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Racial Residential Segregation and Risky Sexual Behavior Among Non-Hispanic Blacks, National Survey of Family Growth, 2006 – 2010

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Abstract

Sexually transmitted infections (STIs) including human immunodeficiency virus (HIV) have disproportionately affected the non-Hispanic black population in the United States. A person's community can affect his or her STI risk by the community's underlying prevalence of STIs, sexual networks, and social influences on individual behaviors. Racial residential segregation—the separation of racial groups in a residential context across physical environments—is a community factor that has been associated with negative health outcomes. The objective of this study was to examine if non-Hispanic blacks living in highly segregated areas were more likely to have risky sexual behavior. Demographic and sexual risk behavior data from non-Hispanic blacks aged 15 – 44 years participating in the National Survey of Family Growth were linked to Core-Based Statistical Area segregation data from the U.S. Census Bureau. Five dimensions measured racial residential segregation, each covering a different concept of spatial variation. Multilevel logistic regressions were performed to test the effect of each dimension on sexual risk behavior controlling for demographics and community poverty. Of the 3,643 participants, 588 (14.5%) reported risky sexual behavior as defined as two or more partners in the last 12 months and no consistent condom use. Multilevel analysis results show that racial residential segregation was associated with risky sexual behavior with the association being stronger for the centralization [aOR (95% CI)][2.07 (2.05 – 2.08)] and concentration [2.05 (2.03 – 2.07)] dimensions. This suggests risky sexual behavior is more strongly associated with neighborhoods with high

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concentrations of non-Hispanic blacks and an accumulation of non-Hispanic blacks in an urban core. Findings suggest racial residential segregation is associated with risky sexual behavior in non-Hispanic blacks 15 – 44 years of age with magnitudes varying by dimension. Incorporating additional contextual factors may lead to the development of interventions that promote healthier behaviors and lower rates of HIV and other STIs.

Keywords

Residential segregation; Sexual behavior; NSFG; Census; Non-Hispanic blacks

Introduction

An estimated 19 million new sexually transmitted infections (STIs) each year represent an estimated \$16.4 billion burden on the U.S. healthcare system (CDC, 2012). STIs can also lead to reproductive health issues, cancer, fetal health problems, and facilitate the transmission of human immunodeficiency virus (HIV) (Satterwhite et al., 2007). Sexually transmitted infections, including HIV, have disproportionately affected the non-Hispanic black community in the United States. The HIV incidence rate among non-Hispanic black males was 6.6 times higher than that among non-Hispanic white males in 2010 (103.6 vs. 15.8 per 100,000, respectively)(CDC, 2013a). That same year the HIV incidence rate among non-Hispanic black females was 20.1 times higher than that among non-Hispanic white females (38.1 vs. 1.9 per 100,000 per year, respectively)(CDC, 2013a). From 2007 – 2012, the chlamydia prevalence among non-Hispanic blacks was seven times the prevalence seen among non-Hispanic whites (Torrone, Papp, & Weinstock, 2014). In 2012, the chlamydia incidence rate among non-Hispanic black males was eight times the rate of non-Hispanic white males and six times higher among non-Hispanic black females compared with non-Hispanic white females (CDC, 2013b). From 1999 – 2008, the gonorrhea prevalence among non-Hispanic blacks was nearly five times the prevalence seen among other races (Torrone et al., 2013). In 2012, non-Hispanic black males had a gonorrhea incidence rate sixteen times higher than that of non-Hispanic white males; the non-Hispanic black females rate was fourteen times that of their non-Hispanic white counterparts (CDC, 2013b). In addition to racial disparities, females and younger age groups are disproportionately affected by STIs. Nearly half of all STI incident cases each year are attributable to individuals 15 – 24 years of age (Satterwhite et al., 2013). Similarly in 2012, non-Hispanic black females had chlamydia incidence rates that were twice as high as the rates for non-Hispanic black males (1,613.6 vs. 809.2 per 100,000)(CDC, 2013b).

These large disparities may be partially attributable to individual behavioral and/or community factors. An individual's risky sexual behavior can be defined as an act that increases an individual's risk of contracting or transmitting a sexually transmitted infection. Research has found concurrent partnerships to be more prevalent among non-Hispanic blacks compared to non-Hispanic whites (Adimora et al., 2013). Concurrent partnerships increase the speed of STI transmissions throughout a sexual network (Adimora & Schoenbach, 2005). 'Number of partners during the last 12 months' is an important measure of risky sexual behavior; it has been demonstrated that the more sexual partners an

individual has, the more likely they are to encounter an infected partner (Finer, Darroch, & Singh, 1999; Gerver et al., 2011). Lack of condom use is another important measure because an individual is not reducing their risk of STI transmission (Finer et al., 1999; Gerver et al., 2011).

Studies have found that individual risky behaviors alone do not fully account for the STI disparities (Hallfors, Iritani, Miller, & Bauer, 2007; Dariotis, Sifakis, Pleck, Astone, & Sonenstein, 2011). Community factors such as STI prevalence, poverty, male to female sex ratio, and racial residential segregation can affect an individual's risk of acquiring a sexually transmitted infection through several mechanisms (Adimora & Schoenbach, 2005). A low male-to-female sex ratio exists in many predominately non-Hispanic black communities, and this affects the structure and stability of sexual networks. Fewer males limit the power of women to choose monogamous relationships since males can more easily find another relationship than when the sex ratio is balanced (Adimora & Schoenbach, 2002; 2005). Previous research has found that a lack of males is associated with multiple partners within the last year (Pouget, Kershaw, Niccolai, Ickovics, & Blankenship, 2010). Along with unemployment, poverty is associated with a lower number of marriageable males that are financially stable enough to support a family (Adimora & Schoenbach, 2005). The importance of community measures becomes more evident as an individual with risky sexual behavior may not encounter an infected person if they reside in a low STI prevalence community. Conversely, communities with a high STI prevalence create more opportunities for an individual to come into contact with an infected individual via an increased number of infected persons in their sexual network.

Hallfors et al. (2007) found that non-Hispanic blacks are at an elevated STI risk regardless of whether sexual behaviors are risky or not. This implies that within the non-Hispanic black community neighborhood-level factors, in addition to individual behavior, may be more useful to account for racial disparities. The residential environment may operate through pathways such as concentrated poverty, low sex ratio, and STI prevalence (Adimora & Schoenbach, 2005). Residential stability was associated with STD risk (Upchurch, Mason, Kusunoki, & Kriechbaum, 2004) and sexual initiation (Cubbin, Santelli, Brindis, & Braveman, 2005). However, Browning, Leventhal, & Brooks-Gunn (2004) found that residential stability was not significantly associated with sexual initiation. Previous research has also associated two or more partners with neighborhood structural inequality (Browning, Burrington, Leventhal, & Brooks-Gunn, 2008) as well as sex ratio and male incarceration rates (Pouget et al., 2010). These factors measure different aspects of the neighborhood environment. The use of racial residential segregation may provide a more complete depiction of the neighborhood through its associations with physical, economic, and social factors.

Racial residential segregation—the separation of racial groups in a residential context across spatial environments—is a ubiquitous pattern seen in the U.S. population and is considered a primary cause of racial disparities (Williams & Collins, 2001). Non-Hispanic blacks are the racial group most likely to experience high levels of racial residential segregation (Massey, White, & Phua, 1996) with two thirds of non-Hispanic blacks residing in highly segregated areas (Williams & Collins, 2001). Previous research has associated residential segregation

with negative non-Hispanic black health outcomes (Subramanian, Acevedo-Garcia, & Osypuk, 2005; Bell, Zimmerman, Almgren, Mayer, & Huebner, 2006; Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003; Collins & Williams, 1999). However, the consequences of residential segregation for non-Hispanic whites and Hispanics are not well understood or uniform (Collins & Williams, 1999; Lee & Ferraro, 2007). Evidence suggests high levels of residential segregation may be beneficial to non-Hispanic whites by isolating them from adverse conditions experienced by non-Hispanic blacks in segregated areas (Chang, 2006) and to Hispanics through higher levels of social resources (Lee & Ferraro, 2007). For these reasons, along with the disproportionate STI rates seen in the non-Hispanic black community, non-Hispanic blacks are the focus of this study.

Racial residential segregation is thought to impact risky behavior through direct and indirect pathways. Five distinct dimensions measure racial residential segregation: unevenness, exposure, concentration, centralization, and clustering. Directly, the clustering, concentration and exposure dimensions increase the density and level of contact of non-Hispanic blacks to only other non-Hispanic blacks, increasing transmission risks (Poundstone, et al., 2004). The unevenness dimension is typically included in segregation and health literature for comparability since it is the most often used dimension despite the relationship with health not being as clear as it is for the other dimensions. Indirect pathways through which segregation operates include concentrated poverty (Polednak, 1997), overcrowding, housing deterioration, limited access to care, and social disorganization (Acevedo-Garcia, 2000). Concentrated poverty is associated with the loss of resources out of a neighborhood (Massey & Denton, 1993) resulting in the deterioration of neighborhood quality. These resources include quality medical care (Walker et al., 2011), quality education (Acevedo-Garcia, Osypuk, McArdle & Williams, 2008), and employment opportunities (Poundstone et al., 2004). The loss of quality medical care hinders access to and quality of preventive services (Kim, Samson, & Lu, 2010). The loss of quality educational opportunities may limit access to STI prevention courses generally received in schools. The lack of employment opportunities may impact the number of marriageable males, which is associated with partner instability, which is associated with partner concurrency as well as other risky sexual behaviors (Adimora & Schoenbach, 2002; 2005; Pouget et al., 2010). The centralization dimension measures how likely non-Hispanic blacks are to reside in the central city, which is typically the oldest and most deteriorated portion of a metropolitan area (Acevedo-Garcia, 2000). Deteriorated neighborhoods have been associated with negative health behaviors and outcomes such as mortality and gonorrhea rates, possibly due to the lack of a safe environment or suitable health care facilities (Cohen et al., 2003). Social disorganization is thought to encourage behaviors such as drug use (Furstenberg & Hugues, 1997), which has been associated with engaging in risky sexual behaviors (Cooper, Friedman, Tempalski, & Friedman, 2007). Through these direct and indirect pathways, residential segregation may create differential access to economic, educational, and employment resources and exposures to negative environments for non-Hispanic blacks (Polednak, 1997).

Our objective was to examine the association between racial residential segregation and risky sexual behavior for non-Hispanic blacks 15 – 44 years of age using a nationally representative sample. This study hypothesized that risky sexual behavior would be more

strongly associated with people residing in highly segregated areas compared with those residing in non-segregated areas. In addition, from our evaluation of the literature as well as the epidemiologic burden observed, we explored age and gender differences through stratification. We hypothesized that the effects of racial residential segregation would be stronger for younger adults and females due to differences observed in age and gender STI patterns.

Methods

This study uses individual-level demographic and sexual risk behavior data from the National Survey of Family Growth (NSFG) and data on racial residential segregation and community poverty from the United States (U.S.) Census Bureau. The NSFG is administered by the National Center for Health Statistics (NCHS) and is a continuous health survey of men and women between 15 – 44 years of age living in U.S. households. The 2006 – 2010 survey completed a nationally representative sample from 110 primary sampling units (PSUs) generating 22,682 completed interviews resulting in a final sample size of 3,643 non-Hispanic blacks. PSUs are counties or groups of adjoining counties that represent the eight largest metropolitan areas in the United States (each year) as well as 25 smaller metropolitan and nonmetropolitan areas that change each survey year (Lepkowski, Mosher, Davis, Groves, & Van Hoewyk, 2010). Racial residential segregation indices and poverty values were calculated for core-based statistical areas (CBSAs) by the U.S. Census Bureau, using 2010 data for segregation and 2006 – 2010 data for poverty. “CBSA” is a collective term for both metropolitan and micropolitan statistical areas. Metropolitan and micropolitan areas are composed of at least one urban core with a population of at least 50,000 (metro) or a population between 10,000 and 50,000 (micro) and the surrounding areas that are socioeconomically connected with that urban core.

The variable, CBSA, was used to merge NSFG individual data and U.S. Census Bureau community data. CBSA is a restricted variable; therefore, these data were accessed through the NCHS Research Data Center. To limit disclosure risk, the Research Data Center did not provide the researchers the identity of the specific CBSAs. NSFG participants who did not reside in a CBSA were excluded from the study.

Risky Sexual Behavior

Risky sexual behavior was measured in three ways: “number of partners in the last 12 months,” “condom use at last sex,” and a composite measure composed of these two. Based on previous literature, “number of partners in the last 12 months” was a dichotomous variable composed of “0 or 1 partner” or “2 or more partners” (Kalichman, Cain, & Simbayi, 2011). Individuals with “two or more partners in the last 12 months” were considered engaging in risky sexual behavior. “Condom use at last sex” was also a dichotomous variable. Responses for condom use were “yes” or “no” with responses of “no” considered engaging in risky sexual behavior. Used alone, “condom use at last sex” does not account for the relationship status of the individual. Anderson et al. (1999) and Anderson (2003) found that unmarried adults were more likely to have used a condom at last sex than married adults. To account for relationship status, a composite measure of risky sexual

behavior was created combining the preceding two variables. Risky sexual behavior was henceforth defined as having 2 or more partners in the last 12 months and no condom use at last sex.

Residential Segregation

CBSA was chosen as the area of interest because previous research has shown that CBSAs approximate the housing markets (Wilkes & Iceland, 2004), which allows the measurement of segregation at a level where an individual has strong economic and social connections. In addition, selection into neighborhoods is an important factor when examining geographic health associations and can be accounted for by using CBSA-level segregation indices (Oakes, 2004). When measuring residential segregation, there is the area of interest (CBSA) and its component areas, termed units of analysis. Census tracts are the most commonly used unit of analysis for census-based segregation studies (Wilkes & Iceland, 2004) and residential segregation studies (Fabio, Sauber-Schatz, Barbour, & Li, 2009). Census tracts are used as proxies for neighborhoods within a CBSA (Bell et al., 2006). To calculate CBSA segregation, the minority and majority population and sometimes land area values are needed for the census tracts and CBSA overall. Iceland, Weinberg, and Steinmetz (2002) provide excellent technical and visual descriptions of the formulas for each segregation index (p.119–123).

We chose to measure residential segregation using Massey & Denton (1988) census-tract derived indices instead of spatial or surface-density derived measures used by Wong (1993) and Kramer, Cooper, Drews-Botsch, Waller, & Hogue (2010). An advantage of using spatial and surface-density measures is that they do not rely on the arbitrary boundaries of the census tract, which assumes homogeneity within its boundaries; they instead use distance-based or egocentric measures to depict an individual's neighborhood. Despite the strength of spatial measures of segregation we chose census-tract derived measures due to their high correlation with surface-density measures in highly populated metropolitan areas (Kramer et al., 2010), to preserve comparability with the literature, and to use standardized U.S. Census Bureau measures. There are several dimensions of racial residential segregation, and an index for each dimension was chosen based on previous research by Massey & Denton (1988) (Table 1). The index of dissimilarity, a measure of evenness, measures the percentage of non-Hispanic blacks that must change residence for the neighborhood to have the same racial composition as the overall CBSA (Massey & Denton, 1988). The isolation index, a measure of exposure, measures the level of exposure of non-Hispanic blacks to only other non-Hispanic blacks (Massey & Denton, 1988). The relative concentration index measures the amount of physical space taken by non-Hispanic blacks in a CBSA relative to the amount of physical space occupied by non-Hispanic whites (Massey & Denton, 1988). The resulting value is then compared to the ratio that would exist if non-Hispanic blacks were maximally concentrated and non-Hispanic whites were maximally scattered. The absolute centralization index measures the degree to which non-Hispanic blacks are distributed around the CBSA center compared to outlying areas (Massey & Denton, 1988). The spatial proximity index, a measure of clustering, measures the degree to which non-Hispanic black neighborhoods cluster with one another. (For a detailed description of the segregation indices and their formulas, refer to Iceland, Weinberg, & Steinmentz (2002)).

This study also examines hypersegregation, a dichotomous (hypersegregated or not) variable that measures segregation across multiple dimensions. Residential segregation indices with values greater than or equal to 0.60 are considered highly segregated. A CBSA is considered hypersegregated if it is highly segregated on at least four of the five dimensions (Massey et al., 1996). Non-Hispanic blacks are the only racial group to experience widespread hypersegregation in the U.S. (Acevedo-Garcia et al., 2003), and it is noted that being highly segregated across multiple dimensions increases the negative influences of segregation.

Individual-level variables

Individual-level variables were age, gender, marital status, educational attainment, and income. Age was grouped as 15 – 24, 25 – 34, and 35 – 44 years; marital status was grouped as married/cohabitating or not married/not cohabitating; and income was grouped as “less than \$15,000,” “\$15,000 – \$34,999,” “\$35,000 – \$74,999,” and “\$75,000 or more” per year. Educational attainment was measured as “no high school diploma and in school,” “no high school diploma and not in school,” “high school diploma,” “some college,” and “college degree.”

CBSA-level variables

This study has two CBSA-level measures: racial residential segregation and poverty. Racial residential segregation index values are measured as “less than 0.60” and “greater than or equal to 0.60” (Massey et al., 1996; Biello et al., 2012). Poverty is the second community-level measure and is measured as the percentage of a CBSA with a family income below the poverty level. Poverty has four levels: “less than 6.9%,” “between 6.9% and 8.9%,” “between 9.0% and 11.9%,” and “12.0% or more.” The described poverty levels represent quartiles of the poverty distribution.

Analysis

Bivariate analyses were conducted using the Rao-Scott F-adjusted chi square test statistic to identify statistically significant variables ($p < 0.05$). We performed multilevel logistic regression models using PROC GLIMMIX to examine associations between risky sexual behavior (level 1) and CBSA-level segregation (level 2). The first model separately examined the association of each racial residential segregation measure and risky sexual behavior, generating crude odds ratios (ORs). The second model examined the association of risky sexual behavior and individual-level variables alone. The third model examined the adjusted association of racial residential segregation and risky sexual behavior with individual-level variables included. The first, second, and third models are not shown in tables. Likelihood ratio tests were conducted to assess the best-fit model. The final model examined the association of racial residential segregation and risky sexual behavior with the inclusion of individual-level variables and community poverty. The final model was computed six times, once with each segregation index. In addition, the final model was computed separately as age- and gender-specific models for each racial residential segregation index. NSFG analyses require use of weighting, stratification, and clustering variables due to the complex sampling system. Statistical analyses were conducted using SAS software, Version 9.3 (Cary, NC, USA).

Results

The final sample included 3,643 non-Hispanic blacks 15 – 44 years of age from 2006 – 2010. Descriptive characteristics of participants stratified by risky sexual behavior status are presented in Table 2. A greater proportion of respondents who were younger than 35 years of age, were male, only had a high school diploma, and were not married or cohabitating reported risky sexual behavior (two or more partners within last 12 months and no condom use at last sex) compared to other respondents. Income and CBSA poverty did not have a significant association with risky sexual behavior but were included in the models because of the importance of income and poverty when examining racial residential segregation.

The multilevel logistic regression models in Table 3 were conducted for each segregation index for the risky sexual behavior variable. After adjusting for age, gender, educational attainment, marital status, income, and CBSA poverty, overall racial residential segregation was associated with risky sexual behavior for all indices except hypersegregation, which was protective. Relative concentration and absolute centralization were most strongly associated with risky sexual behavior [adjusted odds ratio (aOR) (95% CI)][2.05 (2.03 – 2.07)] and [2.07 (2.05 – 2.08)] respectively. Non-Hispanic blacks most likely to engage in risky sexual behavior were male, 25 – 34 years of age, with a high school diploma, and not married or cohabitating [Not shown in tables].

Age group stratification

Logistic regression analyses were stratified by age with adjusted associations displayed in Table 3. Counter to our hypothesis, the association of racial residential segregation and risky sexual behavior was not stronger among the 15 – 24 year-old age group. No consistent pattern was present for the residential segregation and risky sexual behavior association. In the 15 – 24 year-old age group, isolation, centralization, and spatial proximity indices were associated with risky sexual behavior. In the 25 – 34 year-old age group, dissimilarity, centralization, and concentration indices were associated with risky sexual behavior. All indices except dissimilarity were associated with risky sexual behavior among the 35 – 44 year-old age group. Hypersegregation was associated with risky sexual behavior only among the 35 – 44 year-old age group.

Gender stratification

Stratifying by gender, the adjusted association between risky sexual behavior and racial residential segregation was stronger for females than males (Table 3). This result is consistent with our hypothesis, but does differ from the bivariate association presented in Table 2. The centralization and concentration indices were associated with risky sexual behavior for both males and females. For the dissimilarity, isolation, and hypersegregation indices, the aORs indicate that racial residential segregation was more strongly associated with risky sexual behavior for females. For the spatial proximity index, the aORs indicate that racial residential segregation was more strongly associated with risky sexual behavior for males. Figure 1 displays the gender-stratified aORs in comparison with overall aORs for risky sexual behavior.

Discussion

There are four main findings of this study. First, racial residential segregation, as measured by all indices except hypersegregation, is associated with risky sexual behavior while controlling for CBSA-level poverty. Second, racial residential segregation is most strongly associated with risky sexual behavior when measured by the centralization and concentration indices. Third, the association between risky sexual behavior and racial residential segregation does not vary by age group in a consistent way. Fourth, risky sexual behavior is more strongly associated with racial residential segregation for females than males.

The finding that high levels of racial residential segregation are associated with risky sexual behavior supports our main hypothesis. Higher levels of racial residential segregation are known to concentrate economic, educational, health, and other social disadvantages, which can influence negative health behaviors through elevated risks (Acevedo-Garcia et al., 2003; Adimora & Schoenbach, 2005; Adimora, Schoenbach, & Floris-Moore, 2009; Biello et al., 2012; Kramer & Hogue, 2009; Poundstone et al., 2004; Williams & Collins, 2001). Previous research has also shown various community measures such as low sex ratio (Adimora, & Schoenbach, 2005; Adimora et al., 2013; Pouget et al., 2010), incarceration rates (Pouget et al., 2010), low collective efficacy (Browning et al., 2004; Browning et al., 2008), discrimination (Adimora & Schoenbach, 2005), and social disorganization (Cubbin et al., 2005) to be associated with risky health behaviors. Despite different measures of neighborhood context, our results are in agreement with previous literature examining neighborhood context and risky health behaviors. It is worth noting the majority of variables were significantly associated with risky sexual behavior as seen in tables 2 and 3. That may be partially related to the large sample size, resulting in the ability to detect small differences.

Additionally, absolute centralization and relative concentration were more strongly associated with risky sexual behavior than the dissimilarity and isolation indices. The stronger associations for absolute centralization and relative concentration suggest that they may, in concert, influence risky sexual behavior by a high density of non-Hispanic blacks in an urban core. High centralization places non-Hispanic blacks into typically deteriorated high crime inner city neighborhoods (Acevedo-Garcia, 2000), which impact incarceration rates and sex ratio, leading to partner instability (Adimora & Schoenbach, 2005). High concentration creates densely populated non-Hispanic black neighborhoods that yield higher STI transmission rates due to sexual network constraints (Adimora & Schoenbach, 2005; Biello et al., 2012). The dissimilarity index has the least conceptually clear relevance for health outcomes and is not as strongly associated with neighborhood environment (Acevedo-Garcia et al., 2003) as other indices. The dissimilarity index is typically used due to its ease of computation and historical comparability (Massey, 2012). The isolation index may be more conceptually relevant for segregation studies with infectious disease outcomes as it measures the amount of contact non-Hispanic blacks have to other non-Hispanic blacks (Acevedo-Garcia, 2000). Previous research has associated high gonorrhea rates with high isolation (Thomas & Gaffield, 2003; Biello et al., 2012). These findings suggest that certain dimensions of segregation are more highly related to risky sexual behavior. They also

indicate the importance of analyzing multiple dimensions of segregation when examining the role of segregation on health outcomes. Interventions focused on reducing the incidence of non-Hispanic black risky sexual behavior may locate at-risk populations by seeking highly centralized and concentrated populations. These highly centralized and concentrated non-Hispanic black populations are quite common since the majority of non-Hispanic blacks reside in segregated areas. For example, the non-Hispanic black population in major metropolitan areas such as Baltimore, Cincinnati, and St. Louis are highly centralized and concentrated (U.S. Census Bureau, 2012a). Additional research should focus on examining prevention strategies such as increased STI education for adolescents as well as methods to combat partner instability in these areas that may lower the incidence of risky sexual behavior.

Adjusted analyses showed risky sexual behavior was not most strongly associated with racial residential segregation for younger adults. Another factor such as peer influence may be an influential factor as it has been associated with negative outcomes in adolescents (Buhi & Goodson, 2007; DiIorio et al., 2001). Different levels of risk may exist within wider age groups, affecting the risk of the overall age group. When examining younger populations, previous research has chosen smaller age groupings such as 15 – 19 and 20 – 24 (Liddon, Leichliter, & Markowitz, 2012; Tyler et al., 2014). We attempted to use 5-year age groups, but small cell size issues forced us to create the larger age groups. For future research, the use of smaller age groupings would allow one to examine the differences between a 16 and a 22 year old, for example. This is important as an individual attending high school is in a much different place in their life compared to an individual who is considered an emerging adult (Arnett, 2000; Lam & Lefkowitz, 2013). An emerging adult refers to late adolescents, college students, and young professionals, groups that carry a significant STI burden. Emerging adults are also known to engage in risky behaviors, possibly to gain experiences before engaging normal adult responsibilities (Lam & Lefkowitz, 2013). In addition, examining measures of peer influence in young adults and adolescents, as well as delving deeper into the emerging adults may provide a more accurate assessment of risky sexual behavior.

Adjusted analyses showed risky sexual behavior was more strongly associated with racial residential segregation for females than males. Females and males residing in the same CBSA may experience the same level of racial residential segregation, but there are likely contextual factors associated with racial residential segregation that affect females more than males. Adimora and Schoenbach (2005) suggest that discrimination, sex ratio, and incarceration rates are contextual factors likely to impact sexual behavior, which have also been associated with racial residential segregation (Kramer & Hogue, 2009; Russell et al., 2012). A low male-to-female sex ratio negatively impacts sexual network STI transmission (Adimora, Schoenbach, & Doherty, 2006) and supports concurrent partnerships (Adimora et al., 2013; Poundstone et al., 2004).

Limitations

One limitation of this study is the National Survey of Family Growth (NSFG) relies on individual self-report data. Self-reported data may introduce accuracy issues as individuals

are asked to recall their sexual history over the last 12 months (number of partners) and whether they used a condom the last time they had sex. Previous research has used 'number of partners within the last three months' (Mustanski, Andrews, Herrick, Stall, & Schnarrs, 2014) and other research called shorter recall periods more reliable (Napper, Fisher, Reynolds, & Johnson, 2010). A recommendation is to use datasets that ask individuals to recall their sexual history over a shorter time period.

A second limitation is there was low CBSA variability; large portions of the 4,000 individuals were sampled from a small number of CBSAs. This was particularly a problem in the analyses using the spatial proximity index. Only 3.3% (n=131) of non-Hispanic blacks reside in highly segregated CBSAs using the spatial proximity index, those individuals likely resided in the same few CBSAs. The low variability negatively impacts the validity of the spatial proximity measure and can also lead to high population CBSAs being the driving force behind the segregation and poverty information.

A third limitation is we do not know the degree of racial residential segregation to which each participant was exposed. Each participant resided in a CBSA and was associated with a specific level of racial residential segregation. In most instances, CBSAs contain areas that are more and less segregated than the CBSA overall. Therefore, the racial residential segregation to which a participant was exposed may be higher or lower than the level of racial residential segregation for the CBSA overall. The geographic positioning of these differentially segregated areas within the CBSA is in part what differentiates between the dimensions of segregation.

Lastly, individual and community factors both affect the likelihood that an individual will become infected. However, residence in a low STI prevalence community may make risky sexual behavior less likely to result in STI transmission than risky sexual behavior in a high STI prevalence community. The STI prevalence of a community partnered with the behavioral choices of an individual affect whether an individual encounters an infected individual and subsequently becomes infected. We were not able to incorporate community STI prevalence. In the future, incorporating a community factor such as STI prevalence can only strengthen the study.

Conclusion

Our findings suggest racial residential segregation is associated with risky sexual behavior in non-Hispanic blacks 15 – 44 years of age. The magnitudes of the associations vary by racial segregation index used, but were strongest for the absolute centralization and relative concentration indices. This suggests non-Hispanic blacks residing in urban areas, as opposed to suburban areas, and non-Hispanic blacks residing in areas with a high density of non-Hispanic blacks are at higher risk of engaging in risky sexual behavior. While some U.S. cities have experienced changes in non-Hispanic black residential segregation, the largest U.S. metropolitan areas remain highly segregated (U.S. Census Bureau, 2012b). The data show non-Hispanic black residential segregation is still present at high levels across multiple dimensions. It is important to investigate the mechanisms of how racial residential segregation may lead to risky sexual behaviors. A better understanding of mechanisms such as peer influence, crowding, and incarceration rates may lead to the development of

interventions that promote healthier environments and behaviors and, in turn, lower rates of HIV and STIs in affected populations.

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- We examine the association of residential segregation and risky sexual behavior.
- Multilevel regressions used to explore individual and community-level factors.
- Segregation measured by indices for each of five different dimensions.
- Centralization and concentration indices associated with risky sexual behavior.

Figure 1.

Adjusted odds ratios[†] for risky sexual behavior for non-Hispanic blacks, overall and gender-stratified, National Survey of Family Growth, 2006 – 2010 (n=3,643)

[†]Overall models adjusted for age group, gender, educational attainment, marital status, income, and CBSA Poverty

**Adjusted odds ratios for risky sexual behavior modeled using each segregation index, separately

Table 1

Description of Residential Segregation Indices with Accompanying Dimensions

Index	Dimension	Range	Description
Dissimilarity	Evenness	0.00 – 1.00	0.0 = maximal integration 1.0 = maximal segregation of non-Hispanic blacks from non-Hispanic whites
Isolation	Exposure	0.00 – 1.00	0.0 = non-Hispanic are most likely to only encounter non-Hispanic whites 1.0 = non-Hispanic blacks are most likely to only encounter other non-Hispanic blacks
Absolute Centralization	Centralization	–1.00 – 1.00	–1.00 = non-Hispanic blacks reside only in outlying areas 0.00 = non-Hispanic blacks reside equally in the CBSA center and outlying areas 1.00 = non-Hispanic blacks reside only in the CBSA center
Relative Concentration	Concentration	–1.00 – 1.00	–1.00 = non-Hispanic whites are maximally concentrated 0.00 = non-Hispanic blacks and non-Hispanic whites are equally concentrated 1.00 = non-Hispanic blacks are maximally concentrated
Spatial Proximity	Clustering	Any real value	1.00 = no differential clustering between non-Hispanic blacks and non-Hispanic whites –Values greater than 1.00 indicate non-Hispanic black neighborhoods are closer to each other than non-Hispanic white neighborhoods –Values less than 1.00 indicate non-Hispanic black neighborhoods are closer to non-Hispanic white neighborhoods

Source: Massey Denton, 1988

Table 2

Descriptive characteristics for non-Hispanic black National Survey of Family Growth participants (2006 – 2010) by risky sexual behavior status (n=3,643)

	Risky Sexual Behavior		
Characteristics	Two or more partners within last 12 months and no condom use at last sex (n=588; 14.5%)	All else (n=3,055; 85.5%)	P-value
Age group			
15 – 24 years	210 (36.8)	991 (30.3)	0.0032
25 – 34 years	234 (37.6)	1,077 (33.0)	
35 – 44 years	144 (25.6)	987 (36.7)	
Gender			
Female	317 (45.9)	1,829 (55.4)	0.0027
Male	271 (54.1)	1,226 (44.6)	
Educational Attainment			
No HS dip#/in school	30 (4.4)	249 (6.9)	0.0194
No HS dip/out of school	133 (22.5)	608 (19.8)	
HS diploma	214 (36.6)	961 (30.2)	
Some college	118 (22.0)	636 (21.5)	
College degree	93 (14.5)	601 (21.6)	
Marital status			
Married/cohabitating	91 (20.9)	1,039 (44.7)	<0.0001
Not Married/not cohabitating	497 (79.1)	2,016 (55.3)	
Income			
<\$15,000 per year	224 (30.5)	990 (27.7)	0.5742
\$15,000 – \$34,999	165 (28.6)	896 (28.1)	
\$35,000 – \$74,999	158 (30.9)	870 (31.5)	
\$75,000 or more	41 (10.0)	299 (12.7)	
Percent family poverty of CBSA			
<6.9%	166 (25.4)	754 (22.6)	0.6417
6.9% – 8.9%	115 (25.9)	715 (25.2)	
9.0% – 11.9%	158 (24.6)	749 (25.2)	
12.0% or more	124 (24.1)	659 (26.9)	

Notes: Bivariate analysis conducted using the Rao-Scott F-adjusted Chi square test

[#] HS dip = high school diploma

Table 3

Adjusted odds ratios[†] for risky sexual behavior for non-Hispanic blacks, overall and gender- and age-stratified, National Survey of Family Growth, 2006 – 2010 (n=3,643)

	Risky Sexual Behavior**					
	Dissimilarity, aOR (95% CI)	Isolation, aOR (95% CI)	Absolute Centralization, aOR (95% CI)	Relative Concentration, aOR (95% CI)	Spatial Proximity, aOR (95% CI)	Hypersegregation*, aOR (95% CI)
Overall						
Segregated [#]	1.16 (1.15–1.17)	1.04 (1.03–1.05)	2.07 (2.05–2.08)	2.05 (2.03–2.07)	1.02 (1.00–1.03)	0.864 (0.854–0.873)
Not Segregated	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Males						
Segregated	0.831 (0.822–0.840)	0.699 (0.689–0.709)	1.65 (1.63–1.67)	1.82 (1.80–1.84)	2.51 (2.45–2.57)	0.450 (0.442–0.458)
Not Segregated	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Females						
Segregated	1.63 (1.61–1.66)	1.34 (1.33–1.36)	2.56 (2.52–2.60)	2.06 (2.04–2.09)	0.543 (0.531–0.555)	1.36 (1.34–1.38)
Not Segregated	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
15 – 24 years						
Segregated	0.409 (0.402–0.415)	1.08 (1.07–1.10)	2.53 (2.48–2.57)	0.976 (0.960–0.993)	1.68 (1.64–1.72)	0.861 (0.847–0.876)
Not Segregated	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
25 – 34 years						
Segregated	3.24 (3.20–3.29)	0.813 (0.799–0.828)	3.27 (3.22–3.33)	5.05 (4.97–5.12)	0.472 (0.458–0.486)	0.749 (0.734–0.764)
Not Segregated	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
35 – 44 years						
Segregated	0.614 (0.601–0.627)	2.53 (2.47–2.58)	2.02 (1.98–2.07)	1.50 (1.47–1.53)	1.59 (1.53–1.64)	1.90 (1.85–1.95)
Not Segregated	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Note: aOR = adjusted odds ratios; CI = confidence interval

[†] Models adjusted for age group, gender, educational attainment, marital status, income, and CBSA Poverty; Random intercept included to account for CBSA clustering

[#] Segregated refers to an index value greater than or equal to 0.60 // not segregated refers to an index value less than 0.60

* Segregated for this variable refers to being hypersegregated

** aORs for risky sexual behavior modeled using each segregation index, separately