Extended Abstract

Title: The Contribution of the Neighborhood Context to Young Adults' HIV Testing Behaviors

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Background

HIV testing is considered a critical element of HIV prevention as positive individuals aware of their status have the opportunity to modify their risk behaviors and hopefully, obtain earlier access to antiretroviral therapy (ART), both of which could reduce their infectivity to others and their own morbidity and mortality.[1,2] However, recommendations for universal HIV testing[3] and advances in rapid HIV screening have increased testing rates only marginally, even among vulnerable populations.[2] For example, according to our preliminary analyses of the National Survey of Family Growth (NSFG), in 2002 only 19.4% of young adults aged 18-26 years had been tested for HIV in the prior year. In 2006-2008, this proportion increased to only 20.4%. Follow-up of HIV testing results also is a concern as one study of a high-risk STD clinic population found 55% of those who were HIV tested failed to return for their results, including 58% of those who had tested positive.[4] These findings are consistent with Add Health STI data as one study found only 32% of young adults who were urine tested for chlamydia and gonorrhea called to obtain their results.[5] Rapid screening measures circumvent the need to return or call for initial results,[3,6] but currently their availability and use is not widespread. Furthermore, follow-up and verification of positive results also are needed,[7] including linkage to HIV care if positive results are confirmed as well as guidance on disclosure of HIV status to social support systems.[8-10]

Although Healthy People 2020 recently declared increasing HIV testing among young adults a national priority,[11] a better understanding of why rates remain low is imperative to achieve this goal. Currently, most studies on HIV testing have examined more proximal determinants, but a growing field of research has found neighborhood contexts play an important role in shaping adolescent and young adult sexual health.[12-19] However, to date, only two neighborhood studies of HIV testing have been conducted[20,21] although their findings suggests the social structure plays a substantial role, above and beyond individual characteristics. For example, in a cross-sectional study of Los Angeles County adults,[20] researchers found residents who lived in zip codes with higher concentrations of black/African Americans had a greater likelihood of HIV testing within the past 2 years. No significant differences in HIV testing were found for those adults living in zip codes with higher concentrations of other racial or ethnic groups, lower income or less educated residents or HIV testing sites. These findings suggest the greater likelihood of HIV testing among residents in African American communities may be due to increased public health HIV campaigns in communities known to be vulnerable to HIV. In the other study,[21] the researchers examined the influence of neighborhood socioeconomic disadvantage and HIV prevalence over time on lifetime HIV testing among a local sample of African American adolescents as they transitioned to young adulthood. Findings indicated African American youth who lived in neighborhoods with greater socioeconomic disadvantage were less likely to have ever been tested for HIV compared to their peers in more advantaged neighborhoods. According to theory[22,23] and prior research,[24,25] disadvantaged communities typically have fewer institutional resources, such as health care, which could impact HIV testing rates.

Although the findings of these studies illustrate the need for further investigation of the contextual influences on HIV testing, several limitations exist. First, both studies examined local samples, thus reducing generalizability of their findings. Second, both examined uptake of HIV testing only, but a better understanding of the factors that contribute to or hinder follow-up to HIV testing is imperative, particularly if rapid testing was not available or confirmation of positive testing results is needed. Third, the HIV testing outcomes in both studies were measured via self-report of past behavior, which could increase bias due to poor recall or social desirability. Therefore, the purpose of our research was to examine the contribution of the neighborhood social structure (racial and ethnic concentration, concentrated poverty and residential instability) to young adults' (1) uptake of HIV testing in the past

year, (2) uptake of free salivary HIV testing offered at the time of the interview and (3) active phone follow-up of the free salivary HIV testing results one month after the interview.

Theoretical Framework

Our study was guided by a blend of theories across disciplines to better understand to better understand the extent to which the neighborhood social structure contributes to young adults' HIV testing behaviors. First, the Aday and Andersen access to care framework is one of the most commonly recognized and utilized frameworks among health services researchers for examining the factors that influence access to and use of health care.[26-29] The framework has been revised numerous times since its inception due to advances in our understanding of the contribution of broader ecological forces to social disparities in health. The most recent conceptualization incorporates principles from both population and individual health models to highlight the need for an integration of micro and macro approaches to effectively inform health policy.[29] Although these advances in the framework enhance its utility to multilevel research on access to and use of health care, the mechanisms through which the macro environment influences micro-level processes, and ultimately, access to and use of health care are not well explicated. Thus, we apply aspects of social disorganization theory[22,23,30-33] and the ethnic enclave hypothesis[34-35] to facilitate our understanding. Specifically, social disorganization theory posits communities characterized by concentrated poverty, residential instability, and racial and ethnic heterogeneity are more likely to experience a wide range of problematic outcomes due to the associated weakening of social ties and informal social control capacities and reduced access to institutional resources, such as quality schools and health care. A long history of research supports the basic claims of social disorganization theory with respect to the effects of poverty and residential instability on the prevalence of risk behavior.[22,23] The role of community racial and ethnic composition in shaping behavioral outcomes, however, has proven to be more complex. Social disorganization theory hypothesizes racially and ethnically diverse neighborhoods weaken social ties between residents due to distrust of dissimilar "others" while homogeneity enhances community cohesion and facilitates recognition of shared norms and goals. [22,23,30-33] Prior research on the ethnic enclaves of Latino immigrant communities supports this hypothesis as residents have been found to have healthier behaviors and outcomes despite typically high levels of socioeconomic disadvantage. [34-35] However, evidence suggests segregated African American communities do not benefit from residential racial homogeneity as longstanding discrimination has limited the ability of these communities to procure institutional resources and to build strong informal social control capacities and shared norms and goals.[31] Recent research supports both theories' application to the explanation of neighborhood-level variations in a variety of sexual health outcomes, [12-19] as do the two neighborhood studies on HIV testing. [20,21]

Methods

Study Design and Sample

We used cross-sectional data from Add Health, Wave III (2001-2002)[36,37] to examine associations between young adults' contemporaneous neighborhood conditions and their HIV testing behaviors. Add Health is a school-based, longitudinal study of students in 7th-12th grade that utilized a multistage, stratified and clustered sampling design to ensure a nationally representative sample of U.S. schools with respect to region of country, urbanicity, school size, school type and ethnicity.[36,37] Four waves of data have been collected spanning from adolescence to young adulthood. Data are available from multiple sources, including adolescents, parents, partners, schools and communities. Wave 3 data were collected in 2001-2002 and included an in-home interview of those respondents from wave 1 who were able to be relocated and interviewed during the data collection time frame (N= 15,170).[36,37] The young adult data were collected via laptop computer to protect confidentiality. The interviewer read less sensitive items to the young adults and entered their responses into the computer. However for more sensitive topics, the young adults listened to the questions on an audio headset and then independently entered their responses directly into the computer. Interview items included information about sociodemographic factors, health and health behaviors, romantic and sexual relationships, pregnancies and health care access/utilization,

among others. In addition, free, confidential salivary HIV testing was conducted on consenting young adults who were then instructed to call a toll-free number 1 month after testing to obtain the results using their unique ID and password. Wave 3 neighborhood contextual data were derived by Add Health from the Census of Population and Housing, 2000: Summary Tape File 3A (STF 3A) and linked to the participant's geo-coded residential address.[36,37]

The sampling frame for our study included young adults who had sampling weights (N= 14,322). In addition, young adults who were missing data were excluded from analyses (n=1,288 or 9%) as researchers have shown that imputation methods would not perform better than listwise deletion based on the low proportion of missing data due to item non-response.[38,39] Thus, for our outcome measures uptake of HIV testing in the prior year and uptake of HIV testing at the time of the interview our sample consisted of 13,034 young adults across 5,425 neighborhoods. In addition, the sample for the outcome measure, follow-up of HIV testing results was a subsample of those young adults who consented to having HIV testing at the time of the interview for a total of 12,058 young adults across 5,121 neighborhoods.

Measures

Dependent Variables

Three dependent variables were examined: (1) *HIV testing in past 12 months* was a categorical measure based on participants' response to one item asking if they had been tested for "HIV infection or AIDS" in the past 12 months (yes=1); (2) *Uptake of free salivary HIV test at interview* was a categorical measure based on participants' consent for a free salivary HIV test collected on the day of the interview (yes=1), and (3) *Follow up of HIV testing* was a categorical measure based on participants' active phone follow-up of their HIV test results 1month after the interview as instructed by Add Health researchers (yes=1).

Independent Variables

Individual-level variables

Individual-level variables were based on respondent self report and selected for inclusion based on previous research and theory. *Sociodemographic characteristics* included age (continuous measure), married (yes/no), race and ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian, and non-Hispanic American Indian), foreign birth (yes/no), economic hardship (if received food stamps, housing assistance or AFDC in the past year coded as yes), high school degree or GED (yes/no), employed at least 10 hours weekly (yes/no), enrolled in college (yes/no), current residence in parental household (yes/no), and heterosexual orientation (yes/no). *Sexual-risk factors* included diagnosis with a sexually transmitted infection in prior year (yes/no), number of sexual partners in the past year (continuous measure), perception of risk for HIV (continuous ranging from none=1 to high=5), level of binge drinking in past year (continuous measure of the number of days during the past year the respondent drank five or more drinks ranging from never to every/almost every day) and a categorical measure of drug use in the past year (whether the respondent used marijuana, methamphetamine, cocaine, or other illegal drugs=1). Health care access and utilization measures included insurance status (continuous measure of number of months insured over the prior year) and receipt of a physical exam in the prior year (yes/no). In addition, for outcome measures of uptake of HIV testing at the time of the interview and follow-up of HIV testing results, we controlled for uptake of HIV testing in the prior year (yes/no) as this may have influenced the young adults' decision to consent to another HIV test.

Neighborhood-level variables

The neighborhood was defined as a geographic unit and measured as the census tract of residence. Census tracts commonly serve as proxies for neighborhoods and are often the basis for geographically delimited resource allocation.[23] Neighborhood social disorganization was measured via 4 indicators based on theory, previous research and available data: racial and ethnic composition, concentrated poverty and residential instability. Racial and ethnic composition was measured via 2 variables – (1) non-Hispanic Black concentration, which was composed of one standardized item: proportion of Black residents living in the census tract and (2) immigrant concentration, which was composed of 3 standardized items: proportion of Latino/Hispanic residents, proportion of linguistically isolated residents and proportion of foreign born residents. Exploratory factor analysis and internal consistency was conducted and results supported the inclusion of the 3 immigrant concentration items into one index (factor loadings > 0.65 onto one factor and internal consistency α=.95).

Concentrated poverty was a composite of 4 standardized items: proportion of households below poverty, proportion of households on public assistance, total unemployment rate and proportion of female-headed households with children. Exploratory factor analysis and internal consistency was conducted and results supported the inclusion of the 4 items into one index (factor loadings > 0.65 onto one factor and internal consistency α=.82). Residential instability was composed of 2 standardized items: proportion of households living in the census tract for 5 years or more and proportion of owner occupied homes. Internal consistency was α=.82. Last, three neighborhood control variables were included: region (Northeast, Midwest, West and South-reference), urbanicity (standardized item of proportion of persons living in an urbanized area) and a standardized item of the proportion of residents in the neighborhood aged 18-24 years.

Analysis

We employed multilevel logistic regression modeling with robust standard errors to examine the contribution of neighborhood socio-structural factors to young adults' HIV testing behaviors. Continuous variables were grand mean centered. Multicollinearity was examined prior to multilevel analyses; tolerance and variance inflation factors were within range. The findings presented are from unweighted analyses because the Add Health sampling weights account only for the clustering of schools and not neighborhoods and their inclusion could lead to erroneous findings (personal communication, Kim Chantala, Add Health User's Conference, 2008). However, we did include the Add Health stratification variables to account for potential sampling design effects.[40] In addition, our use of multilevel modeling adjusted for non-independence of observations due to clustering within neighborhoods.[41]

Results

Descriptive statistics for the outcome measures are presented in Table 1. The prevalence of HIV testing uptake in the year prior to the interview was 18% and uptake of testing at the time of the interview was 93%. Of those 93% who consented to HIV testing at the time of the interview, 31% called for their results. Characteristics of the two samples are presented in Table 2.

Multivariate Results

Findings from multivariate analyses on the associations between neighborhood structural conditions and young adults' HIV testing behaviors are presented in Table 3. The findings include only the final models, but further explication of our model building process and the extent to which the individual and neighborhood level measures accounted for the variation in the outcomes across neighborhoods will be described in our final paper. Our findings suggest the neighborhood social

structure is significantly associated with HIV testing uptake and follow-up, after adjusting for individual and neighborhood level control measures. First, we found the uptake of HIV testing in year prior to the interview was greater among young adults who lived in neighborhoods with increasing concentrations of African American residents (OR=1.09, 95% CI=1.01, 1.19) or those neighborhoods with increasing residential instability (OR= 1.18, 95% CI=1.10, 1.27), adjusting for individual and neighborhood level controls. In addition, young adults who lived in neighborhoods with increasing concentration of poverty were less likely to have been tested for HIV in the year prior to the interview (OR=0.89, 95% CI=0.82, 0.98). Second, we found that neighborhood poverty was also associated with uptake of HIV testing at the time of the interview. Specifically, young adults who lived in neighborhoods with increasing concentrations of poverty were more likely to consent to free HIV testing at the time of the interview compared to their more advantaged peers (OR=1.27, 95% CI=1.08, 1.50). However, neither racial and ethnic concentration nor residential instability was associated with uptake of testing at the time of the interview. Third, in respect to follow-up of the results of HIV testing at the time of the interview, the young adults' in our sample who lived in neighborhoods with increasing concentrations of poverty were less likely to call for their HIV testing results (OR=0.92, 95% CI=0.85, 0.99) compared to their peers who lived in more socioeconomically advantaged neighborhoods. However, young adults who lived in residentially unstable neighborhoods were more likely to call for their HIV testing results compared to young adults who lived in more residentially stable neighborhoods (OR=1.10, 95% CI=1.03, 1.17). Neither neighborhood racial or ethnic concentration was significantly associated with follow-up of HIV testing results.

Discussion and Next Steps

Our findings suggest the contemporaneous neighborhood conditions to which young adults are exposed play a role in shaping their HIV testing behaviors, above and beyond numerous individual and neighborhood level controls. Neighborhood poverty was associated with all three outcome variables. Specifically, young adults who lived in poor neighborhoods were less likely than their more advantaged peers to have been HIV tested in the year prior to the interview and they were more likely to consent to the free salivary HIV testing at the time of the interview. However, they were less likely to call back for their HIV testing results compared to young adults who lived in more socioeconomically advantaged neighborhoods. These findings suggest that young adults who live in poor neighborhoods may be less likely to receive HIV testing due to reduced access to resources, poor health literacy and/or greater HIV testing stigma. In contrast, young adults who lived in residentially unstable neighborhoods were more likely to report having been tested for HIV in the year prior to the interview and to call for their HIV testing results compared to those who lived in more stable neighborhoods. Perhaps residentially unstable neighborhoods contribute to increased perceptions of anonymity and reduced stigma because of the increased in and out migration of residents in the neighborhood, which may ultimately increase the likelihood of HIV testing. Consistent with prior research, [20,21] we also found that young adults who lived in racially segregated African American neighborhoods were more likely to report HIV testing in the year prior to the interview. However, we did not find any significant differences in the uptake of HIV testing at the time of the interview or follow-up of testing results between young adults who lived in more racial or ethnically segregated African American or Hispanic neighborhoods. Our findings suggest the increased likelihood of HIV testing among young adults in racially segregated African American neighborhoods may be due to community interventions targeting known high-risk populations. Further research on neighborhoods composed of more diverse racial and ethnic compositions is needed.

Nest steps for this research include employment of inverse probability of treatment weighted (IPTW) estimation of contextual effects to more rigorously examine associations between the neighborhood context and HIV testing.[42-44] Because participants in the Add Health study were not randomized to their neighborhood, observed differences in the outcome may be due to unmeasured differences between the comparison groups. Add Health's rich collection of individual, family, and contextual data facilitates our use of this recently developed causal inference method for observational data to strengthen our inferences. The approach has also recently been extended to the multilevel case.[44]

Table1 Young adults' HIV testing behaviors, 2001-2002 National Survey of Adolescent Health (Add Health)

	N	Mean (SD)
Uptake of testing in prior year	13,034	0.18 (0.38)
Uptake of testing at interview	13,034	0.93 (0.26)
Follow-up of HIV testing results	12,058	0.31 (0.46)

Table 2 Characteristics of the sample of young adults aged 18-27 years, 2001-2002 National Survey of Adolescent Health (Add Health)

	Uptake of HIV Testing N=13,034	**Follow-up of HIV Testing** N=12,058
	Mean (SD)	Mean (SD)
Individual level		
Sociodemographic characteristics		
Age in years	22.0 (1.75)	22.0 (1.75)
Male	0.47 (0.50)	0.47 (0.50)
Race and ethnicity		
Hispanic	0.16 (0.37)	0.16 (0.37)
Black	0.20 (0.20)	0.20 (0.40)
Asian	0.07 (0.26)	0.07 (0.25)
American Indian	0.01 (0.10)	0.01 (0.10)
White (ref)	0.56 (0.50)	0.56 (0.50)
Foreign born	0.08 (0.27)	0.08 (0.27)
Economic hardship	0.07 (0.25)	0.07 (0.26)
No high school degree	0.09 (0.28)	0.09 (0.28)
Employed	0.71 (0.46)	0.71 (0.46)
Enrolled in school	0.38 (0.49)	0.38 (0.48)
Married	0.18 (0.50)	0.18 (0.38)
Lives with parents	0.40 (0.49)	0.40 (0.49)
Heterosexual orientation	0.89 (0.31)	0.89 (0.31)
STI risk factors		
Number of sexual partners prior year	1.48 (2.04)	1.51 (2.10)
Diagnosed with a STI prior year	0.06 (0.25)	0.07 (0.25)
Perceptions of HIV risk	1.18 (0.48)	1.18 (0.48)
Drug use in past year	0.22 (0.41)	0.22 (0.42)
Binge drinking	1.19 (1.55)	1.20 (1.56)
Health care access/use		
Months insured prior year	8.87 (4.76)	8.83 (4.78)
Received a physical exam prior year	0.80 (0.40)	0.80 (0.40)

Table 3 Multilevel logistic regression findings of the associations between neighborhood social structure and young adults' HIV testing behaviors, 2001-2002 National Survey of Adolescent Health (Add Health).

	HIV Testing Uptake Prior Year AOR (95% CI)	HIV Testing Uptake at Interview AOR (95% CI)	HIV Testing Follow-up AOR (95% CI)
Fixed Effects			
Individual level	(N=13,034)	(N=13,034)	(N=12,058)
Sociodemographic characteristics			
Age in years	0.98 (0.95, 1.01)	0.91 (0.88, 0.95)***	1.02 (0.99, 1.04)
Male	0.76 (0.68, 0.84)***	1.16 (1.00, 1.34)	0.64 (0.59, 0.70)***
Race and ethnicity			
Hispanic	1.03 (0.87, 1.22)	1.32 (1.00, 1.74)*	1.08 (0.92, 1.26)
Black	1.12 (0.94, 1.33)	1.34 (1.03, 1.74)*	1.00 (0.86, 1.17)
Asian	0.61 (0.47, 0.79)***	1.25 (0.89, 1.75)	0.89 (0.73, 1.10)
American Indian	0.86 (0.51, 1.47)	0.98 (0.48, 2.01)	0.66 (0.42, 1.03)
White (ref)	1.00	1.00	1.00
Foreign born	1.06 (0.86, 1.31)	0.91 (0.69, 1.20)	0.96 (0.81, 1.13)
Economic hardship	1.26 (1.06, 1.49)**	1.47 (1.04, 2.07)*	1.01 (0.86, 1.19)
No high school degree	0.78 (0.65, 0.94)**	1.08 (0.82, 1.41)	0.85 (0.72, 1.00)*
Employed	0.90 (0.81, 0.99)*	1.04 (0.90, 1.21)	1.10 (1.00, 1.20)*
Enrolled in school	0.79 (0.71, 0.89)***	0.95 (0.82, 1.11)	1.14 (1.04, 1.25)**
Married	0.98 (0.86, 1.12)	1.40 (1.14, 1.71)**	0.69 (0.61, 0.78)***
Lives with parents	0.88 (0.79, 0.99)*	0.77 (0.66, 0.89)**	1.03 (0.94, 1.13)
Heterosexual orientation	0.71 (0.61, 0.81)***	0.88 (0.70, 1.11)	0.78 (0.69, 0.89)***
STI risk factors			
Number of sexual partners prior year	1.11 (1.08, 1.14)***	1.09 (1.03, 1.16)**	1.04 (1.02, 1.07)***
Diagnosed with a STI prior year	2.11 (1.81, 2.45)***	1.48 (1.05, 2.09)*	1.19 (1.03, 1.39)*
Perceptions of HIV risk	1.06 (0.96, 1.16)	0.99 (0.86, 1.15)	1.05 (0.97, 1.14)
Drug use in past year	1.10 (0.97, 1.24)	1.25 (1.04, 1.50)*	1.18 (1.07, 1.31)**
Binge drinking	1.01 (0.98, 1.05)	1.07 (1.02, 1.13)**	1.06 (1.03, 1.09)***
Health care access/use			
Months insured prior year	1.01 (1.00, 1.02)	0.98 (0.97, 1.00)*	1.00 (0.99, 1.01)
Received a physical exam prior year	2.11 (1.81, 2.45)***	1.17 (0.99, 1.38)	1.01 (0.90, 1.13)
HIV test in prior year	NA	1.12 (0.93, 1.36)	1.12 (1.01, 1.24)*
Neighborhood level	(N=5,425)	(N=5,425)	(N=5,121)
Neighborhood controls			
Region			
West	1.19 (1.02, 1.38)*	0.98 (0.78, 1.23)	0.94 (0.82, 1.07)
Midwest	0.96 (0.83, 1.12)	0.75 (0.60, 0.93)**	0.99 (0.88, 1.12)
Northwest	1.22 (1.03, 1.44)*	0.66 (0.52, 0.83)**	1.10 (0.95, 1.27)
South (ref)	1.00	1.00	1.00
Urbanicity	0.93 (0.80, 1.08)	0.97 (0.77, 1.11)	1.06 (0.93, 1.21)
Proportion residents aged 18-24 years	0.61 (0.36, 1.02)	0.66 (0.30, 1.46)	0.61 (0.36, 1.02)
Neighborhood disorganization			
Racial/ethnic composition			
Black concentration	1.09 (1.01, 1.19)*	0.95 (0.83, 1.09)	0.99 (0.92, 1.06)
Immigrant concentration	0.96 (0.89, 1.04)	0.90 (0.80, 1.01)	0.96 (0.90, 1.03)
Concentrated poverty	0.89 (0.82, 0.98)*	1.27 (1.08, 1.50)**	0.92 (0.85, 0.99)*
Residential instability	1.18 (1.10, 1.27)***	0.98 (0.88, 1.10)	1.10 (1.03, 1.17)**
Intercept	0.20 (0.13, 0.32)***	25.2 (12.8, 49.7)***	0.62 (0.41, 0.94)*
Random Effects			
T_{00}	0.07567*	0.23059	0.06204

Unweighted analysis *p<0.05, **p<0.01,***p<0.001

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