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Social causation and neighborhood selection underlie associations of neighborhood factors with illicit drug-using social networks and illicit drug use among adults relocating from public housing

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Abstract

Theories of social causation and social influence, which posit that neighborhood and social network characteristics are distal causes of substance use, are frequently used to interpret associations among neighborhood characteristics, social network characteristics and substance use. These associations are also hypothesized to result from selection processes, in which substance use determines where people live and who they interact with. The potential for these competing selection mechanisms to co-occur has been underexplored among adults.

This study utilizes path analysis to determine the paths that relate census tract characteristics (e.g., economic deprivation), social network characteristics (i.e., having ³ 1 illicit drug-using network member) and illicit drug use, among 172 African American adults relocated from public housing in Atlanta, Georgia and followed from 2009 to 2014 (7 waves). Individual and network-level characteristics were captured using surveys. Census tract characteristics were created using administrative data. Waves 1 (pre-relocation), 2 (1st wave post-relocation), and 7 were analyzed.

When controlling for individual-level sociodemographic factors, residing in census tracts with prior economic disadvantage was significantly associated with illicit drug use at wave 1; illicit drug use at wave 1 was significantly associated with living in economically-disadvantaged census tracts at wave 2; and violent crime at wave 2 was associated with illict drug-using social network members at wave 7.

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Findings from this study support theories that describe social causation and neighborhood selection processes as explaining relationships of neighborhood characteristics with illicit drug use and illicit drug-using social network characteristics. Policies that improve local economic and social conditions of neighborhoods may discourage substance use. Future studies should further identify the barriers that prevent substance users from obtaining housing in less disadvantaged neighborhoods.

Keywords

social epidemiology; housing; neighborhoods; drug use

Introduction

Most studies of the social epidemiology of illicit drug use describe neighborhood and social network characteristics as distal causes of illicit drug use (Cooper et al., 2013; de la Haye et al., 2013; Furr-Holden et al., 2015; Genberg et al., 2011a; Carl A. Latkin et al., 2007; Carl A. Latkin et al., 1999; Carl A. Latkin et al., 1995; Linas et al., 2015; Linton et al., 2014; Matto et al., 2007; Mennis & Mason, 2010; Olumide et al., 2014; Sterk et al., 2014; Williams & Latkin, 2007). Substance users, however, may “select” the type of neighborhoods where they live and choose the type of people with whom they interact. When the order of temporality cannot be determined from cross-sectional research, or selection processes are unaccounted for, these oversights limit knowledge about the mechanisms linking neighborhoods, social networks, and substance use. Only a few studies on the epidemiology of substance use among adults have investigated the extent to which selection mechanisms operate (Bohnert et al., 2009; C. Latkin et al., 2013). The current study extends knowledge about the directionality of the associations among neighborhood characteristics, social network characteristics, and illicit drug use using data from a cohort of African American adults relocated from public housing in Atlanta, Georgia.

Social causation and social influence

Neighborhood characteristics, such as economic disadvantage and violent crime (Cooper et al., 2013; Genberg et al., 2011a; Carl A. Latkin et al., 2007; Sterk et al., 2014; Williams & Latkin, 2007), and social network characteristics, such as large numbers of substance-using social network members, (Bohnert et al., 2009; de la Haye et al., 2013; Carl A. Latkin et al., 1999; Carl A. Latkin et al., 1995; Linas et al., 2015; Matto et al., 2007; Mennis & Mason, 2010; Olumide et al., 2014; Williams & Latkin, 2007) are the most widely documented contextual correlates of illicit drug use. Theories of social causation and social influence, which suggest that neighborhood and social network characteristics are distal causes of illicit drug use, have been used to provide explanations of the mechanisms behind these relationships.

The theory of social causation originates in sociological and psychological literature and specifically posits that neighborhood-level economic disadvantage and lower social status are fundamental stimuli that induce psychological distress and behaviors such as substance use (Dohrenwend et al., 1992; Marmot; Rose, 2001; William J. Wilson, 1997; W.J. Wilson,

2012). Living in economically disadvantaged communities that are also plagued by disinvestment, abandonment, substandard housing and crime may confer feelings of disempowerment and boredom that ultimately cause psychological distress (Dohrenwend et al., 1992; C. A. Latkin & Curry, 2003; Marmot; Rose, 2001; William J. Wilson, 1997; W.J. Wilson, 2012) and encourage substance use and other risky behaviors (German & Latkin, 2012; Carl A. Latkin et al., 2007). Abandoned and substandard housing, in particular, may also provide venues for illicit drug use and other illicit behaviors that are hidden from public view and provide sanctuaries for unstably housed people (Bourgois, 1998; Furr-Holden et al., 2015; Carl A. Latkin et al., 2007; Linas et al., 2015; Linton et al., 2014; Linton et al., 2013).

According to social causation theory, social network processes may also lie in the causal pathway linking neighborhood characteristics to illicit drug use. Neighborhoods act as social units where social connections are formed and access to social capital can be facilitated (Carpiano, 2006; Chaskin, 1997). Social cohesion and collective efficacy may be lower in neighborhoods where abandonment is prevalent and these circumstances may limit access to employment opportunities and enable the growth of visible drug market activity and other crimes (Sampson et al., 1997) that facilitate access to illicit drugs, and support individual illicit drug use (Crum et al., 1996; S. G. Sherman et al., 2004; Susan G. Sherman & Latkin, 2002; Wertz & Sayette, 2001).

Social influence theory also posits that social network members influence individual actions by direct influence and conveying descriptive and inductive norms (Cialdini et al., 1991; Cialdini et al., 1990; Lapinski & Rimal, 2005), and these norms can be disseminated through social networks rooted in a specific neighborhood (Davey-Rothwell et al., 2015; K. E. Tobin et al., 2011). In the context of substance use behavior, descriptive norms are defined as direct observation of social network members' use of substances, while inductive norms are characterized as the belief that substance use is acceptable among social network members. Descriptive and injunctive norms have been associated with substance use and risky sexual behaviors in prior research (C. Latkin et al., 2013; Linas et al., 2015; Matto et al., 2007; K. Tobin et al., 2014; Tucker et al., 2015).

Neighborhood selection and social selection

Although several longitudinal studies have strengthened arguments for causal effects of neighborhoods and social network characteristics on illicit drug use, the extent to which selection processes may also occur is often underexplored and unaccounted for in these studies. Arguably, relationships between neighborhood characteristics and illicit drug use and between social network characteristics and illicit drug use may be partly explained by neighborhood selection and social selection processes (Arcaya et al., 2016; Arcaya et al., 2014; Bohnert et al., 2009; Dohrenwend et al., 1992; James et al., 2015; C. Latkin et al., 2013; Smith et al., 2015).

To date, empirical investigations of neighborhood selection according to illicit drug use status have been lacking, but research on physical health outcomes, including obesity, suggest people with poor health conditions are more likely to relocate to neighborhoods that are economically deprived (Arcaya et al., 2016; Arcaya et al., 2014; James et al., 2015).

Thus it is plausible that substance users may exhibit similar patterns of mobility. Chronic unemployment is high among people who use substances (Alexander, 2010; Buchmueller & Zuvekas, 1998; Burgess & Propper, 1998; McCoy et al., 2007; Wall et al., 2000) and because people who use illicit drugs- especially those who are low-income and/or are racial/ethnic minorities- face higher rates of incarceration, they may encounter structural barriers to employment and acquiring affordable housing in less-disadvantaged neighborhoods (Alexander, 2010; Desmond, 2016; Richardson et al., 2016). People who attempt to cease their use of illicit drugs may also move to neighborhoods that they perceive to be less disadvantaged and have less visible drug activity (Comey et al., 2008) to reduce exposure to potential cues of illicit drug use.

The process of social selection in observational studies has been described as both *assortative* and *situational*. In assortative processes, individuals seek out others who can increase access to information, emotional support, and other resources. In situational processes, people select into specific social settings where they believe shared norms and goals are upheld (Cheadle et al., 2013; Rivera et al., 2010). Social selection has also been described as *relational* because network members may be connected by mutual friends (Cheadle et al., 2013; Rivera et al., 2010). Social selection can be understood as "birds of a feather flocking together"(McPherson et al., 2001). In other words, people who use illicit drugs may intentionally select friends and sexual partners who also use illicit drugs. A number of observational studies among adolescents and young adults have documented temporal associations between self-reported substance use and subsequent self-reported interaction with substance-using social network members (Bohnert et al., 2009; Cheadle et al., 2013; Cheadle et al., 2015; Eisenberg et al., 2014; M.-H. Go et al., 2010; M. H. Go et al., 2012; C. Latkin et al., 2013; Reifman et al., 2006). However, to our knowledge, only two studies have investigated social selection and demonstrated similar findings among a sample of adult substance users (Bohnert et al., 2009; C. Latkin et al., 2013). Advancing this line of research to also explore neighborhood selection processes will better identify the mechanisms that should be targeted by social policies, social network interventions, and substance use prevention and treatment strategies.

Study objective

This study investigates whether processes of social causation, social influence, social selection and neighborhood selection influence the relationships among neighborhood characteristics, social network characteristics, and illicit drug use among a predominantly African American cohort of adults relocated from public housing in Atlanta, Georgia. Relocations among this cohort occurred during the last round of federally-funded public housing relocations in Atlanta, Georgia between 2008 and 2010, which sought to decentralize impoverished households from spatially concentrated and "severely-distressed" public housing complexes (e.g., in extreme disrepair and located in neighborhoods characterized by high levels of poverty and violent crime (S. Popkin et al., 2004)). Residents were provided with Housing Choice Vouchers to relocate to rental properties that were privately owned by eligible landlords.

Our prior research documents that, on average, this cohort experienced reductions in exposure to census tract-level economic deprivation and violent crime rates by approximately 40% between wave 1 (baseline) and wave 2 (1st wave following relocation) (citation removed to ensure anonymity). These improvements were maintained until the final wave of data collection (wave 7) (citation removed to ensure anonymity). We also documented significant associations between these reductions in exposure to adverse economic characteristics and violent crime rates and reductions in illicit substance use frequency and numbers of substance-using social network members over time (citation removed to ensure anonymity). These prior analyses, however, did not explore whether processes of social causation, social influence, social selection and neighborhood selection simultaneously influenced relationships among neighborhood characteristics, social network characteristics, and substance use over time (Figure 1). Thus this study utilizes path analysis to test this possibility by specifically assessing associations among exposure to harmful neighborhood characteristics (i.e., economic disadvantage and violent crime), interaction with illicit drug-using social network members, and individual-level illicit drug use in a cohort of African American adults who were relocated from public housing in Atlanta, Georgia, between 2008 and 2010.

Methods

The study design, recruitment strategy, and data collection methods for this study have been described in detail elsewhere (citation removed to ensure anonymity). Briefly, residents of seven public housing complexes slated for demolition in Atlanta, Georgia, were recruited prior to relocation. Numerous strategies were used. Residents were recruited onsite, and enrolled participants were asked to refer other adults. Partnering community- and faith-based organizations were also asked to distribute flyers to community members. Eligible participants included African American adults (aged ≥18 years) who resided in one of the seven complexes slated for demolition. Residents of the selected complexes were not eligible if they resided with a previously-enrolled study participant. Because sexually transmitted infections were primary outcomes in the study, participants who did not report having sex in the past year were ineligible. To establish a cohort that had diverse substance use histories at baseline, non-probability-based quota sampling was conducted. One quarter of participants met criteria for drug/alcohol dependence; ½ reported misusing substances but were not dependent; and ¼ did not report illicit drug use in the past five years or any recent alcohol misuse. The 15-item Texas Christian University (TCU) II instrument (Knight et al., 2003) was used to measure drug and alcohol severity.

A total of 172 participants were enrolled. Baseline visits were scheduled prior to relocation (wave 1: February 2009- December 2009) and six follow-up visits were scheduled every 6–9 months thereafter (wave 2: November 2009- September 2010; wave 7: September 2013- April 2014). Intensive retention strategies were conducted to prevent attrition over the course of follow up. Retention methods included making monthly calls to participants; mailing correspondence to participants who could not be reached by phone, and contacting social network members. When participants could not be contacted through these methods, staff utilized LexisNexis software to obtain new phone numbers and addresses for participants

who gave prior permission to be contacted this way. Only 10.5% (N = 18) of participants were lost between waves 1 and 7.

Data collection and measures

Self-reported data were captured at each wave via audio computer-assisted self-interview (ACASI). Social network information was captured using a social network inventory that asked participants to name and describe characteristics and behaviors of ≤15 social network members. The social network inventory was administered by trained interviewers at waves 1 and 2 and ACASI from waves 3–7. Questions were worded and phrased consistently across modes of data collection. Differences in mode of data collection were not associated with differences in the number of substance-using social network members that participants reported (citation removed to ensure anonymity).

Individual-level illicit drug use

Illicit drug use was a dichotomous measure defined as self-reported use of at least one of the following substances in the past 6 months: marijuana, crack, cocaine and/or heroin, street methadone or other opiates, stimulants, tranquilizers, inhalants, and hallucinogens. No reported use of these substances in the past 6 months was the reference group (=0).

Egocentric illicit drug-using social networks

Because nearly 50% of participants reported no illicit drug-using social network member over time, a dichotomous measure of illicit drug-using social network members was constructed. Specifically, those who reported at least 1 social network member who used illicit drugs in the past six months were coded 1. The reference group (=0) included participants who reported zero illicit drug-using social network members in the past 6 months.

Census tract measures

Participants' home addresses were geocoded to 2010 census boundaries at each wave, and census tract-level measures were acquired from administrative data sources to describe the economic conditions and crime in the neighborhoods where participants lived. Specifically, U.S. Decennial Census data obtained from the Logan's Longitudinal Tract Database (Logan et al., 2014) and data collected as part of the U.S. American Community Survey were used to create the following census tract-level economic measures included in indices of economic disadvantage in prior literature (Genberg et al., 2011a; Linton et al., 2014; Messer et al., 2006): proportion of residents with income in the last 12 months that was below the poverty level, median household income, proportion of residents 25 years or older who did not receive a high school diploma/GED, and proportion of civilian labor force unemployed. One social characteristic of neighborhoods, violent crime rates, was created. Annual data from police departments of 20 jurisdictions were used to construct measures of violent crime rates, which were defined as the number of "Type 1" violent crime incidents (i.e., murder, non-negligent manslaughter, forcible rape, aggravated assault, and robbery) per 1000 residents.

Because the economic measures of interest have been correlated in our prior studies (citation removed to ensure anonymity), we constructed an index of economic disadvantage that included poverty and unemployment rates, median household income, and educational attainment; the index was updated each year to account for temporal changes in the distribution of economic indicators. To account for the varying distributions and scale of these characteristics, all items were standardized before they were summed to create the index. Because violent crime rates were negatively skewed, they were transformed by taking the square root of their raw values.

Reference periods for census tract characteristics were updated annually to correspond to when participant characteristics were measured. Indicators of economic deprivation had a reference period of 2000 at wave 1, and reference periods of 2007–2011 (midpoint: 2009) and 2009–2013 (midpoint: 2011) at waves 2 and 7. The reference periods for violent crime rates at waves 1, 2, and 7 were respectively 2007–2008, 2010, and 2013.

Individual-level confounders and covariates

Participant gender (man vs. woman), age (continuous), and income (ordinal) were considered potential confounders of the associations among neighborhood characteristics, illicit drug-using social network members, and illicit drug use over time. To ensure a parsimonious model, these characteristics were fixed at baseline.

Analysis

Path analysis was conducted using *MPLUS 7* to model relationships of neighborhood characteristics, status of having illicit drug-using social network members, and illicit drug use across waves 1 (baseline), 2 (relocation), and 7 (last wave of data collection). Because prior analyses document negligible changes in census tract characteristics between waves 2–6, waves 3–6 were not analyzed. In contrast to traditional regression approaches, path analysis can model mediating effects and reciprocal relationships simultaneously. Because the number of substance-using social network members and illicit drug use were operationalized as dichotomous variables, we used weighted least square parameter estimates (WLSMV), and evaluated model fit using CFI, TLI, RMSEA, and WRMR fit statistics. Conventionally, CFI>0.95, TLI>0.95, RMSEA<0.06, and WRMR<0.90 suggest good model fit (Hu & Bentler, 1999). We could not utilize multilevel analytic techniques to account for geographic clustering of participants in baseline census tracts because these models failed to converge. Participants were clustered in seven census tracts at baseline. Prior research suggests that standard errors are often misestimated and non-convergence is more likely to occur when < 30 clusters are analyzed (Maas & Hox, 2005). We also could not adjust for baseline census tracts as fixed effects because of their near perfect correlation with baseline measures of place characteristics. However, we included random effects to account for correlation among observations of the same participant.

We first analyzed the hypothesized model based on conceptual frameworks of social causation, social influence, neighborhood selection, and social selection (Figure 1). Specifically to evaluate potential social causation at wave 1, paths linking economic conditions in 2000 and violent crime rates in 2007–2008 to illicit drug-using social network

and illicit drug use data at wave 1 (2009) were analyzed. Thereafter, social causation was evaluated by linking economic disadvantage and violent crime rates at waves 1 and 2 to illicit drug use and illict drug using social networks at waves 2 and 7.

Neighborhood selection processes were evaluated across paths linking illicit drug use at waves 1 and 2 to economic disadvantage and violent crime rates at waves 2 and 7. Social selection and social influence were evaluated using cross-lagged paths temporally linking status of having an illicit drug-using social network member with illicit drug use across waves 1 and 2 and waves 2 and 7.

Because of the chronic nature of substance use (Genberg et al., 2011b; Hser et al., 2007), paths were also directed from illicit drug use and substance-using social network members at waves 1 and 2 to illicit drug use and substance-using social network members at waves 2 and 7. Lastly, correlations between economic disadvantage and violent crime rates and between illicit drug use and illicit drug-using social network members at each of the 3 waves were analyzed.

In a second path model (Figure 2), we removed paths that were not statistically significant at p-value <0.10 in the 1st model and added age, gender, and income as confounders.

Results

Description of participants, their networks, and the census tracts where they lived

A total of 172 participants were enrolled (Table 1). At baseline, more than half of participants were women (57%); the mean age of participants was 42.9 (SD=14); forty eight percent reported illicit drug use and 60% of participants reported at least 1 illicit drug-using social network member. On average, 82% of social network members reported to use illicit drugs or alcohol in excess were sexual partners. Between waves personal income increased and illicit drug use decreased. The proportion of participants who had illicit-using social network members decreased between waves 1 and 2 but slightly increased between waves 2 and 7. The mean percentage of substance-using social network members who were sexual partners increased to 89% at wave 2 and decreased to 65% at wave 7.

As a result of the housing relocations, the average distance residents moved between waves 1 and 2 was 5.81 (SD=4.11) miles. By wave 7, the average distance residents moved from their former housing complexes was 7.34 (SD=5.49) miles. The spatial distributions of participants increased from the 7 census tracts where the former housing complexes were located to 94 census tracts at wave 7. Exposure to more affluent and safer neighborhoods increased following relocation. On average, between waves 1 and 7, exposure to poverty and violent crime rates decreased by 40%. Participants remained in neighborhoods that were predominantly African American.

Path analysis

Model 1 analyzed all hypothesized paths (Figure 1). Model 2 was a reduced path model that included paths significant at p<0.10 in model 1, controlling for age, gender, and income (Figure 2; dashed lines indicate non-significant paths). Both models had good fit (Model 1:

CFI=1.00, TLI=1.05, RMSEA=0.00 and WRMR=0.328; Model 2: CFI=1.00, TLI=1.06, RMSEA=0.00 and WRMR=0.410). Standardized path coefficients are presented in Tables 2 and 3, except for categorical exogenous variables, for which raw coefficients are presented.

Processes of social causation appeared to be operating among this sample of adults relocated from public housing. Specifically, in Model 1 (Table 2), residing in census tracts that were more economically disadvantaged in 2000 was significantly associated with participant illicit drug use at wave 1 ($p=0.003$) and marginally associated with having at least 1 illicit drug-using social network member ($p=0.069$). Residing in census tracts with higher violent crime from 2007–2008 was significantly and inversely associated with illicit drug use and having illicit drug-using social network members at wave 1 ($p<0.05$). Additionally, residing in census tracts with higher violent crime rates at wave 2 was significantly associated with illicit drug-using social network members at wave 7 ($p<0.05$). When age, gender, and income were included in Model 2, the paths that linked prior census tract-level violent crime to illicit drug use and illicit drug-using social network members at wave 1 were not statistically significant ($p>0.05$). The paths linking economic disadvantage to illicit drug use and violent crime to illicit drug-using social network members remained significant ($p<0.05$).

Potential neighborhood selection was also supported by the results of the path analysis. Specifically in Model 1 (Table 2), illicit drug use at wave 1 was signficantly associated with living in census tracts with higher economic disadvantage and violent crime rates at wave 2 ($p<0.05$). When confounders were adjusted for, the association between illicit drug use at wave 1 and economic disadvantage at wave 2 remained significant ($p=0.006$).

Potential social influence was supported by results of Model 1 (Table 2). Illicit drug-using social network members at wave 2 were marginally and inversely associated with illicit drug use at wave 7 ($p=0.081$), but this association was no longer significant after adjusting for age, gender and individual-level income in Model 2 ($p>0.05$). There was no significant relationship of illicit drug use to subsequent illicit drug-using social network members over time.

Illicit drug use and illicit drug-using social network members at waves 1 and 2 were significantly associated with their respective measures at subsequent waves ($p<o.o5$) in Models 1 and 2. Similarly, paths linking census tract characteristics at wave 2 to their respective measures at wave 7 were significant ($p<o.o01$ for all paths) in Models 1 and 2. Cross-sectional correlations between illicit drug use and illicit drug-using social network members and between census tract economic disadvantage and violent crime rates were significant ($p<0.05$) at all waves in Models 1 and 2.

Discussion

Among this cohort of African American adults who were relocated from public housing complexes in Atlanta, Georgia, we observed associations of census tract characteristics with illicit drug use and illicit drug-using social networks that support social causation and the neighborhood selection hypotheses. Specifically, residing in census tracts with prior

economic disadvantage was associated with illicit drug use at wave 1 and residing in census tracts with higher violent crime rates at wave 2 were associated with having at least one illicit drug-using social network member at wave 7 (social causation). Illicit drug use at wave 1 appeared to increase the likelihood of living in an economically-disadvantaged census tract at wave 2 (neighborhood selection).

The relationship of economic disadvantage to illicit drug use is consistent with prior research (Cooper et al., 2013; Genberg et al., 2011a; Nandi et al., 2010; Williams & Latkin, 2007). Unavailability of legal employment opportunities has been associated with the establishment of illicit drug market activities (Ford & Beveridge, 2004; William J. Wilson, 1997), which have been documented to increase availability of and access to illicit drugs and provide cues that encourage illicit drug use (Crum et al., 1996; S. G. Sherman et al., 2004; Susan G. Sherman & Latkin, 2002). Additionally, prior research suggests that illicit drug use can serve as a coping mechanism for the stress and hopelessness induced by economic disempowerment and violence related to drug market activity (Curry et al., 2008; German & Latkin, 2012; C. A. Latkin & Curry, 2003; Carl A. Latkin et al., 2007).

Prior research also suggests that economic disadvantage and drug market activity may increase access to substance-using peers who ultimately encourage individual substance use (Susan G. Sherman & Latkin, 2002). Visible drug market activity has been associated with violent crime in prior literature (Martínez et al., 2008) and this may partly explain the relationship of violent crime with illicit drug-using social networks observed in this study. In support of these hypotheses, our prior longitudinal analyses demonstrated that reductions in economic disadvantage and violent crime rates were associated with reductions in the number of substance-using social network members and reduced frequency of illicit drug use (citations removed to ensure anonymity). We did not observe a direct relationship between economic disadvantage and illicit drug-using social networks and between violent crime and illicit drug use in the current analysis, however. Instead, the current results suggest that economic disadvantage and violent crime may respectively influence illicit drug-using social networks and illicit drug use via indirect pathways.

Strikingly, the legacy of pre-relocation exposure to economic disadvantage appeared to influence future exposure to economic disadvantage through illicit drug use. This result suggests that our prior finding that reductions in exposure to economic disadvantage are associated with reductions in illicit drug use in this cohort (citation removed to ensure anonymity), may partly be explained by processes of neighborhood selection. The potential for pre-relocation illicit drug use to influence subsequent relocation to an economically-disadvantaged area is analogous to results from prior research by Arcaya and colleagues, who documented associations between self-reported physical health outcomes and subsequently residing in impoverished neighborhoods among Hurricane Katrina survivors (Arcaya et al., 2014). Additionally, because violent crime was correlated with economic disadvantage, the prior associations that we documented between reductions in violent crime and illicit drug use in prior research (citation removed to ensure anonymity) may also be influenced by processes of neighborhood selection.

Participants who used illicit drugs prior to relocation may have experienced structural barriers, including discrimination due to their substance use or eviction or incarceration records, which limited their abilities to meet eligibility requirements for housing vouchers in less-deprived areas (Alexander, 2010; Desmond, 2016; S. J. Popkin et al., 2002b). Background qualifications for rental properties are reported to be more relaxed in economically-disadvantaged communities than rental properties located in more affluent communities (Desmond, 2016; Dickson-Gomez et al., 2009). Additionally, because voucher-subsidized housing was costlier than the public housing that participants came from (e.g., residents with vouchers are required to pay utilities and costlier security deposits while public housing residents are not) (S. J. Popkin et al., 2002b) these additional expenses may have served as barriers to securing housing vouchers among illicit drug-using participants who may have had fewer economic opportunities than their counterparts who did not use illicit drugs (Desmond, 2016).

Future housing policies should intensify efforts to help relocated residents, even those with criminal records or histories of substance use, secure employment opportunities, and make concerted efforts to understand and eliminate barriers to relocating to less-disadvantaged areas among current and former substance users. These efforts have the potential to greatly encourage substance use cessation and discourage involvement in illegal income generating activities, including drug market activity. Efforts to integrate additional harm reduction approaches with housing policies may also be warranted for substance users, particularly because of the potential chronicity of illicit drug use.

In contrast to our hypotheses, we observed no statistically significant bidirectional relationship between illicit drug use and illicit drug-using social networks over time, which suggests that processes of social influence and social selection were not strongly operating longitudinally across waves among this cohort. Prior analyses, including our own, revealed low stability of substance-using social networks over time (citation removed to ensure anonymity), and this may have partly explained the lack of association between illicit drug use and substance-using social networks observed in this analysis.

Limitations

The findings from this study should be considered in light of several limitations. This study analyzed data from a cohort of adults relocated from public housing complexes, thus processes of social causation, social influence, neighborhood selection and social selection may operate differently in a sample of participants who did not experience relocation or were not extremely economically disadvantaged at the onset.

Because non-probability-based quota sampling was implemented according to participants' substance use and eligibility criteria required that participants be sexually active one year prior to enrollment, this study's findings are also not generalizable to broader samples of public housing residents relocated due to similar housing policies, whom may be affected by neighborhood conditions differently and have different chances of relocating to neighborhoods with improved conditions when compared to predominantly sexually-active and substance-using adults. However, the distribution of several sociodemographic

characteristics of this sample (e.g., age categories and median household income) is consistent with a broader multi-site sample of residents relocated from public housing in the United States (S. Popkin et al., 2002a).

All severely-distressed public housing complexes were demolished in Atlanta. Therefore an adequate comparison group of non-relocaters could not be established. Also, participant characteristics were self-reported, thus social desirability bias may have influenced the information that participants provided. However, ACASI may have minimized this bias(Perlis et al., 2004).

Because changes in several place-based factors were negligible post relocation, we could not utilize multivariate latent growth curve modeling to explore the possible relationships among trajectories in census tract characteristics, illicit drug-using social network members, and illicit drug use. Additionally, the small number of census tracts where participants resided at wave 1 precluded us from statistically controlling for spatial clustering of participants. We may have also missed annual changes in economic conditions by utilizing data from the American Community Survey, which averages census tract conditions over 5-year intervals. Future studies should explore this research question further to contribute to knowledge of the paths that link neighborhoods, social networks, and substance use.

Conclusion

Despite these limitations, this study suggests that social causation and neighborhood selection processes may influence associations between neighborhood characteristics and substance use over time among African American residents relocated from public housing in Atlanta, Georgia. Findings from this study add to the growing evidence suggesting relationships of economic disadvantage and violent crime with illicit drug use and illicit drug-using social networks. The potential influence of illicit drug use on subsequently residing in economically-disadvantaged neighborhoods requires further investigation and suggests a possible need for urban redevelopment and housing mobility programs to strengthen their efforts to increase equitable access to less disadvantaged neighborhoods among the most marginalized groups of relocated residents.

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- This study's results support social causation and neighborhood selection hypotheses
- Prior residence in impoverished neighborhoods predicted subsequent drug use
- Prior residence in violent neighborhoods predicted subsequent drug-using networks
- Prior drug use predicted subsequent residence in impoverished neighborhoods

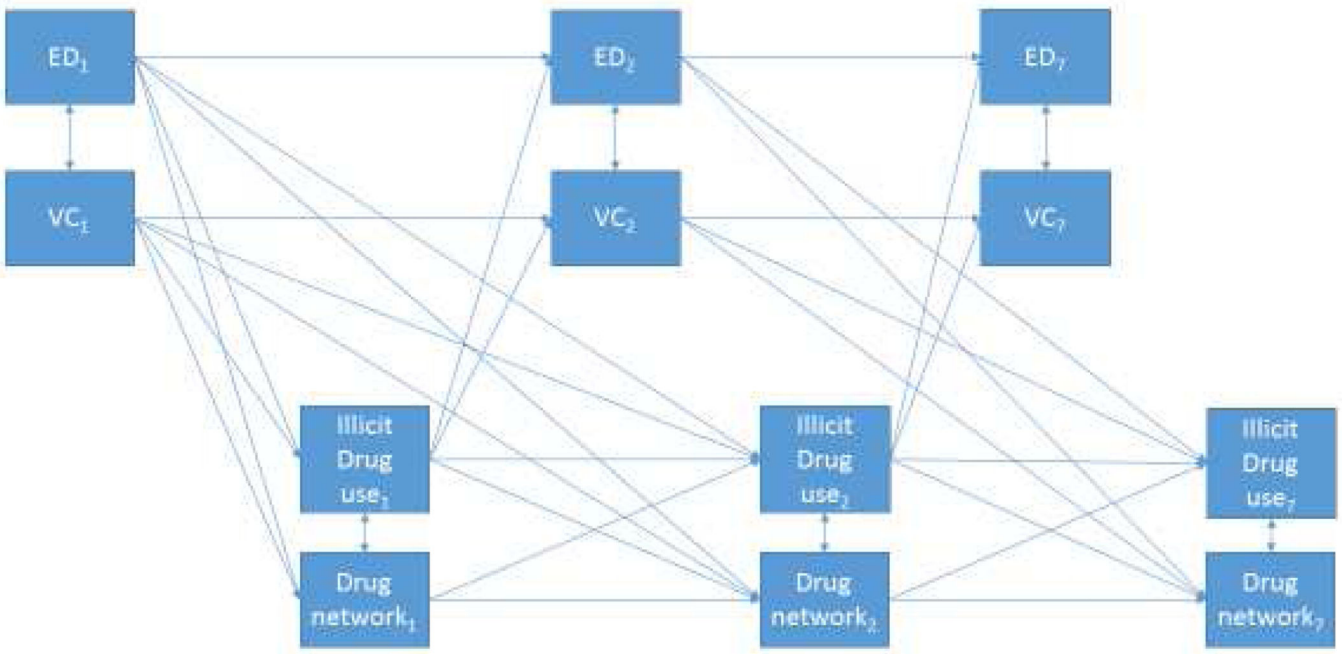

Figure 1.

Full path model of census tract-level conditions, illicit drug-using social networks, and illicit drug use among African American adults relocated from seven public housing complexes in Atlanta, GA

Note: Economic disadvantage (ED); Violent crime (VC)

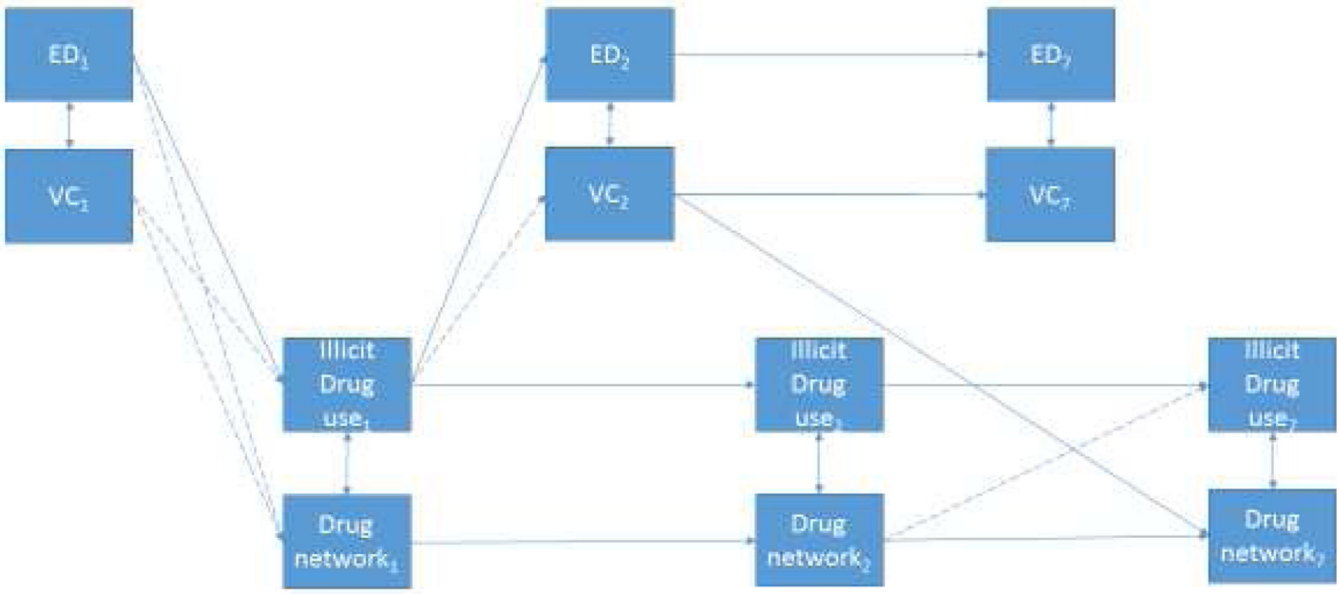

Figure 2.

Reduced path model of census tract-level conditions, illicit drug-using social networks, and illicit drug use among African American adults relocated from seven public housing complexes in Atlanta, GA*

Note: Economic disadvantage (ED); Violent crime (VC); dashed lines denote paths that were not significant at $p<0.05$

*Model adjusts for age, gender, and income at wave 1

Table 1

Participant, network, and census tract characteristics among 172 African American adults relocated from seven public housing complexes in Atlanta, GA, across waves

Characteristics [a]	Wave 1 N(%)[b] or Mean (SD)	Wave 2 N(%) or Mean (SD)	Wave 7 N(%) or Mean (SD)
Participant	N= 171[c]	N=163	N=154
Current age	42.9 (14.0)	43.9 (13.9)	47.3 (13.8)
Women[d]	96 (56.5)	93 (58.1)	87 (57.6)
Personal income	$9,849.4 ($8,733.0)	$10,473.9 ($9,655.9)	$13,918.9 (12399.8)
Illicit drug use[e] (=1)	72 (48.3)	63 (42.0)	53 (36.3)
Marijuana[f] (=1)	63 (42.3)	54 (36.0)	51 (34.9)
Hallucinogens (=1)	0 (0.0)	1 (0.7)	2 (1.4)
Inhalant (=1)	1 (0.7)	0 (0.0)	0 (0.0)
Crack (=1)	6 (4.0)	11 (7.3)	5 (3.4)
Heroin and Cocaine (=1)	1 (0.7)	0 (0.0)	0 (0.0)
Cocaine (=1)	10 (6.7)	9 (6.0)	6 (4.1)
Heroin (=1)	2 (1.3)	1 (0.7)	0 (0.0)
Street Methadone (=1)	2 (1.3)	1 (0.7)	0 (0.0)
Opiates (=1)	1 (0.7)	1 (0.7)	0 (0.0)
Methamphetamines (=1)	0 (0.0)	0 (0.0)	0 (0.0)
Amphetamines (=1)	2 (1.3)	0 (0.0)	1 (0.7)
Tranquilizers (=1)	1 (0.7)	1 (0.7)	1 (0.7)
Network			
Total Network Size	5.8 (3.4)	5.5 (2.7)	5.1 (2.5)
Illicit drug-using social network member (=1)	98 (59.8)	76 (47.8)	78 (51.0)
Percentage of substance-using social network members[g] who were sexual partners	81.8 (32.7)	89.4 (23.8)	64.8 (41.6)
Census tract			
Proportion of non-Hispanic Black residents	81.2 (17.5)	74.0 (28.0)	75.5 (27.3)
Proportion of individuals in poverty	46.0 (9.5)	30.2 (11.9)	32.8 (12.7)
Median household income	$15838.1 ($4484.8)	$33476.0 ($15788.3)	$33337.1 ($16207.4)
Proportion of residents whose highest level of educational attainment is a high school diploma/GED	67.14 (13.4)	49.06 (17.6)	48.1 (16.5)
Proportion of civilian labor force unemployed	21.6 (5.5)	17.0 (7.83)	19.6 (7.9)
Violent crime rates per 1000 residents	35.5 (15.8)	20.7 (14.7)	20.5 (13.6)

[a] Participant characteristics were measured for six-month reporting periods unless otherwise stated

[b] A total of 172 participants were enrolled in the study, however, baseline data was lost for one participant

[c] For some characteristics, numbers do not add up to total due to missing values

[d] Women include 3 transgender women (i.e. male to female)

[e] Use of 1 or more of the following substances in the last 6 months: marijuana, crack, cocaine and/or heroin, street methadone or other opiates, stimulants, tranquilizers, inhalants, and hallucinogens.

[f] Participant responses to individual illicit substances are not mutually exclusive

[g] Substance-using social network members include network members who are reported to use illicit drugs and/or alcohol in excess

Table 2

Beta coefficients and correlations of full path model of neighborhood characteristics, illicit drug-using social networks, and illicit drug use among African American adults relocated from public housing in Atlanta, Georgia

Characteristics	Drug use (1)	Drug use (2)	Drug use (7)	Drug-using network (1)	Drug-using network (2)	Drug-using network (7)	Economic disadvantage (2)	Economic disadvantage (7)	Violent crime (1)	Violent crime (2)	Violent crime (7)
Drug use (1)		0.988 **		(0.518) **	0.164		0.995 *			0.344 *	
Drug use (2)			1.175 *		(0.405) *	0.025		0.209			−0.011
Drug use (7)						(0.885) *					
Drug-using network (1)	(0.518) **	0.167			0.343 ≠						
Drug-using network (2)		(0.405) *	−0.582 ≠			0.676 *					
Drug-using network (7)			0.676 *								
Economic disadvantage (1)	0.498 *	0.082		0.303 ≠	0.084		0.031		(0.753) **		
Economic disadvantage (2)			0.021			0.005		0.439 **		(0.545) **	
Economic disadvantage (7)											(0.696) **
Violent crime rates (1)	−0.370 *	−0.028		−0.488 *	−0.173					0.070	
Violent crime rates (2)			−0.005			0.320 *	(0.545) **				0.525 **
Violent crime rates (7)								(0.696) **			

Note: correlations are enclosed in parentheses

** p<0.001;

* p<0.05;

≠ p<0.10

Table 3

Beta coefficients and correlations of reduced path model of neighborhood characteristics, illicit drug-using social networks, and illicit drug use among African American adults relocated from public housing in Atlanta, Georgia, controlling for baseline participant socio-demographic characteristics

Characteristics	Drug use (1)	Drug use (2)	Drug use (7)	Drug-using network (1)	Drug-using network (2)	Drug-using network (7)	Economic disadvantage (1)	Economic disadvantage (2)	Economic disadvantage (7)	Violent crime (1)	Violent crime (2)	Violent crime (7)
Drug use (1)		0.955**		(0.459)**				0.919*			0.259	
Drug use (2)			1.074*		(0.472)*							
Drug use (7)						(0.962)*						
Drug-using network (1)	(0.459)**				0.387*							
Drug-using network (2)		(0.472)*	−0.517≠			0.626*						
Drug-using network (7)			(0.962)*									
Economic disadvantage (1)	0.575*			0.156						(0.821)**		
Economic disadvantage (2)									0.430**		(0.562)**	
Economic disadvantage (7)												(0.713)**
Violent crime rates (1)	−0.351≠			−0.320			(0.821)**					
Violent crime rates (2)						0.307*		(0.563)**				0.524**
Violent crime rates (7)									(0.713)**			
Control variables												
Baseline age	−0.251*	−0.004	−0.108	−0.461**	−0.036	0.024	−0.060	−0.031	−0.193*	0.162*	−0.046	0.023
Baseline gender	0.171	−0.179	0.201	−0.076	−0.236	−0.251	0.092	−1.051≠	0.047	0.137	−0.424	0.014
Baseline income	0.031	0.107	−0.060	−0.015	0.086	0.097	−0.054	0.160≠	−0.093	−0.064	0.074	−0.136≠

Note: correlations are enclosed in parentheses

** p<0.001;

* p<0.05;

≠ p<0.10