Chapter 9

Residential Segregation and the Prevalence of Injection Drug Use among Black Adult Residents of US Metropolitan Areas

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Abstract *Objectives*: We analyzed the relationships of two dimensions of racial residential segregation (isolation and concentration) in 1990 to the 1998 prevalence of injection drug use (IDU) among Black adult residents of 93 large US metropolitan statistical areas (MSAs).

Methods: We estimated IDU prevalence among Black adults in each MSA by analyzing three databases documenting injectors' encounters with the healthcare system. Multiple linear regression methods were used to investigate the relationships of isolation and concentration to the natural log of Black IDU prevalence, controlling for possible confounders.

Results: The median IDU prevalence was 1983/100,000 Black adults (interquartile range: 1422/100,000–2759/100,000). The median isolation index was 0.48 (range: 0.05–0.84): in half of the MSAs studied, the average Black resident inhabited a census tract where ≥48% of the residents were Black. The multiple regression model indicates that an increase of 0.50 in the isolation index was associated with a 23% increase in IDU prevalence among Black adults. Concentration was unrelated to the outcome.

Conclusions: Residential isolation is positively related to Black IDU prevalence in MSAs. Research into the pathways linking isolation to IDU is needed.

As recognized by the National Institutes of Health (National Institute on Drug Abuse, 2001), identifying the determinants of injection drug use (IDU) among Black adults holds importance for public health, given the substantial and persistent overrepresentation of Black Americans among people diagnosed with injection-related health problems, including HIV/AIDS and fatal illicit drug overdoses (Tardiff, Gross, and Wu, 1989; Substance Abuse and Mental Health Services Administration,

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2003; Harlow, 1990; Galea, Ahern, and Tardiff, 2003; Friedman et al., 1987; Friedman et al., 1988; Novick et al., 1989; Selik et al., 1989; Selik, Castro, and Pappaioanou, 1988; Centers for Disease Control and Prevention, 2001). Structural factors, including racial residential segregation, have been hypothesized to be potent determinants of drug use patterns among Black individuals and, in fact, some have suggested that such factors play a more important role in determining drug use among Blacks than Whites (Johnson and Mulffler, 1997; Roberts, 2000; Cooper et al., 2005; Friedman, 2002; Fullilove, 1993; Galea, Nandi, and Vlahov, 2004; Lillie-Blanton, Anthony, and Schuster, 1993; Taylor and Jackson, 1990; Wingo, 2001; King, 1997; Saunders-Phillips, 2002; Fuller et al., 2005). Few studies, however, have pursued related lines of inquiry (Lille-Blanton, Anthony, and Schuster, 1993; Fuller et al., 2005; Jones-Webb et al., 1997; Delva, Mathiesen, and Kamata, 2001). This omission is striking when placed within the broader context of public health, a discipline which has increasingly emphasized the structural determinants of health and health-related behaviors (Berkman and Kawachi, 2000; Diez-Roux, 2001, 2000, 1998). The micro-level focus of research on drug use patterns among Blacks is, however, consonant with the larger body of research into the etiology of licit and illicit drug use and dependence in the general population, a body of research which has tended to locate the causes of drug use and abuse within the individual, family, and peer group (Galea, Nandi, and Vlahov, 2004). This micro-level orientation is also evident in drug-related interventions: the two principle methods of addressing active drug use and addiction, drug treatment programs and, particularly for Black Americans, the criminal justice system, primarily target individuals (Harrison and Beck, 2003; Drucker, 2002, 1999).

The present analysis investigates the relationships of two dimensions of racial residential segregation, namely residential isolation and concentration, to the subsequent prevalence of IDU among Black adults residing in 93 large US metropolitan statistical areas (MSAs). Residential segregation has been found to adversely affect the physical and mental health status of Black populations across the lifecourse (Hart et al., 1998; Jackson et al., 2000; Polednak, 1996; Acevedo-Garcia, 2001; La Veist, 1989, 2002; Subramanian, Acevedo-Garcia, and Osypuk, 2005). While no research has yet investigated the association of segregation with IDU prevalence among Black adults, available studies allow us to trace a pathway linking these two phenomena. Black residents of segregated communities are at elevated risk of depression, anxiety, and general psychological distress (Aneshensel and Sucoff, 1996; Schultz et al., 2000). These mental health outcomes, in turn, create vulnerability to both engaging in IDU and using injectable drugs (Crofts et al., 1996; Irwin et al., 1996; Khantzian, 1997; Dunn and Laranjeira, 1999; Weinberg and Glantz, 1999; Swendsen and Merikangas, 2000; Fuller et al., 2001; Neaigus et al., 2001). Research regarding the relationship of structural factors to drug use in the general population also testifies to the salience of structural determinants: rates of unemployment, poverty, and arrest and neighborhood disorder have been found to be associated with patterns of IDU and heroin and cocaine use in various geographically defined communities (Friedman et al., 2004; Hunt and Chambers, 1976; Duncan, Duncan, and Strycker, 2002; Nurco, Shaffer, and Cisin, 1984; Bell,

Carlson, and Richard, 1998; Boardman et al., 2001). Since segregation concentrates and amplifies material deprivation in Black communities (Massey and Denton, 1988), this research collectively suggests that segregation may contribute to the prevalence of IDU in Black MSA populations.

Our examination of the relationship of each of two segregation dimensions to IDU prevalence among Black adults reflects emerging recognition in public health that residential segregation is a multidimensional construct. Until recently, public health research regarding segregation and health has almost exclusively conceptualized residential segregation as a uni-dimensional phenomenon consisting of unevenness (defined as the extent to which the racial composition of an MSA deviates from that of its constituent neighborhoods [Massey and Denton, 1988; Massey, White, and Phua, 1996]) and operationalized using the Dissimilarity Index (Subramanian, Acevedo-Garcia, and Osypuk, 2005; Collins and Williams, 1999; Acevedo-Garcia et al., 2003; Acevedo-Garcia, 2000; Acevedo-Garcia and Lochner, 2003). However, Massey and Denton's 1988 factor analysis of 20 segregation measures found that segregation is instead a highly complex phenomenon consisting of multiple dimensions, including but not limited to unevenness, isolation, and concentration, each signaling a particular spatial configuration (Massey and Denton, 1988). This complexity has historical roots: while the overarching origins of racial residential segregation lie largely in efforts to restore and maintain White supremacy in the wake of emancipation, its multidimensional nature is in part a product of variations across geographic areas in the specific methods employed to perpetuate this supremacy (Massey and Denton, 1993; Du Bois, 1962; Foner, 2002; Lemann, 1991). Acevedo-Garcia and others have thus recommended expanding inquiries into segregation and health beyond the current focus on unevenness to include these additional dimensions (Subramanian, Acevedo-Garcia, and Osypuk, 2005; Acevedo-Garcia et al., 2003; Acevedo-Garcia, 2000; Acevedo-Garcia and Lochner, 2003). The Index of Dissimilarity has itself been questioned because of concerns about its conceptual links to health and interpretability (Subramanian, Acevedo-Garcia, and Osypuk, 2005; Acevedo-Garcia et al., 2003; Acevedo-Garcia and Lochner, 2003; Lieberson and Carter, 1982). The following paragraphs review the definitions of the two segregation dimensions studied here, namely residential isolation and concentration, and trace their possible relationship to IDU.

Isolation refers to the extent of potential intra-racial contact for a group in its residential area and thus reflects a combination of the percent of the overall population constituted by that group in an MSA and its distribution across the MSA's neighborhoods (Massey and Denton, 1988; Massey, White, and Phua, 1996). Some have hypothesized that isolation is the segregation dimension that holds the most salience for health, and higher Black isolation has been associated with poorer self-reported health and higher mortality and homicide rates among Black Americans (Subramanian, Acevedo-Garcia, and Osypuk, 2005; Collins and Williams, 1999; Peterson and Krivo, 1993). MSAs with high levels of Black isolation were often produced through White violence and legal actions, including zoning laws and restrictive covenants, designed to exclude Black individuals and families from historically majority-White neighborhoods (Massey and Denton, 1993;

McMurry, 1998; Boyle, 2004; Massey and Mullen, 1984; National Association for the Advancement of Colored People, 2005). Ongoing discrimination by the real estate and banking industries against Black individuals seeking to buy or lease homes outside of majority-Black neighborhoods has perpetuated Black residential isolation (Massey and Denton, 1993; Bonilla-Silva, 2001). Drawing on past research indicates that isolated Black areas suffer high rates of unemployment, poverty, and violence (Denton, 1994; Galster and Mikelsons, 1995), each of which has been linked to IDU or the use of injectable drugs (Friedman et al., 2004; Hunt and Chambers, 1976; Duncan, Duncan, and Strycker, 2002; Nurco, Shaffer, and Cisin, 1984; Bell, Carlsom, and Richard, 1998; Boardman et al., 2001; Dee, 2001; Vermeiren et al., 2003), we posited that MSAs with elevated Black isolation would have a relatively high prevalence of IDU among Black adults.

Concentration refers to "the relative amount of physical space occupied by a minority group in the urban environment" (Massey and Denton, 1988). As Black migration to cities mounted between 1870 and 1970 (Massey and Denton, 1993; Lemann, 1991), Whites' refusal to permit Blacks to live outside strictly delineated areas created highly concentrated Black neighborhoods as existing housing units were divided and sub-divided to create new homes for the burgeoning Black population (Massey and Denton, 1993, Boyle, 2004). Mid-century urban renewal programs that relocated large numbers of Black households from "renewed" areas to majority-Black neighborhoods compounded this concentration (Massey and Denton, 1993, Lemann, 1991). As has been suggested previously (Jones-Webb et al., 1997; Wallace and Wallace, 1998), we posited that the overcrowded conditions characterizing concentrated Black areas would contribute to the prevalence of IDU, in part by creating intensely stressful living conditions. Further, the urban renewal programs that produced some concentrated Black communities might have disrupted social networks and institutions, both in the "renewed" community and the new host community, for a prolonged period (Fullilove, 2001). Such disruptions have been linked to increased IDU and injectable drug use (Wallace and Wallace, 1998, Rhodes et al., in press; Friedman et al., 1999; Sterk-Elifson and Elifson, 1992).

Methods

We tested the hypotheses that isolation and concentration would be positively related to Black IDU prevalence in a sample of 93 large US MSAs using a lagged cross-sectional design, a design commonly used in comparative research in which predictor variables precede the outcome variable (Mellor and Milyo, 2003; Lyson, Torres, and Welsh, 2001; Blakely, Lochner, and Kawachi, 2002), thus allowing the statistical model to mirror the conceptual model's temporal sequence. Defined by the US Census Bureau, MSAs are adjacent counties that include at least one central city home to 50,000 people or more that collectively form a single cohesive socioeconomic unit (Office of Management and Budget, 2000; U.S. Bureau of the Census, 1998). To be included in our sample, MSAs had to have been home to at

least 500,000 residents in 1993. Ninety-six MSAs met this criterion. Three MSAs, however, lacked sufficient data on IDU among Black adults and were dropped from the sample. The boundaries of 50 MSAs changed between 1990 and 1998 (U.S. Bureau of the Census, 2005); all measures were operationalized using 1998 boundaries.

Measures

Segregation: Massey and colleagues have identified the isolation and relative concentration indexes (RCIs) as valid measures of their respective constructs (Massey, White, and Phua, 1996). The isolation index captures, for the average member of racial/ethnic group X in a MSA, the percent of individuals sharing his/her residential census tract who are also in group X (Table 9.1) (Lieberson and Carter, 1982; Lieberson and Carter, 1982; Bell, 1954). The RCI compares the surface area of census tracts occupied by one racial/ethnic group in an MSA to that occupied by another (Table 9.1) (Massey and Denton, 1988). As Massey and Denton note, this area-based measure also reflects tract population density: because tract boundaries are partially determined by population size, tracts with a smaller surface area are usually more concentrated than larger tracts (Massey and Denton, 1998). Where MSA boundaries remained constant between 1990 and 1998, index values were obtained from the 1990 Census. Otherwise, we calculated values using 1990 US Census STF1 data.

IDU prevalence among Black adults: It is difficult to estimate IDU prevalence in geographic areas because IDU is both illegal and heavily stigmatized (Larson, Stevens, and Wardlaw, 1994; Larson and Bammer, 1996; Hickman et al., 1999; Cox and Shipley, 1997). Our calculation method estimated the 1998 prevalence of IDU among Black adults in each of the 93 MSAs in a four-stage process: (1) estimating the proportion of injectors in each MSA who are Black; (2) calculating the number of injectors, regardless of race, in each MSA; (3) calculating the prevalence of IDU among Black adults using project data produced in Stages 1 and 2, combined with US Census data on the number of Black and White adults in each MSA in 1998; and (4) validating our IDU prevalence estimates. Project Stages 1 and 2 have been described in detail elsewhere (Cooper et al., 2005; Friedman et al., 2004).

Stage 1: We calculated the proportion of injectors who were Black in 1998 in each of the three databases that documented injectors' encounters with the healthcare system and then averaged these database-specific percents to create a single estimate for each MSA (Cooper et al., 2005). The three databases analyzed were the Substance Abuse and Mental Health Administration's (drug) Treatment Entry Data Set (TEDS) and the Center for Disease Control's HIV Counseling and Testing Database (CTS) and AIDS Public Information Database (APID) (Table 9.2). Because the proportion of injectors who were Black in APID reflected racial patterns of both HIV seroprevalence and IDU, APID-based estimates were adjusted for the HIV seroprevalence among Black injectors in the MSA. We analyzed CTS, APID, and TEDS because each captures a slightly different segment of the underlying

Table 9.1 Construct definitions, operational definitions, and formula for calculating two dimensions of racial residential segregation in metropolitan statistical areas (MSAs) (Massey and Denton, 1988, 1998)

Construct and construct definition	Measure and operational definition	Measure formula, range, and interpretation
Isolation: Extent of potential contact among members of a single racial/ethnic group within their residential area.	*Isolation Index:* For the average member of racial/ethnic group X in a MSA, the percent of individuals sharing his/her residential census tract who are also in group X.	*Formula*: $\sum\limits_{i=1}^{N} [x_i/X][x_i/t_i]$ where x_i = no. of members of group X in census tract i X = no. of members of group X in the MSA t_i = total population of census tract i *Range*: proportion of population in group X – 1.0 *Interpretation*: A value of 1.0 indicates total isolation.
Concentration: "The relative amount of physical space occupied by a minority group in the urban [and suburban] environment" (Massey and Denton, 1988 p. 289)	*Relative Concentration Index:* Ratio of the urban and suburban space occupied by one racial/ethnic group relative to that occupied by another in a MSA.	*Formula*: $\dfrac{\{[\sum\limits_{i=1}^{n} (x_i a_i/X)]/[\sum\limits_{i=1}^{n} (y_i a_i/Y)] - 1\}}{\{[\sum\limits_{i=1}^{n_1} (t_i a_i/T_1)]/[\sum\limits_{1=n_2}^{n} (t_i a_i/T_2)] - 1\}}$ where census tracts are ordered from smallest to largest in surface area and a_i = the area of census tract i n_1 = rank of tract where cumulative total population of tracts equals the total minority population of the MSA, summed from smallest tract up n_2 = rank of tract where cumulative population of tracts equals the majority population total from the largest tract down T_1 = total population of tracts from 1 to n_1 T_2 = total population of tracts from n_2 to n y_i = no. of members of group Y in census tract i Y = no. of members of group Y in the MSA X, x_i and t_i as defined above *Range*: no lower bound to 1.0 *Interpretation:* A value of 1.0 indicates that X's concentration exceeds Y's concentration to greatest extent possible.

injecting population in each MSA. Collectively, they should represent the racial demographics of this underlying population better than any single database could alone (Cooper et al., 2005).

Stage 2: To calculate the number of injectors in each MSA, we first adjusted the 1998 National Household Survey on Drug Abuse estimate of the number of past-year injectors nationwide to account for under-reporting of IDU and undercoverage

Table 9.2 Description of databases analyzed to calculate the prevalence of injection drug use among black adults in 93 Large US Metropolitan Statistical Areas in 1998

Database characteristics	Treatment episode data system (TEDS)	HIV counseling and testing service	AIDS public information database
Description	SAMHSA database recording admissions to public and private drug treatment facilities licensed by the state.	CDC database documenting HIV test incidents at 11,640 HIV counseling and testing sites. Participating sites include family planning and STD clinics, hospitals and private medical centers, drug treatment programs, correctional facilities, and freestanding counseling and testing clinics (Centers for Disease Control and Prevention, 1999).	CDC database describing newly-diagnosed cases of AIDS.
Coverage	SAMHSA estimates that the 1997 TEDS database described 87% of all admissions to facilities participating in TEDS and 67% of admissions to all treatment programs nationwide (Substance Abuse and Mental Health Services Administration, 2004).	No coverage estimates are available.	85% of all AIDS cases are eventually reported in most areas (U.S. Department of Health and Human Services, 2000).

of injectors (Friedman et al., 2004; Turner et al., 1998; Wright and Gfroerer, 1997). The adjusted nationwide figure was then apportioned to each of the 93 MSAs studied using data on national and MSA-specific patterns of utilization of IDU-related services and past MSA-specific IDU estimates (Friedman et al., 2004).

Stage 3: We calculated the number of Black injectors in each MSA by multiplying the proportion of injectors in the MSA who were Black (from Stage 1) by the estimated number of past-year injectors in that MSA (from Stage 2). Race-specific IDU prevalence estimates were then calculated by dividing the number of Black

injectors in each MSA by the total number of Black adults aged 19–65 in that MSA in 1998 obtained from the US Census.

Stage 4: We investigated our estimates' validity by correlating them with two theoretically related variables, the prevalences of heroin and cocaine overdose fatalities (calculated using the CDC's Multiple Cause of Death database) and of injection-related AIDS among Black adults (calculated using APID). Because the prevalences of IDU, overdose mortality, and AIDS among Black adults were each highly correlated with the region of the country in which the MSA was located and the MSA population size and racial composition, we used partial correlation methods to validate our prevalence estimates that controlled these factors. Recognizing possible circularities inherent in analyzing the relationship between IDU prevalence (calculated using APID data) and the prevalence of IDU-related AIDS, we examined the relationship between the prevalence of injection-related AIDS and IDU prevalence calculated both with and without APID data.

Potential Confounders: Past literature suggests that MSA population size, racial/ethnic composition (percent Black and percent White), and geographic region might confound the relationship between segregation and Black IDU prevalence (Friedman et al., 2004; Massey and Denton, 1993). MSAs are nested within regions; dummy variables for these regions were included in the model as fixed effects that serve as proxies for all characteristics that vary across these regions. All of these variables were calculated using 1990 Census data.

Analysis

Multiple linear regression methods were used to test our hypotheses. To insure that our data met our model's assumptions, and to gain a comprehensive understanding of key variables' distributions and inter-relationships, we conducted extensive exploratory data analysis and regression diagnostics (Fox, 1991; Hartwig and Dearing, 1979). Because the distributions of Black IDU prevalence and population size were skewed, they were transformed using a natural log function. Observations that had undue influence in the multiple regression analysis, assessed using the DFFITS test, were re-weighted (Fox, 1991). An examination of variance inflation factors (VIF) in the multiple regression model indicated that the two segregation measures were not collinear and thus could be simultaneously included in the model (Fox, 1991). The percent of MSA residents who were Black was, however, collinear with the isolation index (VIF = 3.5) in this model, a relationship rooted in the index's incorporation of MSA racial composition (Table 9.1) (Massey and Denton. 1988). The variable denoting the percent of MSA residents who were Black was therefore dropped from the main analysis to increase the point estimates' precision (Fox, 1991). To investigate the extent to which the observed relationship between isolation and Black IDU prevalence was an artifact of MSA racial composition, we ran a second regression model that incorporated the variable percent Black and compared the magnitude of the relationship of isolation to IDU prevalence across the two regression models.

Results

Our IDU prevalence estimates indicate that, in half of the MSAs studied, there were 1983 injectors or more per 100,000 Black adults (Table 9.3). IDU prevalence among Black adults ranged considerably (interquartile range = 1422/100,000–2758/ 100,000; see Fig. 9.1). The validation analysis indicated that these IDU prevalence estimates were positively and significantly associated with the prevalences of over-dose deaths ($R = 0.31$, $p = 0.003$) and injection-related AIDS among Black adults ($R = 0.49$, $p < 0.001$); the latter correlation persisted when IDU prevalence estimates were re-calculated without APID data ($R = 0.47$, $p < 0.0001$).

The median adult population size in the 93 MSAs studied was over 720,000 and the median percent of the total MSA population who self-identified as Black was 9% (Table 9.3). Parallel to other research on US MSAs (Massey and Denton, 1993), values were high on both segregation measures. In 47 of the 93 MSAs studied, the isolation index indicated that the average Black adult or child lived in a census tract in which at least 48% of the tract population was Black (Table 9.3; note that this is lower than published values of the isolation index for 1990 calculated using 1990, rather than 1998, MSA boundaries [Massey and Denton, 1993]). In 50% of the MSAs sampled, the RCI was ≥ 0.72, exceeding the 0.60 cutpoint. Massey and colleagues use to identify high levels of segregation in this dimension (Massey, White, and Phua, 1996).

Bivariate regression analyses indicated that the isolation index was not associated with the natural log of IDU prevalence among Black adults (Table 9.4). However, once we controlled for MSA sociodemographic characteristics and region, particularly the West where isolation was low and Black IDU prevalence high (Tardiff, Gross, and Wu, 1989),[11] a positive relationship between the isolation index and

Table 9.3 Sociodemographic characteristics, geographic distribution, and prevalence of Injection Drug Use (IDU) among black residents of 93 large US Metropolitan Statistical Area (MSA) residents

MSA characteristic	Descriptive statistics (N=93)
Adult population size, 1990 (median, range)	$720,975$ ($256, 123 - 5, 684, 204$)
Racial/Ethnic Composition, 1990 (median, range)	
% White, Non-Hispanic	79.00 ($25.58 - 97.95$)
% Black, Non-Hispanic	9.28 ($0.90 - 40.59$)
Region (number of MSAs in each region)	24
Northeast	21
South	21
Midwest	27
West	
Isolation index, 1990 (median, range)	0.48 ($0.05 - 0.84$)
Relative concentration index, 1990 (median, range)	0.72 ($-1.02 - 0.94$)
IDU Prevalence among Black adults age 19 through 65 (per 100,000), 1998 (median, interquartile range)	$1,983.43$ ($1, 421.56 - 2, 758.59$)

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[11] Statistical tests indicate that region is a suppressor variable, that is, its inclusion in the model allowed the isolation index to explain more of the variance in the dependent variable.
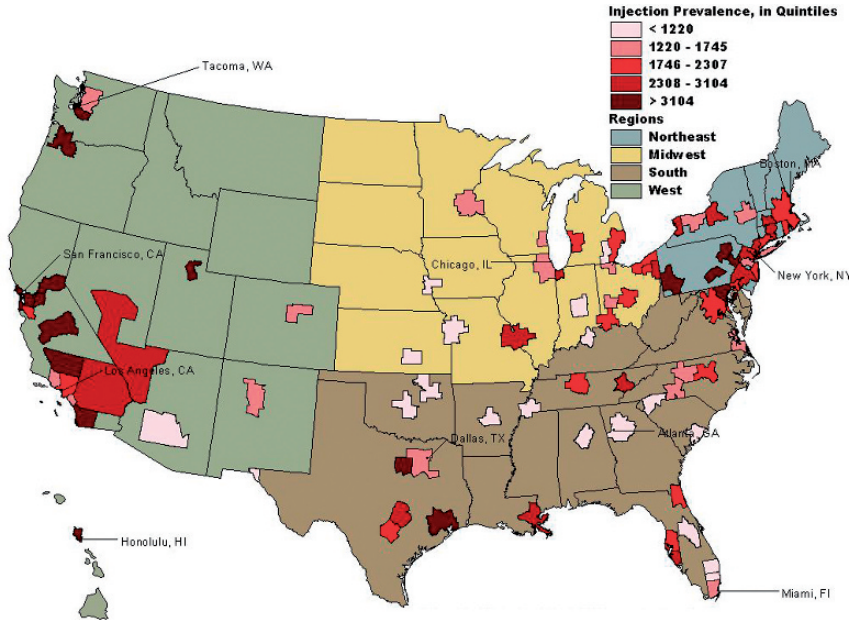
Fig. 9.1 Prevalence of injection drug use per 100,000 Black adult residents of large US metropolitan statistical areas in 1998 (See also Plate 13 in the Colour Plate Section)

the natural log of IDU prevalence among Black adults emerged (Table 9.4). By exponentiating the regression equation, we find that an increase of 0.50 in the isolation index was associated with a 23% increase in the (unlogged) IDU prevalence among Black adults. Adding percent Black to the model only slightly altered the magnitude of the relationship between isolation and the natural log of IDU

Table 9.4 Bivariate and multiple linear regression of two segregation dimensions on the natural log of the prevalence of injection drug use among black adult residents in 93 large US Metropolitan Statistical Areas (MSAs)

Covariates	Unadjusted coefficient (SE)	Adjusted coefficient (SE)
Intercept	N/A	3.72 (0.55)***
Natural log of the adult population size	0.08 (0.10)	-0.12 (0.09)
% Population Non-Hispanic White	-0.003 (0.002)	0.002 (0.002)
Region (reference category: Northeast)		
South	-0.35 (0.07)***	-0.33 (0.07)***
Midwest	-0.26 (0.07)**	-0.29 (0.07)***
West	0.03 (0.07)	0.15 (0.08)
Isolation index	-0.26 (0.15)	0.41 (0.20)*
Relative concentration index	0.05 (0.08)	0.07 (0.08)

$^*p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.0001$

prevalence, from $b = 0.41$ to $b = 0.43$, suggesting that the relationship between isolation and IDU prevalence was not an artifact of MSA racial composition. There was no relationship between the RCI and the log of Black IDU prevalence in bivariate or multivariate analyses. The model accounted for 31% of the outcome's variation in these MSAs.

Discussion

MSAs with higher levels of Black residential isolation in 1990 had a higher prevalence of IDU among Black adults in 1998 than other MSAs. It is noteworthy, however, that concentration was not associated with IDU prevalence. These divergent relationships testify to the distinct association each segregation dimension has with particular health outcomes and, more specifically, lend support to the proposition that residential isolation may be the segregation dimension that holds particular significance for health (Subramanian, Acevedo-Garcia, and Osypuk, 2005; Collins and Williams, 1999; Acevedo-Garcia et al., 2003; Acevedo-Garcia, 2000; Acevedo-Garica and Lochner, 2003).

There are multiple pathways through which Black residential isolation could be linked to IDU prevalence among Black adults in MSAs. In contrast to concentrated Black census tracts, which are primarily characterized by elevated poverty rates, isolated Black tracts tend to be associated with multiple indicators of social and material disadvantage, including poverty, unemployment, and violence (Peterson and Krivo, 1993; Denton, 1994; Galster and Mikelsons, 1995). Each of these characteristics, alone or in combination, could create vulnerability to IDU. Exposure to community violence creates a risk of illicit drug use (including heroin and cocaine use), perhaps because witnesses or victims of violence use drugs to manage subsequent depression, fear, and anxiety (Vermeiren, 2003). Likewise, poverty may promote the transition to (and continuation of) injecting among active drug users because IDU is a more efficient drug administration method than sniffing or snorting (Neaigus et al., 2001). Moreover, evidence suggests that injectable drugs are more overtly available in disadvantaged neighborhoods than they are elsewhere (Crum, Lillie-Blanton, and Anthony, 1996).

Another interpretation of our findings is also possible. Isolated Black census tracts may protect against IDU by creating a place where Black residents encounter, daily, organizations fostering a positive Black identity; endure little White-initiated interpersonal discrimination; and seek and offer solace and racial solidarity in the face of racial inequality and discrimination. The absence of these protections may create vulnerability to IDU among Black individuals living outside isolated Black census tracts (Yen et al., 1999; Martin, Tuch, and Roman, 2003; Bennet et al., 2005; Richman, Flaherty, and Rospenda, 1996; Landrine and Klonoff, 2000; Guthrie et al., 2002; Gibbons et al., 2004; Caldwell et al., 2004), though this risk may be offset by the greater access these individuals tend to have to socioeconomic resources and reduced exposure to violence (Jones-Webb et al., 1997).

Further research is needed to elucidate the pathways through which elevated isolation is associated with IDU prevalence and to determine, as we could not in this ecologic study of MSAs, whether the relationship is evident only among Black residents of isolated Black tracts, Black individuals residing outside such tracts, or both. Two additional avenues of research are also indicated. First, a positive relationship between residential isolation and IDU prevalence may exist in other racial/ethnic groups. Puerto Ricans, who appear to have the highest prevalence of cocaine use of all Latino groups (Amaro et al., 1990), are also the sole racial/ethnic group experiencing a level of isolation that approaches that of Black Americans (Massey and Denton, 1993). Research is needed to determine whether isolation promotes IDU among Puerto Ricans, and perhaps other racial/ethnic groups. Our findings also suggest an additional line of inquiry: studying the extent to which Black isolation shapes the distribution of IDU-related health problems across Black MSA populations by elevating the prevalence of IDU. This inquiry is particularly pressing given the high prevalence of overdose deaths and IDU-related AIDS borne by Black Americans (Tardiff, Gross, and Wu, 1989; Substance Abuse and Mental Health Services Administration, 2003; Harlow, 1990; Galea, Ahern, and Tardiff, 2003; Friedman et al., 1987; Friedman et al., 1988; Novick et al., 1989; Selik et al., 1989; Selik, Castro, and Pappaioanou, 1988; Centers for Disease Control and Prevention, 2001). Collectively, the results of this research could help injectors and their allies identify communities in need of drug-related health services, including drug treatment and syringe exchange programs.

Our findings must be understood in the light of their limitations, which lie principally in the study's ecological and cross-sectional design and measurement of IDU prevalence among Black adults. Because our unit of analysis was the MSA, we could not investigate the role of neighborhood- or individual-level factors, such as socioeconomic status, gender, and age, as confounders or modifiers of the relationship between MSA-level residential isolation (or concentration) and Black IDU prevalence (Diez-Roux, 2001, 1998). Multilevel research into these possibilities should address these limitations. Additionally, though we used a lagged cross-sectional design in which predictors pre-dated the outcome, the possibility of autocorrelation precludes assessing the causal direction of our findings. Our service-based method of calculating IDU prevalence leaves room for an alternative interpretation of our findings: while it is possible that residential isolation produces a higher prevalence of IDU, it is also possible that isolation results in a higher prevalence of health problems among injectors and thus greater use of drug-related services. Possibly, countering this bias, however, is the fact that isolated Black areas of segregated MSAs tend to be medically underserved (Institute of Medicine Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care, 2003), and CTS and TEDS capture individuals accessing routine or non-emergency health services.

We place our findings in the context of past research regarding racial inequality and discrimination and health. Our analysis suggests that IDU should be added to the growing list of the adverse health behaviors and outcomes among Black Americans that may be generated by racial inequality and discrimination (La Veist,

2002; Polednak, 1996). Further and more specifically, this analysis also adds a new dimension to the body of research documenting the relationship between inequitable and discriminatory racial relations and licit and illicit drug use and abuse. Investigators have concluded that Black adolescents and adults who report higher levels of interpersonal or everyday discrimination are more likely to report lifetime smoking, smoking more frequently, and engaging in problem drinking than other Black individuals (Yen et al., 1999; Martin, Tuch, and Roman, 2003; Bennet et al., 2005; Richman, Flaherty, and Rospenda, 1996; Landrine and Klonoff, 2000; Guthrie et al., 2002; Gibbons et al., 2004). Likewise, Black adults reporting higher levels of internalized racism also report consuming more alcohol than other Black adults (Taylor and Jackson, 1990). Our findings extend this body of research by concluding that structural, in addition to intra-psychic and interpersonal, manifestations of racial inequality and discrimination may adversely shape IDU rates among Black adults.

If substantiated by additional research, our finding that a structural factor is related to Black IDU prevalence may also hold consequence for US domestic drug policy. As noted earlier, the criminal justice system, which locates cause within the individual and calls it culpability, plays a major role in the US government's response to illicit drug use among Black Americans that dwarfs its role in addressing White drug use (Harrison and Beck, 2003; Drucker, 2002, 1999). If, as our research suggests, the cause of IDU among Black adult MSA residents lies partially in isolation, related prevention, and intervention efforts may also benefit from altering social structures – and, more broadly, from eradicating racial inequality and discrimination in the USA – rather than from arresting and incarcerating large numbers of Black individuals.