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The built environment & the impact of neighborhood characteristics on youth sexual risk behavior in Cape Town, South Africa

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Abstract

Youth sexual risk behavior is often described in social terms, and there has been limited attention to date on how measures of the built environment, including access to municipal services, impact sexual risk behavior, particularly in resource-limited countries. Using the Cape Area Panel Study, we assessed the impact of neighborhood conditions (six single items and a built environment index (BEI)), net of individual socio-demographic factors. The results suggest that built environment factors are associated with sexual risk behavior. Also, the magnitude of associations between built environment factors and sexual risk behavior was more pronounced for females than for males.

Keywords

HIV/AIDS; Built environment; Sexual risk behavior; Adolescents; Neighborhoods; Structural disadvantage

1. Introduction

In the U.S. there is a growing body of literature which has examined the effects of neighborhoods on youth sexual risk behavior (Bauermeister et al., 2010; Fichtenberg et al., 2010; Lindberg and Orr, 2011; Browning et al., 2008; Fullilove, 2003; Jewkes and Abrahams, 2002; Cohen et al., 2003; Brewster et al., 1993). The majority of these studies focus on the social environment of neighborhoods e.g., social cohesion and collective efficacy, neglecting the built environment or physical characteristics of neighborhoods. Despite the evidence of the influence of the neighborhood context on youth sexual risk-taking behavior, only a few notable exceptions have considered the effects of the built environment on sexual vulnerability, particularly in resource-limited countries (Burgard and Lee-Rife, 2009; Yamanis et al., 2010; Wojcicki, 2005; Zulu et al., 2004; Fullilove, 2003; Cohen et al., 2000). Typically, when researchers attempt to translate neighborhood constructs to low-income countries the definitions and categories suffer conceptual limitations. Oftentimes, physical characteristics of neighborhoods are conflated with notions of the social environment (Mujahid et al., 2007; Macintyre et al., 2000). In addition, common constructs do not accordingly reflect the conditions and realities of resource-poor countries where a large proportion of the population may live in dire circumstances of

chronic and persistent poverty without the most rudimentary of resources and services. Aside from reliability and validity of measures, there is little to no consistency on how to measure neighborhoods (Mujahid et al., 2007; Macintyre et al., 2000). Commonly used measures include housing quality, abandoned cars, graffiti, trash, public school deterioration, and the distribution of liquor stores (Hembree et al., 2005; Krieger and Higgins, 2002; Cohen et al., 2003; LaViest and Wallace, 2000; Weich et al., 2001; Wallace and Wallace, 1997; Wallace, 1993; Wallace and Fullilove, 1991).

The recent use of the term built environment is an effort to better clarify the difference between social environment and the physical environment of neighborhoods. For the purposes of this study, we use the term the built environment to delineate the physical features of the neighborhood environment from the social aspects of the neighborhood. Health Canada (1997) broadly defines the built environment as comprising all the human manufactured material products and goods elaborated in space, "It encompasses all buildings, spaces, and products that are created or modified by people. It includes our homes, schools, workplaces, parks/recreation areas, business areas and roads. It extends overhead in the form of electric transmission lines, underground in the form of waste disposal sites and subway trains, and across the country in the form of highways" (Health Canada, 1997, cited in Srinivasan et al., 2003, p. 1446). The present study uses a truncated definition more relevant for material conditions of slum neighborhoods in poorer countries and defines the built environment as access to four key basic services: (1) water, (2) electricity, (3) sanitation facilities and (4) type and/or quality of housing. Provisions of these municipal services represent the minimum material goods and services necessary for a standard of living adequate for health and well-being. In this study, we use the terms built environment and structural characteristics of neighborhoods interchangeably. Structural characteristics of neighborhoods is an umbrella term that also refers to the broader physical aspects of the neighborhood which includes the built environment, but also includes the larger historical, political and economic forces that influences the production of the built environment. Moreover, we use the term structural characteristics of neighborhoods in instances when we wish to broaden the interpretation of our findings and acknowledge there are other structural/built environment indicators that we were unable to test, because we are limited by the data.

We extend this research by elaborating and testing hypotheses regarding the role of the residential built environment, specifically housing quality and municipal services, in influencing patterns of sexual risk behavior among youth. We have examined whether: (1) use of condoms at last sex and (2) number of sexual partners in the last 12 months are a function of access to basic services and housing quality, net of socio-demographic variables. The analyses employ data from Cape Area Panel Study (Wave 1 2002) comprising 4800 young people from the Cape Town Metropolitan Area (Lam et al., 2008). To our knowledge this is the first large scale population study to examine built environment characteristics, in conjunction with demographic and behavioral characteristics to explore sexual vulnerability examining specific dimensions of the built environment.

Considering the potential influence of the role of characteristics of the built environment as determinants of health behavior, more attention is warranted to understand how the structural character of neighborhoods themselves, manifest in the material landscape, and its impact on promoting or constraining pro-social sexual behavior. Although existing studies on the impact of neighborhoods on adolescent reproductive and sexual health provide important information, they also reveal significant gaps in knowledge regarding how specific built environment factors associated with high poverty urban neighborhoods may influence sexual risk behavior. We know even less about the mechanisms underlying the ways that living in degraded slums in resource-limited countries affects youth sexual risk

behavior. The lack of such studies is especially notable in South Africa, given that informal townships have the highest HIV prevalence rates in the country (Shishana et al., 2009; Connolly et al., 2004). Further examination of these factors in the South African context is critical in elucidating how specific risk environments may promote behaviors which drive the transmission of HIV and STIs, and in advancing our understanding of the multi-level factors that determine population-level disease burden. Therefore, we conducted this study to determine if built environment factors, independent of individual-level characteristics, predict engagement in sexual risk behavior among a sample of youth.

1.1. The built environment and sexual risk behavior

Neighborhood structural disadvantage researchers have emphasized neighborhood-level poverty, residential instability and ethnic heterogeneity as key structural factors in understanding health related behaviors (Diez Roux, 2001; Yen and Kaplan, 1999; Sampson et al., 1997; Massey and Denton, 1993; Wilson, 1987, 1991). Concentrated poverty and urban social disorganization also have been hypothesized to disrupt local social control regimes and reduce social cohesion, resulting in a breakdown of social networks and the ability of communities to implement collective goals and values around normative sexual behavior (Browning and Cagney, 2003; Sampson et al., 1997; Shaw and McKay, 1969). Social disorder and a breakdown of social networks can also reduce the likelihood that young residents will adopt health-promoting sexual behavior, such as condom use or delayed sexual debut (Camlin and Snow, 2008; Driscoll et al., 2005; Krishnan et al., 2008; Billy and Moore, 1992; Brewster et al., 1993). Cross-nationally several studies have shown economic deprivation and the lack of access to opportunity structures increased the likelihood of women and girls involvement in transactional sex or sex work and its association with HIV risk behaviors (Saggurthi et al., 2011; Hong and Li, 2008; Bucardo et al., 2004; Chattopadhyay et al., 1994). While these studies have provided valuable information on the influence of the social environment on sexual risk behavior, the extent to which their findings can be extrapolated to include the built environment is limited. More importantly, these studies have not examined the relationship between the built environment and sexual risk behavior in low-income countries.

This study also draws on place-based theories that posit that the place of residence or the physical characteristics of a neighborhood can have profound consequences for health (Diez Roux and Mair, 2010; Cresswell, 2004; Frumkin, 2003; Cohen et al., 2003; Krieger and Higgins, 2002; Cohen et al., 2000; Kawachi, 1999). Place is a concept that has been used in the fields of urban planning, geography, philosophy and anthropology where the notion of place is foundational to the discipline and central to its theoretical propositions on understanding the human condition (Cresswell, 2004; Massey: Frumkin, 2003; Lefebvri, 1991). The notion of place refers to a number of different concepts, both tangible and abstract, e.g. location, locale, sense of place, place attachment, as well as aspects of the physical environment (Wakefield and McMullan, 2005; Popay et al., 2003; Lewis et al., 2002; Harvey, 2000). Place here refers to a location, in this case the city of Cape Town, which is made up of different neighborhoods where people live. In addition to having an objective location, these neighborhoods also have a material form which consists of the built environment (e.g. resources—factories, schools, parks; services—utilities, fire, and police). This materiality of place or the built environment is not static, but in relationship with larger historical, political and cultural processes (Perdue et al., 2003). Related people are embedded in neighborhoods and the meaning people attach to the experience of places and how these interact with the material conditions shape behavior (Wakefield and McMullan, 2005; Massey, 2004; Popay et al., 2003; Lewis et al., 2002; Harvey, 2000; Levebre, 1999).

Research has shown place of residence can shape risk environments and vulnerability to STIs and HIV/AIDS (Maas et al., 2007; Fullilove, 2003; Szwarcwald et al., 2000). Broken

Windows theory suggests that neighborhood conditions influence social behavior and have been used to demonstrate how features of poor neighborhoods structure risk for HIV/AIDS and STIs (Cohen et al., 2000; Wallace and Fullilove, 1991; Wilson and Kelling, 1989). According to the theory, the physical appearance of a neighborhood signals to residents what kinds of social behavior are acceptable. For example, a disorderly and littered environment suggests residents tolerate littering signaling to others that littering is an acceptable social norm. Using data from the 1990 and 1995 U.S. census, Cohen et al. (2000) examined the association between neighborhood characteristics and risk of gonorrhea. The researchers found a broken windows index, an aggregate measure of housing quality, abandoned cars, graffiti, trash, and public school deterioration, explained more of the variance in gonorrhea rates than did a poverty index measuring income, unemployment, and low education. In high-poverty neighborhoods, neighborhoods with high broken windows scores had significantly higher gonorrhea rates than neighborhoods with low broken windows scores (46.6 per 1000 vs. 25.8 per 1000; $P < 0.001$). By drawing on the built environment and broken windows theory this paper explores how neighborhood characteristics are central to the understanding of sexual risk behavior. We go as far as to posit that sexual risk behavior in South Africa is a multi-layered, geographically-situated, historically-specific practice that is simultaneously material and symbolically produced and articulated through the built environment. In other words, places such as neighborhoods are socially constructed in contexts of unequal distribution of power relations and resources; and further the built environment as a structural phenomenon may contribute to the reproduction and maintenance of spatially derived sexual risk environments. Consequently, the built environment may operate as a direct effect which shapes access to resources that can be used to avoid risks or to minimize the consequences of sexual risk behavior. We assert that the experience of neighborhoods and the effects and meanings attached to these places give needed insight into the differential effects of neighborhood characteristics on youth sexual risk behavior.

Dramatic urbanization trends and the growth of urban slum settlements unsuitable for human habitation in sub-Saharan Africa makes it imperative that we better understand to what extent neighborhoods both offer opportunities for, and constrain sexual risk behavior, particularly in South Africa given its distorted, racially-determined spatial framework. The origin and nature of the post-Apartheid city's spatial framework often expressed in binaries of relations of power (e.g. black/white, ruling class/working class, rich/poor, male/female, developed/undeveloped) is derived out of regimes of structural inequalities mediated through more than 300 years of Colonialism and Apartheid practices (e.g. rural to urban labor migration, labor segmentation, forced removals, residential segregation). Twenty years after the end of Apartheid, South African cities remain profoundly segregated, divided and unequal reflecting previously codified racial divisions in housing, employment, education, public utilities and infrastructure. According to the United Nations (2009), South Africa ranked #5 on its Human Development Index with a gini coefficient of 0.578, indicating high income inequality. Only the Comoros, Haiti, Angola, and Bolivia are ranked higher. The gini coefficient is a common measure of the concentration of income inequality with values ranging from 0 to 1, where zero corresponds to perfect equality and 1 is complete inequality. In South Africa, HIV prevalence rates are highest in townships and urban informal settlements, where it is estimated that as many as one in five (21.6%) residents are HIV-positive (Shishana et al., 2009). While 8.7% of the total South African population aged 2 years and above lives in urban informal settlements/slums, they represent 29.1% of the total estimated number of new HIV infections (Rehle et al., 2007). Given the presence of large numbers of people living in slum conditions, combined with high HIV prevalence among them, any critical analysis of HIV related sexual risk behavior must take account of the spatial effects of Apartheid planning.

1.2. A conceptual model for sexual risk behavior

1.2.1. Political-economic structure—The fundamental premise of our model shown in Fig. 1 is that broader dynamic and interactive social, political, and economic processes structure access to societal resources which are mediated through the built environment, and these potentially influence decision-making around sexual behavior. Relative material deprivation in the form of limited access to opportunity structures, particularly adequate housing and basic services, has profound implications for the health and well-being of urban residents (Lynch et al., 2000; Sen, 2001; Krieger, 2003). This model employs a neo-materialist interpretation which states that health inequalities stem from differential accumulation of exposures and experiences that have their origins in the material world (Marmot and Wilkinson, 2006) (Social Determinants of Health). It draws inspiration from Farmer's Theory of Structural Violence (Farmer, 2005, 1996); Geronimus' Weathering Theory (Geronimus, 2001); and Diez-Roux's work on neighborhood effects (Diez Roux, 2001). The first construct is centrally concerned with upstream, macro-level forces that generate the urban built environment and the emergent structural conditions in the construction of cities and regions. Structural violence theory provides a useful theoretical lens to shed light on the spatial legacies of Apartheid policies and its profound impact on patterns of sexual dynamics in post-Apartheid South Africa. Most importantly, the concept illuminates the impact of political power differentials and social and economic policies i.e. land dispossession, urban migration, distorted spatial/gendered settlement patterns and skewed infrastructure investments in the provision of public services (water, electricity) and public goods (housing, transportation, public health) at the neighborhood level. The articulation of these structural processes will translate to features of the places and the material conditions in which people live and work, subsequently either protecting or exposing residents to public health risk.

1.2.2. Neighborhood environment—The second construct represents the neighborhood built environment which is derived out of a combination of historical, cultural, and political-economic processes and events. Neighborhood Effects theory explicitly acknowledges that social influences on health operate through many different processes, one of which may be the types of area or residential environment in which people reside (Diez Roux, 2001). The proliferation of urban slum settlements and a lack of social investments in service provision and infrastructure to address rapid urbanization reveal the spatial effects of Apartheid planning, specifically intensifying poverty levels and increasing exposure to sexual vulnerability among the expanding urban population. Utilizing a framework that separates the neighborhood built environment from its structural antecedents and outcomes offers the opportunity for a thorough examination of neighborhood structural disadvantage, or new ways of conceptualizing existing factors which contribute to our understanding of adolescent sexual behavior. The built environment interpretation proposes that structural factors are paramount in understanding the health effects of sexual risk behavior and exposure to relative deprivation in the form of a poor quality built environment, influencing the extent to which a youth is willing and/or able to adhere to safer sex practices.

1.2.3. Social environment context—As illustrated in the model, a third pathway shows how neighborhoods can shape or constrain local informal social controls and residents' ability to effectively mobilize and implement shared goals around pro-social sexual behavior (Billy and Moore, 1992; Brewster et al., 1993). Social disorganization, measured as social control or mistrust, has been shown to mediate sexual risk behavior suggesting that the higher the level of structural deficits in the neighborhood the greater the likelihood that social disorganization will be associated with sexual risk behavior (Leventhal and Brooks-Gunn, 2003). The effects of the built environment on health may be interacting with individual-level characteristics, revealing a greater overall impact of sexual risk behavior. If

the effects are interactive, the results may reveal that the differential vulnerability on poorer, urban residents is partially dependent on characteristics of their built environments. Again we recognize the impact of social organization in moderating the association of the built environment and sexual behavior, but wish to reinforce that it is the underlying material conditions influencing individual sexual behavior.

1.2.4. Stress effects—The fourth construct, the concept of stress, is included in the model, as studies have shown that the impacts of negative physical environments may become embodied within individuals generating long term health effects in the form of allostatic load (Krieger, 2003; Geronimus et al., 2006; McEwen and Seeman, 1999). Previous studies have shown that children who face cumulative risk, i.e., environmental risk (poor housing quality, noise and pollution) and/or sociocultural risk (poverty, racism, family turmoil, crime, and violence) have greater psychological distress and poorer health outcomes over the lifecourse (Evans and Kim, 2007; Seeman et al., 2004). The active and ongoing adjustments necessary to deal with multiple social and physical challenges posed by a deteriorating built environment can cause wear and tear on vulnerable populations constraining a youth's ability to adhere to proscribed normative sexual behavior and practices. The model construct of stress helps us to better understand how the built environment may function as a potential source of stressors (e.g., lack of public transportation or open sewers) as well as a source of support (e.g., after school programs or parks/playgrounds) (Wells and Harris, 2007; Evans and English, 2002). While we do not deny negative psychosocial consequences of the built environment, we caution that the interpretation of links between neighborhood effects and sexual risk behavior must begin with structural causes. The political-economic processes structuring the built environment exist before these effects are experienced at the individual level. The use of arrows in Fig. 1 between the different constructs illustrates the interactive and dynamic nature of the proximate factors in influencing youth sexual risk behavior.

1.2.5. Data and methods—The Cape Area Panel Study (CAPS) is a longitudinal study of the lives of youth and young adults aged 14–22 in metropolitan Cape Town, South Africa. Initiated in 2002, the study includes 4800 randomly selected young people, and includes data on sexual behavior, social proximity to HIV infection and death, household social capital, and material resources. Data for this study were collected by the Population Studies Centre in the Institute for Social Research and the Centre for Social Research at the University of Cape Town in 2002. The CAPS data is based on 405 enumeration areas (EAs) or census tracts.

1.3. Neighborhood socioeconomic indicators

Measures of the built environment were assessed using self-report of four commonly-used municipal services i.e. access to water, sanitation, electricity, and housing quality. Access to water, sanitation, and electricity are dichotomous variables coded (0 = no, yes = 1). Other built environment measures included housing quality, a dichotomous variable coded (0 = temporary, 1 = permanent), which assessed the structural integrity of the wall materials; and the number of rooms, a three category variable (coded 0 = 1 room, 1 = two to six rooms and 2 = seven or more rooms).

Exploratory factor analysis was used to construct a built environment index (BEI) to assess the individual-level access to municipal services and residential characteristics and conditions beyond socio-demographic factors. The empirical measure of each element is based on the presence or absence and/or type of various material assets in the household. These assets vary from one individual to another depending on the availability of services and the residential character specific to that particular locale. The index is comprised of 8

household material assets including: (1) type of water source; (2) type of sanitation facilities; (3) access to electricity; (4) type of housing structure (wall materials) (permanent/temporary); (5) type of roofing materials (temporary/permanent); (6) type of residential area where respondent lived the majority of life (formal, informal); (7) housing tenure (own/rent); and (8) the number of rooms in the house. Using SPSS, a TwoStep Cluster Analysis was employed to construct the built environment index. This scale is designed to reveal natural groupings or clusters within the dataset. The built environment index is divided into 3 strata by degree of spatial degradation: (1) low, (2) medium, and (3) high. The lower the quality of the built environment the more spatial degradation the individual is exposed to at the individual-level.

1.3.1. Individual socio-demographic covariates—Individual baseline characteristics include educational attainment as a dichotomous value which was used to determine if the respondent is at the appropriate grade level for their reported age (0 = at grade level or 1 year below; 1 = two or more years below grade level); race (0 = White; 1 = Black African; 2 = Colored—a racial category used in South Africa to identify persons of mixed race ancestry); income was examined using a dichotomous variable (0 = less than R207/month or ~\$35; 1 = greater than R207/month).

1.3.2. Dependent variables—The outcome variables for this study are based on reported use of condom at last sex and the number of partners in the past 12 months. From these analyses dichotomous variables were created: for condom use at last sex (0 = no; 1 = yes); for number of sexual partners in past 12 months (0 = one or less; 1 = two or more).

1.3.3. Analytic approach—The analysis is divided into two stages: descriptive and analytic. First, a descriptive analysis of means and percentage distributions of SES indicators was conducted. Next, chi square tests are used to assess the significance of between-group differences. Additionally, multivariate logistic regression analyses relating built environment indicators to condom usage at last intercourse and number of sexual partners, adjusted for personal SES indicators, and socio-demographic characteristics (age, race, income, and gender). The multivariate logistic regression analysis was then conducted for the following household characteristics: (1) housing quality/size, (2) access to water, (3) access to electricity, and (4) access to sanitation.

For two-tailed tests of the null hypothesis that odds ratio = 1, a multivariate logistic regression model was fitted to evaluate the relationship between individual-level access to key basic services adjusted for socio-demographic variables (with condom use at last sex and the number of partners in the past 12 months coded as “1”). Adjusted odds ratios (OR) and their corresponding 95% confidence intervals were calculated. The stepwise procedure (backward elimination) was chosen to select variables to be entered into the final model. The analysis employs STATA v.12 statistical software to account for multistage sampling design and to adjust standard errors and 95% confidence intervals for homogeneity within sampling clusters. All tabulations and regressions are based on weighted data. All participants gave written informed consent and the Institutional Review Boards of participating universities approved all study protocols.

1.3.4. Descriptive results—Table 1 presents a population (race, sex) break-down of socio-demographic and household characteristics as they relate to the built environment; here also are data on sexual behaviors, i.e., the number and percentage of those who used a condom at last sex, and the number of sexual partners in the past 12 months. The CAPS survey shows markedly different patterns by race on a number of socio-demographic characteristics. Data on educational outcomes show significant disadvantage by race; almost

two-thirds (62.5%) of Blacks were 2 or more years below the expected grade level. Poverty was high among Blacks with 36% of Blacks in the lower quintile of the income category compared to 9.75% of Coloureds and 0.98% percent of Whites.

Similarly, there are vast differences in the types of neighborhood by race. Black youth (19.2%) were more likely to live in neighborhoods characterized by neighborhood structural disadvantage, as measured by grade of sanitation, access to water and electricity; housing quality (wall materials); number of rooms; and a composite built environment index (BEI). The majority of Blacks (54.4%) live in inadequate structures or shacks made of temporary materials, compared to 3% of Whites and 9% of Colored youth. Whites and Coloureds have far better access to municipal services, nearing 100% in access to water, private indoor toilets, and electricity. However the situation for Blacks was vastly different, with 56% of Blacks without an indoor water source, 10.4% without access to any sanitation facilities and 16.3% lack access to electricity.

Data on sexual risk behavior shows Colored youth were least likely to use a condom at last sex (63.1%), followed by Blacks (73.1%), and Whites (95.1%). Nearly a third (31.5%) of Black youth reported having 2 or more sexual partners in the past 12 months, compared to 25.4% of Whites, and 23.3% of Colored youth.

Table 1 also presents additional subgroup percentages by sex. females were less likely than males to have used a condom at last sex (67.7%, 78.4% respectively), and over twice as many males had more than 2 or more sexual partners in the past 12 months month compared to females (43.1%, 16.9% respectively). In terms of educational attainment females appear to be more disadvantaged, with 48.8% of males and 56% of females two or more years below the expected grade level. females (21.8%) are slightly more likely than males (20.2%) to come from families that fall in the lowest income category.

While both males and females reside in poor quality residential built environments (females 21.8%, males 20.4%), more females live in poor quality housing, made of temporary materials, compared to males (females 32.7%, males 26.5%), and females are less likely to have access to indoor sanitation than males. Sex differences across other indicators are small, but they continue to persist in access to piped indoor water and access to electricity.

1.3.5. Predictors of condom use at last sex and multiple sexual partners—The percentages and unadjusted odds of youth self-reported condom use at last sex are presented in Table 2. In unadjusted models, self-report of condom use at last sex is significantly associated with the following socio-demographic variables: race, sex, age, income and education. If you are Black or Colored, your likelihood of using a condom is significantly reduced, relative to Whites. For both Blacks and Coloureds, self-reported condom use was negatively associated with race (at $p < 0.001$), with OR relative to Whites of 0.10 and 0.16, respectively. Also, females were significantly less likely to have used a condom at last sex compared to males. Being in the lowest income quintile is negatively associated with self-report condom use at last sex. Moreover, if you are 16–18 years old, you are about 75% more likely to use a condom compared to 14–15 years old. And youth who are two or more years below their expected grade level are 52% less likely to have used a condom at last sex.

In addition, several household level built environment indicators are associated with condom use. No access to electricity is significantly associated with decreased condom use at last sex at the $p = 0.000$, OR = 0.53 (95% CI 0.38, 0.74). Also, if you live in a home with 7 or more rooms, you are more than two and half times more likely to have used a condom at last sex. Furthermore, there is a significant association with self-report condom use at last sex and the

built environment index variable. Youth who fall into the low category on the built environment are significantly less likely to use a condom at last sex.

Table 2 also shows percentages and unadjusted odds of having one or no sexual partners in the past 12 months. There was less overall variation in these outcomes, with no significant differences by race, age or income. Large and significant differences were evident by sex and education. Females were more than three times as likely as males to report only one or no sexual partners in the past 12 months. The odds of having one or no partner in the past year decreases if you are 2 or more years below your expected grade level. Of the household characteristics examined, access to water, electricity and housing type affected the odds of having one or no sexual partner (versus 2 or more) in the past 12 months. The odds of having one or no sexual partner decreased for those without indoor, piped water. The type of sanitation facility used did not bear any association to the number of sexual partners. The odds of having one or no sexual partner for a youth who resides in a larger house (7 or more rooms) was 37% greater compared to those who lived in a one room shack. Similarly, youth living in a neighborhood with poor quality built environment was more likely to have multiple sexual partners.

Turning to determinants for multiple sexual partners in the past 12 months (Table 3), Race is not a significant predictor of number of sexual partners. This finding is consonant with studies which have shown the complex and dynamic factors influencing youth sexual behavior (Furstenberg, 2007). Income was not significantly associated with the number of sexual partners and subsequently not included in the multivariate analysis. Also, males are at more risk of multiple partners than females. The findings suggest youth living in temporary housing are less likely to have only one or no sexual partner compared to those who live in permanent structures. No other individual built environment indicators were significant. Model G excludes the education variable and housing quality increases in significance, suggesting 44% lower odds of having one or no sexual partner. Model H reveal youth who score high on residential built environment quality are at lower risk of having multiple partners.

1.3.6. Multivariate logistic regression results—Table 3 provides findings from multivariate analyses of the factors that may predict condom use and multiple sexual partners. First, we turn to the condom use at last sex as the outcome variable. According to the unadjusted analysis, the following socio-demographic factors were associated with condom use: race, gender, education, age, income, sanitation, electricity, and number of rooms in the house. Table 3 displays six models: (A) only socio-demographic indicators, (B) adds built environment covariates, and (C) adds the built environment index (BEI). Prior to adding the built environment variables, we assessed the correlations between access to sanitation, water and sexual risk-taking behavior; however, associations were not significant. In addition to sanitation and water, education and income were dropped from Model B as they were not significantly associated with self-report condom use at last sex.

Model A controls for race, sex, education, age, and income. Results show that Black and Colored youth are significantly less likely to have used a condom at last sex than their white counterparts. If you are Black, there is a 70% decrease in the odds of you using a condom at last sex relative to Whites, and for Coloureds an 84% decrease in the odds of using a condom. Females are only half as likely as males to use a condom at last sex. The youngest are the least likely to use condoms, with 16–18 years old twice as likely to use a condom at last sex compared to 14–15 years old. Youth residing in higher income households were 50% more likely to use a condom at last sex.

Consistent with expectations derived from the literature on the consequences of neighborhood effects, Model B suggests youths who live in houses with 7 or more rooms, net of demographic factors, are almost twice as likely to use a condom at last sex compared to those who live in a one room house at $p = 0.000$, OR 1.89 (CI 1.14, 3.13). The independent associations between electricity, number of rooms, and condom use at last sex are persistent and robust. Those residing in a household without access to electricity are 40% less likely to use a condom at last sex. Moreover, those residing in a house with 7 or more rooms are 69% more likely to use a condom at last sex. These results suggest that access to electricity and housing size have a significant influence on sexual risk-taking behavior independent of socio-demographic indicators. Lastly, the results reveal a strong association between residential built environment and condom use at last sex. Youth who score high on built environment index are almost twice as likely to use a condom at last sex, net of sociodemographic variables.

1.3.7. Predictors of multiple sexual partners—Turning to determinants for multiple sexual partners in the past 12 months (Table 3), race is not a significant predictor of number of sexual partners. This finding is consonant with studies which have shown the complex and dynamic factors influencing youth sexual behavior (Furstenberg, 2007). Income was not significantly associated with the number of sexual partners and subsequently not included in the multivariate analysis. Also, males are at more risk of multiple partners than females. The findings suggest youth living in temporary housing are less likely to have only one or no sexual partner compared to those who live in permanent structures. No other individual built environment indicators were significant. Model E excludes the education variable and housing quality increases in significance, suggesting 30% lower odds of having one or no sexual partner. Model F reveals that youth who score high on residential built environment quality are at lower risk of having multiple partners.

1.3.8. Reported condom use and multiple sexual partners among males, females—Given the evidence that characteristics of the neighborhood may differentially impact sex, Table 4 provides regression models predicting the odds of condom use and multiple sexual partners estimated separately for males and females. Separate models allow us to determine whether other predictor variables relate to condom use (or no. of sexual partners) for males and females. Table 4 displays the results of the sex-disaggregated analysis. There were significant differences between males and females in relationship to condom use at last sex. Among females, race and educational attainment persist as significant predictors of condom use at last sex, and individual-level built environment indicators, specifically housing size and electricity, are significantly associated with condom use patterns among females. In fact, the positive relationship between individual-level access to key basic services and condom use behavior is stronger for females than males. Results for males suggest a strong age effect with increasing condom use at older teen ages. For example, Black males in age groups 16–18 and 19–22 years are 4 and 3 times, respectively, more likely to use a condom at last sex than the youngest males whereas, girls are less likely to use a condom with increasing age cohorts. Grade level parity is also important for males, and the relationship between race and sexual risk-taking behavior is stronger among males, particularly for Black males. The built environment, however, has no measurable impact on male sexual behavior when they are alone in the model.

Table 4 also presents the odds of having only one or no sexual partner in the past 12 months. Again, there are marked differences in factors between males and females in regard to which indicators predict the odds of having only one or no sexual partner. For instance, in these smaller sex-specific analyses, Colored females are almost three times as likely to report one or no sexual partners compared to White females, and there are no statistically meaningful effects of race among males. Individual access to key basic services was found to predict

multiple sexual partners for males only. Young males in temporary housing were 40% less likely to have only one or no sexual partner and males with a yard tap as their primary source of water had more sexual partners.

2. Discussion

South Africa has been severely impacted by the epidemic with an estimated 5 million persons living with HIV/AIDS, representing the largest number of cases than any other country in the world (UNAIDS, 2009). The fact that South Africa is ranked as a upper-middle-income by the World Bank (2011) tends to mask the role of racialized sexual geographies due to Apartheid social engineering, political unrest, war, spatial planning and the migrant labor system. The analysis presented in this study reveals that features of poor urban neighborhoods, expressed by access to key basic services, influence youth sexual risk behavior. The findings suggest that youth sexual risk behavior and the explosion of HIV/AIDS must be seen in the context of broader geographical, historical, socio-political and economic processes which may influence decision-making around sexual behavior (Farmer, 2005, 1996; Sen, 2001; Parker et al., 2000).

Sexual risk-taking must be seen as a response to the constant exposure to an adverse spatial configuration and economic deprivation of South African society which engenders polarized and contrasting structural conditions of obscene wealth and devastating poverty. This study integrated both theoretical and empirical insights to elucidate the current HIV risk factors in South Africa by incorporating neighborhood effects and heterogeneity in individual level access to basic services. These findings support our hypothesis that differences in the quality of the built environment and access to basic services of young people does have consistent effects in explaining differentials in sexual risk behavior. The lack of access to affordable basic services constitutes a physical environment that militates against a youth's decision to adhere to health-promoting sexual behavior. Youth residing in more structurally deprived residential conditions have more partners, and are less likely to use condoms.

Our findings suggest females living in poorer neighborhoods are more likely than males not to use a condom and males are more likely to have more sexual partners. Research on masculinities in South Africa supports the link between gender structural inequalities, and sexual risk behavior rooted in the political economy induced by colonialism, migrant labor, and Apartheid (Hunter, 2002; Morrell, 1998). Basu's delineation of the current public health approach to HIV prevention reveals the intimate and contingent relations between political economy and sexual risk behavior in driving the HIV pandemic (Basu, 2004). In the South African context where there is a history of racially-determined and gender-based differentiation in urban infrastructure provision, youth and poor black females, in particular, often live in neighborhoods where they are excluded from economic processes of the city and access to municipal service delivery systems (Bekker et al., 2008; Twenge et al., 2007; Northridge et al., 2003). According to the 2010 census, only 54% of households had universal access to basic services, and female headed households were less likely than their male headed counterparts to have access to water, adequate sanitation, or access to refuse or waste removal (Statistics South Africa, 2010).

Sexual networks characterized by multiple concurrent sexual partners have been shown to be a significant factor in driving the AIDS pandemic (HSRC, 2002). Hunter (2002) found that men in the face of high rates of unemployment and low wages who are unable to 'succeed' at traditional forms of manhood, i.e. a secured marriage, enact multiple partnered relations in order to demonstrate masculinity. Moreover, research on gender and HIV in sub-Saharan Africa shows while more women may be employed, generally they are employed in low-wage jobs and the few men who are working are often employed in industries where

they receive higher wages (Hunter, 2004; Schoepf, 1988; Setel, 1999). Gender disparity in wages and employment, exacerbated by tight government spending in a climate of austerity, structure risk of AIDS by fostering gender relations where men have access to multiple sexual partners who are economically dependent.

This study is particularly timely, given recent debates and protests emerging in municipalities throughout South Africa and elsewhere in the aftermath of urban policies to privatize utilities that price water and other basic services out of the reach for majority of the poor (UN, 2008, 2009). A recent study on South African municipality performance documents the trends in both frequency and level of violence of civil disturbances regarding the lack of access to basic services. Between 2007 and 2010, the number of protests for improved municipal service delivery systems doubled from 8.3% to 16.7% (Jain, 2010). Across much of the global South the trend is towards ever more urbanization where the majority of the world's population now lives. It is estimated by 2030, the world's urban population will increase to 60% with the slum or informal settlement becoming the central feature of the urban landscape (UN-Habitat, 2011). Globally, hundreds of millions of people live in urban areas that lack access to essential services which are critical to enable the poor to overcome the deprivations of extreme poverty (UNICEF, 2011; United Nations, 2008). Previous research has shown that a high rate of neighborhood deprivation fosters institutional disruption and social control influencing youth behavior (Moore, 2003; Billy et al., 1994). Our findings suggest that the built environment may also weaken self-efficacy and pro-social behavior for youth at a critical stage of sexual and social development.

The built environment, here defined as access to key basic services, is significantly associated with sexual risk-taking behavior among youth in Cape Town, South Africa. This analysis explicitly recognizes the geographical nature of the link between neighborhood access to key basic services at the individual- and household-level, and incorporates these linked distinctions into the analysis. The results of the study show that explanations of HIV/AIDS risk that rely solely on individual social background factors are incomplete; structural poverty, in particular the distribution of basic services, contributes significantly to the perpetuation of HIV-related behavioral risk within urban townships. The present study extends and operationalizes theories of place, in which features of residential environments shape individual sexual risk behavior to HIV/AIDS and helps to explain the results here (Maas et al., 2007; Farmer, 2005; Cohen et al., 2000; Szwarcwald et al., 2000). The findings are also consistent with work on neighborhood effects emphasizing the role of place in structuring risk to HIV (Cohen et al., 2003). The extent to which these neighborhood built environment indicators promote sexual risk behavior warrants further investigation.

The major findings in this study are that youth are more likely to engage in sexual risk behavior if they reside in an urban poor household characterized by a high concentration of material disadvantage, specifically represented by a low quality built environment. The effect of poor access to key basic services operates at both the individual- and household-level emphasizing the negative relationship between lack of access to municipal services and HIV-related sexual risk. A weakened built environment, particularly low rates of electricity and access to water at the neighborhood-level, significantly reduces the odds of using a condom at last sex, and the odds of having only one or no sexual partner in the last 12 months.

The study also suggests the importance of neighborhood type in relation to sexual risk-taking. While youths may live in a better-off household with access to key basic services, they are not able to alter the interactions within the larger neighborhood structural environment in which they are embedded (Sampon et al., 2002; Jencks and Mayer, 1990). Our bodies and by extension behaviors are influenced by where we live, the degree and

frequency of stressors we experience, the quality and quantity of resources we can access, and the support or lack of support we derive from the community (Kawachi and Berkman, 2003; Krieger, 2000). The study further points to the influence of the built environment as it interacts with the individual to decrease the odds of engaging in pro-social sexual behavior. Theorized mechanisms by which neighborhoods influence sexual risk behavior include mediation by SES including concentrated poverty, residential instability and social capital (Leventhal and Brooks-Gunn, 2003; Browning and Cagney, 2003). The modeling of both individual combined with neighborhood built environment variables lends greater strength to the findings. A mixed methods study undertaken in Nigeria included qualitative interviews with young men who highlighted the lack of social or recreational structures as a constraint to safer sexual behavior, and in the interviews men made specific references to the lack of electricity or piped water interfering with organized social activities in the urban slums, and indirectly contributing to sexual and social risk (Adedimeji et al., 2007).

This study has several limitations. One limitation is that the reported findings are from a cross-sectional study with a study design that precluded causal interpretations. Future studies using longitudinal data with different measures of the built environment are needed to confirm findings in this study. Also, this study focuses on the internal characteristics of the household, but does not consider the broader spatial aspects at the neighborhood level and its relationship to sexual risk behavior. More research is needed to untangle the complex relationships between neighborhood inequality and sexual risk behavior. Regarding future studies, it is notable that South Africa, particularly the City of Cape Town, is in the implementation phase of a large scale development initiative involving infrastructural projects to alleviate service delivery backlogs. Recent estimates of infrastructural backlogs in Cape Town, where this study takes place, show significant gaps in access to basic services highlighting unequal distribution of municipal service delivery. The following are rates of access to key basic services: sanitation (61.4%), water (63.8%), electricity (80.5%), adequate housing (70.5%) (Children's Institute, University of Cape Town, 2010). According to the 2004/2005 City of Cape Town Annual Report there was an estimated housing backlog of 250,000 houses. The infrastructural backlog dramatizes the structural inequalities and the challenges of providing affordable, quality housing and infrastructure. Although the material conditions for slum populations in South Africa are alarming, it is important to acknowledge that other places with larger slum populations (e.g. Delhi or Lagos) are a lot worse and yet South Africa has the highest HIV rates in the world (UN, 2009). However it is worth noting, the evidence regarding structural inequalities and psychosocial effects of racism and discrimination raises some important questions and may help in understanding the differential impacts of neighborhoods on sexual risk behavior between countries (Lynch et al., 2004; Subramanian et al., 2003).

The findings of this study have three important implications for future research. First, the findings expand the scope of social determinants of HIV-related risk studies to elucidate the relationship between spatial aspects of the neighborhood and sexual risk behavior. Second, the findings suggest that features of the neighborhood may promote or hinder one's ability to adhere to pro-social sexual behavior. Researchers can further elucidate the impact of neighborhood effects on sexual risk behavior by analyzing features of the built environment both within- and across-multiple neighborhoods. Finally, from a public health perspective, understanding the mechanisms through which the built environment affects sexual risk behavior may prove useful when designing community HIV prevention interventions; especially in resource-constrained settings, where standards of the built environment oftentimes vary in terms of provision of services, facilities and infrastructure, and the availability of quality, affordable housing.

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Fig. 1.
Determinants of youth sexual risk behavior in Cape Town, South Africa.

Table 1

Descriptive statistics by race and sex.

Population group	White		Colored		Black		Male		Female	
	%	n	%	n	%	n	%	n	%	n
Condom use at last sex										
No	4.9	8	36.9	229	26.9	334	21.6	206	32.3	366
Yes	95.1	156	63.1	391	73.1	906	78.4	692	67.7	766
# of partners										
0–1	74.5	120	76.7	495	68.5	885	56.88	529	83.1	977
2 or more	25.5	41	23.3	150	31.5	407	43.12	401	16.9	198
Educational attainment										
At grade level	90.3	106	43.4	246	37.5	440	51.2	1,074	44.3	1,086
Two years below	9.7	10	56.6	346	62.5	746	48.8	997	55.7	1,366
Income										
1st Quintile (lowest)	0.4	5	9.7	183	36.3	763	20.2	411	21.8	542
2nd Quintile	0.4	7	16.4	306	29.0	611	19.9	404	21.2	527
3rd Quintile	2.6	10	23.0	431	18.9	400	17.4	355	19.8	491
4th Quintile	52.1	87	29.3	550	12.4	261	19.9	404	17.2	428
5th Quintile	44.7	58	21.6	406	3.4	72	22.6	461	19.9	494
Basic services										
Sanitation										
Toilet (Indoor)	100	595	96.36	1,905	80.7	1,729	91.5	1,953	88.3	2,302
Latrine	0	0	2.43	48	10.8	232	4.1	88	7.4	193
None	0	0	1.21	24	8.5	181	4.4	93	4.3	112
Water										
Piped indoor	100	593	92.47	1,871	32.6	685	68.4	1,447	65.08	1,671
Yard	0	0	6.51	128	45.4	958	22.7	481	23.4	603
Public pump	0	0	1.02	20	10.4	220	8.9	187	11.53	297
Housing quality (wall materials)										
Permanent	96.6	575	90.6	1,756	45.6	961	73.5	1,545	72.3	1,773
Temporary	3.4	20	9.4	182	54.4	1,153	26.5	556	32.7	800
Housing (# of rooms)										

Population group	White		Colored		Black		Male		Female	
	%	n	%	n	%	n	%	n	%	n
1 room	3.9	23	2.2	18	17.0	382	7.3	156	8.7	227
2-6 rooms	22.7	135	77.4	1,532	73.3	1,628	69.4	1,485	69.7	1,821
7 or more	73.5	45	20.4	403	9.7	210	23.3	499	21.6	566
Electricity										
Yes	99.3	591	97.2	1,922	83.7	1,794	92.6	1,979	85.2	2,354
No	0.7	4	2.8	55	16.3	350	7.4	157	14.8	410
Built environment index										
Low (Poor quality)	0	0	1.2	21	19.2	366	20.4	397	21.8	1,786
Medium	0	0	2.3	61	45.0	857	21.8	424	19.6	58
High	27.7	157	30.8	567	8.5	161	50.9	990	48.1	14
Very high (good quality)	72.3	409	64.7	1,191	27.3	519	6.9	135	10.5	252

Table 2

Socio-demographic characteristics and housing conditions and the unadjusted odds (OR) for condom use at last sex and reporting one or no sexual partners in the last 12 months, Cape Town, South Africa.

	% Using condom at last sex				% Reporting 1 or no sexual partners			
	N	%	O.R.	95% C.I.	N	%	O.R.	95% C.I.
Socio-demographic characteristics								
Race								
White	164	95.1			161	74.5		
Coloured	620	63.0	0.10****	0.04–0.23	645	76.7	1.03	0.64–1.66
Black	1240	73.0	0.16****	0.07–0.34	1292	68.5	0.69**	0.44–1.09
Sex								
Male	898	77.0			930	56.9		
Female	1132	67.7	0.56****	0.44–0.70	1175	83.2	3.69***	2.84–4.79
Age (years)								
14–15	79	64.6			86	77.9		
16–18	574	75.4	1.77***	1.09–3.14	610	70.2	0.77**	0.41–1.43
19–22	1377	70.7	1.50	0.86–2.16	1409	71.8	0.90	0.48–1.68
Income								
Lowest quintile	289	69.0			295	73.4		
All others	1666	87.2	3.28****	2.24–4.81	1738	70.9	1.12	1.04–4.81
Education								
At grade level	796	77.8			826	74.3		
> 2 yr below grade level	1103	66.4	0.48****	0.14–1.22	1145	69.1	0.77***	0.61–0.97
Household Characteristics								
Housing (Size)								
1 room (shack)	151	66.5			151	66.52		
2–6 rooms	1084	70.6	1.22**	0.86–1.72	1,084	70.62	1.28**	0.86–1.64
7 or more	1529	81.2	2.64***	1.71–4.09	1,529	81.19	1.37***	0.43–0.96
Water								
Indoor piped water	1146	60.9			1077	73.2		

	% Using condom at last sex				% Reporting 1 or no sexual partners			
	N	%	O.R.	95% C.I.	N	%	O.R.	95% C.I.
<i>Piped yard</i>	668	45.2	0.69**	0.00–1.38	201	69.2	0.87*	0.61–0.98
<i>Public tap/none</i>	341	37.3	0.24**	0.33–1.45	96	69.3	0.77***	0.55–1.08
Sanitation								
<i>Indoor toilet (ref)</i>	1729	72.60			1848	54.9		
<i>Latrine/none</i>	296	67.20	0.70**	0.49–0.98	309	45.5	0.89	0.37–1.34
Electricity								
<i>Yes</i>	1782	73.20			1842	71.40		
<i>No</i>	244	61.50	0.53***	0.38–0.74	259	71.80	0.98	0.68–1.41
Built environment index (BEI)								
<i>Very high</i>	535	74.2						
<i>High</i>	350	70.3	0.95	0.66–1.35	612	74.5		
<i>Medium</i>	709	73.5	1.04	0.75–1.43	457	70.6	0.77*	0.56–1.06
<i>Low</i>	245	65.0	0.63***	0.43–0.93	255	66.3	0.57***	0.39–0.82

Note: O.R. = odds ratio; C.I. = confidence interval.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

**** $p < 0.001$.

Table 3

Multiple logistic regression models examining social and built environment predictors of condom use at last sex, and the likelihood of having one or no sexual partners in the past 12 months, Cape Town, South Africa.

Condom use at last sex				Number of sexual partners in last 12 months ^a								
Model A		Model B		Model C		Model D		Model E		Model F		
O.R.	C.I.	O.R.	C.I.	O.R.	C.I.	O.R.	C.I.	O.R.	C.I.	O.R.	C.I.	
Race												
White												
Coloured	0.16***	0.06–0.47	0.12	0.04–0.34	0.11***	0.06–0.47	1.10	0.54–1.34	1.03	0.88–1.45	1.05	0.34–1.32
Black	0.3***	0.1–0.89	0.24*	0.08–0.69	0.19***	0.1–0.89	0.94	0.33–1.45	0.93	0.77–1.03	0.89	0.53–1.12
Gender												
Male												
Female	0.49***	0.39–0.63	0.50***	0.39–0.63	0.52***	0.39–0.63	4.13**	3.15–5.41	3.82***	2.94–4.96	5.27***	3.78–7.33
Income												
R 0–206												
>207	1.51**	0.99–2.34	1.09	0.55–1.23	1.03	0.45–1.45						
Age												
14–15 yr												
16–18 yr	2.07**	1.12–3.84	2.20**	1.2–4.11	2.19***	1.12–3.81						
19–22 yr	1.5	0.8–2.58	1.61	0.9–2.9	1.61	0.80–2.58						
Educational attainment												
At expected grade level												
Below grade level	0.57***	0.45–0.72					0.91	0.65–1.09			1.03	0.74–1.43
Built environment characteristics												
Housing (size)/1 room												
2–6 rooms			1.23	0.86–1.78								
>7 rooms			1.89***	0.14–3.13								
Housing type (permanent)												
Temporary									0.70**	0.51–1.59		
Sanitation (indoor toilet)												

<i>Condom use at last sex</i>				<i>Number of sexual partners in last 12 months^a</i>					
Model A		Model B		Model C		Model D		Model E	
O.R.	C.I.	O.R.	C.I.	O.R.	C.I.	O.R.	C.I.	O.R.	C.I.
Latrine/no toilet									
Electricity (yes)									
No		0.60 ***	0.43–0.83						
Water									
<i>Piped indoor</i>									
<i>Yard Tap</i>						0.94	0.64–1.21		
<i>Public</i>						0.88	0.32–2.23		
Built Environment Index									
<i>Low</i>									
<i>Medium</i>				0.87	0.69–1.24			0.72 **	0.51–1.04
<i>High</i>				1.89 ***	1.34–2.56			0.62 ***	0.4–0.90

Note: O.R. = odds ratio; C.I. = confidence interval.

I < 0.001

*
p < 0.10.

**
p < 0.05.

p < 0.001.

^a Odds of 1 or no sexual partners.

Table 4

Multiple logistic regression models examining predictors of condom use at last sex, and the likelihood of having one or no sexual partners in the past year; separate models presented for males and females, Cape Town, South Africa.

	Condom use at last sex				Number of sexual partners in last 12 Months ^{*a}							
	Females		Males		Females		Males					
	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.				
Individual characteristics												
Race												
White												
Coloured	0.12 ^{***}	0.03	0.41	0.11 ^{***}	0.01	0.85	3.17 ^{***}	1.63	6.11	0.89	0.77	2.88
Black	0.32 ^{***}	0.09	0.89	0.14 ^{***}	0.07	0.8	1.58	0.82	3.01	1.03	0.88	1.98
Age												
14–15 yr												
16–18 yr	1.15	0.49	2.67	3.93 ^{***}	1.61	9.18						
19–22 yr	0.81	0.36	1.79	3.12 ^{***}	1.43	6.82						
Educational attainment												
At expected grade level												
Below grade level	0.52 ^{***}	0.38	0.69	0.67 ^{***}	0.44	0.71	0.87	0.55	1.34	0.87	0.61	1.26
Built environment characteristics												
Housing (size)												
1 room												
2–6 rooms	1.36 ^{**}	0.86	2.11	1	0.58	1.72						
7 rooms	1.84 ^{***}	1.2	2.67	1.5	0.67	3.36						
Housing structure (wall materials)												
Permanent												
Temporary							0.91	0.51	1.61	0.60 ^{***}	0.41	0.88
Electricity												
Yes												
No	0.51 ^{***}	0.33	0.77	0.82	0.48	1.4	0.88	0.34	1.34	0.93	1.56	
Water												

	Condom use at last sex				Number of sexual partners in last 12 Months ^a			
	Females		Males		Females		Males	
	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.
<i>Indoor piped</i>								
<i>Yard tap/none</i>					0.85	0.77	1.34	1.28***
								1.13
								1.74
Sanitation								
<i>Indoor toilet</i>								
<i>Latrine/no toilet</i>	0.91	0.23	1.33	0.93	0.89	0.34	1.23	0.82
								0.22
								1.67

Note: O.R. = odds ratio; C.I. = confidence interval.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

**** $p < 0.001$.

^a Odds of 1 or no sexual partners.