater HIV risk, recent work has found the opposite association, possibly indicating that prior prevention efforts in these "at-risk" areas have been effective.

The relationship between neighborhood disadvantage and HIV risk was also investigated in a sample of 236 former jail inmates, a group at elevated risk for the disease. Controlling for individual demographic characteristics, neighborhood disadvantage was

negatively associated with injection drug use, unprotected sex with non-primary partners, and overall HIV risk; there was a non-significant positive association between neighborhood disadvantage and number of sexual partners. Taken together, these findings lend support to the effectiveness of HIV prevention messages targeted to disadvantaged neighborhoods, and suggest that greater attention to HIV risk and prevention in suburban, affluent communities may be warranted.

INTRODUCTION

Over thirty years into the HIV/AIDS epidemic, notable advances have been made in the treatment of the disease. Still no cure exists. Despite gains in the fight against HIV, the disease's presence has most strongly been felt by specific groups of individuals. Members of marginalized groups, such as individuals living in poverty, and individuals cycling in and out of the criminal justice system have all been identified as at "high risk" due to elevated prevalence rates documented within these groups. In order to "reach them where they are," researchers and policymakers have emphasized the importance of understanding the influence of neighborhood factors to inform community-level interventions aimed at preventing the spread of HIV (Kelly, 1999). As a result, separate explorations of neighborhood influence on HIV risk in disparate communities have been undertaken. To date, these endeavors have remained separate and unsynthesized, making it nearly impossible to make general statements about neighborhood context and HIV risk. To address this problem, Chapters 1 through 6 of the present paper describe a systematic review of neighborhood level influences on individuals' HIV risk. In these chapters, the state of current knowledge of neighborhood effects on HIV risk is described with a focus on the various conceptualizations of neighborhood and the comparability of study samples investigated.

The idea of "meeting them where they are" has been interpreted literally with regard to individuals involved in the criminal justice system, a group three to four times more likely to contract HIV when compared to those in the community at large. HIV prevention efforts have been implemented in some jails and prison systems, though these practices are neither universally incorporated nor universally empirically-based (O'Connell et al., 2013). Although the provision of HIV prevention programming within correctional institutions is an important starting point to reduce the spread of the disease, these interventions may overlook a key element—environmental context. Given that most inmates who contract HIV do so while in the community, rather than while incarcerated, the role of neighborhood context in contributing to HIV risk may be especially relevant. Chapters 7 through 11 describe an empirical study of the relationships between neighborhood disadvantage, as measured by the 2000 US Census, and several HIV risk behaviors among 236 former inmates in their first year following release from jail. To gain an understanding of how and under which circumstances neighborhoods may influence individuals' risk behavior, individuals' connectedness to both the community at large and to the criminal community are examined as potential mediators and moderators of this relationship. Finally, this paper concludes with a brief discussion of the implications of the information presented, along with recommendations for future research and neighborhood-level HIV intervention work.

ABSTRACT: SYSTEMATIC REVIEW OF NEIGHBORHOOD EFFECTS ON HIV RISK

Literature detailing neighborhood influences on HIV risk is growing, but has not yet been synthesized. Nonetheless, there are policy mandates to focus on neighborhood effects on HIV contraction. Using 24 studies meeting inclusion criteria, a systematic review examining 1) the various conceptualizations of neighborhood, 2) the findings regarding neighborhood effects on HIV risk, and 3) an evaluation of the samples' generalizability was conducted.

Studies varied in their selection and combination of neighborhood indicators; most were confined to "at-risk" groups in small geographic locations, limiting comparability and generalizability. Neighborhood characteristics seem to be associated with HIV risk, including drug and sex-related behaviors, independent of individual level characteristics. Disadvantaged neighborhoods may be protective against some risk behaviors, suggesting that prior intervention in these areas may have been effective.

NEIGHBORHOOD EFFECTS AND HIV RISK: A SYSTEMATIC REVIEW

Over thirty years into the HIV/AIDS epidemic, significant improvements have been made regarding the spread and maintenance of the disease in the United States. Due to the introduction of highly active antiretroviral therapy (HAART) in 1996, HIV is no longer considered to be a "death sentence" (Harrison, Song, & Zhang, 2010), and the number of new cases of the disease has remained relatively stable over the past decade (Moore, 2011). Nonetheless, approximately 1.2 million people in the United States are living with HIV, with an estimated one-fifth of these individuals unaware of their infection (Centers for Disease Control, 2011). Aside from the numerous physical and psychological effects of infection for the 50,000 new cases of HIV that occur annually, the financial ramifications of the HIV/AIDS epidemic are undeniable (CDC, 2011). It is estimated that the sum financial impact of these new cases amounts to over $12 billion dollars in medical expenses incurred each year (Schackman et al., 2006).

Numerous resources have been applied to the prevention of HIV, and theory-based behavioral interventions have been shown to be modestly *efficacious* in the reduction of individuals' high risk sexual and drug behaviors (Dutra, Stathopoulou, Basden, Leyro, Powers, & Otto, 2008; Free, Roberts, Abramsky, Fitzgerald, & Wensley, 2011; Noar, 2008). However, questions regarding the *effectiveness* of these programs in the real world have yet to be answered (Noar, 2008). Although many HIV prevention efforts occur at the individual level, there has been increasing recognition that these

interventions are more likely to succeed if they go beyond the individual to address the contextual and structural factors that contribute to high risk behavior (Coates, Richter, & Caceres, 2008).

Prevention programming and interventions implemented on a community-level often focus on important social phenomena, occurring outside of the individual, that may contribute to HIV risk (Auerbach, 2009). For example, a jewelry-making HIV prevention program for low-income, drug-using women was piloted in Baltimore, Maryland with a key aim to reduce sex-trade by generating income via jewelry-making. At the end of the program, the researchers found significant reductions in the women's frequency of sex-trade, and at three months follow-up, income earned from jewelry sales was negatively related to the women's number of sexual partners (Sherman, German, Cheng, Marks, & Bailey-Kloche, 2006). The JEWEL intervention, which created new economic pathways for these women to reduce high risk behaviors, represents one of few community-level interventions on HIV risk with available outcome data.

Community-level interventions reflect that, fundamentally, HIV is a social disease, and its transmission relies upon one's interactions with others and the environment; the development of healthier, safer interactions may prevent transmission. Interventions that fail to promote health by altering the social context in which HIV risk behaviors occur may be neglecting a vital component.

How Do Neighborhood Features Confer Individual Risk?

Links between individuals' environments, often conceptualized as their neighborhood settings, and their overall physical and mental health have been explored

extensively in the last twenty years (Diez Roux & Mair, 2010). In general, research suggests that living in socioeconomically disadvantaged neighborhoods is associated with poorer health outcomes and poorer health behaviors, independent of individual-level factors (Mujahid & Diez Roux, 2010), and a causal link between neighborhood poverty and individuals' overall health has been supported (Do & Finch, 2008). These effects have been found with regard to the relationships between neighborhood disadvantage and individuals' obesity (Roberts & Reither, 2004), incidence of ischemic stroke (Brown et al, 2011), and alcohol abuse and tobacco use (Stimpson, Ju, Raji, & Eschbach, 2007). Although they employ different names, including neighborhood-disadvantage, disorder, deprivation, and poverty, several theories have been developed to explain the mechanisms through which neighborhood environments confer health risks.

Social disorganization theory. Developed during the 1940s to explain differences in crime rates by geographic location, social disorganization theory has remained a highly-cited framework used to understand the association between neighborhoods and individual behavior (Shaw & McKay, 1942, 1969). Shaw and McKay (1942, 1969) suggested that social disorganization within a community, a combination of low socioeconomic status, high residential mobility, and ethnic heterogeneity, hindered the development of community ties and connections that establish control and supervision over youth in a neighborhood. Family disruption was later incorporated into social disorganization theory, suggesting that single-parent households have more difficulty controlling the behavior of their children, and that a high concentration of these households fosters criminal and other unhealthy behavior within a community (Sampson,

1987). Empirical examinations of neighborhood effects on a variety of individual health behaviors and outcomes have incorporated, and supported the utility of social disorganization theory for adolescents and adults (Jones-Webb & Wall, 2008; Reichman, Teitler, & Hamilton, 2009; Sampson, 2003). Specifically, these studies suggest that disorganized neighborhoods create an environment that limits access to health-promoting resources and contribute to higher stress levels, which in turn negatively affect individuals' health (Kubrin & Weitzer, 2003; Latkin & Curry, 2003).

Social norms. The concept of social norms posits that economically disadvantaged neighborhoods may not dissolve social ties completely. Instead, these neighborhoods may actually foster social norms, or shared understandings of expected behaviors, that support and promote high risk behaviors. In fact, the presence of social norms that are accepting of high risk behaviors has been found to mediate the relationship between neighborhood factors and individual risk behaviors (Kubrin & Weitzer, 2003; Latkin & Curry, 2003). Norms may be descriptive in nature, describing a person's perceptions of the behaviors of others (e.g., people who live here use drugs), or they may be injunctive in nature, describing whether a person believes that a behavior is right or wrong (e.g., people who live here think it is acceptable to use drugs). The presence of visible high risk behaviors (e.g., drug use) or even perceptions that behaviors occur and are sanctioned within a community may influence how an individual within that neighborhood behaves (Berkowitz, 2004).

Neighborhood Context, HIV/AIDS, and the United States Government

Researchers' growing attention to neighborhood effects has been driven by the recognition that neighborhood characteristics are not randomly distributed and are not simply the sum of the people who comprise them (Diez Roux & Mair, 2010). Instead, residential areas are both reflective of and shaped by social position, and are characterized by multiple interdependent phenomena that can guide health behavior, making them key targets for policy-based interventions to enhance health and well-being (Diez Roux & Mair, 2010).

Aligned with this interest in neighborhood effects on health, the United States government has introduced the National HIV/AIDS Strategy (NHAS), a plan for reducing, and ultimately ending, the nation's HIV burden (Millett et al., 2010). This strategy is multifaceted, with efforts aimed at preventing new HIV infections through the use of evidence-based approaches and improved access to education about the disease. A key component of this endeavor relies on increasing strategies to prevent HIV in communities in which the disease is prevalent. Within this multi-pronged approach, the NHAS aims to develop a greater understanding of the *contexts* in which HIV risk emerges in order to determine how to eradicate the disease.

The State of Neighborhood Effects on HIV Risk Research

To date, a small collection of separate studies has explicitly explored neighborhood factors associated with HIV risk, making it difficult to address the NHAS. The present review aims to synthesize the current state of knowledge regarding neighborhood effects on HIV risk behaviors within the United States, thus providing

guidance for developing contextually-based prevention interventions. Specifically, the present review aims to:

1) Detail the various conceptualizations and measurement methods used to study neighborhood effects employed in these studies, along with the implications of these approaches;

2) Provide an overall assessment of the relationship between neighborhood-level indicators and individuals' HIV risk behaviors, including injection drug use, risky sexual practices, and HIV testing;

3) Discuss the generalizability of the set of findings based on the various samples included in the extant literature.

METHODS OF SYSTEMATIC REVIEW

Article Selection

Articles for possible inclusion were identified through a search of databases (Figure 1), incorporating articles published from January 1, 2000 to March 1, 2013. Search terms included were a combination of 1) "neighborhood," "community," "area-level," "Census," and 2) "HIV," "sexual behavior," "intravenous drugs," and "injection drugs." Regarding, inclusion and exclusion criteria, English-language empirical studies of United States neighborhood effects on "HIV risk" were included. To be comprehensive in addressing "HIV risk," we included studies in which the primary outcome was injection drug use, injection drug cessation, unprotected sexual behavior, HIV testing, or multiple sexual partnerships. Although a high number of sexual partners may be indicative of risky sexual practices, these behaviors do not *necessarily* indicate sexual risk associated with unprotected sex or with high-risk partners. When considering HIV risk, promiscuity, in the absence of unprotected sex and high-risk partners, represents a relatively minor determinant of HIV infection (Bolton, 1992; Williams, Gilgen, Campbell, Taljaard, & MacPhail, 2000). However, given the preponderance of literature on risky sexual behavior that assesses number of sexual partners as a primary indicator of risk, this outcome was included in the present review. Articles focusing on initiation to sex within adolescent samples were also included, as this has been to found be associated with unprotected sex and a greater number of sexual partners (Smith, 1997). Studies were

excluded if (1) the study did not take place in the United States, (2) neighborhood-level variables were not primary independent variables in the research question, (3) the outcome was limited to non-injectable drugs, or if injection drug use could not be assessed independent of non-injection drugs, or (4) the study did not assess neighborhood effects using objective measures (e.g., Census data).

Abstracts were reviewed by a single reviewer. Reference sections of articles meeting inclusion criteria were further reviewed to identify additional articles for possible inclusion (yield = 15 articles). Of all 549 articles screened for inclusion, 513 were excluded because they did not meet full inclusion criteria, and 36 full-text articles were reviewed. Figure 1 shows the flow of article selection. Twenty-four articles are included in the present review, and are summarized in Table 1 with information about study sample, type of study (e.g., cross-sectional), and location.

Identified Studies of Neighborhood Effects on HIV Risk

Fifty-four percent (n=13) of the studies were cross-sectional; the remaining 11 were longitudinal. Study samples included adolescents (n=13), adults (n=10), and both adolescents and adults (n=1). HIV risk outcomes included initiation of sex among adolescents (n=9), number of sexual partners (n=4), unprotected sex (n=6), HIV testing (n=2), and injection drug use (n=8). Of the eight articles that focused on drug use, two primarily examined injection drug cessation, rather than use.

RESULTS OF SYSTEMATIC REVIEW

Measurement of Neighborhood Effects

All 24 studies included used Census data to measure neighborhood effects. Although the publication range of these studies was from 2000 to 2012, Census data obtained ranged from the 1980 Census to the 2000 Census. Given that the Census is updated only decennially, published studies that incorporate Census data may represent a significant lag in the dissemination of findings or may be relying on outdated information as neighborhoods change and develop over time. If the effects reported in these studies are no longer relevant, or if they do not operate in the same way after many years, interventions based upon them may be misinformed.

Census data can be aggregated in numerous ways, and there is no gold standard for the level at which they are assessed in neighborhood effects research (Pebley & Sastry, 2004). The most commonly used levels, decreasing in size, are zip code, neighborhood cluster, tract, and block groups. Four of the 24 articles reviewed here used zip codes to measure neighborhood effects. Zip codes are boundaries assigned by the US Postal Service, vary greatly in size (mean=30,000 individuals), and can cross county and state lines (Soobader, LeClere, Hadden, & Maury, 2001). Zip codes can be matched to Census information based on Census zip code tabulation areas (ZCTAs); however, there is not perfect concordance between these two designations. Given their potential for heterogeneity, it has been suggested that zip codes may underestimate neighborhood

effects (Krieger, Chen, Waterman, Soobader, Subramanian, & Carson, 2003). Three studies in the present review used neighborhood clusters, which comprise several Census tracts and average approximately 8,000 people (Browning, Burrington, Leventhal, & Brooks-Gunn, 2008). Census tracts are based upon the number of people in an area, rather than a geographic size, and contain 4,000 people on average. For example, despite an enormous difference in size, the District of Columbia has more Census tract designations than the entire state of Wyoming. Tracts are delineated with the aim of remaining stable over long periods of time, and do not cross jurisdictional boundaries; in the present review, tracts were the most commonly employed unit to assess neighborhood effects (n=12). Block groups represent the smallest unit of measurement in the Census and describe a relatively small residential area with a population of approximately 1000 people. Given their small size, block groups tend to yield the most homogenous neighborhood data (Krieger et al., 2002). In the present review, five studies relied on Census block groups to assess neighborhood effects.

When interpreting neighborhood effects, the unit of analysis for the neighborhood-level variables has important implications. Failing to find evidence for contextual effects on high risk behavior may be more indicative of the level of analysis, rather than the presence or absence of such effects. For example, in two separate investigations Roche and colleagues (2005), and Roche and Levanthal (2009) explored neighborhood effects on teens' initiation to sex. There was no evidence of neighborhood disadvantage influencing sexual initiation when using neighborhood clusters, but these effects were evident when neighborhoods were conceptualized using smaller Census

tracts (Roche et al., 2005; Roche & Levanthal, 2009). Although these studies differed in other important methodological ways, they highlight the possibility that for some behaviors, neighborhood effects may be quite localized. The larger the neighborhood under study, the greater the opportunity for groups of homes, school districts, and parks that vary considerably in financial resources, safety, and social norms to be aggregated, potentially wiping out meaningful differences. Failure to consider the proper level of aggregation of neighborhood effects may unintentionally influence outcomes.

Studies vary substantially in the number and nature of neighborhood-level variables considered. Among the 24 studies in this review, the number of Census indicators used to assess neighborhood-level effects ranged from one to eleven, with the majority (67%) drawing upon at least five indicators. Neighborhood poverty was the most common indicator of neighborhood effects with 83% of the studies including this characteristic. Neighborhood employment rate was also commonly included (71%). Roughly half (50%) of the studies assessed the percentage of single-headed households (generally headed by a female) or two-person married households, and 54% considered the educational attainment of adults in the neighborhood. Racial composition, or the percentage of either African-Americans or whites (38%), and the proportion of recipients of welfare (38%) were frequently incorporated into the neighborhood-level analyses. Table 2 details the Census indicators included in all 24 studies.

Mirroring the heterogeneity in Census indicators used, these studies varied greatly in the method of combining data. A few studies relied upon a single, standardized indicator (n=4), measured continuously or with various cut-points (e.g., 30%, 20%, 10%

below poverty); the remainder aggregated the indicators. Aggregation was typically achieved via standardization and summation of indicators or through data reduction techniques such as Confirmatory Factor Analysis (CFA) and Principal Components Analysis (PCA). While these approaches may yield similar results, they are conceptually distinct. The primary aim of PCA is efficiency, obtained through the reduction of the number of indicators by maximizing the amount of total variance explained; in this case, unique variance of individual indicators is considered meaningful in the creation of components. The goal of CFA is to reveal the underlying cause or construct that accounts for the associations present between indicators by incorporating only their shared variance; unique variance is not considered in the creation of factors (Gorsuch, 1997; Velicher & Jackson, 1990). Applied to the relationship between neighborhood indicators and HIV risk, studies that employ PCA suggest an association between a composite of neighborhood-level indicators and HIV risk, where individual neighborhood indicators' associations with HIV risk may vary. On the other hand, studies using CFA analyses suggest that there is a single, inherent, underlying quality of neighborhoods that influence these behaviors; all neighborhood indicators should be equally associated with HIV risk. When comparing studies of neighborhood effects, these methodological differences must be attended to.

What Are The Key Findings?

HIV risk is a composite of a variety of dangerous behaviors, including both risky injection drug use practices and unprotected sexual behaviors. In this review, only one study focused on both injection drug use and sexual behavior. The remainder assessed

neighborhood effects on either drug use or sexual behavior. Given the various conceptualizations of neighborhood, the geographic limitations of the studies, and their focus on a variety of at-risk groups, direct comparison of the 24 studies' results is nearly impossible. Nonetheless, several conclusions can be reached given the trend of the majority of their findings. These conclusions should be considered a *summary* of the state of our present knowledge of objectively defined neighborhood effects on HIV risk behavior, and all aforementioned caveats should be employed when reflecting upon them.

Injection drug use. In general, neighborhood poverty was associated with initiation of injection drug use (Fuller et al, 2005), frequency of drug use (Galea, Ahern, & Vlahov, 2003; Williams & Latkin, 2007), drug arrests (Schroeder et al., 2000), and lower odds of quitting drugs either for a short period of time (Nandi et al, 2010) or for over three years (Genberg et al., 2011). The majority of these findings remained after controlling for individual level traits, such as individuals' poverty and employment status and educational attainment.

Two studies yielded results in the opposite direction expected. Sunder, Grady, and Wu (2007) found that neighborhood disadvantage, measured by a composite of the proportion of individuals living below the poverty line, percentage of unemployed adults, and percentage of adults without a high school diploma, was negatively associated with drug use. Although initially surprising, these results must be considered in context, as this study was conducted with low-income women. Thus the relationship observed between neighborhood disadvantage and drug use may reflect the fact that the poorest individuals were simply unable to afford the cost of drugs; in fact, the authors described these women

as "exceptionally impoverished" (Sunder, Grady, & Wu, 2007). Bluthenthal and colleagues (2007) found that the neighborhood's racial composition, defined as the percent of African-Americans residing in the tract, predicted syringe sharing. Specifically, they found that for every 10 percent increase in the number of African-Americans in the neighborhood, the odds of receptive syringe sharing decreased by a factor of 0.93. The authors theorized that this finding may be due to greater access to HIV prevention services in predominantly African-American communities or due to the fact that African-Americans may be more motivated to avoid HIV exposure given its historical impact on the black community (Bluthenthal et al., 2007).

Both Sunder and colleagues (2007) and Bluthenthal and colleagues (2007) used data from the 2000 Census to assess neighborhood effects, while the other researchers who assessed neighborhood influence on drug use and cessation relied upon 1990 Census data.[1] The differences in direction of effects yielded may reflect this methodological variation, and may lend support to the idea that, to the extent that they have been implemented in these communities, HIV prevention programs have been moderately successful. Geographic location may also explain the different set of findings. Six of the eight studies were located on the east coast (Baltimore and New York City); all of these yielded positive associations between neighborhood disadvantage and injection drug use. The two that did not find such relationships took place in San Francisco (Bluthenthal et al., 2007) and in southeast Texas (Sunder et al., 2007). Taken together, these eight studies suggest that there are neighborhood-level influences on the injection drug behavior of adults, but the nature of these effects vary.

Sexual behavior. Findings from studies of neighborhood effects on sexual behavior were even more varied. With regard to neighborhood influences on initiating sex, the majority of studies found that greater neighborhood disadvantage predicted early initiation to sex (Bauermeister et al., 2010; Browning et al., 2008; Browning, Leventhal, & Brooks-Gunn, 2005; Cubbin et al., 2005; Roche et al., 2005) though some found moderating effects by age and by gender, with neighborhood poverty predicting initiation to sex among older (15-17 years old) rather than younger (11-14 years old) adolescents (Cubbin et al., 2010) and a greater influence on boys' initiation relative to girls' (Ramirez-Valles, Zimmerman, & Juarez, 2002). In line with a component of social disorganization theory, Upchurch, Aneshensel, Mudgal, and McNeely (2001) found that Hispanic teens living in low to medium density Hispanic neighborhoods were more likely to have sex than their Hispanic counterparts who lived in high density Hispanic neighborhoods, suggesting that ethnic homogeneity in the community protected against early sexual initiation; these authors did not include other neighborhood indicators in their analyses. Still, Teitler and Weiss (2000) found only an indirect effect of neighborhood on initiation to sex through school environment, while Roche and Levanthal (2009) found no evidence for neighborhood effects on initiation to sex.

In general, neighborhood disadvantage was associated with early initiation to sex among adolescents in samples assessed using the 1980 and 1990 Censuses, though Teitler and Weiss (2000), who used the 1990 Census, did not find this association. This trend was found in studies of specific cities and in studies that used national databases. Only one study used the 2000 Census, and the authors did not find an association between

neighborhood and initiation to sex (Roche and Levanthal, 2009). This finding may also reflect changes in the behavior of individuals in disadvantaged neighborhoods, perhaps owing to effective intervention. However, this is difficult to assess with just one study using more recent neighborhood-level data.

There was strong evidence to suggest that neighborhood disadvantage was associated with more sexual partners among adolescents, as this finding emerged in both studies using nationally representative samples and Census figures dating from 1980 to 2000 (Baumer & South, 2001; Lindberg & Orr, 2011). Only one study used an adult sample to examine these effects; no relationship between neighborhood socioeconomic disadvantage and number of short term sexual partners emerged (Browning & Ollinger-Wilborn, 2003). However, the authors did find that for adult men, residential stability was negatively associated with short term sexual partnering; no such effects were found for women (Browning & Ollinger-Wilborn, 2003). Taken together, this suggests that neighborhood poverty may be a stronger influence for partnering among young people, than among adults.

Neighborhood effects on unprotected sex were varied. Some researchers found no relationship between neighborhood context and condom use (Cubbin et al., 2005; Lindberg & Orr, 2011), others found the expected relationship that neighborhood disadvantage was associated with engaging in unprotected sex (Baumer & South, 2001), and still others yielded unexpected results (Bauermeister et al., 2011; Bluthenthal et al., 2007). Bauermeister and colleagues (2010) found that living in greater disadvantage was associated with more consistent condom usage among teens, and Bluthenthal and

colleagues (2007) found that the prevalence of African-Americans in neighborhoods was associated with lower odds of unprotected sex. Frye and colleagues (2010) found that among homosexual men, the only neighborhood-level predictor of condom use above and beyond individual characteristics was community gay presence, which served as a protective factor against unprotected sex. The only positive association between neighborhood disadvantage and frequency of unprotected sex, above and beyond individual characteristics, employed data from the 1980 Census (Baumer & South, 2001). Again, these results suggest that perhaps prior intervention and the presence of HIV in previously defined "high risk" (e.g., low-income African-American, homosexual) communities may be protective against engaging in HIV risk behavior like unprotected sex.

HIV testing. Two studies explored neighborhood effects on HIV testing. One study focused on adolescents at risk for high school dropout (Johns et al, 2010) and the other on adults living in Los Angeles county (Taylor et al, 2006). Both found evidence of neighborhood effects on testing behavior. Johns and colleagues (2010) found that females were more likely to test, especially in areas of greater disadvantage, but not when living in HIV-prevalent neighborhoods.

Taylor and colleagues (2006) found that individuals living in zip codes with a high concentration of African-Americans tested more frequently than people living in zip codes with a high concentration of whites or Latinos. Contrary to popular belief, both studies suggest that some indicators thought to predict increased risk behavior, like economic disadvantage and a high concentration of African-Americans, may actually be

protective in some cases. As Bluthenthal and colleagues (2007) suggest, perhaps areas with these characteristics already have easy access to HIV prevention services.

How Generalizable Are the Findings?

Neighborhood effects research is often criticized due to the reliance on specific residential areas such as single cities; few studies have examined neighborhood effects on a larger scale, incorporating multiple cities, states, or regions. In this review, only 21% of the studies relied upon national survey data, with the remaining 79% confined to a single city or specific region of a state. Of the 5 studies that incorporated national data, all were adolescent samples. In the remaining 19 studies set in a specific region, nine major metropolitan areas were represented and, with the exception of Detroit, all are set within the 10 states reporting the highest number of AIDS diagnoses (CDC, 2011). Studies of neighborhood-level influences on the behaviors of individuals in specific communities are important; they can provide meaningful information about places to intervene and can promote ideas about *potential* places for intervention in other communities. However, the tendency to limit studies of neighborhood effects to single localities reduces the results' generalizability.

Perhaps owing to the policy implications of neighborhood economic disadvantage on health, most studies of the effect of neighborhood on health outcomes have focused on urban communities and "at risk" groups. Consequently, such research becomes very narrow in scope, essentially examining the effects of neighborhood on the behavior of a small subset of people living in a specific city. For example, in the present review, many studies were limited to "at-risk" adolescents, defined as ethnic minority teens, children at

risk for dropping out of high school, drug-abusing teens, or "inner-city" youth. Investigations including adults were often limited to "low income" adults, men who have sex with men (MSM), and injection drug users. As a result, these studies' effects may be limited by low variability in neighborhood-level indicators. For example, Genberg and colleagues (2011) acknowledged that all participants in their study (adult IDUs in inner city Baltimore) objectively lived in poverty; thus the results suggesting that neighborhood economic deprivation decreased the likelihood of long-term injection drug cessation are censored. Rather than neighborhood economic deprivation decreasing the likelihood of injection drug cessation *across* the economic spectrum (e.g., impoverished through affluent), the authors found that *among those who are economically deprived*, living in the most impoverished neighborhoods reduced the likelihood of IV drug cessation the most (Genberg et al., 2011); these conclusions are not identical and may carry different implications.

To date, few studies of neighborhood effects have examined affluence per se; instead, the majority of these studies explore samples ranging from indigence to low-middle income. The hypothesis that affluent neighborhoods protect against high-risk behaviors is an empirical one that has not yet been fully addressed in the HIV risk literature. However, there is some reason to believe that, currently, suburban and high socioeconomic environments may be associated with greater risk. Adolescents in middle to high-income environments have been shown to engage in higher rates of substance abuse, to use substances to medicate feelings of isolation, and to engage in high levels of promiscuity compared to youth in urban environments (Luthar, 2003). Thus, the

assumption that neighborhood disadvantage is linearly associated with risk, and that the relationship is a *positive* one with more disadvantage conferring more risk, may miss high levels of risky behavior that occur at the upper end of the social strata.

Neighborhood contextual models are often based upon the assumption that selected neighborhood indicators are generalizable across regions, that the influence of poverty in Washington, DC on drug behavior is the same as the influence of poverty on drug behavior in rural Iowa. However, this is also an empirical question that has not yet been broadly addressed. In the present review, we found evidence that neighborhood effects on injection drug use may vary by geographic location, as significant associations between poverty and drug use were found in Baltimore and New York, but not San Francisco and Texas. Given the impact of the heroin epidemic in Baltimore, specifically, and in other areas of the east coast, the injection drug culture may be more ingrained in low-income communities in the mid-Atlantic than other areas of the country. This suggests that researchers should consider locations' unique histories when embarking on neighborhood-level work.

Although the potential lack of generalizability in the presently reviewed studies does limit the broad impact of the exploration of neighborhood effects on HIV risk behavior, the various populations and behaviors explored do not render the results meaningless. Instead, they highlight and call for what has become a commonplace and lauded approach—targeted and tailored intervention (Kreuter, Lukwago, Bucholtz, Clark, & Sanders-Thompson, 2003). Such an approach recognizes the value of turning attention towards specific groups of people who are at heightened risk of an outcome, like HIV

acquisition, while also appreciating the fact that interventions set in different places and with different people will likely need to focus on different contextual characteristics.

Conclusions

Current directions in HIV risk intervention are aimed at intervening on more than the individual level. Due to a greater recognition that context matters in individuals' behavior, research on neighborhood effects on health behaviors has blossomed. This trend has extended to the study of neighborhood effects on HIV risk behaviors. To date, there has been no published attempt to systematically review the available literature on neighborhood effects on HIV risk behaviors. The goals of the present review were to synthesize the extant literature with regard to how neighborhood has been conceptualized and measured in these explorations of neighborhood effects on HIV risk behavior, to assess the generalizability of their findings, and to provide a single outlet to summarize the knowledge about this topic to date. Twenty-four articles were included in the review.

With regard to the conceptualization of neighborhood, one key finding emerged: there is no gold standard for measuring neighborhood. This was evident in the variety of ways in which researchers chose the level of analysis (e.g., zip codes, Census tracts), the collection of indicators they included (ranging from one to eleven), and the ways they created the neighborhood variables (e.g., summing scales, factor analysis). Currently, great care must be taken to understand how the study-specific conceptualization and measurement of neighborhood effects influences the interpretation of the results. In order to aid in the interpretability and comparison *between* studies examining neighborhood

effects on HIV risk behavior, it would be helpful if a guide for measuring these effects was developed and agreed upon. For example, despite significant variation in researchers' methods of combining neighborhood indicators, providing the correlations between the separate indicators included and the outcomes of interest prior to data reduction (e.g., CFA, PCA, summation) may be a simple solution that can aid in cross-study comparisons.

The ways in which neighborhood indicators are combined can affect interpretation of the findings. For example, Galea, Ahern, and Vlahov (2003) and Williams and Latkin (2007) examined neighborhood effects on adult intravenous drug users' injection behaviors. While both studies found evidence that living in disadvantaged neighborhoods predicted injecting drugs more frequently, independent of individual level variables, the conclusions that can be drawn are not identical. Galea and colleagues (2003) included only one neighborhood indicator, the proportion of individuals living in poverty, while Wiliams and Latkin (2007) standardized and summed ten indicators to achieve their neighborhood disadvantage score. Thus, one set of findings suggest that residential poverty is a key contextual contributor to individuals' injection drug use (Galea et al, 2003) and the other set suggests that an amalgamation of contextual factors influence individuals' injection drug behavior (Williams & Latkin, 2007). Although these results are not mutually exclusive, maintaining their distinction is important, especially as these findings are incorporated into the development of prevention programming and interventions. To date, studies have largely relied upon very narrow groups of people in specific metropolitan areas when investigating neighborhood effects on HIV risk

behaviors. As such, researchers and public health professionals should exercise caution when drawing conclusions from the available research, as the genereralizability of these findings to other types of individuals (e.g., those not "at high risk") and to people living in other parts of the country is limited.

Overall, it does appear that there is evidence that neighborhood level characteristics affect individuals' HIV risk behaviors, including drug use, sexual behavior, and HIV testing behavior, independent of their individual traits. These results have been found for both teens and adults, though it appears that these effects may be strongest for adolescents. Taken as a whole, the 24 studies suggest that living in economically disadvantaged has increased the likelihood of using injection drugs, making it more difficult to cease such use, and has predicted early initiation to sex. However, not all studies find a negative influence of neighborhood disadvantage on HIV risk; some studies suggest neighborhood disadvantage may be associated with greater HIV risk protective behavior. The studies that yielded these unexpected results ranged in setting (e.g., Los Angeles, Texas, Michigan) and in age of participants, including both adolescents and adults. Interestingly, these studies were conducted fairly recently (2006-2010) and used the 2000 Census to create neighborhood level variables, rather than earlier Census reports. Although it has not been explicitly explored, this finding may be due to greater attention to HIV risk in these communities in recent times and the implementation of more resources to promote HIV safety behaviors. For example, a preponderance of data suggest that neighborhood disadvantage may promote earlier

initiation to sex and more sexual partners, but it is not clear that this also leads to a failure to use contraceptives or to adopt other health-protective behaviors.

Limitations

The present review is not without limitations. The search criteria excluded studies of perceptions of neighborhood-level influences. Although perceived neighborhood-level characteristics may not overlap perfectly with objective measures, they are important and may better capture an individual's experience within a specific community. Another limitation is that a specific set of literature databases were searched; it is possible that articles may have missed. To address this limitation, reference lists of included articles were reviewed to identify additional articles potentially missed by the database search. Finally, the review was limited to articles published between 2000 and 2012, thus excluding earlier work which may have created a historical framework for the present findings.

Implications for Future Research and Practice

Future research should begin to explore the mechanisms through which neighborhood characteristics influence risk behaviors. Several mechanisms, like social support, collective efficacy, and community connectedness have been explored in other studies of neighborhood effects on health behaviors (e.g., exercise, eating well, adherence to medical regimens; Ellen, Mijanovich, & Dillman, 2001); this work has not yet permeated neighborhood effects on HIV risk research. Broadening the scope of communities explored may also provide more information regarding neighborhood effects on HIV risk behaviors, and would allow researchers to address the possibility that

neighborhood context influences behaviors differently at various social strata. The idea that interventions in previously designated "at-risk" communities may have resulted in citizens' adoption of safer behaviors in these communities should be investigated. In order to do this, interventions must be empirically evaluated and their findings must be disseminated. The extent to which interventions and preventive programming have been implemented in neighborhoods under study may prove to be an important variable in neighborhood effects research. Despite the difficulties inherent in research on contextual effects, those who endeavor to pursue such work continue to reveal important macro-level influences on behavior that can be addressed through policy, thereby creating multi-level interventions that may have stronger effects on reducing HIV risk behavior.

ABSTRACT: NEIGHBORHOOD DISADVANTAGE AND JAIL INMATES' POST-RELEASE HIV RISK BEHAVIORS

Public health researchers have begun to investigate the role of neighborhood disadvantage in predicting individuals' HIV risk behaviors in several high-risk groups (e.g., urban adolescents, injection drug users, MSM), finding that neighborhood context is a relevant consideration in understanding individuals' behavior. Although inmates represent a high-risk group for HIV infection, no study has examined how the neighborhoods to which these individuals enter post-release relates to their HIV risk behaviors. The present study explored the relationships between neighborhood disadvantage, as measured by data from the 2000 US Census, and several HIV risk behaviors among 236 former jail inmates in their first year post-release. Controlling for individual gender, poverty, educational attainment, and employment status, neighborhood disadvantage was negatively associated with injection drug use, unprotected sex with non-primary partners, and overall HIV risk; there was a non-significant positive association between neighborhood disadvantage and number of sexual partners. Individuals' connectedness to the community at large and connectedness to the criminal community were examined as moderators and as mediators in the relationship between neighborhood disadvantage and HIV risk behaviors; neither connectedness to the community at large nor connectedness to the criminal community moderated or mediated these relationships. Taken together, these findings suggest that, contrary to theory,

individuals living within disadvantaged communities may be more likely to engage in HIV-protective behaviors relative to their peers in more affluent communities, possibly owing to targeted HIV prevention efforts in less affluent environments. These results also suggest that more attention to HIV risk and HIV prevention in suburban and affluent communities may be warranted.

NEIGHBORHOOD DISADVANTAGE AND JAIL INMATES' POST-RELEASE HIV RISK BEHAVIORS: DOES CONNECTEDNESS TO THE COMMUNITY MATTER?

HIV & Inmates

The financial ramifications of the HIV/AIDS epidemic are undeniable. It is estimated that there are nearly 40,000 new HIV infections in the U.S. annually, amounting to over $12 billion dollars in medical expenses incurred each year (Schackman et al., 2006). Although HIV/AIDS has become a serious concern for many individuals, its occurrence is even more pronounced among people who cycle in and out of the correctional system, with a prevalence over 3.5 times greater for this population than the general population (Braithwaite & Arriola, 2003; Maruschack, 2010).

Despite the need for HIV prevention programming within jails and prisons, few facilities provide empirically informed and evaluated interventions (O'Connell et al., 2013), thus returning many inmates to their communities in the same state in which they first entered the system. Leading researchers have called out for community-level interventions to prevent the spread of HIV/AIDS among high risk groups (Kelly, 1999), as there is emerging evidence that neighborhood context is related to engaging in HIV risk behavior such as injection drug use and unprotected sex (Adams, in preparation). However, the extent to which the makeup of neighborhoods to which former inmates are returned plays a role in their HIV risk practices post-release is unknown. This information is vital, as research indicates that most previously incarcerated individuals who are HIV-positive contracted the disease while out in the community, and not while

incarcerated (Spaulding, Stephenson, Macalino, Ruby, Clarke, & Finnigan, 2002). The present paper seeks to inform future community-level interventions by exploring whether and how former inmates' neighborhood environments are related to their HIV risk behavior during the first year post-release.

Why Context Matters

Individuals do not exist within a vacuum, and the same is true for former inmates. When these individuals are released from jail, they return to a variety of communities, all with differing characteristics and opportunities. Studies of the determinants of health behaviors have historically focused on individual risk factors, often omitting the wider social environment in which the outcomes occur (Pickett & Pearl, 2001). Especially within the field of public health, this practice has begun to shift. Epidemiological studies have shown a consistent relationship between neighborhood deprivation and various physical health outcomes, above and beyond individual economic measures (Echeverria, Diez-Roux, Shea, Borrell, & Jackson, 2008; Pickett & Pearl, 2001). In fact, a causal link between neighborhood poverty and individuals' physical overall health has been supported (Do & Finch, 2008).

Social disorganization theory has been used to conceptualize the relationship between people's environments and their behavior. This theory suggests that "disorganized" communities, characterized by high crime, high unemployment rates, high residential mobility, and low income, perpetuate their decline as individuals with resources leave these neighborhoods, while those without the means to exit may turn to drugs and criminal activity as sources of income (Sampson, 2003a; Wilson, 1987). Extant

literature suggests that community-level characteristics are associated at both the community and the individual level with a range of unhealthy and risky behaviors, including substance use and unprotected sexual behavior (Adams, in preparation; Jones-Webb & Wall, 2008; Reichman, Teitler, & Hamilton, 2009). However, most of these studies have been limited to specific high-risk groups and narrow geographical regions, making it difficult to generalize to other groups and locales.

Community characteristics may affect individuals' HIV risk behaviors through both direct and indirect mechanisms (Poundstone et al., 2004). Directly, risky contact with HIV positive individuals is more frequent in disadvantaged communities because of the higher rates of HIV/AIDS in these communities (Cohen et al., 2000). Indirectly, neighborhood disadvantage has been linked to chronic stress, which is associated with psychological distress (Latkin & Curry, 2003; Steptoe & Feldman, 2001). In turn, psychological distress has been found to predict both the initiation and relapse of injection drug use, thus increasing risk of HIV contraction (Hasin et al., 2002; Latkin et al., 2005).

Not only are partners (injection drug or sexual) more likely to be HIV positive in disadvantaged communities, partners may be more likely to engage in risky practices. Research supports the notion that behavior is in part based upon social cues, and high risk behaviors may be promoted in certain environments. In fact, the presence of social norms that are accepting of high risk behaviors has been found to mediate the relationship between neighborhood factors and individual risk behaviors (Kubrin & Weitzer, 2003). The presence of visible high risk behaviors (e.g., injection drug use) or even the

perception that these behaviors occur and are sanctioned within a community may influence how an individual within that community behaves (Latkin & Knowlton, 2005). Given that HIV is a social disease in which a person's exposure depends upon exposure and contact with others, researchers should attempt to reconcile individual and structural factors that may contribute to risk. Investigating how neighborhood environment affects individual behavior may be especially important for recently released inmates who must re-establish a presence in their communities.

Are Disadvantaged Neighborhoods Still Riskier?

To date, the majority of researchers have hypothesized a positive relationship between neighborhood disadvantage and HIV risk behaviors, owing to the increased prevalence of the disease in economically underprivileged settings. However, in a review of 24 studies of neighborhood effects on HIV risk behaviors, Adams (in preparation) found that studies conducted more recently and that used the 2000 Census rather than the 1990 Census to code neighborhood disadvantage tended to find no relationship or a negative relationship between neighborhood disadvantage and HIV risk behaviors, suggesting that in some cases, living in disadvantaged settings may be protective against risk behaviors. While there is evidence that disadvantaged communities may promote earlier initiation to sexual activity among teenagers and may be associated with having more sexual partners, it is unclear that this extends to unprotected sex (Adams, in preparation). Several researchers have posited that this observed shift in the direction of neighborhood effects on HIV risk behaviors may be due to increased awareness of the disease in these communities and may be indicative of successful intervention in targeted

disadvantaged communities (Bluthenthal, Do, Finch, Martinez, Edlin, & Kral, 2007; Taylor, Leibowitz, Simon, & Grusky, 2006). Due to researchers' divergent strategies in conceptualizing neighborhood context, reliance on specific, narrow populations and geographic regions, and omission of direct assessments of HIV-prevention efforts in these communities, it is difficult to determine whether neighborhood disadvantage has truly become protective against HIV risk or whether these findings have been due to study-specific research artifacts.

Connectedness to the Community: A Key to Understanding How Neighborhood Disadvantage Affects HIV Risk?

Beyond understanding that there are neighborhood-level influences on HIV risk behavior, the following questions arise: 1) how does environmental context affect behavior and 2) under which conditions? The first question refers to mechanisms through which neighborhood context may affect behavior, seeking potential mediators of this relationship. The second question refers to moderators of the relationship between neighborhood and individual risk, examining under which circumstances and for whom this relationship may exist. Although there are a plethora of possible constructs that can be incorporated in order to better understand the complex relationship between environment and individual behavior, one's connectedness to the community emerges as a useful potential source of information.

In the same way that individuals can feel connected to each other, they can also feel connected to their neighborhoods, as people may derive a sense of belonging and receive regular feedback about their value from their environments (Mashek, Cannaday,

& Tangney, 2007; Whitlock, 2007). Deriving a sense of belonging and attachment to a community environment has generally shown positive associations with healthy development and wellbeing, along with negative associations with poor health (Baumeister & Leary, 1995; Putnam, 2000). However, individuals may also feel connected to a community environment with antisocial characteristics, such as a criminal community. Should it be expected that individuals attached to a criminal community would experience the same positive associations with healthy development and physical wellbeing that have been documented in traditional communities? It is intuitive that connectedness to an antisocial community would negate healthy practices, insofar as it provides messages endorsing high risk behaviors. To date, this question has not been empirically examined. Because individuals may be connected to multiple communities simultaneously (Mashek, Stuewig, Furukawa, & Tangney, 2006; Roccas & Brewer, 2002), it is important to assess the roles of the community at large, along with the criminal community in understanding former inmates' post-release HIV risk behaviors.

Does neighborhood disadvantage travel through connectedness to the community? Research has not yet examined connectedness to the community as it operates within the context of neighborhood effects on HIV risk behavior. Some theories, including social disorganization theory, suggest that connectedness to the community acts as a mediating variable between neighborhood and behavior. In this framework, disadvantaged neighborhoods diminish the ability to become attached to the community through high residential mobility and general instability; the resulting lack of informal control and pro-social feedback leads to more frequent high risk behavior (Robert, 1999).

According to these theories, highly disadvantaged communities will have less community connectedness among residents. This perspective linking neighborhood disadvantage, connectedness to the community, and individual risk behavior has been supported in the literature focusing on adolescents' risky behaviors (see Kerrigan, Witt, Glass, Chung, & Ellen, 2006; Resnick et al., 1993), but has not yet been applied to a high risk adult sample such as recently released inmates.

Does the effect of neighborhood disadvantage on HIV risk depend on one's connectedness to the community? Alternatively, connectedness to the community may affect (i.e., moderate) the relationship between neighborhood disadvantage and individual behavior, rather than acting as a mechanism through which influence travels (i.e., mediator). Even in the face of extreme neighborhood disarray, some individuals do not engage in high risk behavior; "positive deviants" exist (Marsh, Schroeder, Dearden, Sternin, & Sternin, 2004). Neighborhood effects on risk behavior may depend greatly on the type of community to which one is connected. People can feel connected to impoverished communities or to communities that present views that oppose the mainstream. For instance, connectedness to the criminal community has shown positive associations with having a short-term orientation, and this may increase the likelihood of engaging in high risk behavior (Mashek, Stuewig, Furukawa, & Tangney, 2006). The deleterious effects of a disadvantaged community may not come to fruition if individuals residing in that neighborhood do not feel connected to it; in some cases, the lack of connectedness to the community may act as a buffer to HIV risk. This line of questioning has yet to be examined.

The Present Study

Given the growing interest in neighborhood effects on health behaviors, especially as they exist among high-risk individuals, the present study aims to be the first to explore the direct link between the neighborhood disadvantage to which inmates are released and their HIV risk behavior in the first year post-incarceration. This inquiry represents a crucial first step toward understanding the impact of contextual factors on this high-risk group. It is hypothesized that, controlling for individual level characteristics, individuals who are released into disadvantaged neighborhoods will report more HIV risk behaviors, as measured by injection drug use, number of sexual partners, unprotected sex with high-risk partners, and overall HIV risk level.

Additionally, the study aims to delve into an aspect of the neighborhood disadvantage and HIV risk relationship by exploring the roles of individuals' connectedness to the community at large and to the criminal community as both mediators and moderators of this association. It is hypothesized that rather than acting as mediators of the relationships between neighborhood disadvantage and HIV risk behaviors, connectedness to the community at large and connectedness to the criminal community, separately, will moderate these associations. Specifically, it is hypothesized that for individuals in more affluent communities, connectedness to the community at large will be negatively associated with engaging in HIV risk behaviors. For individuals in disadvantaged communities, connectedness to the community at large will be positively associated with engaging in HIV risk behaviors. Further, it is hypothesized that connectedness to the criminal community will be positively related to engaging in HIV

risk behaviors, but that the association between connectedness to the criminal community and HIV risk behaviors will be stronger for individuals living in more disadvantaged communities than in less disadvantaged environments.

METHODS

Participants

Data are from 235 of 508 participants in a larger longitudinal study examining moral emotions (e.g., shame and guilt) and criminal recidivism in a single jail in a Washington, DC suburb (Tangney, Mashek, & Stuewig, 2007). Inmates were eligible to participate in the study provided that they were (1) either (a) sentenced to at least 4 months in jail, or (b) arrested on at least one felony charge other than probation violation, with no bond or with a bond greater than $7,000, (2) assigned to the jail's medium or maximum security "general population" (e.g., not in solitary confinement, not in a separate forensic unit), and (3) had sufficient language proficiency to complete study protocols in English or Spanish. Enrollment within the jail occurred between 2002 and 2007. Participants were assured that their data were protected by a Certificate of Confidentiality from DHHS. The Institutional Review Board for the University approved the full study protocol.

Analyses presented in the current paper use data from the one year post-release interview. Although these data are still being obtained, the majority of these interviews have been collected (n=343). Most post-release interviews were conducted via telephone; 38% were completed in person owing to the participant's re-incarceration. Individuals who completed the two hour one year post-release interview received an honorarium of

$50. Figure 2 shows the flow of data collection included in this paper's analyses.

Measures

Individual level controls. Participants' individual demographic characteristics were treated as control variables in the present analyses. Participant's gender, poverty, high school graduation, and employment statuses were assessed during the one year post-release interview. A dichotomous variable reflecting individuals' poverty status was determined by whether participants reported an annual income greater than the 2000 poverty level for an individual ($8,959); a 1 on this variable reflects living below the national poverty level. On the high school graduation status, participants received a score of 0 if they had graduated from high school by the time of the post-release interview and a 1 if they had not. Participants received a value of 0 if they reported being employed (full-time, part-time) during the first year post-release, and a 1 if they were unemployed.

Unlike other demographic characteristics, participants' race was not included in the present analyses as a control variable for two reasons. First, due to sample size restrictions, the only groups that could be reliably examined were African-Americans and whites, which significantly reduced sample size and statistical power. Second and most importantly, where race is often used as a proxy variable for other social and structural phenomena, in the present analyses, these phenomena (disadvantage) were precisely the constructs of interest and were included in all analyses.[1]

Neighborhood disadvantage. To assess neighborhood disadvantage, participants' self-reported home addresses at one year post-release were matched to tracts from the 2000 decennial US Census. Census tracts are delineated with the aim of

remaining stable over long periods of time, and do not cross jurisdictional boundaries. On average, each tract contains 4,000 people. This level of analysis has been found to be sensitive to neighborhood effects while also incorporating enough geographic space to be easily conceptualized as a full neighborhood (Finch, Phuong, Heron, Bird, Seeman, & Lurie, 2010). Consistent with other studies of neighborhood disadvantage, the present study assessed 1) the percentage of households living below the poverty level, 2) the percentage of home renters, 3) the percentage of adults without a high school education, 4) the percentage of unemployed adult males, 5) the percentage of households receiving public assistance, 6) the percentage of African-Americans, and 7) the median household income as indicators of disadvantage.

Connectedness to the community. The Inclusion of Community in Self (ICS; Mashek, Cannaday, & Tangney, 2007) was used to assess participants' connectedness to 1) the community at large and 2) the criminal community at one year post-release. The ICS is generally provided as a pictorial measure with six overlapping circles; each pair of circles overlaps slightly more than the preceding pair. Participants are asked to pick the pair that represents how connected they feel to the community at large, defined as "people who live in your town, city or county," and to the criminal community, defined as "people who commit crimes whether they are in jail, prison, or living in the community." Data from college samples and inmate samples indicate that these items represent separate constructs, show discriminate validity, and have adequate test-retest reliability over a two-week period (Mashek, Stuewig, Furukawa, & Tangney, 2006). The connectedness to the community at large item is also correlated with the Psychological

Sense of Community (r = .27 to .45; Obst et al., 2002) and has been shown to be a separate entity from relationship closeness (Mashek, Cannaday, & Tangney, 2007). Because the one year post-release interview was designed to be completed via telephone, a verbal version of the ICS was created which replaced the six overlapping circle pairs with a Likert-type scale ranging from 1 "not at all connected" to 6 "as connected as possible."

HIV risk. HIV risk in the domains of injection drug use and sexual behavior was assessed via the TCU AIDS Risk Assessment (TCU ARA; Simpson, 1997) during the one year post-release assessment. Participants answered whether they injected drugs in the 12 months post-release; participants who injected drugs responded on a nine point scale (0 "not at all" to 8 "about 4 or more times per day") regarding their frequency of sharing needles and "the works" (e.g., cotton, cooker, rinse water) within the timeframe. Participants detailed their frequency of unprotected sex with a variety of partners (e.g., non-primary spouse/partner; IV drug user; while trading sex for money, goods, and favors) in the year post-release using a five point scale (0 "never" to 4 "about every day"). Participants also provided their number of sex partners over the year.

To compute an overall measure of HIV risk, we used items from the TCU ARA measuring the frequency of unprotected sexual acts (e.g., vaginal, oral, anal sex) and injection drug sharing behaviors in the 30 days prior to the post-release interview. We used a modified Bernoulli mathematical model to express the probability P of HIV infection, where P represents the cumulative likelihood that a given person becomes infected after engaging in multiple, specific acts of unprotected intercourse and/or sharing

needles and drug paraphernalia over a given time period (Holtgrave, Leviton, Wagstaff, & Pinkerton, 1997; Pinkerton & Abramson, 1993), and is expressed via the equation:

$P = 1- (1-A)(1-D)$, (1)

where A is the probability of infection from unprotected vaginal, anal, and oral sex contacts:[2]

$A = \pi_1[1-(1-\alpha_1)^{n1} (1-\alpha_2)^{n2} (1-\alpha_3)^{n3}]$, (1a)

and D is the probability of infection from injection drug-related activities:

$D = 1-(1-\pi_2\alpha_4)^{n4}$, (1b)

Equation 1 parameters are shown in Table 3. The Bernoulli model includes both estimated and measured parameters. Measured parameters (n1-n4) were obtained from participants' self-reported risk behaviors (e.g., frequency of sex, frequency of shared needle use). Estimated parameters ($\pi_{1,2}$, α_{1-4}) were approximated from available data regarding the infectivity of specific acts and high- versus low-risk partners. Based upon the work of Tempalski et al. (2009), we estimated that there was a 10% chance that the participant's partner was HIV-positive if the participant reported having unprotected sex with an injection drug user or a person who exchanges sex for drugs or money. For all other participants, we estimated that there was a 3% chance that their partners were HIV-positive (CDC, 2012).

Data Analysis

Missing data. Missing data can result in the loss of study power, making it difficult to find hypothesized effects, and can create an additional burden when comparing models with different missing data patterns. A primary aim of the present

study was to assess neighborhood disadvantage on HIV risk behaviors; in order to do so, the analyses only include cases for which an address could be coded within a 2000 Census tract. Of the 343 post-release interviews available, 10% did not provide addresses, 8% spent fewer than six months in the community in the first year post-release due to re-incarceration, and an additional 12% provided addresses that could not be coded to the 2000 Census, resulting in a final sample of 236. With regard to comparisons between individuals with post-release Census information and those without, participants who provided addresses that could be coded to Census tracts were more likely to be female, feel less connected to the criminal community, and be at an overall higher risk for HIV; the results of these analyses can be found in Table 4.

Nearly 20% of participants had missing values for the connectedness to the community variables due to these interviews being conducted outside of the window of eligibility for the one year post-release interview; however, these individuals did provide information regarding their home addresses. Fewer participants had missing data for demographic characteristics. Missing data on independent variables (individual demographics, connectedness to the community) were treated using multiple imputation in Mplus (Muthén & Muthén, 2012).[3,4] Multiple imputations are preferred to single imputation strategies, such as mean or regression imputation, which systematically underestimate variance (Rubin, 1987). Rubin (1987) showed that using five imputed datasets with 50% missing information resulted in only a 5% increase in standard deviation compared to an estimate based on an infinite number of datasets. Schafer (1999) further showed that in the presence of moderate amounts of missing data, little is

gained by the inclusion of more than 10 imputed datasets. For the present analyses, ten complete datasets were imputed, and pooled parameter estimates averaged across the datasets are presented.

Power analysis. Non-significant results can reflect a lack of statistical power. Sample size is one integral determinant of statistical power, and power analyses can help identify the adequate sample size to test hypothesized models (MacCallum, Browne, & Sugawara, 1996). For the present study, three separate Monte Carlo simulation studies were conducted to determine power for 1) assessing the effect of neighborhood disadvantage on HIV risk behaviors, controlling for individual demographic characteristics, 2) examining individuals' connectedness to the community as a mediator of the relationship between neighborhood disadvantage and HIV risk behaviors, controlling for individual demographics, and 3) assessing the moderating effect of connectedness to the community on the relationship between neighborhood disadvantage and HIV risk behaviors, controlling for individual demographic characteristics.

In each simulation, latent factor indicators were fixed to have a 0.80 factor loading and to correlate 0.60 with each other. Dichotomous variables (i.e., individual level characteristics, injection drug use) were identified as such, and all effects were estimated to be small to medium in magnitude. Maximum likelihood with robust standard errors (MLR) was used in the analysis of generated data and 500 replications were specified. A sample size of 235 yielded acceptable power (0.80) for all parameters in the models. However, in the moderation model, a sample size of 235 was powered to find

direct effects, but exhibited limited power to detect an interaction between the latent construct and connectedness to the community (power = 0.20).

Preliminary analyses. Preliminary analyses explored variable distributions, sample characteristics, simple correlations, and attrition using SPSS Version 19.0 software (IBM Corporation, 2010). Chi-square and t-tests were conducted to determine if participants who completed post-release interviews differed from those who did not, and whether individuals who provided post-release addresses differed from those who did not.

Model estimation. Structural equation modeling (SEM) was conducted in Mplus Version 6.12 (Muthén & Muthén, 2012). Models with a continuous outcome (neighborhood disadvantage, number of sexual partners, overall HIV risk) were estimated using a Full Information Maximum Likelihood (FIML) algorithm, which uses all of the information of the observed data to create parameter estimates and standard errors. When data are either missing completely at random or are missing at random, FIML estimates are unbiased and efficient (Enders & Bandalos, 2001). Even when data are not missing at random, FIML estimates on average outperform conventional approaches like listwise deletion (Enders & Bandalos, 2001).

Model fit was evaluated using a variety of indices. A non-significant chi-square suggests that the model fits the data. However, due to the chi-square statistic's sensitivity to sample size, resulting in a tendency to reject models with large samples, it is recommended that additional indices be used to determine model fit (Hooper, Coughlan, & Mullen, 2008). A Root Mean Square Error of Approximation (RMSEA) under 0.05, a

Comparative Fit Index (CFI) over 0.95, and a Standardized Root Mean Square Residual (SRMR) under 0.08 indicate close fitting models (Hu & Bentler, 1999). Models with a dichotomous (injection needle use) or categorical (unprotected sex with non-primary partners, IV drug using partners, while trading sex for money, goods, and favors) outcome were fitted using a Robust Weighted Least Squares (WLSMV) estimator (Flora & Curran, 2004). Within a WLSMV framework, a Weighted Root Mean Square Residual (WRMR) of less than 1.0 indicates good model fit (Yu & Muthén, 2002).

Models including an interaction between the latent neighborhood disadvantage factor and connectedness to the community were estimated using the latent-moderated SEM (LMS) approach (Klein & Moosbrugger, 2000). Rather than requiring the researcher to create a product term for the predictor variables, in LMS, the mathematical structure implied by the interaction is estimated directly. LMS assumes that the latent independent variable and the error terms are normally distributed. To date, LMS procedures do not provide standard model fit indices or standardized parameter estimates, as it is unclear how fit should be evaluated in latent moderated models (Muthén, 2012). Standardized regression coefficients for the moderator models were calculated by hand according to Muthén (2012).

RESULTS

Sample Demographics

Participants were initially incarcerated for a variety of reasons, including violent offenses (22%), theft/fraud (54%), drug offenses (28%), noncompliance with a legal mandate (26%), and miscellaneous (20%). (Percentages do not add up to 100% because many were charged with more than one offense). The sample was predominantly (67%) male, though female inmates were over-sampled in the jail for the study. Male participants were on average 32 years old (SD=9.9, range: 18-60), had completed 12 years of education (SD=2.1, range: 5-18), and were diverse in terms of race and ethnicity: 42% African-American, 35% Caucasian, 8% Latino, 4% Asian, 4% "Mixed," and 7% "Other." Female participants were on average 35 years old (SD=10.4, range: 18-69), had also completed 12 years of education (SD=2.2, range: 8-18), and were equally diverse in terms of race and ethnicity: 44% African-American, 44% Caucasian, 2% Latino, 4% Asian, 4% "Mixed," and 2% "Other." Consistent with other studies of incarcerated individuals, 2.5% reported being HIV positive; these participants were excluded from the present analyses.

In the first year post-release, 13% of the sample reported being unemployed for the entire year, 46% had not graduated from high school, and 40% lived below the 2000 national poverty level. With regard to HIV risk behaviors, nearly 7% of participants reported using injection drugs. Only two participants reported sharing needles or drug

paraphernalia, precluding additional analysis. On average, participants reported having 4 sexual partners over the course of the year. Although post-release unprotected sex with non-primary partners was endorsed (21%), very few participants reported unprotected sex with IV drug users or while trading sex for money or goods. These two variables were dropped from additional analysis. Participants' overall HIV risk, as assessed by the Bernoulli mathematical model, was highly variable. Although 41% of the sample did not report measurable HIV risk, those who did show calculable risk ranged from 0 to 0.07. To put these probabilities in context, it should be noted that a single unprotected sexual encounter with a known HIV-positive person carries a 3 out of 1000 chance (0.003) of disease transmission, suggesting that the level of overall HIV risk at one year post-release was quite high.

Neighborhood Disadvantage

Participants resided in 217 unique Census tracts (Table 5). On average, these neighborhoods were 43% renter-occupied, 40% African-American, 4% assisted by public funds, 13% below poverty level, 19% residents with below a high school education, 25% unemployed males, with a median household annual income of $56,526. Using Confirmatory Factor Analysis (CFA), each of the seven Census neighborhood indicators was fitted to a single factor, labeled "neighborhood disadvantage." On this factor, high scores represent greater disadvantage. A single factor fit the data well, $\chi^2(5) = 6.47$, $p = .26$, RMSEA = .04, CFI = 1.00, SRMR = .01.

As expected, all indicators loaded positively and significantly onto the factor, with Median Household Income being the only indicator to load negatively (Figure 3). The

underlying neighborhood disadvantage factor explained a significant portion of the variance of each indicator (Table 6).

Bivariate Associations.

Table 7 presents the bivariate relationships between neighborhood disadvantage, individual characteristics, HIV risk, and connectedness to the community. In general, neighborhood disadvantage was unrelated to individuals' demographic characteristics (gender, unemployment status, high school graduation status), though there was a trend suggesting that individuals living below the poverty line tended to live in disadvantaged neighborhoods (r=.14, p =.08). Relative to white participants, African-Americans were more likely to live in disadvantaged communities (r= -.36, p <.01). Greater neighborhood disadvantage was associated with abstinences from injection drug use (r= -.28), less unprotected sex with non-primary partners (r= -.17), and there was a trend that more neighborhood disadvantage was associated with less overall HIV risk (r = -.15, p=.07). Although the relationship was not statistically significant, neighborhood disadvantage was positively associated with the number of sexual partners reported in the year post-incarceration (r =.09, p=.19). Neighborhood disadvantage was unrelated to individuals' connectedness to the community at large, but was positively related to their connectedness to the criminal community (r = .16, p=.04). Gender and race were associated with several HIV risk behaviors, though other individual demographic characteristics were primarily unrelated to these outcomes. Subsequent analyses control for all demographic characteristics, excluding race.

What Is The Relationship Between Neighborhood Disadvantage and HIV Risk Behaviors, Controlling for Individual Characteristics?

Once individuals' demographic characteristics were accounted for, neighborhood disadvantage remained a significant predictor of abstinence from injection drugs (β = -.32, p =.01); this model fit the data well, $\chi^2(39) = 40.96$, p= .38; RMSEA = 0.02, CFI = 1.00, WRMR = 0.68, R^2=0.32 (Table 8). There was evidence of a small suppressor effect when any individual level characteristic, excluding gender, was included in the model predicting injection drug use; when these variables were included, the regression coefficient increased from -0.28 to -0.32. Neighborhood disadvantage failed to predict the number of participants' sexual partners in the year post-release (β = .08, p =.22), $\chi^2(39)$ = 42.68, p= .32; RMSEA = 0.02, CFI = 1.00, SRMR = 0.05, R^2=0.03. However, after controlling for individuals' demographic characteristics, neighborhood disadvantage predicted less unprotected sex with non-primary partners (β = -.17, p =.04), $\chi^2(39)$ = 37.79, p= .52; RMSEA = 0.01, CFI = 1.00, WRMR = 0.64, R^2=0.10. After accounting for individual's characteristics, neighborhood disadvantage was unrelated to participants' overall HIV risk in the 30 days prior to the one year post-release interview (β = -.12, p =.13), $\chi^2(39) = 43.45$, p= .29; RMSEA = 0.02, CFI = 1.00, SRMR = 0.05, R^2=0.08.

Does Individuals' Connectedness to the Community Mediate the Relationship Between Neighborhood Disadvantage and HIV Risk Behaviors?

Connectedness to the community at large. The indirect effect of neighborhood disadvantage to injection drug use via connectedness to the community at large was non-significant (indirect β = -.01, p =.68); however, controlling for individual characteristics,

the direct effect of neighborhood disadvantage on injection drug use remained intact (β = -.31, p =.01), $\chi^2(49) = 59.47$, p= .15; RMSEA = 0.03, CFI = 0.98, WRMR = 0.78 (Table 9). Connectedness to the community at large did not mediate the relationship between neighborhood disadvantage and number of partners (indirect β = .00, p =.73), $\chi^2(49) = 59.69$, p= .14; RMSEA = 0.03, CFI = 0.99, SRMR = 0.05, unprotected sex with non-primary partners (indirect β = -.00, p =.68), $\chi^2(49) = 58.30$, p= .17; RMSEA = 0.03, CFI = 0.98, WRMR = 0.75, or overall HIV risk (indirect β = .00, p =.72), $\chi^2(49) = 60.24$, p= .13; RMSEA = 0.03, CFI = 0.99, SRMR = 0.05. In the model predicting unprotected sex with non-primary partners, the direct effect of neighborhood disadvantage remained (β = -.17, p =.05).

Connectedness to the criminal community. In the model predicting injection drug use, neighborhood disadvantage predicted connectedness to the criminal community (β = .15, p =.02), which in turn, predicted injection drug use (β = .29, p =.01; Table 9). The indirect effect of neighborhood disadvantage on injection drug use via connectedness to the criminal community was not significant (indirect β = .05, p =.09), but a direct effect remained (β = -.36, p <.01), $\chi^2(49) = 60.23$, p= .13; RMSEA = 0.03, CFI = 0.98, WRMR = 0.78. Connectedness to the criminal community did not mediate the relationship between neighborhood disadvantage and number of partners (indirect β = .00, p =.80), $\chi^2(49) = 59.76$, p= .14; RMSEA = 0.03, CFI = 0.99, SRMR = 0.05, unprotected sex with non-primary partners (indirect β = .01, p =.57), $\chi^2(49) = 59.15$, p= .15; RMSEA = 0.03, CFI = 0.98, WRMR = 0.75, or overall HIV risk (indirect β = -.02, p =.15), $\chi^2(49) = 60.24$, p= .13; RMSEA = 0.03, CFI = 0.99, SRMR = 0.05.

Does Individuals' Connectedness to the Community Moderate the Relationship Between Neighborhood Disadvantage and HIV Risk Behaviors?

Connectedness to the community at large. Participants' connectedness to the community at large did not moderate the relationship between neighborhood disadvantage and number of sexual partners (β = -.07, p =.82), unprotected sex with non-primary partners (β = .07, p =.61), or overall HIV risk (β = -.03, p =.67; Table 10). Due to base rate restrictions, no moderation model was estimated to predict injection drug use.

Connectedness to the criminal community. Participants' connectedness to the criminal community did not moderate the relationship between neighborhood disadvantage and number of sexual partners (β = .08, p =.31) or unprotected sex with non-primary partners (β = -.07, p =.69; Table 10). In the model predicting overall HIV risk, there was a trend toward a significant interaction between connectedness to the criminal community and HIV risk (β = .13, p =.08), such that at low levels of neighborhood disadvantage, being connected to the criminal community was protective against HIV risk. However, individuals living in highly disadvantaged neighborhoods were at low overall risk in the year post-release, regardless of their connectedness to the criminal community (Figure 4). Connectedness to the criminal community still exerted a direct effect on overall HIV risk in this model (β = -.17, p =.02), though effect this should be interpreted cautiously in light of the trending interaction term. Due to base rate restrictions, no moderation model was estimated to predict injection drug use.

DISCUSSION

Although recent research has begun to explore the impact of neighborhood disadvantage on specific groups' HIV risk, no study has explored the role of neighborhood context on jail inmates' HIV risk behaviors once they have returned to the community post-release. Given jail inmates' unique position as "high risk" adults forced to re-integrate into their communities, the role of the community to which former inmates return deserves special attention. The identification of particular communities that may confer additional risk, or that may protect against subsequent high risk behaviors, may be especially useful for optimally directing prevention efforts. The present investigation of neighborhood disadvantage on jail inmates' post-release HIV risk behaviors begins to shed light on this issue, resulting in several conclusions.

First, we found that at the bivariate level, neighborhood disadvantage was associated with decreased risk for several HIV risk behaviors, including injection drug use, unprotected sex with non-primary partners, and overall HIV risk. Although contrary to theory and early empirical findings, the negative relationship between neighborhood disadvantage and HIV risk behaviors mirrors a trend in the recent literature as studies rely on more recent Census data and continue to initiate these investigations in "at-risk" communities. A review of the literature on neighborhood effects on HIV risk shows that the majority of these studies have taken place in areas that have been heavily affected by the HIV/AIDS epidemic (Adams, in preparation). As such, recent studies that find a

negative relationship between neighborhood disadvantage and HIV risk behaviors may be indirectly capturing the effectiveness of interventions and prevention programming in these communities.

Given that participants were drawn from a jail in a DC suburb, this claim is highly relevant when interpreting the current study's results. Participants in the most disadvantaged neighborhoods were overwhelmingly likely to be DC residents. The District of Columbia has the highest rate of HIV in the country, with the prevalence of the disease rivaling that found in some developing countries. Numerous efforts have been implemented to control the spread of HIV within the District, and in surrounding regions. Unlike many areas, DC has a well-developed syringe exchange program, active condom distribution interventions, and a visible HIV testing program (Kaiser Family Foundation, 2012). Perhaps most relevant to individuals' decisions to engage in HIV risk behaviors, survey results indicate that residents in the DC Metropolitan area are more concerned about HIV than the national public overall, and this worry was especially salient among those individuals living in Wards 7 and 8, two of the most economically disadvantaged areas within the District (Kaiser Family Foundation, 2011). Interestingly, the negative relationships between neighborhood disadvantage and several HIV risk behaviors emerged in light of a small, non-significant positive relationship between neighborhood disadvantage and number of sexual partners. Taken together, this set of findings suggests that although individuals in disadvantaged communities may have more sexual partners, they may also engage in protective behaviors more frequently (e.g., condom use) than

their counterparts living in more advantaged communities, possibly due to increased awareness of the risk of contracting HIV.

Second, we found that neighborhood effects tended to remain, even after controlling for individual demographic characteristics such as gender, poverty, employment, and high school graduation status. Aside from gender and race, few individual characteristics were associated with HIV risk behaviors, indicating that these behaviors occur across individual demographic traits. Individual demographic characteristics are most often included in neighborhood effects research as control variables to emphasize that neighborhood effects remain after accounting for individual socioeconomic position; little attention is paid to how these variables are related to the outcomes of interest.

In the case of injection drug use, the inclusion of individual characteristics slightly inflated the predictive power of neighborhood disadvantage (suppressor effect). Although the "suppressor situation" has been studied extensively, no final decision for how to treat suppressor variables has been determined. Maassen and Bakker (2001) suggest that when the suppressor variable is strongly related to the other predictor variable, it may be excluded for parsimony. However, in the present case, neighborhood disadvantage was modestly related to some individual characteristics, and the inclusion of both sets of variables was important in the theoretical setup of the model. As such, we echo the assertion of Gaylord-Harden, Cunningham, Holmbeck, and Grant (2010) that in cases where predictor and suppressor variables are each substantively important, researchers may be better served by acceptance of "suppressor situations," as they

highlight the complex ways in which neighborhood context and individual demographic characteristics are interrelated. In situations in which individual demographic characteristics are unrelated to the outcomes of interest, researchers may be better served by including individual level constructs that are known predictors of the outcome into their models, as this may provide a stronger test for the influence of neighborhood context relative to other important factors.

Third, explorations of the influence of neighborhood disadvantage on health behaviors have routinely excluded mechanisms that explain how and when neighborhoods influence individuals' behaviors. In the present study, connectedness to the community at large and connectedness to the criminal community were examined as potential mediators and moderators of HIV risk behaviors. In general, connectedness to the community at large and connectedness to the criminal community were unassociated with HIV risk behaviors. However, connectedness to the criminal community was positively related to neighborhood disadvantage and to injecting drugs. It was hypothesized that connectedness to the community at large and to the criminal community would moderate, rather than mediate the relationships between neighborhood disadvantage and HIV risk behaviors. Connectedness to the community at large neither mediated nor moderated any of these relationships.

Connectedness to the criminal community appeared to play a bigger role in the relationships between neighborhood disadvantage and HIV risk behaviors than connectedness to the community at large. A non-significant positive indirect effect from neighborhood disadvantage to injection drug use emerged once connectedness to the

criminal community was included in the model. This small effect may highlight an important way in which disadvantaged neighborhoods confer risk for injecting drugs. The full model suggests that for some individuals, neighborhood disadvantage leads to feeling connected to the criminal community, which increases the chances of injecting drugs. However, people who live in these disadvantaged communities, but do not feel connected to the criminal community, may be protected against injection drug use. This finding suggests that in disadvantaged communities, two-pronged approaches that both implement prosocial programming (e.g., community centers, continuing education opportunities) and reduce the presence of antisocial and criminal behaviors (e.g., policing practices) to ensure that connectedness to the criminal community does not develop may provide the best solution for protecting individuals from HIV risk.

There was a trend towards an interaction between connectedness to the criminal community and neighborhood disadvantage when predicting overall HIV risk in the 30 days preceding the one year post-release interview (Figure 4). Specifically, individuals living within low disadvantage neighborhoods were at the greatest risk of HIV if they were not connected to the criminal community, while individuals in these communities who were connected to the criminal community and individuals in disadvantaged neighborhoods, regardless of connectedness to the criminal community, were at significantly lower risk of HIV. This finding may suggest that individuals in disadvantaged communities or those who may be in close contact with antisocial communities may be especially aware of the risks of HIV, and as a result, may be more likely to use condoms. However, individuals in advantaged communities and without ties

to antisocial communiteis may not perceive their pool of partners to be at risk for HIV, and may be more likely to engage in unprotected sex with them.

The present study should be interpreted in light of several limitations. First, connectedness to the community at large and to the criminal community were assessed using single item measures, which may compromise reliability and validity when compared to scales with more items. Second, HIV risk was assessed via self-report. Although alternative options for measuring HIV risk behaviors are limited, reports of these behaviors may be subject to concerns about social desirability. On the other hand, we did not find an association between measured HIV risk behaviors and the Positive Impression Management (PIM) scale on the Personality Assessment Inventory. Third, there was considerable attrition in the sample owing to the transient nature of this population; even after accounting for missing data, we had limited power to find interactions or to test complex models. Moderating effects of individuals' connectedness to the community at large and/or to the criminal community may emerge in a larger sample. Relatedly, we had limited power to assess the roles of dual connectedness to the community at large and to the criminal community within single models of neighborhood disadvantage and HIV risk behaviors. Fourth, although data collection for one year post-release interviews began in 2003 and is ongoing, we relied on the 2000 Census to assess neighborhood effects. Even though the majority of these interviews were obtained by 2007 (76%), the environments tapped by the 2000 Census indicators may have been outdated as neighborhood contexts may have changed due to gentrification and redistribution of resources. Unfortunately, this is a common problem in research on

neighborhood effects, as the US Census is collected decennially. Replication of these findings with the 2010 Census may provide additional support for the present results. Last, like most studies of neighborhood effects, the present study was limited to a single locale; findings to other populations and geographic areas may not generalize.

Despite these limitations, our findings provide novel data on the influence of neighborhood disadvantage on HIV risk behaviors among a high risk group, former jail inmates within a very high risk geographic region. Regardless of the direction of effects, our findings show that neighborhood context matters, even for personal and private behaviors like sexual practices. Broadening the scope of communities explored may also provide more information regarding neighborhood effects on HIV risk behaviors, and would allow researchers to address the possibility that neighborhood context influences behaviors differently at various social strata.

Further, these findings suggest that researchers should be cognizant of prevention efforts and knowledge of individuals within communities about HIV risk and transmission. To the extent that prevention programs have been implemented in disadvantaged communities, such interventions may be having a positive effect on reducing risk. However, less is known about the influences of suburban and more affluent environments on risk behaviors. Theory, and perhaps public opinion, would suggest that these affluent communities protect against negative outcomes. However, the very sense of security that living within advantaged communities offer, may provide a false sense of safety and protection against HIV. It may be especially important to ensure that individuals who may not witness the effects of HIV or come into contact with HIV-

positive individuals in their typical environments are still aware of the risks of the potential for infection. Given the number of individuals who cycle in and out of local jails annually -- 12.9 million people -- and the fact that inmates represent a high risk group for HIV/AIDS contraction, it is imperative that research be conducted to inform interventions to reduce risk, capitalizing upon what is known about where these individuals return, along with known strategies for health promotion.

GENERAL CONCLUSIONS

Where individuals live, whether they are adolescents, injection drug users, or former inmates, is associated with HIV risk behaviors, but the nature of this relationship is somewhat surprising. While older studies provided a concerted message of elevated HIV risk within disadvantaged communities, more recent messages differ. Contrary to theory, and what may be popular belief, greater neighborhood disadvantage now seems to be associated with a decrease in HIV risk behaviors. This trend was common among the articles reviewed, and a similar pattern emerged in an empirical investigation of neighborhood disadvantage and HIV risk among former jail inmates. At first glance, this may be a promising finding, perhaps suggestive of the work of countless hours of intervention to reduce the spread of the disease.

Upon further examination, these findings are more troubling, as they suggest that high risk practices have not merely ceased. Instead, they seem to be increasingly concentrated among individuals in higher social strata. It may be the case that while prevention efforts have focused on "high risk" individuals, people in more affluent settings failed to get vital information regarding HIV risk. More troubling still, perhaps the risk of HIV infection has been portrayed as a "poor person's illness," making the disease less salient to individuals in advantaged communities. Regardless of why HIV risk behaviors seem to be more prevalent in more affluent neighborhoods, one take home point remains clear: in keeping with the US government's vision to eradicate the spread

of HIV, prevention efforts must be implemented at individuals across social strata, as the "at risk" designation may no longer mean today what it meant yesterday.

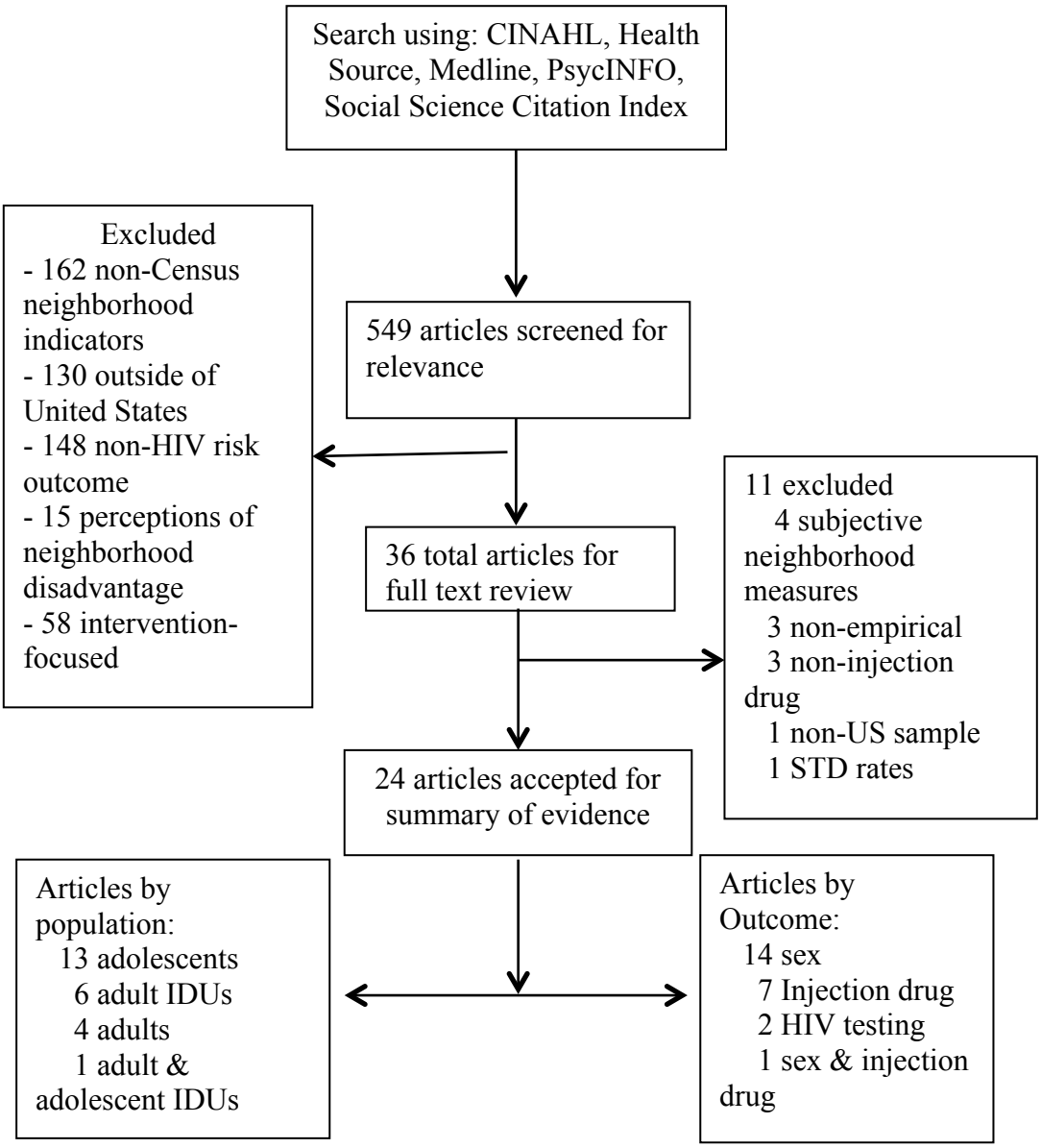

Figure 1: Flowchart of article selection for systematic review.

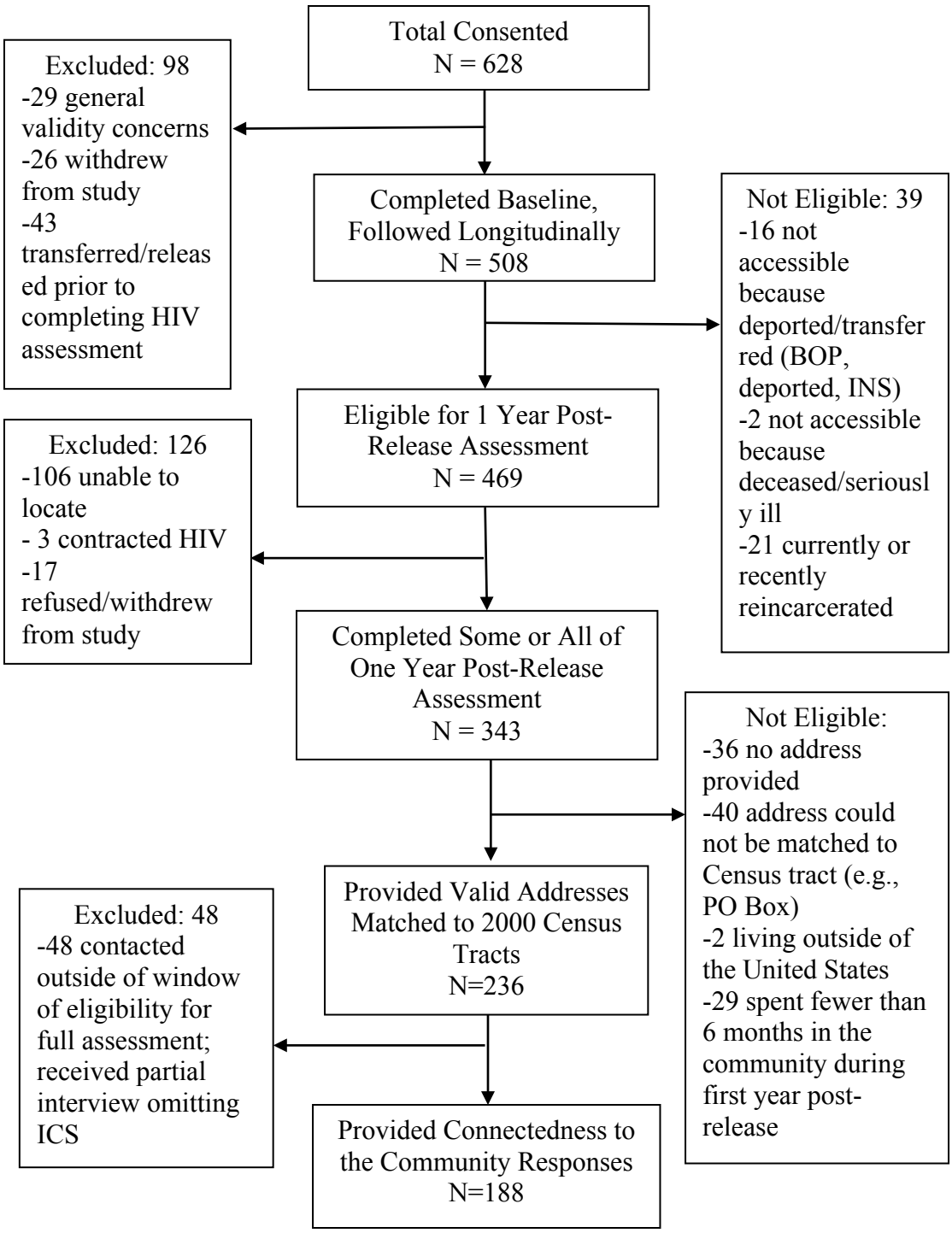

Figure 2: Consort Diagram of Study Participants.

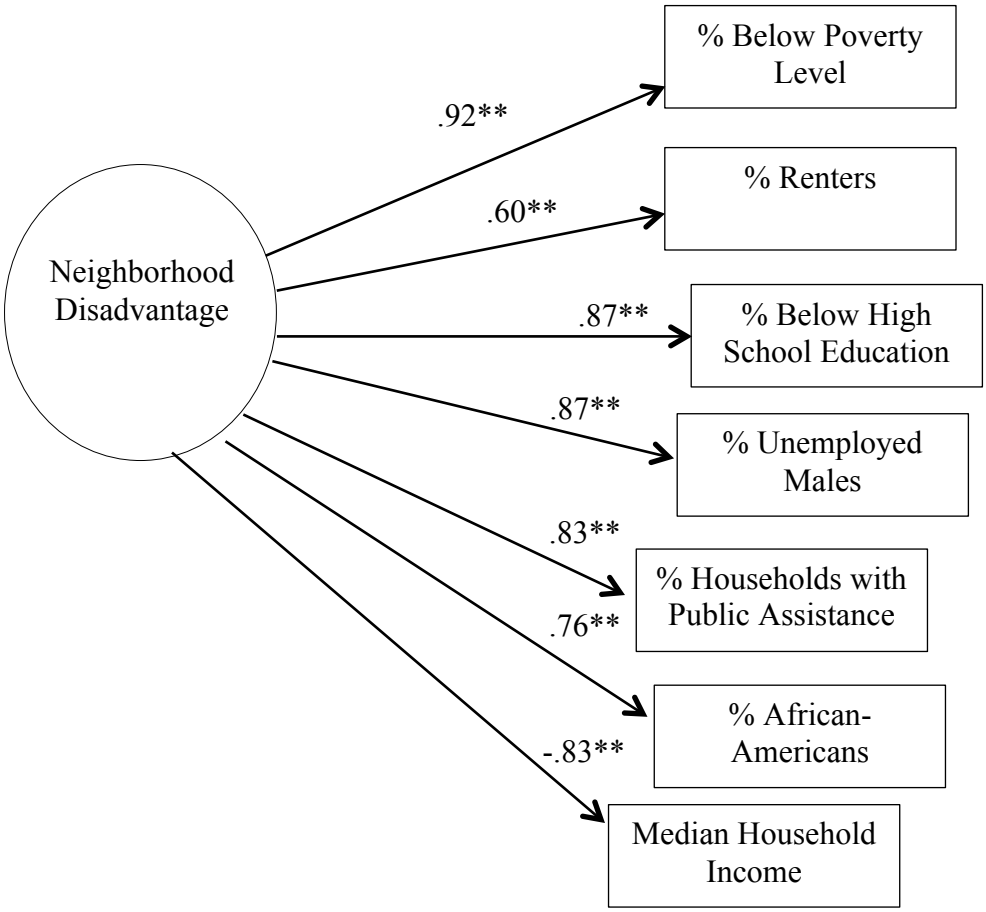

Figure 3: Factor Loadings for Neighborhood Disadvantage Measurement Model. Note. Numbers on paths represent standardized factor loadings. *$p < .05$, **$p < .01$.

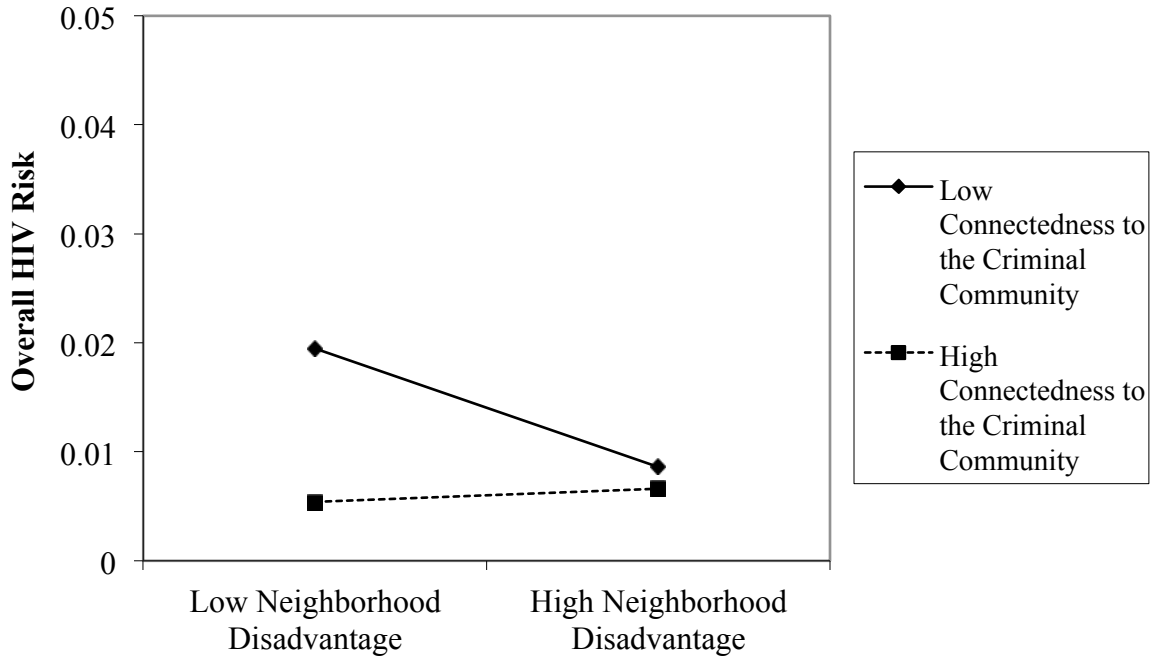

Figure 4: Connectedness to the Criminal Community Moderates the Relationship Between Neighborhood Disadvantage and Overall HIV Risk.

Table 1: Sample Information for Studies Included in Systematic Review Grouped by Outcome.

Study	Sample	Location	N	Gender (% F)	Study Design
Drug-Related Outcomes					
Bluthenthal et al., 2007 *	Adult IDU	San Francisco, CA	4589	29	C
Fuller et al., 2005	Adolescent IDU Adult IDU	Baltimore, MD	144	60	C
Galea, Ahern, & Vlahov, 2003	Adult	New York, NY	610	37	C
Genberg et al., 2011	Adult IDU	Baltimore, MD	1697	25	L
Nandi et al., 2010	Adult IDU	Baltimore, MD	1875	25	L
Schroeder et al., 2001	Adult IDU	Baltimore, MD	342	38	L
Sunder, Grady, & Wu, 2007	Adult	Southeast Texas	594	100	C
Williams & Latkin, 2007	Adult IDU	Baltimore, MD	1305	39	C
Sex-Related Outcomes					
Bauermeister, Zimmerman, & Caldwell, 2010	Adolescent	Detroit, Michigan	681	51	L
Baumer & South, 2001	Adolescent	National	1111	51	L
Bluthenthal et al., 2007 *	Adult IDU	San Francisco, CA	3742	30	C
Browning et al., 2008	Adolescent	Chicago, IL	768	51	L
Browning, Leventhal, & Brooks-Gunn, 2005	Adolescent	Chicago, IL	907	52	L
Browning & Olinger-Wilborn, 2003	Adult	Chicago, IL	468	59	C
Cubbin, Brindis, Jain, Santelli, & Braveman, 2010	Adolescent	National	5838	54	L
Cubbin, Santelli, Brindis, &	Adolescent	National	14151	49	C

Braveman, 2005					
Frye et al., 2010	Adult MSM	New York, NY	385	0	C
Lindberg & Orr, 2011	Adolescent	National	1092	0	C
Ramirez-Valles, Zimmerman, & Juarez, 2002	Adolescent	Detroit, Michigan	558	58	C
Roche & Leventhal, 2009	Adolescent	Philadelphia, PA	846	52	C
Roche et al., 2005	Adolescent	National	2559	51	L
Teitler & Weiss, 2000	Adolescent	Philadelphia, PA	Tract	Tract	C
Upchurch, Aneshensel, Mudgal, & McNeely, 2001	Hispanic Adolescent	Los Angeles County, CA	497	50	L
HIV Testing Outcomes					
Johns, Bauermeister, & Zimmerman, 2010	Adolescent	None listed	396	51	L
Taylor, Leibowitz, Simon, & Grusky, 2006	Adult	Los Angeles County, CA	5475	N/A	C

Notes: * = Same study, IDU=Injection Drug User, MSM=Men who have sex with men, C=cross-sectional, L=longitudinal

Table 2: Census Data Used in Studies of Neighborhood-Level Influences on HIV Risk Grouped by Outcome.

Study	Census Year	Census Measurement	Neighborhood-level Indicators	Aggregation Technique
Drug-Related Outcomes				
Bluthenthal et al., 2007 *	2000	Tract	Public assistance, Unemployment (males only), Race (% AA), Income	Separate indicators
Fuller et al., 2005	1990	Tract	Poverty, Unemployment, Education, Race (% non-minority)	Separate indicators; some dichotomized
Galea, Ahern, & Vlahov, 2003	2000	Zip code	Poverty	Separate indicator
Genberg et al., 2011	1990 2000	Tract	Crowding, Poverty, Public assistance, Single-headed, Unemployment, Education, Income	PCA; 1 component
Nandi et al., 2010	1990	Tract	Poverty	Separate indicator with 4 cut-points
Schroeder et al., 2001	1990	Block group	Poverty, Unemployment, Education, Stability (% owner), Household size	Separate indicators; median-split
Sunder, Grady, & Wu, 2007	2000	Tract	Poverty, Single-headed, Unemployment, Education, Ethnicity (% foreign-born)	PCA; 3 components
Williams & Latkin, 2007	1990	Block group	Poverty, Public assistance, Single-headed, Unemployment, Education, Income, Stability (% renters), % Vacant housing, Job type (% blue collar; % professional workers); % Disabled	Standardized and summed

Sex-Related Outcomes				
Bauermeister, Zimmerman, & Caldwell, 2010	1990	Block group	Crowding, Poverty, Single-headed, Unemployment, Education	EFA; 1 factor
Baumer & South, 2001	1980	Zip code	Poverty, Public assistance, Unemployment (males only), Education, Income, Job type (% blue collar)	Standardized and summed
Bluthenthal et al., 2007 *	2000	Tract	Public assistance, Unemployment (males only), Race (% AA), Income	Separate indicators
Browning et al., 2008	1990	Neighborhood cluster	Poverty, public assistance, Single-headed, Unemployment, Ethnicity (% H, % foreign-born), Stability (% owner)	PCA; 3 components
Browning, Leventhal, & Brooks-Gunn, 2005	1990	Neighborhood cluster	Poverty, Public assistance, Single-headed, Unemployment, Ethnicity (% H, % foreign-born), Stability (% owner)	PCA; 3 components
Browning & Olinger-Wilborn, 2003	1990	Neighborhood cluster	Poverty, Public assistance, Single-headed, Unemployment, Race (% AA), Ethnicity (% H, % foreign-born), Stability (% owner)	PCA; 3 components
Cubbin, Brindis, Jain, Santelli, & Braveman, 2010	1990	Tract	Poverty	Separate indicator
Cubbin, Santelli, Brindis, & Braveman, 2005	1990	Tract	Poverty (% below poverty level, % affluent), Single-headed (% married couples), Unemployment (% women with full time work), Race (% AA), Ethnicity (% H), Stability, % Idle youth	Separate indicators
Frye et al., 2010	2000	Zip code	Poverty, Unemployment, Education (% with high school diploma), Age, Race, Ethnicity (% foreign-	Separate indicators

			born), Income, Stability, % Vacant housing, Gay presence	
Lindberg & Orr, 2011	2000	Tract	Poverty, Single-headed, Unemployment (men only), Education, Stability	Standardized and summed
Ramirez-Valles, Zimmerman, & Juarez, 2002	1990	Tract	Public assistance (% living in low-income housing), Single-headed, Education, Race (% AA),	Separate indicators
Roche & Leventhal, 2009	2000	Tract	Poverty	Separate indicator
Roche et al., 2005	1990	Block group	Poverty, Unemployment (% employed), Education (% with college degree), Income, Job type (% laborers)	PCA; 1 component
Teitler & Weiss, 2000	1990	Tract	Poverty, Single-headed, Unemployment, Race (% W, % AA), Income, Teenage fertility rate	Separate indicators
Upchurch, Aneshensel, Mudgal, & McNeely, 2001	1990	Tract	Ethnicity (% H)	Separate indicator
HIV Testing Outcome				
Johns, Bauermeister, & Zimmerman, 2010	2000	Block group	Poverty, Public assistance, Single-headed, Unemployment, Education	CFA; 1 factor
Taylor, Leibowitz, Simon, & Grusky, 2006	2000	Zip code	Unemployment, Education, Ethnicity (% non-English speaking), Income, Stability, Number of public HIV testing sites, % male same-sex couples, % single adults	Separate indicators

Notes: * = Same study, Poverty = Proportion of households living below poverty level, Public assistance = Percentage of households on public assistance, Single-headed = Percentage of female-headed households with dependent children (< 18 years), Unemployment = Percentage of unemployed males and females (> 16 years), Education = Percentage of individuals with less than high school education, Stability = Percentage of residents who had been living at the same address for 5 years or more, Income = Median household income, AA = African-American, H = Hispanic, W = White, PCA = Principal Components Analysis, EFA = Exploratory Factor Analysis, CFA = Confirmatory Factor Analysis.

Table 3: Bernoulli HIV Risk Equation Parameters.

Symbol	Description	Model parameter estimates	Source of estimate
Estimated parameters			
π_1	Probability that a sex partner is infected	0.10 (high-risk partner) 0.03 (low-risk partner)	Tempalksi et al., 2009; CDC, 2012
π_2	Probability that a non-sexual injection partner is infected	0.10	Tempalksi et al., 2009
α_1	Per contact probability of HIV transmission for vaginal sex	0.0006	Boily et al., 2009
α_2	Per contact probability of HIV transmission for anal sex	0.0073	Baggaley et al., 2010
α3	Per contact probability of HIV transmission for oral sex	0.0002	Baggaley et al., 2008
α_4	Per contact probability of HIV transmission for syringe sharing	0.0067	CDC, 2012a
Measured parameters			
n1	Number of acts of unprotected vaginal sex	All measured parameter values were derived from individual-level self-reported risk behavior	
n2	Number of acts of unprotected anal sex		
n3	Number of acts of unprotected oral sex		
n4	Number of acts of syringe sharing		

Note. Probability of partner's infection is based on local prevalence rates.

Table 4: Comparison of Participants With and Without One Year Post-release Neighborhood Disadvantage Scores.

	Neighborhood Disadvantage Score? Yes % / M (SD)	No % / M (SD)	χ^2- / t-statistic	p-value
Individual Characteristics				
Gender (Male)	67.23%	79.35%	4.70	0.03
Race (African-American)	53.13%	64.94%	3.12	0.08
Unemployment	12.12%	7.41%	1.89	0.17
HS Non-graduate	45.49%	53.33%	1.60	0.21
Poverty	40.04%	31.94%	1.80	0.18
HIV Risk				
IV Drug Use (Yes)	6.70%	5.81%	0.08	0.78
Number of Partners	4.21 (14.38)	4.01 (8.42)	-0.12	0.91
Unprotected Sex with non-primary partner	0.35 (0.83)	0.51 (1.02)	1.27	0.21
Overall HIV Risk	0.005 (0.02)	0.002 (0.01)	-2.60	0.01
Community Connectedness				
Community at Large	3.12 (1.53)	3.20 (1.72)	0.34	0.74
Criminal Community	2.01 (1.50)	2.78 (1.89)	2.92	0.01

Notes. n=236 with neighborhood disadvantage score; n=107 without neighborhood disadvantage score.

Table 5: Descriptive Statistics for 2000 Census Indicators of Neighborhood Disadvantage.

	N	Mean Percentage (SD)	Range
Renter Occupied Home	236	42.5 (25.0)	1.0-99.2
African-American	236	40.0 (32.4)	0.0-98.2
Less than High School Education	236	18.5 (12.2)	1.9-53.5
Unemployed Adult Males	236	25.4 (12.7)	7.6-71.3
Households Receiving Public Assistance	236	3.8 (5.4)	0.0-30.8
Households Living Below Poverty Level	236	13.3 (12.2)	0.3-65.9
Median Household Income (dollars)	236	56,526 (22,646)	14,083-124,759

Table 6: Percent of Indicator Variance Accounted for by Neighborhood Disadvantage Factor.

	Percent of Variance Explained (%)	P-value
% Below Poverty Level	83.8	< .001
% Renters	36.9	< .001
% Below High School Education	73.7	< .001
% Unemployed Males	75.4	< .001
% Households with Public Assistance	68.7	< .001
% African-Americans	57.4	< .001
Median Household Income	68.2	< .001

Table 7: Zero-order Correlations Between Neighborhood Disadvantage, Individual Demographics, HIV Risk, and Connectedness to the Community.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Neighborhood Disadvantage	--											
Individual Characteristics												
2. Gender (Ind)	.00	--										
3. Race	-.36**	-.05	--									
4. Unemployment (Ind)	.09	-.13	.06	--								
5. HS Non-graduate	.04	.07	-.09	.06	--							
6. Poverty (Ind)	.14	-.17*	-.03	.25**	.08	--						
HIV Risk												
7. IV Drug Use (Y/N)	-.28*	-.05	.22**	.09	.19*	-.04	--					
8. Number of Partners	.09	.13	-.07	.01	.08	.02	.01	--				
9. Unprotected Sex with non-primary	-.17*	.19**	.06	.01	.03	-.03	.00	.02	--			
10. Overall HIV Risk	-.15	.13	.07	-.06	-.06	-.12	.01	.07	.07	--		
Community Connectedness												
11. Community at Large	.05	-.09	-.04	-.19*	-.09	.05	-.12	-.04	-.04	.02	--	
12. Criminal Community	.16*	.09	-.10	.02	.29**	.10	.21**	.08	.07	-.12	-.12	--

Notes. *$p < .05$, **$p < .01$, Ind=individual-level; HS = high school; Gender: 0=female, 1=male; Race: 0=African-American, 1=white; Unemployment: 0=employed, 1=unemployed; HS Non-graduate: 0=graduate, 1=non-graduate; Poverty: 0=above poverty level, 1=below poverty level; IV Drug Use: 0=no, 1=yes.

Table 8: Neighborhood Disadvantage Predicts HIV Risk Behaviors Above and Beyond Individual Characteristics.

	β	SE	p-value
IV Drug Use (Y/N)			
Gender	-.07	.14	.63
Unemployment	.11	.16	.49
HS Non-graduate	.39	.15	.01
Poverty	-.20	.17	.24
Neighborhood Disadvantage	-.32	.12	.01
Number of Sexual Partners			
Gender	.13	.07	.11
Unemployment	.00	.09	.99
HS Non-graduate	.04	.08	.62
Poverty	.02	.08	.71
Neighborhood Disadvantage	.08	.08	.22
Unprotected Sex with Non-primary partner			
Gender	.17	.08	.03
Unemployment	.03	.08	.70
HS Non-graduate	.02	.07	.79
Poverty	-.01	.08	.92
Neighborhood Disadvantage	-.17	.07	.04
Overall HIV Risk (30 days)			
Gender	.10	.07	.18
Unemployment	-.12	.09	.19
HS Non-graduate	-.12	.09	.17
Poverty	-.05	.13	.71
Neighborhood Disadvantage	-.12	.08	.13

Note. IV Drug Use and Unprotected sex with non-primary partner outcomes treated as dichotomous/categorical.

Table 9: Connectedness to the Community at Large and Connectedness to the Criminal Community as Mediators of the Relationship Between Neighborhood Disadvantage and HIV Risk.

	Connectedness to Community At Large			Connectedness to Criminal Community		
	β	SE	p-value	β	SE	p-value
IV Drug Use (Y/N)						
Gender	-.07	.14	.63	-.06	.13	.64
Unemployment	.11	.16	.49	.10	.07	.13
HS Non-graduate	.38	.15	.01	.36	.14	.01
Poverty	-.20	.17	.24	-.28	.16	.15
Neighborhood Disadvantage	-.31	.11	.01	-.36	.12	.02
Neighborhood →Connectedness	.03	.07	.66	.15	.06	.02
Connectedness → DV	-.23	.09	.01	.29	.12	.01
Number of Sexual Partners						
Gender	.12	.07	.07	.12	.07	.07
Unemployment	-.02	.07	.78	-.01	.07	.89
HS Non-graduate	.07	.06	.29	.07	.07	.33
Poverty	.02	.07	.78	.02	.07	.83
Neighborhood Disadvantage	.09	.07	.16	.09	.07	.18
Neighborhood →Connectedness	.03	.07	.67	.14	.06	.03
Connectedness → DV	-.04	.07	.55	.02	.07	.80
Unprotected Sex with Non-primary partner						
Gender	.17	.11	.11	.17	.11	.11
Unemployment	-.01	.09	.92	-.01	.09	.92
HS Non-graduate	.05	.10	.63	.05	.10	.63
Poverty	-.06	.12	.64	-.06	.12	.64
Neighborhood Disadvantage	-.17	.09	.05	-.18	.09	.05
Neighborhood →Connectedness	.03	.07	.68	.14	.06	.02
Connectedness → DV	-.16	.08	.05	.06	.07	.37

Overall HIV Risk (30 days)						
Gender	.07	.06	.30	.07	.06	.29
Unemployment	-.16	.07	.02	-.17	.07	.01
HS Non-graduate	-.11	.06	.10	-.07	.06	.30
Poverty	-.06	.07	.35	-.06	.07	.40
Neighborhood Disadvantage	-.11	.07	.09	-.09	.07	.17
Neighborhood →Connectedness	.03	.07	.69	.14	.07	.03
Connectedness → DV	.05	.06	.44	-.13	.07	.05

Note. IV Drug Use and Unprotected sex with non-primary partner outcomes treated as dichotomous/categorical.

Table 10: Connectedness to the Community at Large and Connectedness to the Criminal Community as Moderators of the Relationship Between Neighborhood Disadvantage and HIV Risk.

	Connectedness to Community At Large			Connectedness to Criminal Community		
	b	SE	p-value	b	SE	p-value
Number of Sexual Partners						
Gender	.12	.07	.07	.12	.07	.07
Unemployment	-.02	.07	.78	-.01	.07	.89
HS Non-graduate	.07	.06	.29	.07	.07	.33
Poverty	.02	.07	.78	.02	.07	.83
Neighborhood Disadvantage	.09	.07	.16	.09	.07	.18
Connectedness	.03	.07	.67	.14	.06	.03
Neighborhood Disadvantage X Connectedness	-.04	.07	.55	.02	.07	.80
Unprotected Sex with Non-primary partner						
Gender	.17	.11	.11	.17	.11	.11
Unemployment	-.01	.09	.92	-.01	.09	.92
HS Non-graduate	.05	.10	.63	.05	.10	.63
Poverty	-.06	.12	.64	-.06	.12	.64
Neighborhood Disadvantage	-.17	.09	.05	-.18	.09	.05
Connectedness	.03	.07	.68	.14	.06	.02
Neighborhood Disadvantage X Connectedness	-.16	.08	.05	.06	.07	.37
Overall HIV Risk (30 days)						
Gender	.07	.06	.30	.07	.06	.29
Unemployment	-.16	.07	.02	-.17	.07	.01
HS Non-graduate	-.11	.06	.10	-.07	.06	.30
Poverty	-.06	.07	.35	-.06	.07	.40
Neighborhood Disadvantage	-.11	.07	.09	-.09	.07	.17

Connectedness	.03	.07	.69	.14	.07	.03
Neighborhood Disadvantage X Connectedness	.05	.06	.44	-.13	.07	.05

Note. Unprotected sex with non-primary partner outcome treated as dichotomous/categorical.

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CURRICULUM VITAE

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