Neighborhood Disadvantage and Changes in Condom Use among African American Adolescents

Jose A. Bauermeister, Marc A. Zimmerman,
and Cleopatra H. Caldwell

ABSTRACT *Neighborhood context may influence youth sexual decision-making. We examined the association between neighborhood characteristics and condom use in a sample of African American youth followed across the high school years (N=681; 51% female). Using a three-level hierarchical linear model, we modeled inconsistent condom use over time and then examined its association with youth's sexual risk trajectories (sexual intercourse frequency, number of partners, and pregnancy concerns) and individual-level characteristics (sex, age, SES, and household composition), and neighborhood disadvantage. While sexual intercourse frequency was associated with inconsistent condom use over time, youth reporting greater pregnancy concerns and number of partners reported more consistent condom use over time. Females were more likely to report more inconsistent condom use over time. Neighborhood disadvantage characteristics were associated with less baseline condom use, but did not have an association with changes in youth's condom use over the high school years. We discuss the implications for community-based HIV/AIDS prevention for youth.*

KEYWORDS *Adolescence, Condoms, HIV, Neighborhood, Multilevel, Risk behavior, Disadvantage*

Current incident trends suggest a resurgence of new HIV infections among adolescents. Even when medically treated, HIV is incurable, leading to family planning difficulties, medication side effects, psychological distress, discrimination and stigma, and comorbidity with other diseases across the lifespan. From 2004 through 2007, the estimated number of HIV/AIDS cases¹ increased among youth ages 15 to 19. Furthermore, a persistent unequal distribution of HIV/AIDS across the US population exists by race, sex, and social economic status (SES). African Americans between the ages of 13 to 24 comprise one of the largest racial groups affected by HIV.¹ Current estimates suggest African American males and females are approximately at ten times greater risk for HIV infection than their White counterparts across the United States.¹ New HIV infections among youth have also been linked to SES indicators, including living in poverty, lacking access to quality medical care, and/or dropping out of high school.²

Socioeconomic position influences the privileges and disadvantages individuals and groups have in society.³ Accounting for sociodemographic characteristics at the individual level is customary in HIV/AIDS behavioral research, but few researchers

Bauermeister, Zimmerman, and Caldwell are with the University of Michigan, Ann Arbor, MI, USA.

Correspondence: Jose A. Bauermeister, University of Michigan, Ann Arbor, MI, USA. (E-mail: jbauerme@umich.edu)

have examined how community-level indicators (e.g., concentrated economic disadvantage) are associated with HIV/AIDS risk.⁴⁻⁹ The inclusion of macro-level indicators acknowledges that HIV/AIDS risk is not the sole result of individual-level characteristics but, rather, a reflection of how structural factors may shape behaviors and create health inequalities.^{10,11}

Increasingly, researchers have begun to assess how these structural factors are associated with HIV/AIDS risk behaviors in order to create multilevel HIV/STI prevention programs that go beyond traditional, individual-level behavior change efforts.¹²⁻¹⁶ Given our interest in understanding how neighborhood disadvantage may influence youth HIV/AIDS risk, we focused on youth condom use across adolescence as it is the only reproductive health technology that serves as a barrier method against HIV/STI infection during youth's exploration of their sexuality. Specifically, we examined how neighborhood disadvantage was associated with condom use in a sample of African American youth followed over the high school years.

SOCIAL DISORGANIZATION THEORY: A CONCEPTUAL FRAMEWORK TO EXAMINE YOUTHS' SEXUAL BEHAVIORS

Social Disorganization Theory informs how neighborhood factors influence health.^{17,18} Specifically, the Social Disorganization Theory posits that neighborhoods with greater structural disadvantage will be subjected to greater neighborhood disorganization. As a result, individuals living in more disadvantaged neighborhoods will be more likely to manifest higher rates of problem behaviors than counterparts living in more advantaged neighborhoods. Researchers have reported findings to support this theory as an explanation for a variety of outcomes. Neighborhood factors have been found to affect several health outcomes via segregation and racial discrimination,¹⁹ poor quality housing,²⁰ disproportionate exposure to environmental toxins,²¹ lack of accessible food markets,²² health-compromising behaviors,^{23,24} poor quality jobs and decreased income earnings,²⁵ limited access to social service assistance,²⁶ strained social networks and increased stress,²⁷ and lack of access to medical care.^{28,29}

Among the studies examining neighborhood characteristics and youth sexual behaviors, neighborhood disadvantage (i.e., concentrated economic disadvantage) has been posited to limit the availability of social capital and HIV/STI prevention within these communities.³⁰ Neighborhood disadvantage may also shape localized norms regarding sexuality and childbearing,^{31,32} including earlier sexual debut, greater sexual activity, and lower rates of consistent condom use. Burgard and Lee-Rife,⁷ for example, found greater neighborhood disadvantage was associated with earlier sexual onset and inconsistent condom use among male and female adolescents and young adults in South Africa. Similarly, Cubbin and colleagues⁸ found sexual onset occurred earlier among male youth who lived in communities with greater neighborhood disadvantage in a national sample of youth in the United States; however, this association was not identified among female adolescents. In a study of Chicago neighborhoods, Browning and colleagues⁶ found youth living in neighborhoods with greater concentrated poverty were more likely to be sexually active than youth living in less concentrated poverty areas. This association was noted for males and females alike. Taken together, these findings highlight the presence of an association between neighborhood disadvantage and sexual behaviors, while underscoring the variability across studies. This variability may

be attributable to differences across contexts, timing of sexual behaviors, and gender. In light of these findings, we proposed a multilevel model to examine how neighborhood disadvantage was associated with condom use in a Midwestern sample of African American male and female youth, respectively.

Social disadvantage may further increase youths' vulnerability to HIV/STI through correlates associated with inconsistent condom use. Youth who live in more disadvantaged neighborhoods are more likely to report psychological distress and substance use during adolescence than youth living in areas with fewer disadvantages.³³⁻³⁵ This is particularly troublesome for HIV prevention given the robust relationship between condom use and psychological distress and substance use.³⁶⁻³⁸ Economic disadvantage may also influence the composition of sexual networks and place youth at risk for greater HIV/STI vulnerability.^{6,39,40} Sexual contact, for example, may serve to create bonds between individuals and create kinship in a social network.^{41,42} Condom use, however, may be perceived as signifying distrust between partners and may ultimately be foregone, even when youth express concerns regarding pregnancy and HIV/STI vulnerability.⁴³ Taken together, these findings suggest that the Social Disadvantage Theory may be extended to condom use because youth living in neighborhoods with greater disadvantage may experience compounded risks of engaging in inconsistent condom use.

To our knowledge, no study has examined the relationship between neighborhood disadvantage and youth condom use prospectively across the adolescent years, while simultaneously accounting for the additional contribution of youths' condom use correlates. Therefore, in this study, we also examined how the association between neighborhood disadvantage and condom use correlates (i.e., changes in psychological distress and substance use, pregnancy concerns, number of partners, and sexual intercourse frequency over time) could influence changes in condom use across the high school years. This approach is particularly important to advance our understanding of neighborhood disadvantage and youths' HIV/AIDS risks for three reasons. First, given that condom use decreases as youth age,⁴⁴ it is possible that the association between neighborhood disadvantage and condom use also varies over time. Compared to youth living in neighborhoods with fewer disadvantages, for example, youth living in greater disadvantaged areas may start off at greater risk (i.e., less condom use) and (1) maintain their risk over time, (2) increase their risk over time, or (3) decrease their risk over time. Understanding how neighborhood disadvantage contributes (or not) to changes in condom use over time may inform the adequacy, timing, and duration of HIV prevention programs for youth living in economically disadvantaged areas.

Second, researchers have previously noted that changes in condom use during adolescence are correlated with youths' increased number of partners, opportunities to engage in sexual intercourse, and considerations of childbearing and parenthood, as well as psychological distress and substance use.^{45,46} Consequently, not accounting for these time-varying covariates may result in misestimated time parameters for condom use (i.e., rate of change in condom use over time) and a biased estimate of the association between condom use and neighborhood disadvantage.

Finally, we do not know whether neighborhood disadvantage is associated with condom use (direct association), or is a byproduct of the association between neighborhood disadvantage and a condom use correlate (indirect effect). Examination of these complex relationships may extend our current understanding of neighborhood processes on youth's sexual behaviors, and inform the development of community-based HIV prevention programs.

STUDY OBJECTIVES AND HYPOTHESES

We contribute to previous findings examining Social Disorganization Theory by exploring how neighborhood disadvantage is associated with inconsistent condom use in an urban Midwestern sample followed across the high school years. First, we modeled inconsistent condom use and included five time-varying predictors (i.e., sexual intercourse frequency, number of partners, pregnancy concerns, psychological distress, and substance use) associated with changes in condom use over time. Consistent with national trends, we expected inconsistent condom use to increase over time. We hypothesized that each time-varying covariate would contribute to the estimation of African Americans' change in inconsistent condom use during the high school years. Second, we tested whether these relationships differed across sociodemographic characteristics (i.e., age, sex, SES). Consistent with national disparities in HIV incidence among youth, we hypothesized that inconsistent condom use would be greater among females, youth who were sexually active at younger ages, and youth coming from lower SES households. Finally, we examined whether neighborhood disadvantage was associated *directly* with inconsistent condom use (i.e., direct association hypothesis), and/or *indirectly* associated with inconsistent condom use through these time-varying covariates (i.e., indirect association hypothesis). Consistent with the Social Disorganization Theory and previous findings, we hypothesized that neighborhood disadvantage would have a positive direct and indirect association with youths' inconsistent condom use.

METHODS

Sample

This study is based on an 8-year longitudinal study of youth from mid-adolescence to the transition into young adulthood. Participants in this study were recruited based on their risk for school dropout. To be eligible for the study, participants had a grade point of 3.0 or lower at the end of the 8th grade, were not diagnosed by the school as having emotional or developmental impairments, and identified as African American, White, or Bi-racial (African American and White). Data were collected from 850 adolescents beginning their 9th grade year (Wave 1: 1994) in four public high schools in Flint, Michigan. Waves 1 through 4 correspond to the participants' high school years (1994–1997). Waves 5 through 8 correspond to the transition to young adulthood years (2000–2004).

Data for this report focus on the first four Waves (e.g., the high school years). We focus on adolescents self-reporting as African American (80% of the original sample; $N=681$, 51% female). The mean age at Wave 1 for African American participants was 14.86 years ($SD=.65$). Mother's highest educational level completed at Wave 1 was as follows: 10.5% grade school or some high school, 40.8% high school, 31.8% some college or vocational training, 13.6% college, and 3.3% graduate or professional school. Parent's marital status at Wave 1 was: 27% married, 8% separated, 19% divorced, and 46% never married. By Wave 8, 80% of our participants had a high school degree or higher.

Procedures

Structured face-to-face interviews were conducted with students in school or in a community setting if the participants could not be found in school. On average, each interview lasted 50–60 min. After the interview portion of the protocol, participants

completed a self-administered paper and pencil questionnaire about alcohol and substance use, sexual behavior, and other sensitive information. The study had a 90% response rate by Wave 4. Participants were given an incentive (\$15 for Wave 1, \$20 for Wave 2, \$25 for Waves 3 and 4, respectively) as remuneration for taking time to participate in the study. The University of Michigan’s Institutional Review Board approved the study design and procedures (UMIRB #H03-0001309).

Measures

We present the mean and standard deviation for study variables included in our analyses in Table 1. Each measure is described below.

Time-Varying Covariates. We included five condom use correlates in our analyses (frequency of sexual intercourse, number of sex partners, pregnancy concerns, psychological distress, and substance use) to account for potential confounding when modeling condom use over time.

Inconsistent Condom Use. Across all Waves, participants self-reported their condom use over the previous year (“How often have you used a condom when having sex in the last year?”). Participants could respond with one of the following categories: 0=Always, 1=Most of the time, 2=Half of the time, 3=Not very often, and 4=Almost never. We gave participants a missing value if they had not been

TABLE 1 Descriptive statistics for study variables

	Wave 1	Wave 2	Wave 3	Wave 4
Time-varying covariates				
Condom use	0.84(1.26)	0.79(1.22)	0.94(1.25)	1.22(1.34)
Sex frequency	1.91(1.84)	2.11(1.83)	2.41(1.93)	2.82(2.00)
Number of partners	2.34(3.38)	2.04(2.84)	2.20(3.13)	1.88(2.28)
Pregnancy concerns	2.49(1.68)	2.61(1.56)	2.48(1.63)	2.36(1.68)
Psychological distress	0(0.92)	0(0.95)	0(0.94)	0(0.96)
Substance use	0(0.93)	0(0.91)	0(0.91)	0(0.89)
Individual characteristics (N=681)				
Age	14.86(0.65)			
Females (%)	51%			
SES	39.79(9.80)			
Lives with mother or mother and siblings	42.60%			
Neighborhood characteristics (N=123)				
Neighborhood disadvantage	0(1)			
Single households with children <18 years old (%)	23.00(14.32)			
Households receiving public assistance (%)	25.68(14.51)			
Households earning less than \$15,000 (%)	38.25(21.42)			
Households without a HS degree (%)	30.66(8.98)			
Area unemployment (%)	19.82(9.76)			

sexually active at a given Wave. It is important to note, however, that our findings did not change when we re-ran our analyses with non-sexually active youth assigned to the “Always” category. The intraclass correlation for condom use over the four Waves was 0.52.

Frequency of Sexual Intercourse. Participants self-reported their frequency of sexual intercourse in the previous year (“How many times have you had sex in the last year?”). Participants could respond using the following categories: 0=None, 1=1 or 2 times, 2=3 to 5 times, 3=6 to 8 times, 4=9 to 11 times, and 5=12 or more times. Participants reporting never having sex or not having had sex in the previous year were coded as zero. The intraclass correlation for frequency of sexual intercourse over the four Waves was 0.81.

Number of Sex Partners. Participants reported the number of sex partners in their lifetime using an open-ended question format at Wave 1 (“How many partners have you had?”). For all other Waves, participants self-reported the number of sex partners in the past year by answering an open-ended question (“How many sex partners have you had in the last year?”). Participants reporting never having had sex or not having had sex in the previous year were coded as zero. The intraclass correlation for number of partners over the four Waves was 0.69.

Pregnancy Concerns. Participants were asked to indicate at each Wave whether they (or their partner) were concerned about getting pregnant (“How concerned or worried are you about getting pregnant or getting your girlfriend pregnant?”). Participants responded on a five-point scale ranging from 0=Not At All Concerned to 4=Very Concerned. The intraclass correlation for pregnancy concerns was 0.07, which reflects the changes in youths’ intentions to conceive as they grow older.

Psychological Distress. Two indicators of psychological distress, depression (six items) and anxiety (six items), were measured using the Brief Symptom Inventory.⁴⁷ Participants answered these items using a five-point scale ranging from 1=Never to 5=Very Often. We created a standardized psychological well-being composite score for each Wave based on participants’ mean standardized values for depression and anxiety symptoms, respectively. The reliability for the depression scale ranged between 0.70 and 0.77 across the 4 years. The reliability for the anxiety scale ranged between 0.78 and 0.88 across the four years. The intraclass correlation for psychological well-being over the four Waves was 0.66.

Substance Use. Alcohol and marijuana use were measured with the same questions employed by the Monitoring the Future Study.⁴⁸ Questions included frequency of alcohol and marijuana use, respectively, over the past year on a seven-point Likert scale (0=0 times; 6=40+ times). We created a standardized drug use composite score per each Wave based on the mean standardized value of participants’ frequency reports for both alcohol and marijuana use. The intraclass correlation for substance use over the 4 Waves was 0.85.

Individual Characteristics. We used Wave 1 baseline data to assess youth demographic characteristics. Age was computed for each Wave by subtracting the interview date to their month and year of birth. Participant’s sex was collapsed into a dichotomous variable; males served as the referent group.

Participants reported the occupations of both parents. Occupations were assigned a prestige score using Nakao and Treas' classification and rating scheme.⁴⁹ The highest occupational group received a score of 64.38 (professional), and the lowest group received a score of 27.84 (private household worker). If scores were available for both parents, the higher prestige score was used for analysis. Parents were mostly blue-collar workers from the local factories. Given that household composition may also influence a household's socioeconomic status,⁶ we included a dichotomous variable comparing youth living in single-headed households (i.e., live with mother and siblings) to all other household configurations (e.g., live with mom and stepdad, live with mom and dad, live with extended family). All other household configurations served as the referent group.

Neighborhood Economic Disadvantage. We linked study data with 1990 census information (tract and block group level) based on address information reported by respondents in Wave 1 of the study. Participants were sampled from 123 census block groups.

We defined neighborhood as a census block group. Similar to Sampson and colleagues,⁵⁰ we created a standardized neighborhood concentrated economic disadvantage score through a principal axis factor analysis with varimax rotation using Census data. This composite score ($\alpha=0.89$) had a one-factor solution that explained 62.55% of the variance, and included the following indicators: proportion of poverty, welfare receipt, single-headed households with children under the age of 18, unemployment, and percentage of residents without a high school diploma. We examined the association of economic disadvantage on youths' condom use over time using the z scored composite score, followed by each unique indicator in an effort to understand which subcomponents were correlated with our outcome.

Data Analytic Strategy

We matched participants by their study and neighborhood block IDs, and noted mean differences in Wave 1 condom use by census block groups [$F(121, 524)=1.30$, $p<0.05$]. We then used HLM⁵¹ to model youths' condom use across the high school years (Level One; i.e., changes in condom use over time) and test its association with individual-level (Level Two; i.e., differences in condom use by demographic characteristics) and neighborhood-level factors (Level Three; i.e., differences by neighborhood disadvantage). This modeling strategy allowed the total variance to be partitioned into within-individual error (e), between-individual error (r), and between-neighborhood error (u) variation.

HLM maximizes all available Level One data because its algorithms do not require full information across all Waves in order to compute growth estimates for participants.⁵² Yet, similar to repeated measures regression, HLM requires the handling of missing data at Level Two in order to avoid list-wise deletions. Consequently, we ran a maximum likelihood estimation using the Expectation-Maximization algorithm within EQS⁵³ to impute missing values for participants with missing SES scores (86 cases). Our multilevel results with the imputed SES values did not change the observed associations when included in the analyses, so we included these cases to maximize the number of African American participants represented within each neighborhood block. Given the complexity of the three-level model and the potential that we decreased our statistical power to detect meaningful

relationships, we briefly outline our three-level model estimation below and discuss statistically significant trends ($p \leq 0.10$) and findings ($p \leq 0.05$).

RESULTS

Modeling Inconsistent Condom Use Over Adolescence. We modeled the change in inconsistent condom use over the high school years as our unit of time, centering our time variable at 9th grade (i.e., the mean initial inconsistent condom use score at Wave 1). This approach models the change in inconsistent condom use for every additional year of high school following 9th grade. After modeling the linear growth of condom use, we included a quadratic growth term to reflect a non-linear change (i.e., acceleration) for inconsistent condom use over time (see Model 1 in Table 2). In a stepwise fashion, we then included the condom use time-varying covariates (i.e., frequency of sexual intercourse, pregnancy concerns, number of partners, psychological distress, and substance use) as they have been previously noted to influence youth’s decision to use condoms (see Model 2 in Table 2). Inclusion of the time-varying covariates improved the overall model fit ($p \leq 0.001$)

Approximately 60% of the sample was sexually active in the 9th grade ($N = 403$). As shown in Table 2, we found most 9th-grade participants who were sexually active reported using condoms consistently at Wave 1 ($\pi_0 = 0.70$; $p \leq 0.001$). Inconsistent condom use increased across high school years at an accelerating rate, as represented by the linear ($\pi_1 = -0.18$; $p \leq 0.10$) and non-linear ($\pi_2 = 0.09$; $p \leq 0.01$) growth terms. Furthermore, inconsistent condom use increased over the high school years if participants also reported greater sexual intercourse frequency during high school ($\pi_3 = 0.18$; $p \leq 0.001$). The change in inconsistent condom use decreased,

TABLE 2 Condom use growth curve model for youth across adolescence

	Base model	Inclusion of time-varying covariates	Model by sex
Mean initial score, π_0	0.86(0.07)***	0.70(0.12)***	0.72(0.16)***
SES, b_{01}			0.002(0.005)
Female, b_{02}			0.04(0.24)
Age, b_{03}			0.001(0.07)
HH composition, b_{04}			0.12(0.08)
Mean linear change, π_1	-0.16(0.10) †	-0.18(0.09)*	-0.54(0.12)***
Female, b_{11}			0.52(0.21)**
Mean non-linear change, π_2	0.09(0.03)**	0.08(0.03)**	0.18(0.04)***
Female, b_{21}			-0.14(0.07)*
Sex frequency, π_3		0.18(0.02)***	0.08(0.04)#
Female, b_{31}			0.15(0.05)**
Number of partners, π_4		-0.04(0.01)**	0.006(0.01)
Female, b_{41}			-0.06(0.03)*
Pregnancy concerns, π_5		-0.08(0.02)***	-0.05(0.03)#
Female, b_{51}			-0.07(0.04)#
Psychological distress, π_6		0.06(0.04)	
Substance use, π_7		0.005(0.04)	
Model fit (parameters)	5,374.01 (11)	5,088.85 (16)	4,011.60 (23)
χ^2 difference (Δ in df)		285.16(5)***	1,077.25 (7)***

$p \leq 0.10$; * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

however, if youth reported greater number of partners ($\pi_4=-0.04$; $p\leq 0.01$) and pregnancy concerns ($\pi_5=-0.08$; $p\leq 0.001$) over time. We found no association between inconsistent condom use over the high school years, and the time-varying covariates for psychological distress and substance use, respectively.

Examining Between-Individual Differences. To ensure adequate estimation in condom use trajectories and acknowledge the different rates in sexual development between adolescent males and females, we included participants' sex on the time-varying parameters (see Model 3 in Table 2). As shown in Figure 1, males and females had differing condom use trajectories across the high school years. Whereas males' inconsistent condom use followed a U-shaped pattern, with increases in inconsistent condom use starting at 11th grade (linear: $\pi_1=-0.54$; $p\leq 0.001$; non-linear: $\pi_2=0.18$; $p\leq 0.001$), females' inconsistent condom use increased continuously over time (linear: $b_{11}=0.52$; $p\leq 0.05$; non-linear: $b_{21}=-0.14$; $p\leq 0.05$). Sex differences were also noted in the contribution of the time-varying covariates to the growth curve. The positive association between sex frequency and inconsistent condom use over time was greater for females ($b_{31}=0.52$; $p\leq 0.01$) than for males ($\pi_3=-0.54$; $p\leq 0.001$), whereas the negative temporal association between number of partners and inconsistent condom use was noted only for females ($b_{51}=-0.06$; $p\leq 0.05$). We also found the negative association between inconsistent condom use and pregnancy concerns over time was greater for females ($b_{61}=-0.07$; $p\leq 0.10$) than for males ($\pi_6=-0.05$; $p\leq 0.10$). We found no sex differences in the temporal relationship between inconsistent condom use and psychological distress and substance use, respectively. Consequently, given that we did not find an association between these variables in either set of analyses (i.e., with the full or sex-specific sample), we did not include these time-varying covariates further. Inclusion of sex across all parameters in our model further improved our model's overall fit ($p\leq 0.001$).

We then examined whether the mean condom use score at Wave 1 (i.e., intercept) or any growth term varied at random between individuals. In examining the random effects table, we found between-individual variation in participants' initial condom use score ($\chi^2(238)=646.70$; $p\leq 0.001$), and in the linear ($\chi^2(354)=$

FIGURE 1. Changes in condom use across high school by sex.

511.05; $p \leq 0.001$) and quadratic ($\chi^2(354)=514.34$; $p \leq 0.001$) slopes for condom use during adolescence. Consequently, we explored whether Wave 1 individual-level demographic characteristics (i.e., age, SES, and household composition) explained the random variation in youths' initial condom use score (π_{0i}) or the linear and quadratic slopes (π_{1i} , π_{2i}). We found no evidence to suggest that individual-level demographic characteristics were associated with differences in initial condom use scores or changes in condom use over time. Nevertheless, given our interest in understanding differences across neighborhood economic disadvantage, we included the non-significant SES indicator in all subsequent models to avoid any cross-level confounding. We dropped from the analysis all other demographic variables.

Testing Between-Neighborhood Differences. Finally, we examined whether neighborhood disadvantage was directly and/or indirectly associated to condom use. We examined whether random between-neighborhood variation existed across the predictors in the model, and found random variation between neighborhoods on the initial mean condom use score ($\chi^2(112)=160.31$; $p \leq 0.01$). Consequently, all other neighborhood equations were treated as fixed effects.

To test the *direct association hypothesis*, we modeled the neighborhood indicators on youths' initial condom use score (i.e., 9th grade). A significant association would suggest that, for every unit change in neighborhood disadvantage, we could expect a change in condom use at baseline. As shown in Figure 2, youth who lived in neighborhoods with greater economic disadvantage were less likely to report inconsistent condom use at 9th grade ($b=-0.10$; $p \leq 0.05$). Given that the association was in the opposite direction than expected (i.e., disadvantage is protective), we examined whether this association was an artifact of our composite measure. We re-ran our multilevel model using each neighborhood disadvantage indicator (see Table 3), and found a relationship between initial condom use scores and single-headed households with children under the age of 18, households earning less than \$15,000, and households receiving public assistance. We found no association between initial condom use scores and proportions of households with less than a high school degree or with varying unemployment rates.

FIGURE 2. Condom use during adolescence by neighborhood disadvantage.

We then modeled the neighborhood indicators on the change in condom use over time; however, we found no support for a relationship between-neighborhood disadvantage and the linear or quadratic growth terms for condom use, respectively. These null findings did not change whether we used the composite disadvantage score or individual neighborhood indicators.

To test the *indirect association hypothesis*, we then modeled the neighborhood indicators on the time-varying covariates. Although a significant association between neighborhood disadvantage and a time-varying covariate (e.g., number of partners) would suggest an indirect association with condom use (i.e., cross-level interaction), we found no relationship between neighborhood disadvantage and the time-varying covariates for males or females, respectively (data not shown).

DISCUSSION

In this study, we examined whether neighborhood economic disadvantage was associated with inconsistent condom use in a sample of urban African American youth followed during adolescence. Consistent with Social Disadvantage Theory, we hypothesized that youth living in neighborhoods with greater disadvantage would report less condom use over time than youth living in more advantaged neighborhoods. Given the variability of findings in previous studies examining the relationship between neighborhood disadvantage and youths' sexual risk behaviors, however, we hypothesized that neighborhood disadvantage would have a direct relationship to condom use, and an indirect association through youths' condom use correlates such as sexual intercourse frequency, number of partners, and pregnancy concerns. We sought to understand these pathways given the need to create multilevel HIV/STI prevention programs that go beyond traditional, individual-level prevention efforts.⁵⁴

Initial differences in inconsistent condom use were associated with *contextual* indicators (e.g., neighborhood-level variables) rather than *individual* SES characteristics (e.g., household composition or occupational prestige). Consistent with past research examining the relationship between neighborhood factors and youth sexual behaviors,⁶⁻⁸ we found neighborhood disadvantage was related to youths' likelihood of having initiated sexual activity by 9th grade. Contrary to our initial hypothesis, however, we found youth who lived in neighborhoods with more economic disadvantage were *more* likely to report using condoms if they were sexually active at 9th grade. While this finding contradicts the expected theoretical relationship (i.e., greater social disorganization should be associated with poorer health outcomes), this result contributes to the growing inconsistency noted in past cross-sectional studies that have examined the association between neighborhood characteristics and sexual behaviors. This association was consistent whether we employed the Census-derived composite neighborhood disadvantage score employed in previous neighborhood studies,⁵⁰ or its constituent parts (e.g., percent of single-headed households with children under the age of 18).

Neighborhood disadvantage differences on initial condom use may be interpreted to suggest that African American youth who are sexually active earlier in adolescence (i.e., by 9th grade) and who live in contexts with greater economic disadvantage may engage in greater condom use to avoid sequelae linked to unprotected sex (e.g., teen pregnancy, HIV/STI infection). It is plausible, for example, that youth who live in neighborhoods with a greater proportion of single-headed households or lower income may use condoms more frequently in

TABLE 3 Final model of initial mean score for youths' condom use across neighborhood characteristics

Model	Neighborhood disadvantage	Single household children <18 years old	Households receiving public assistance	Households earning less than \$15 k	Households with less than HS degree	Area unemployment
	<i>b</i> (se)	<i>b</i> (se)	<i>b</i> (se)	<i>b</i> (se)	<i>b</i> (se)	<i>b</i> (se)
Mean initial condom use score, π_0	0.77(0.16)***	1.04(0.18)***	0.93(0.18)***	0.94(0.18)***	0.81(0.20)***	0.80(0.17)***
Neighborhood characteristic, b_{01}	-0.10(0.04)*	-0.01(0.003)***	-0.006(0.003)#	-0.004(0.002)*	-0.002(0.003)	-0.002(0.004)
SES, b_{02}	0.002(0.004)	0.001(0.004)	0.002(0.003)	0.002(0.004)	0.002(0.004)	.002(0.004)
Female, b_{03}	-0.07(0.21)	.09(0.20)	-0.07(0.21)	0.07(0.21)	-0.08(0.21)	-0.08(0.21)

Only initial mean score for youth condom use (π_0) is presented; nevertheless, model adjusts for changes over time in condom use, sex frequency, number of partners, and pregnancy concerns

$p \leq 0.10$; * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

order to avoid greater social and economic hardships that arise from childbearing or HIV/STI treatment. Similarly, given the negative correlation between HIV prevalence and income in urban areas,⁵⁵ it is plausible that youths' condom use mirrors their increased awareness of HIV in their communities. While additional qualitative and quantitative research is warranted to examine these plausible explanations, our finding underscores the value of exploring the role of neighborhood disadvantages within specific locales as they may elucidate patterns differing from aggregated national data, and inform the development of community-specific interventions.^{14,56}

We found no evidence to suggest that neighborhood disadvantage had a time-varying *direct* (i.e., neighborhood factors are associated to the linear and non-linear estimates of inconsistent condom use) or *indirect* (i.e., neighborhood factors are associated to condom use correlates; such as sexual intercourse frequency and number of partners) association with the change in inconsistent condom use over time. In other words, contrary to our initial hypotheses, neighborhood disadvantage was not associated with changes in inconsistent condom use across the high school years, after accounting for baseline differences. These findings, however, should be interpreted cautiously. First, although we have employed a prospective design in this study, we cannot infer causation. Moreover, consistent with previous neighborhood studies, our findings are constrained by the endogeneity of community choice.⁵⁷ In other words, individuals may not be able to self-select and live in their community of choice. Consequently, it is plausible that unmeasured structural processes (e.g., housing discrimination), which determined participants' living arrangements prior to 9th grade *and* limit participants' residential mobility over time, may be more relevant than neighborhood characteristics per se. Furthermore, the absence of an association between neighborhood disadvantage and changes in inconsistent condom use across high school, both directly (i.e., changes in the linear and non-linear parameters) and indirectly (i.e., changes in the time-varying covariates), may be attributable to our inability to model a time-varying effect for neighborhood disadvantage. Like most neighborhood studies, we employed a static measure of neighborhood disadvantage in our analyses. Unfortunately, this approach assumes that (1) the exposure of neighborhood disadvantage on youth development is linear and consistent over the high school years, (2) neighborhoods do not improve or worsen over time, and (3) there is low mobility, whether upward or downward, among youth. These assumptions may lead to theoretical and statistical imprecision, and mask time-varying associations between changes in youths' sexual behaviors and their neighborhoods. Future research that examines whether time effects at the neighborhood-level influence condom use over time is warranted.

Study Strengths and Limitations

Several additional limitations should also be noted. First, the study's findings may not be generalizable because participants in this study were recruited based on their risk for school dropout. Nonetheless, previous studies with this sample have found that adolescents improved their GPA by 12th grade,⁵⁸ with 80% having pursued a high school degree or higher by Wave 8.⁵⁹ This suggests that youth who appeared to be at risk for high school dropout during 8th grade improved their school performance over time, making them more comparable to other studies and samples of youth selected based on their high school GPA. Second, our analyses assume no neighborhood mobility or, in the case of relocation, movement into a similar neighborhood. This is problematic as 40% reported a change in address across the high school years (i.e., 31% changed their address once, 9% changed twice, and 1%

reported three different addresses). Given our sample's age and their increased mobility as they gain autonomy and reach the legal age to drive, however, it may be plausible that neighborhood effects become less salient during middle to late adolescence. As noted above, future research exploring whether neighborhood influences change over time if youth move between neighborhoods would be useful. Third, we acknowledge that family (e.g., parental support) and peer (e.g., sexual permissiveness norms) correlates may also mediate the association of neighborhood disadvantage and adolescent condom use.^{60,61} The inclusion of these covariates was beyond the scope of this manuscript, but they do warrant future exploration. Similarly, future research that explores the role of protective community factors (e.g., social cohesion, community participation) on youth's condom use over time would also be useful, as prior cross-sectional analyses have suggested a positive association between-neighborhood cohesion and adolescent condom use.⁶² Finally, marriage and childbearing may be critical factors in considering predictors of condom use. While we accounted for pregnancy concerns, youth who got married or became parents at an earlier age may be different. Few respondents in our sample, however, reported ever being married (6.2% across all eight Waves, including the young adulthood years) or having children during the adolescent years (13% by Wave 4). Therefore, we could not examine these effects adequately given the small subgroup sample sizes.

These limitations notwithstanding, our study contributes to our understanding of neighborhood effects on sex risk behavior in a number of ways. First, we focused on a highly vulnerable population for HIV/STI infection—a predominantly African American sample of youth at risk for high school dropout who participated in a longitudinal study of adolescent risk and resilience. Second, our study is one of the few to examine the role of neighborhood disadvantage on youth's HIV/STI risk prospectively across the high school years. Compared to other longitudinal studies, we were able to include a time point for every year of high school, thus covering a critical developmental period. Finally, we accounted for time-varying condom use correlates in our analyses.

Consistent with national samples, we found inconsistent condom use increased across adolescence; however, it should be noted that condom use was still fairly high among African American youth in our sample. Condom use remained high even after we had included the condom use correlates. Overall, youth were more likely to report inconsistent condom use if they had had greater sexual intercourse opportunities. Yet, youth were more likely to use condoms if they had a greater number of partners and had greater pregnancy concerns over time, respectively. Consistent with findings noting gender-based differences in condom use negotiation, however, we found the magnitude of these time-varying associations differed for males and females. While marginally significant for males, these time-varying covariates seemed to have more relevance on the estimation of females' change in inconsistent condom use. These findings suggest that sexual health interventions may need to address gender-based disparities in condom negotiation, both for HIV/STI and pregnancy prevention.⁶³ Moreover, in order to increase the adoption of condoms among high-school aged youth, sexual health programs should include strategies focused on increasing youths' concerns regarding pregnancy and decreasing youths' number of partners, as well as including strategies to increase and maintain youths' self-efficacy and ability to negotiate condoms as they become more sexually active.

Taken together, our findings suggest that youth may seek to engage in safer sex behaviors across adolescence, with neighborhood characteristics influencing condom use among youth who are sexually active by 9th grade. While advances in HIV

prevention may affect the generalizability of our findings, few studies have maximized the use of existing longitudinal data to inform current efforts. Our findings, for example, are consistent with ongoing, large-scale economic projects to reduce HIV/STI vulnerability by alleviating concentrated disadvantage (e.g., the Millenium Project).⁶⁴ Future research exploring how positive (e.g., presence of churches and non-profit organizations) and negative (e.g., racial segregation, gender inequality) neighborhood characteristics influence youths' sexual behaviors is needed as it may provide relevant information for creating community-level HIV/STI prevention programs.

In conclusion, we were unable to find support for the Social Disorganization Theory in a sample of urban African American youths' condom use behavior across the high school years. Our results do suggest, however, that more detailed analysis of different neighborhood factors may be necessary to fully understand how neighborhoods may play a role in HIV/STI risk. Finally, our results suggest that neighborhood effects may be multifactorial, suggesting that HIV/STI prevention efforts focused on context may require programs that address multilevel factors.

REFERENCES

1. Centers for Disease Control and Prevention. *2007 HIV/AIDS Surveillance Report*. Atlanta: US Department of Health and Human Services; 2009.
2. Office of the Surgeon General. Surgeon General's call to action to promote sexual health and responsible sexual behavior, 2001. Retrieved from <http://www.surgeongeneral.gov/library/sexualhealth/call.htm>. Accessed April 28, 2010.
3. Lynch J, Kaplan G. Socioeconomic position. In: Berkman L, Kawachi I, eds. *Social Epidemiology*. Oxford: Oxford University Press; 2000: 13–35.
4. Aiello AE, Simanek AM, Galea S. Population levels of psychological stress, herpesvirus reactivation and HIV. *AIDS Behav*. 2010; 14(2): 308–317.
5. Latkin CA, Curry AD, Hua W, Davey MA. Direct and indirect associations of neighborhood disorder with drug use and high-risk sexual partners. *Am J Prev Med*. 2007; 32(6 Suppl): S234–S241.
6. Browning CR, Burrington LA, Leventhal T, Brooks-Gunn J. Neighborhood structural inequality, collective efficacy, and sexual risk behavior among urban youth. *J Health Soc Behav*. 2008; 49(3): 269–285.
7. Burgard SA, Lee-Rife SM. Community characteristics, sexual initiation, and condom use among young Black South Africans. *J Health Soc Behav*. 2009; 50(3): 293–309.
8. Cubbin C, Santelli J, Brindis CD, Braveman P. Neighborhood context and sexual behaviors among adolescents: findings from the National Longitudinal Study of Adolescent Health. *Perspect Sex Reprod Health*. 2005; 37(3): 125–134.
9. Ramirez-Valles J, Zimmerman MA, Juarez L. Gender differences of neighborhood and social control processes: a study of the timing of first intercourse among low-achieving, urban, African-American youth. *Youth Soc*. 2002; 33(3): 418–441.
10. Lazarus JV, Moghaddassi M, Godeau E, et al. A multilevel analysis of condom use among adolescents in the European Union. *Public Health*. 2009; 123(2): 138–144.
11. Sampson RJ, Morenoff JD, Gannon-Rowley T. Assessing “neighborhood effects”: social processes and new directions in research. *Annu Rev Sociology*. 2002; 28: 443–478.
12. Aidala AA, Lee G, Abramson DM, Messeri P, Siegler A. Housing need, housing assistance, and connection to HIV medical care. *AIDS Behav*. 2007; 11(6 Suppl): S101–S115.
13. Bauermeister JA, Tross S, Ehrhardt AA. A review of HIV/AIDS system-level interventions. *AIDS Behav*. 2009; 13(3): 430–448.
14. Blankenship KM, Friedman SR, Dworkin S, Mantell JE. Structural interventions: concepts, challenges and opportunities for research. *J Urban Health*. 2006; 83(1): 59–72.

15. Frye V, Koblin B, Chin J, et al. Neighborhood-level correlates of consistent condom use among men who have sex with men: a multi-level analysis. *AIDS Behav.* 2010; 14(4): 974–985.
16. Wolitski R, Kidder D, Pals S, Royal S, Aidala A, Stall R et al. Randomized trial of the effects of housing assistance on the health and risk behaviors of homeless and unstably housed people living with HIV. *AIDS Behav.* 2010; 14(3): 493–503.
17. Brooks-Gunn J, Duncan GJ, Klebanov PK, Sealander N. Do neighborhoods influence child and adolescent development? *AJS.* 1993; 99(2): 353–395.
18. Kawachi I, Berkman LF. *Neighborhoods and Health.* New York: Oxford University Press; 2003.
19. Williams DR, Jackson PB. Social sources of racial disparities in health. *Health Aff (Millwood).* 2005; 24(2): 325–334.
20. Smith SJ, Easterlow D, Munro M, Turner KM. Housing as health capital: how health trajectories and housing paths are linked. *J Soc Issues.* 2003; 59(3): 501–525.
21. Evans GW, Kantrowitz E. Socioeconomic status and health: the potential role of environmental risk exposure. *Annu Rev Public Health.* 2002; 23: 303–331.
22. Diez Roux AV, Merkin SS, Arnett D, et al. Neighborhood of residence and incidence of coronary heart disease. *N Engl J Med.* 2001; 345(2): 99–106.
23. Johns MM, Bauermeister JA, Zimmerman MA. Individual and neighborhood correlates of HIV testing among African American youth transitioning from adolescence into young adulthood. *AIDS Educ Prev.* 2010; 22(6): 510–523.
24. Xue Y, Zimmerman MA, Caldwell CH. Neighborhood residence and cigarette smoking among urban youths: the protective role of prosocial activities. *Am J Public Health.* 2007; 97(10): 1865–1872.
25. Wilson WG. *When Work Disappears: the World of the New Urban Poor.* New York: Knopf; 1996.
26. Edin KJ. The myths of dependence and self-sufficiency: women, welfare, and low wage work. *Focus.* 1995; 17(2): 1–9.
27. Schulz AJ, Northridge ME. Social determinants of health: implications for environmental health promotion. *Health Educ Behav.* 2004; 31(4): 455–471.
28. van Ryn M, Burke J. The effect of patient race and socioeconomic status on physicians' perception of patients. In: LaVeist T, ed. *Race, Ethnicity, and Health: A Public Health Reader.* San Francisco: Jossey-Bass; 2002: 547–574.
29. van Ryn M, Fu SS. Paved with good intentions: do public health and human service providers contribute to racial/ethnic disparities in health? *Am J Public Health.* 2003; 93(2): 248–255.
30. Nacion M. Concentrated disadvantage in urban neighborhoods: psychopolitical validity as a framework for developing psychology-related solutions. *J Community Psychol.* 2008; 36(2): 187–198.
31. Geronimus AT. The weathering hypothesis and the health of African American women and infants: implications for reproductive strategies and policy analysis. In: Sen G, Snow R, eds. *Power and Decision: The Social Control of Reproduction.* Cambridge: Harvard University Press; 1994: 77–100.
32. Parker R. Sexuality, culture and society: shifting paradigms in sexuality research. *Cult Health Sex.* 2009; 11(3): 251–266.
33. Galea S, Ahern J, Nandi A, Tracy M, Beard J, Vlahov D. Urban neighborhood poverty and the incidence of depression in a population-based cohort study. *Ann Epidemiol.* 2007; 17(3): 171–179.
34. Haney TJ. “Broken windows” and self-esteem: subjective understandings of neighborhood poverty and disorder. *Soc Sci Res.* 2007; 36(3): 968–994.
35. Winstanley EL, Steinwachs DM, Ensminger ME, Latkin CA, Stitzer ML, Olsen Y. The association of self-reported neighborhood disorganization and social capital with adolescent alcohol and drug use, dependence, and access to treatment. *Drug Alcohol Depend.* 2008; 92: 173–182.

36. Donenberg GR, Pao M. Youth and HIV/AIDS: psychiatry's role in a changing epidemic. *J Am Acad Child Adolesc Psychiatry*. 2005; 44(8): 728–747.
37. Elkington KS, Bauermeister JA, Zimmerman MA. Psychological distress, substance use, and HIV/STI risk behaviors among youth. *J Youth Adolesc*. 2010; 39(5): 514–527.
38. Houck CD, Lescano CM, Brown LK, et al. "Islands of risk": subgroups of adolescents at risk for HIV. *J Pediatr Psychol*. 2006; 31(6): 619–629.
39. Baumer EP, South SJ. Community effects on youth sexual activity. *J Marriage Fam*. 2001; 63(2): 540–554.
40. Dembo R, Belenko S, Childs K, Wareham J, Schmeidler J. Individual and community risk factors and sexually transmitted diseases among arrested youth: a two-level analysis. *J Behav Med*. 2009; 32(4): 303–316.
41. Friedman SR, Cooper HL, Osborne AH. Structural and social contexts of HIV risk among African Americans. *Am J Public Health*. 2009; 99(6): 1002–1008.
42. Baumeister RF, Vohs KD. Sexual economics: sex as female resource for social exchange in heterosexual interactions. *Pers Soc Psychol Rev*. 2004; 8(4): 339–363.
43. Bauman LJ, Karasz A, Hamilton A. Understanding failure of condom use intention among adolescents. *J Adolesc Res*. 2007; 22(3): 248–274.
44. Fergus S, Zimmerman MA, Caldwell CH. Growth trajectories of sexual risk behavior in adolescence and young adulthood. *Am J Public Health*. 2007; 97(6): 1096–1101.
45. Buhi ER, Goodson P. Predictors of adolescent sexual behavior and intention: a theory-guided systematic review. *J Adolesc Health*. 2007; 40(1): 4–21.
46. Kirby DB. Effective approaches to reducing adolescent unprotected sex, pregnancy, and childbearing. *J Sex Res*. 2002; 39: 51–57.
47. Derogatis LR, Spencer PM. *Brief Symptom Inventory: Administration, Scoring, and Procedure Manual*. Baltimore: Clinical Psychometric Research; 1982.
48. Johnston LD, O'Malley PM, Bachman JG. *Monitoring the Future National Survey Results on Drug Use, 1975–2002. Secondary School Students Vol. I*. Bethesda: National Institute of Health; 2003.
49. Nakao K, Treas J. Updating occupational prestige and socioeconomic scores: how the new measures measure up. *Sociol Method*. 1994; 24: 1–72.
50. Sampson RJ, Raudenbush SW, Earls F. Neighborhood and violence crime: a multilevel study of collective efficacy. *Science*. 1997; 277(5328): 918–924.
51. Scientific Software International. *Hierarchical Linear Models (v.6.08)*. Chicago: SSI; 2009.
52. Raudenbush S, Bryk A. *Hierarchical Linear Models: Applications and Data Analysis Methods*. 2nd ed. Thousand Oaks: Sage; 2002.
53. Bentler PM. *EQS Structural Equations Program*. Encino: Multivariate Software; 2004.
54. Frieden TR. A framework for public health action: the health impact pyramid. *Am J Public Health*. 2010; 100(4): 590–595.
55. Piot P, Greener R, Russell S. Squaring the circle: AIDS, poverty, and human development. *PLoS Med*. 2007; 4(10): 1571–1575.
56. Dworkin SL, Pinto RM, Hunter J, Rapkin B, Remien RH. Keeping the spirit of community partnerships alive in the scale up of HIV/AIDS prevention: critical reflections on the roll-out of DEBI (Diffusion of Effective Behavioral Interventions). *Am J Community Psychol*. 2008; 42(1–2): 51–59.
57. Jencks C, Mayer S. The social consequences of growing up in a poor neighborhood. In: Lynn L, McGeary M, eds. *Inner-City Poverty in the United States*. Washington: National Academy Press; 1990: 111–186.
58. Zimmerman MA, Caldwell C, Bernat DH. Discrepancy between self report and school-record grade point average: correlates with psychosocial outcomes among African American adolescents. *J Appl Soc Psychol*. 2002; 32(1): 86–109.
59. Bauermeister JA, Zimmerman MA, Gee GC, Caldwell C, Xue Y. Work and sexual trajectories among African American youth. *J Sex Res*. 2009; 46(4): 1–11.

60. DiClemente RJ, Salazar LF, Crosby RA. A review of STD/HIV preventive interventions for adolescents: sustaining effects using an ecological approach. *J Pediatr Psychol.* 2007; 32(8): 888–906.
61. Miller BC, Benson B, Galbraith KA. Family relationships and adolescent pregnancy risk: a research synthesis. *Dev Rev.* 2001; 21: 1–38.
62. Kerrigan D, Witt S, Glass B, Chung SE, Ellen J. Perceived neighborhood social cohesion and condom use among adolescents vulnerable to HIV/STI. *AIDS Behav.* 2006; 10(6): 723–729.
63. Wingood GM, DiClemente R. The theory of gender and power: a social structural theory for guiding public health interventions. In: DiClemente R, Crosby A, Kegler M, eds. *Emerging Theories in Health Promotion Practice and Research: Strategies for Improving Public Health.* San Francisco: Jossey-Bass; 2002: 313–346.
64. Sachs JD, McArthur JW. The Millenium Project: a plan for meeting the Millenium Development Goals. *Lancet.* 2005; 365(9456): 347–353.